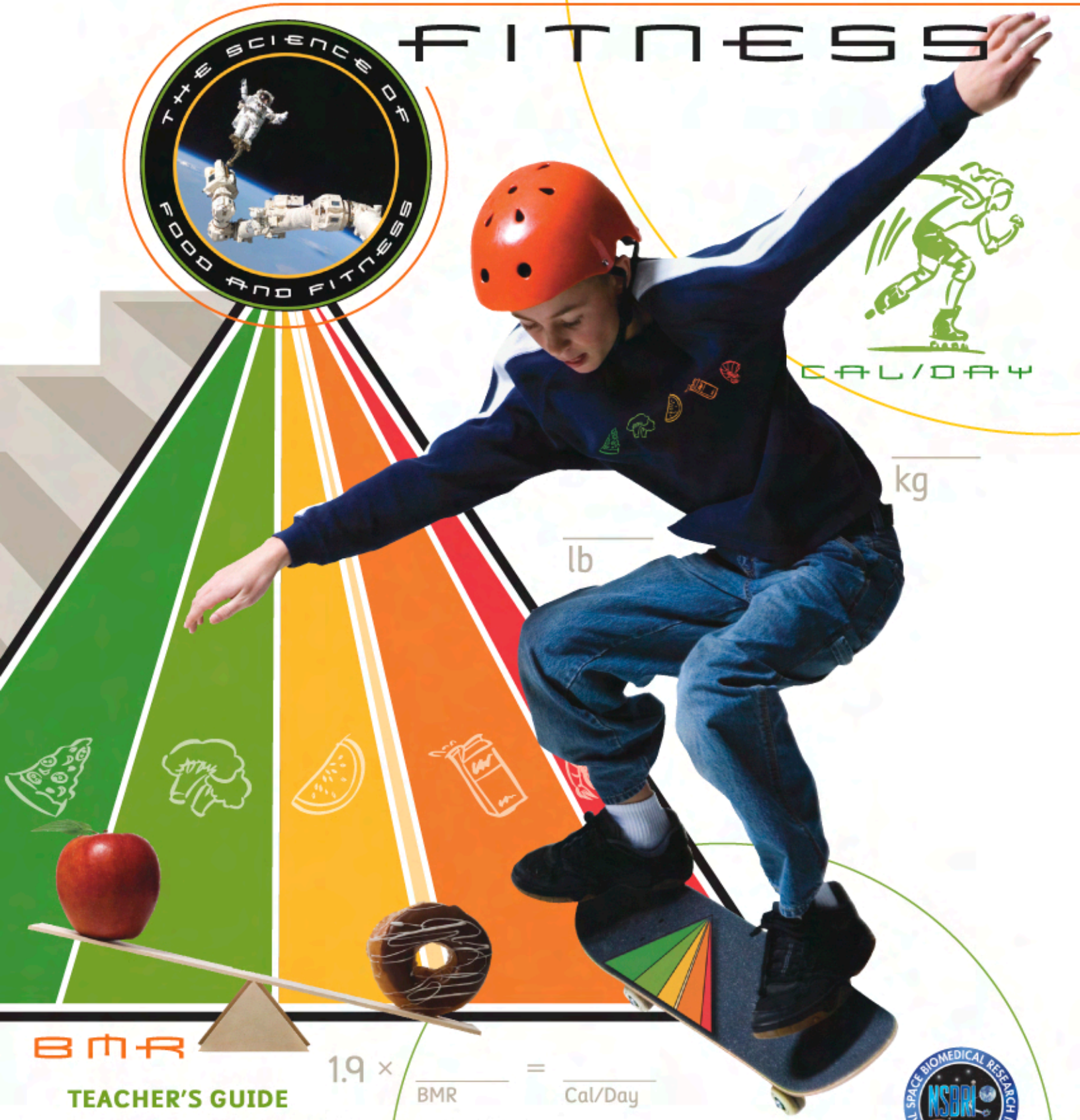
BioEd℠

THE SCIENCE OF FOOD AND FITNESS



TEACHER'S GUIDE

Nancy P. Moreno, Ph.D., Sonia Rahmati Clayton, Ph.D.,
Paula H. Cutler, Martha S. Young and Barbara Z. Tharp, M.S.

THE SCIENCE OF FOOD AND FITNESS

by

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RESOURCES

This publication is available in PDF format at www.NSBRI.org and in the Teacher Resources section at www.BioEdOnline.org.

For online presentations of each activity, downloadable slide sets for classroom use, or to enroll in The Science of Food and Fitness online professional development workshop (2 contact hours), go to www.BioEdOnline.org.

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The media bombard us with the latest nutrition fads and trends. At the same time, a growing percentage of American children and adolescents are overweight and at risk of developing chronic illnesses, such as diabetes or cardiovascular disease. The activities in this teacher's guide allow students to explore a variety of physical and life science concepts related to energy, metabolism and the role of nutrients in the body.

Contents

Education is an important part of the National Space Biomedical Research Institute (NSBRI), which is teaming some of the nation's best biomedical researchers to create new strategies for safe human exploration and development of space.

Scientists supported by the NSBRI are examining the role of nutrition in promoting health and preventing diseases. Their research is benefiting not only NASA and space travelers, but also people right here on Earth.

Concepts in this guide relate directly to recommendations of the National Science Education Standards about exercise, food, energy and nutrition.

For more information about all NSBRI research areas, visit the NSBRI Web site at www.NSBRI.org.

EATING AT CAFÉ ISS

by Dr. Edward T. Lu, Science Officer and Flight Engineer, NASA International Space Station (ISS), Expedition 7

What's it like to eat in outer space? According to Astronaut Ed Lu, it can be tricky—but fun, too!

This week I thought I'd write about a subject near and dear to my heart—food. You are what you eat after all. First off, let me say I actually like the food here. It isn't quite like Mom's cooking, but it isn't bad! In fact it isn't really cooking at all, more like reheating or rehydrating.

We don't have a real kitchen up here, but we do have a kitchen table. You might wonder of what use a table is if you can't set anything down on it. But we have bungee straps and Velcro on the tabletop so you can keep your food containers, spoon, napkins, etc., from floating away. Even though we only have two crew members, the table is where we congregate when we have time off. Of course there are no chairs around the table. What we do is float around the table while we prepare our meals and eat. There are a couple of hand rails on the floor to slide your feet under to stabilize yourself.

Next to the table is our water dispenser, which has a tap for warm water and hot water. That's right, no cold water. If you want a cold drink, you need to prepare the drink, then leave it for a while in one of the colder locations on ISS. It will never get really cold, so the next cold drink I have will be when I get back to the ground! Speaking of which, we don't have a refrigerator up here either, so all of our food is canned, dehydrated, or packaged so it doesn't need refrigeration. Of course this means we can't keep leftovers!

The only utensil we use is a spoon. Don Pettit had a pair of chopsticks up here, but I haven't found where he stashed them yet. It turns out there is no need for a fork or a knife. [*Ed. note:* Ed finally found the chopsticks!] All of the food that requires a utensil to eat has some sort of sauce or at least some moisture to it, so it naturally sticks to the spoon. This is the same effect on the ground that allows drops of water to stick to windows. This force isn't very strong, so you have to move fairly slowly when eating or the food will literally fly right off your spoon and onto the wall.

Our drinks are all dehydrated and come in packets. We have lots of different kinds of juices, tea, coffee, and milk. My favorite juices are apricot and apple with black currant. We also have a lot of other dehydrated foods, such as tvorog (a sweet Russian cottage cheese with nuts—my favorite breakfast item), vegetables, pastas, potatoes, fried rice, shrimp, soups, etc. You just add water to these packages and wait a few minutes, then cut a flap in the package to get your spoon in, and eat. When rehydrating all these items, you have to make sure the water is mixed thoroughly or you get dry powdery sections in your food. It helps to shake the packages back and forth, or to hold the package in your outstretched arms and flap them up and down so centrifugal force moves the water through the package. This trick also works great to settle all the food down to the bottom of the packet so you can cut the packet open without getting food all over your scissors.

Photo courtesy of NASA.

Ed finally found the chopsticks!

Much of the American-supplied foods come in sealed pouches. These are basically like canned foods, but without the can. Here, all you have to do is heat and eat. There are a large variety of foods, but most haven't arrived yet. They are being shipped up here on an unmanned space freighter called *Progress*. We are definitely looking forward to the arrival of the *Progress* because it carries fresh apples, oranges, and other goodies.

Finally, we have things like nuts, dried fruit, breads, etc., which come in sealed packets. These are good when you are really busy and have to eat and run, and also are fun to let float so you can gobble them out of the air like a goldfish. Even though your parents may have told you not to play with your food, up here it is encouraged!

We also get to choose a few personal items which have a long enough shelf life to last up here. I chose some Chinese foods, beef jerky from Hawaii, dried calamari, beef with burgundy sauce, and ready-to-eat sticky rice (much better than that fluffy stuff!).

We have a variety of sauces like hot pepper sauce, sweet and sour, Thai hot sauce, barbecue sauce, etc., which you can use to spice up most anything. Most of these come in squeeze bottles or little packets. Getting the sauce to settle to the end of the squeeze bottle so you can get it out is kind of fun. You can either use a variation of the arm flapping technique, or hold the bottle with the top facing away from yourself, and then spin your entire body like a top. The centrifugal force makes the sauce settle to the outside, and you can then squeeze some out while you are rotating.

I have noticed that for some reason I really like putting a lot more spicy seasonings on my food. A lot of other astronauts have mentioned that they have this urge, too. I sometimes add huge amounts of hot sauce, garlic paste or Thai hot sauce to the soups and meat dishes. Luckily, we have enough hot sauce to feed all of Thailand. I'm not sure why I like much spicier food here. I don't crave sweets, salty things or sour things—so it isn't just that I want stronger tastes. I can also say that it isn't because my nose is congested and I can't taste as well, although some astronauts sometimes have this effect for the first few days in space. I wonder if people on submarines or who spend months in Antarctica also love spicy foods, in which case it is probably an effect of isolation or limited food choices. If not, perhaps it is an effect of weightlessness on your body. I am curious how my tastes will change over the next five months!

Excerpt from "Greetings, Earthlings: Ed's Musings from Space." For more Astronaut Journals, visit NASA's Web site at http://www.nasa.gov/centers/johnson/astronauts/journals_astronauts.html/.

OVERVIEW

Students will observe and quantify the growth of yeast (a single-celled fungus) when it is given table sugar as a food source.

ACTIVITY 1

ENERGY FOR LIFE

All living things on Earth require energy to move, grow and maintain themselves. Some organisms, especially plants and algae, are able to build all of the materials they need from very simple substances. Using energy from light, these organisms, known as **producers**, are able to make food in the form of carbohydrates from water and carbon dioxide. All other organisms, called **consumers**, rely on producers for food. Food provides energy and other raw materials necessary for life.

CONCEPTS

- All organisms are composed of cells. Cells carry out functions necessary for life.
- Plants and related organisms use energy from the sun to produce food. Animals, fungi and other living things must eat plants or other organisms to obtain energy and building blocks for life.
- Living things give off carbon dioxide and heat, among other byproducts, when they use food.

SCIENCE, HEALTH & MATH SKILLS

- Observing
- Measuring
- Graphing
- Using a microscope

When used by organisms, food is broken down and energy is released. Oxygen is consumed during this process, and carbon dioxide is given off as a waste product. Some energy in living things is used to maintain their bodies and conduct the reactions necessary for life. During these processes, some of the energy also escapes as heat.

This activity is designed to introduce students to the relationship between food and energy. Students will observe what happens when yeast, a single-celled fungus, is provided with food (table sugar).

TIME

15 minutes for setup; 45 minutes to conduct activity. (Optional: If students make temperature observations, total time is one hour.)

MATERIALS

Each group will need:

- 100 mL of water at room temperature
- 2 250-mL beakers or plastic cups
- 2 craft sticks or plastic spoons
- 2 pkgs of rapid rising yeast
- 2 tsp of sugar (or 2 single serve sugar packets)
- Plastic ruler, metric (mm marked)
- Sheet of graph paper
- Tape, paper and marker (for labeling)
- Copy of student sheet

Optional, per group (see Setup):

- 12-in. laboratory thermometer or temperature probe

Continued

They're Alive!

Yeast are tiny members of the Fungus Kingdom, which also includes mushrooms. Fungi (plural of fungus) are important decomposers of waste and dead plant and animal materials. Yeast also is used for baking bread.

Sugars are small molecules made of carbon, hydrogen and oxygen. The energy in sugar is held in the chemical bonds between atoms. When sugar molecules are used for energy, carbon dioxide (CO_2) and water (H_2O) are given off. The energy that becomes available can be used immediately or stored as other chemical bonds. Some energy also is transformed and given off as heat.

- Dropper or plastic pipette
- Glass or plastic slides and coverslips
- Microscope

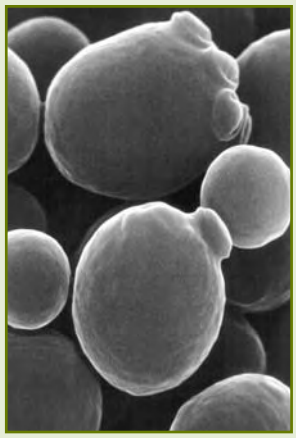
SETUP & MANAGEMENT

Students will observe yeast growing in sugar water. Adjust the temperature of the water to room temperature.

Read "Using Cooperative Groups in the Classroom," p. 3. Prepare name tags for each group of four students. Place all materials in a central location for each group of students to collect.

Optional. If you have access to 12-in. laboratory thermometers or electronic probes to measure temperature, have students also measure the starting temperature of the yeast mixtures and record the temperatures at 10 minute intervals. OR set up a demonstration with a temperature probe inserted in the yeast, sugar and water mixture. Students will be able to observe that the temperature of the water in which the yeast is growing will increase between 0.5–1.5°C during the class period. Have students construct a graph showing the change in temperature over time.

If microscopes are available, have students observe a drop of water containing yeast cells from the beakers containing sugar. Students should place a drop of solution on a slide and cover it with a cover slip.



Scanning electron micrograph of common baker's yeast, *Saccharomyces cerevisiae*. (x3000)

PROCEDURE

1. Begin a class discussion of energy and living things by asking questions such as, *What are the basic needs of living things? Do all organisms need exactly the same things to live? What do plants need? What about animals? Do animals need the same things as plants?* Mention that plants are able to manufacture everything they need from very basic raw materials (carbon dioxide from air, water, nutrients from soil and energy from sunlight) through the process known as photosynthesis. Also mention that plants and other photosynthetic organisms are called producers, and that animals, fungi and others that rely on photosynthetic organisms for food are known as consumers.
2. Have the Materials Manager from each group collect all of the supplies. The Materials Manager should measure 50 mL of water into each of the 250-mL beakers before taking them to his or her work area.
3. Tell students that they will be investigating the behavior of a common fungus (baker's yeast) when it is fed. Ask students to share anything they know about yeast. Students will follow the instructions and record their observations on their student sheet.
4. Before beginning, each group should label one beaker as "Sugar" and the other beaker, "No Sugar."
5. Have each group predict what will happen when yeast and water are combined. They also should predict what might happen when yeast, water and sugar are combined. Let the groups add yeast to the water in each of the beakers and stir the mixture gently. Groups should observe the appearance of the mixtures and record their observations.
6. Next, have students add approximately two teaspoons of sugar to the beaker labeled "Sugar."
7. Have students observe the appearance of the yeast mixtures at 5-minute intervals and record their observations. They may gently stir the mixtures periodically with separate craft sticks or plastic spoons.
8. Once some of the yeast cultures have accumulated a thin layer of foam, ask

Energy from the Sun

Almost all energy on Earth comes from the sun. We can see part of this energy as visible light and feel part of it as heat. Heat and light that we can detect are just part of the entire spectrum of radiation given off by the sun.

Radiation travels in waves. Some kinds of radiation are listed below, from longest to shortest wavelengths.

- Long wave radio
- Short wave radio
- Radar
- Microwaves
- Visible light
- Ultraviolet light
- X-rays
- Gamma rays
- Cosmic rays

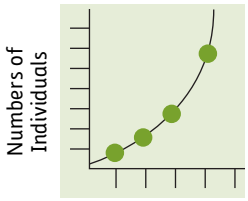
Away from Earth's atmosphere, spacecraft are exposed to all types of radiation from the sun.

Did You Know?

Have you ever wondered why a room crowded with people becomes warmer?

At rest, the average person gives off about the same amount of heat as a 60 watt light bulb.

Growth Curves



TYPICAL GROWTH CURVE

Students might notice that the graphs of yeast foam are curved rather than straight lines. This is because the yeast with sugar are growing and reproducing very rapidly. This type of growth is seen in groups of organisms with abundant resources and no limits on growth.

Plants can manufacture all of the molecules they need. Most animals, on the other hand, have to obtain both energy and nutrients from food. Different animals vary in their abilities to use food sources. For example, cattle have a complex digestive system that allows them to break down and use tough fibers in grasses for food.

USING COOPERATIVE GROUPS IN THE CLASSROOM

Cooperative learning is a systematic way for students to work together in groups of two to four. It provides organized group interaction and enables students to share ideas and to learn from one another. Students in such an environment are more likely to take responsibility for their own learning. Cooperative groups enable the teacher to conduct hands-on investigations with fewer materials.

Organization is essential for cooperative learning to occur in a hands-on science classroom. Materials must be managed, investigations conducted, results recorded, and clean-up directed and carried out. Each student must have a specific role, or chaos may result.

The Teaming Up! model* provides an efficient system for cooperative learning. Four "jobs" entail specific duties. Students wear job badges that describe their duties. Tasks are rotated within each group for different activities so that each student has a chance to experience all roles. For groups with fewer than four students, job assignments can be combined.

Once a cooperative model for learning is established in the classroom, students are able to conduct science activities in an organized and effective manner. The job titles and duties are as follows.

Principal Investigator
- Reads the directions,
- Asks the questions
- Checks the work

Maintenance Director
- Follows the safety rules
- Directs the cleanup
- Asks others to help

Reporter
- Records observations and results
- Explains the results
- Tells the teacher when the group is finished.

Materials Manager
- Picks up the materials,
- Uses the equipment
- Returns the materials

* Jones, R.M. 1990. Teaming Up! LaPorte, Texas: ITGROUP.

students, *What is happening to the yeast?* Help students understand that the yeast cells have begun to grow and multiply in the presence of water and food (sugar). The gas being produced is carbon dioxide, the same waste product that we give off when food is processed inside cells in our bodies.

9. Next, students will observe the production of carbon dioxide gas by yeast. Have students measure and record the height of the foam in each beaker at 5-minute intervals. (The beaker labeled "No Sugar" may not produce any foam at all.) Students should record their observations on their student sheets.
10. Conclude by leading students in a discussion of yeast growth. Help them understand that they used different kinds of evidence to show that the yeast were using the sugar as food. First, the yeast were breaking down sugar to obtain energy. In the process, the yeast released observable carbon dioxide gas (visible as bubbles). Second, the yeast mixture became warmer. Heat was released as a by-product of the energy conversions happening inside the yeast cells. The yeast in the beaker without sugar did not have food to grow, so these reactions did not occur in this beaker.

EXTENSIONS

- Challenge students to come up with other ways to measure yeast growth and development.
- Have students use an acid/base indicator solution (such as bromothymol blue) to detect the presence of carbon dioxide in the air they exhale. Students should blow through a straw into a glass of water and use the indicator to observe whether the water becomes more acidic from the presence of dissolved carbon dioxide (forms a weak acid in water). OR have them make their own indicator by boiling purple cabbage to create a dark blue or purple liquid. This liquid turns pink in the presence of acids, and green or blue in the presence of bases.
- Challenge students to compare and contrast the use of sugar by yeast and the burning of a candle. What are the similarities between the two processes? What are the differences?

ACTIVITY 1

IS IT ALIVE?

What do you think will happen when yeast is combined with water, and with sugar and water? Write your predictions below.

Yeast and Water: _____

_____

Yeast, Water and Sugar: _____

_____

Making Yeast and Water

1. Measure 50 mL of room temperature water into each beaker. Label one beaker "No Sugar" and the other "Sugar."
2. Add a package of yeast to each beaker and stir gently. Add two teaspoons of sugar to the beaker labeled "Sugar" and stir it gently. Observe the appearance of the mixtures every five minutes. For each observation, record the appearance of the mixtures, including any bubbles or foam that develop, and the total height of each mixture. Use a metric ruler on the outside of the beaker to measure the mixture in millimeters, from the bottom of the beaker to the top of the foam.

Time	YEAST + WATER		YEAST + WATER + SUGAR	
	Appearance	Height of mixture (mm)	Appearance	Height of mixture (mm)

3. On a sheet of graph paper, create a bar graph of the height of each mixture at each observation.
4. On a separate sheet of paper, write a paragraph describing your yeast observations. Did your observations match your predictions? Why or why not?
5. What was the role of the sugar in this experiment?

_____

_____

_____

_____

OVERVIEW

Students will compare how much energy is released as heat from two different food types.

ACTIVITY 2

ENERGY SOURCES

Living things that cannot harness solar energy through photosynthesis must eat other organisms or the products of other organisms as food. Consumers, which include members of the animal and fungus Kingdoms, frequently use a variety of food sources to meet their energy and nutritional needs.

The amount of energy stored in food usually is measured in **calories**. One calorie is defined as the amount of energy it takes to raise the temperature of one gram of pure water (equivalent to one milliliter of water) one degree Celsius. The calories shown on most food labels are written with an uppercase "C" and represent one kilocalorie or 1,000 calories.

Carbohydrates, fats and proteins are the primary sources of energy in foods. Sugars, starches (such as those in bread, pasta and potatoes) and fiber (such as in many vegetables, whole fruits and whole grains) are the main forms of carbohydrates. Foods rich in fats include animal and vegetable oils, lard, butter and cream. Proteins, the building blocks of muscles and molecules within cells, are present in meats, eggs, and animal products, as well as in plant materials, like nuts and beans.

Each of these classes of nutrients provides a different amount of energy as food. Fats and oils provide about nine Calories (Cal) per gram. Carbohydrates and proteins each provide four Cal per gram. The amount of energy provided by each of these kinds of foods is independent of the source and presence of other nutrients. In other words, olive oil and peanut oil both provide about nine Cal per gram.

This activity introduces students to the concept of "calorie" and allows them to compare the relative amounts of energy in similar-sized portions of a carbohydrate-based food and a food rich in oils.

CONCEPTS

- **Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion and the nature of chemicals.**
- **Food provides energy for living things.**
- **Different foods provide different amounts of energy.**

SCIENCE, HEALTH & MATH SKILLS

- **Observing**
- **Comparing**
- **Predicting**
- **Inferring**

TIME

15 minutes for setup; 45 minutes for activity

MATERIALS

- Single-hole punch

Each group will need:

- Prepared soft drink can (see Setup)
- Pencil (to be used as a holder for can)

Fast Facts

- Carbohydrates provide most people with about 50% of their energy needs.
- The word "calorie" comes from the Latin word for heat.
- Energy also is measured in joules. One calorie is about 4.2 joules.
- Food must be digested before the body can use it. Digestion changes food into substances like glucose, a simple sugar, that can be carried in the bloodstream to provide energy for cells throughout the body.

- Graduated cylinder or beaker
- 6-in. thermometer (°C)
- 2 pieces of round unsweetened oat cereal ("Cheerios")
- 1/2 pecan (without shell)
- Large paper clips
- 2-cm piece of clay
- Matches or birthday candles
- Safety goggles (one per student)
- Water
- Copy of student sheet

SETUP & MANAGEMENT

For each group, cut the top one third off of a soft drink can using scissors. Discard top half. Smooth the edges by cutting around again or by covering them with masking tape. Use a single-hole punch to make a pencil sized hole on each side of the open end of the can, so that a pencil may be inserted as a holder (see sidebar). Each class will need a new set of cans.

Students should work in teams. They should wear goggles and conduct the investigation on a nonflammable, flat surface. Set out all materials for each group of students to collect. OR you may choose to conduct this activity as a demonstration to the class.

PROCEDURE

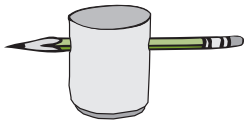
1. Remind students of the previous activity, in which they cultivated yeast in sugar water. Ask, *What happened to the temperature or appearance of the water in which the yeast cells were growing?* Students should be able to report that water became warmer or that the yeast used sugar as food. Follow by asking, *What do you think would happen if we tried to release all of the energy in the sugar as heat?* Use students' answers to guide them into a discussion of energy stored in food. Ask, *Do all kinds of food provide the same amount of energy?*
2. Challenge students to predict which provides more energy: the same portion of a carbohydrate-rich food or an oil-rich food.
3. Have the Materials Managers collect the materials for their groups from a central area in the classroom.
4. Each group will need to make a holder for the food they will be investigating. They should bend a paper clip so that it looks like the image on the right (see "Food Holder,") and anchor the base using clay.
5. Have students follow the instructions on their activity sheets to complete the investigation. They will pour 50 mL of water into the prepared soft drink can and measure the temperature of the water. Next, they will hang two oat cereal pieces on the paper clip and light them from below. They should hold the can by the pencil support with the bottom of the can about one inch above the flame. If necessary, they should relight the cereal pieces until they will no longer burn. They should record the final water temperature.
6. Have students repeat the investigation using a piece of pecan approximately the same size as two pieces of cereal together (place on top of holder).
7. Have students follow the instructions on the student page to calculate (approximately) the number of calories released by the similar volume of different foods.
8. Discuss results with students. Ask, *Which food released more heat when burned? Which volume of food had more calories?* Help students understand that fats and oils are more energy-rich than carbohydrates, because of the nature of the chemicals involved

EXTENSIONS

- Have students conduct the investigation again using similar masses of cereal and pecan. Have students weigh the pieces in advance and make adjustments so that similar masses of cereal and pecan are compared.
- The diets of some ethnic groups living in extremely cold climates are very high in fats. Have students investigate why such diets might be necessary.

Food Holder

Prepared Can with Pencil Holder



Fats

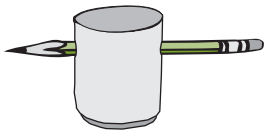
Fats are rich sources of energy. Certain fats and oils are healthier than others. Fats that are solid at room temperature, such as shortening, margarine and lard, should be avoided. Healthier choices include olive, flaxseed, nut and fatty fish or canola oils. Foods that can contain large amounts of unhealthy fats include some red meats, whole milk dairy products and cream, some salad dressings, chocolate, cakes, cookies and some crackers.

ACTIVITY 2

CALORIES = ENERGY

What has more calories, breakfast cereal or a similar-sized portion of nuts? You will need: piece of pecan, two pieces of cereal, clay, large paper clip, thermometer, 100 mL of water, matches or birthday candle, soda can and a pencil.

1. Straighten the sections of a paper clip so that it looks like the image on the right. Anchor the base in the clay, with the curved part of the paper clip in the air.
2. You also will need a soft drink can with the top removed. Slide a pencil through the holes in the sides of the can to make a handle.



CEREAL

3. Add 50 mL of water to the can. Measure the starting temperature of the water and record your results in the box on the right.
4. Hook the cereal pieces on the paper clip. Carefully light the cereal from below using a match or candle.
5. Hold the can by the pencil, about one inch above the top of the flame. If the cereal stops burning, light it again until it won't burn any more. Measure the temperature of the water again and record the final water temperature.
6. How many degrees did the temperature of the water change? Record your answer.

CEREAL	
Starting water temperature:	°C
Final water temperature:	°C
Change in temperature:	°C

PECAN

7. Repeat steps 3 through 6 using the pecan piece. Place the pecan on top of the holder. Record the water temperatures in the box on the right.

PECAN	
Starting water temperature:	°C
Final water temperature:	°C
Change in temperature:	°C

MEASURING ENERGY

A calorie is the amount of energy needed to raise the temperature of one mL of water by one degree Celsius. Based on this information and your investigation, answer the following questions. Use the back of this sheet or a separate sheet of paper to record your answers.

1. How many calories are needed to raise the temperature of 50 mL of water by one degree?
2. Based on your observations, how many calories were given off by the cereal? (Hint: multiply the change of temperature in degrees that you observed by 50.)
3. How many calories were given off by the pecan?
4. Would you get more energy from eating a similar size portion of pecans or cereal? Why?

OVERVIEW

Students will estimate their average daily energy (Calorie) needs.

ACTIVITY 3

YOUR ENERGY NEEDS

Energy fuels growth, movement and all the processes in every cell inside the body. It has many different forms and cannot be created or destroyed, only transformed from one form to another. Both light and heat are examples of energy.

Many students may have difficulty understanding energy and its measurement. One way to approach these concepts is to think of energy as the ability to make either a change or a movement. There are many ways of making a change or creating movement, and energy can have many forms. For example, when a person kicks a ball, the energy from the kick makes the ball move forward. Or in cooking, energy in the form of heat changes an egg white from a clear liquid to an opaque solid. Energy in food commonly is measured as calories.

The easiest way to describe calories is to introduce them as one would introduce any other unit of measure. Weight can be measured in kilograms or pounds; distance can be measured in meters or feet; and energy can be measured in calories. As demonstrated in the previous activity, one calorie is the amount of energy necessary to raise the temperature of one milliliter of water by one degree Celsius. Usually, when we refer to calories in food, we actually are considering **kilocalories**. One kilocalorie equals one thousand calories and usually is written in the capitalized form, "Calorie."

In this activity, students will figure out how many Calories a typical teenager needs every day. Baseline Calorie needs (also called **Basal Metabolic Rate**, or BMR), can be estimated based on gender, age, height and weight. Each student also may calculate his or her own baseline Calorie needs (see Step 6).

CONCEPTS

- **All organisms need energy for their activities.**
- **Food is the only energy source for people and other animals.**
- **People's energy needs depend on body composition and level of activity, and correlate directly with fitness.**
- **Regular exercise is important to maintain and improve health.**

SCIENCE, HEALTH & MATH SKILLS

- **Calculating**
- **Predicting**
- **Converting measurements**
- **Drawing conclusions**
- **Inferring**

TIME

10 minutes for setup; 45–60 minutes to conduct activity

MATERIALS

Each student will need:

- Copy of "Baseline Energy Needs" and "Total Energy Needs" student sheets
- Calculator

Physical Activity

For most people, physical activity accounts for individual differences in the actual amounts of calories expended during the day. The amount of lean body tissue also affects how much energy the body uses for basic functions.

Fitness Benefits

The benefits of physical fitness include maintaining healthy weight; having energy and strength for routine activities; promoting good muscle tone, bone strength, and strong heart/ lung systems; reducing risk of some diseases and contributing to improved mental health.

Using Energy

Total energy expenditure includes energy used at rest and during physical activity. Other important variables to consider are age, sex, body size and composition, genetic factors and overall health. The rate at which the body uses energy (metabolic rate) increases after eating and reaches a maximum about one hour after a meal is consumed. Metabolism refers to all the chemical reactions inside a living organism. Metabolism also releases small amounts of energy as heat (as observed in Activity 1).

People with a high Basal Metabolic Rate (BMR) include: athletes, children, pregnant women, and tall, thin people.

Factors that raise BMR include: stress, fever and extreme temperatures (both heat and cold).

Energy expenditures for humans are reduced in space. Astronauts must exercise frequently to counteract some of the effects of living in space.

SETUP & MANAGEMENT

Have students work individually.

PROCEDURE

1. Begin a class discussion of energy by asking questions such as, *What is energy? Where do we get our energy? What do we do with the energy? Do we all need the same amount of energy? What happens to the food we eat?* Tell students that they will be investigating how many Calories adolescents need every day. Explain that "calorie" is a measure of energy that can be applied to food.
2. Give each student copies of the two activity sheets and have them follow the instructions to calculate the daily Calorie needs of an average teenage boy and girl.
3. Students may need assistance with metric measurements, such as kilograms (kg) and centimeters (cm), necessary for their calculations. If appropriate, talk about conversion factors and different measurement systems. One kg is approximately 2.2 pounds (lb) and one cm is 0.4 inches (in.).
4. Discuss students' calculations. Mention that a person's energy needs are based not only on sex, weight and height, but also on daily activities. Explain that Basal Metabolic Rate (BMR) represents the amount of Calories necessary to maintain life. Ask, *What are the differences among caloric requirements of different physical activities?*
5. Expand the discussion by introducing the idea that athletes and other persons who are physically fit spend more Calories and as a result require more Calories. Help students understand that to stay fit and healthy, a person must maintain a balance between the intake and expenditure of Calories.
6. As a take-home activity, give students clean copies of both activity sheets and have them calculate their own BMRs and total daily Calorie needs.

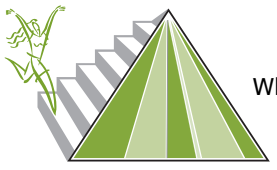
Photo courtesy of NASA.

Dr. John L. Phillips, Science Officer and Flight Engineer, NASA ISS Expedition 11, uses the cycle while participating in a Foot-Ground Reaction Forces During Spaceflight experiment. Phillips is wearing specially instrumented cycling tights outfitted with sensors for the experiment.

THE HARRIS-BENEDICT EQUATION

To maintain a constant weight, the amount of Calories used in a day should equal the amount of Calories eaten. To calculate how many Calories are used each day, we first have to determine the baseline rate at which the body uses energy. This rate is called the Basal Metabolic Rate (BMR).

At the beginning of the twentieth century, Francis Benedict directed numerous studies of human basal metabolic rate (BMR). He developed a set of equations that could estimate BMR in humans without complex measurements. The Harris-Benedict equations, shown below, continue to be the most common methods for calculating BMR.



For men, BMR = 66.5 + (13.75 x W) + (5.003 x H) - (6.775 x A)
For women, BMR = 655.1 + (9.5663 x W) + (1.85 x H) - (4.676 x A)
Where: W = actual weight in kilograms (0.454 kilograms per pound)
H = height in centimeters (2.54 cm per inch)
A = age in years

ACTIVITY 3

BASELINE ENERGY NEEDS

How much energy does a person use in a day? To answer this question, you first need to know how much energy the body uses when it isn't doing anything. This provides a baseline estimate of a person's energy needs. Use the information provided to calculate the amount of energy needed by an average 15 year old boy and girl. Follow the instructions carefully to complete each equation.

1. Fill in the values to convert weight from pounds (lb) to kilograms (kg), and height from inches (in.) to centimeters (cm).

BOY (Weight = 136 lb | Height = 67 in.)	GIRL (Weight = 127 lb | Height = 64 in.)
_____ (lb) × 0.45 = _____ (kg)	_____ (lb) × 0.45 = _____ (kg)
_____ (in.) × 2.54 = _____ (cm)	_____ (in.) × 2.54 = _____ (cm)

2. Use the information from Item 1 to complete the equations below and figure out resting energy needs. This is called Basal Metabolic Rate, or BMR. Begin with the equations at the the top and work down.

BOY	GIRL
_____ (kg) × 13.8 = _____ (A)	_____ (kg) × 9.6 = _____ (A)
_____ (cm) × 5 = _____ (B)	_____ (cm) × 1.9 = _____ (B)
_____ (A) + _____ (B) = _____ (C)	_____ (A) + _____ (B) = _____ (C)
_____ (C) + 66.5 = _____ (D)	_____ (C) + 655.1 = _____ (D)
_____ (Age) × 6.8 = _____ (E)	_____ (Age) × 4.7 = _____ (E)
_____ (D) − _____ (E) = ☐ (BMR)	_____ (D) − _____ (E) = ☐ (BMR)

Note. The tables and equation models on this page may be used to calculate your own resting energy needs.

ACTIVITY 3

TOTAL ENERGY NEEDS

Resting energy needs, also called BMR, account for only part of the Calories used by the body. Physical activities also use energy. The total amount of energy used depends on the kind of activity being done and time spent working on it. Use the BMRs (from the Baseline Energy Needs sheet) you already calculated for the boy and girl and add their exercise habits (shown below) to the equation to find out how many Calories a typical boy and girl might actually use each day.

BOY: Spends most of his time watching TV or sitting in school.
GIRL: Attends daily soccer practice after school for two hours and runs (jogs) for at least one hour each day on the weekend.

1. Select the category that best describes the exercise level for each teenager and solve the corresponding equation below. You also will need the BMR numbers from the "Baseline Energy Needs" page.

Low Energy	Medium Energy	High Energy
Most strenuous activities in a day include at least an hour of one of the following: reading, sitting or eating.	Most strenuous activities in a day include at least an hour of one of the following: walking, dancing, skating, bowling, golfing or other light exercise.	Most strenuous activities in a day include at least an hour of one of the following: running, bicycling, playing basketball, playing soccer, gymnastics, playing tennis or other moderate to intense exercise.

	BOY	GIRL
Low Energy	1.3 × _____ (BMR) = _____ (Cal/Day)	1.3 × _____ (BMR) = _____ (Cal/Day)
Medium Energy	1.7 × _____ (BMR) = _____ (Cal/Day)	1.7 × _____ (BMR) = _____ (Cal/Day)
High Energy	1.9 × _____ (BMR) = _____ (Cal/Day)	1.9 × _____ (BMR) = _____ (Cal/Day)

2. What were the total energy needs of the boy? _____ Cal/Day
3. What were the total energy needs of the girl? _____ Cal/Day
4. Based on your calculations, did the boy or girl have higher total daily Calorie needs? _____
5. What could a person do if he or she wanted to use more Calories in a day?

_____

_____

_____

OVERVIEW

Students will estimate serving sizes of different foods and compare their estimates to serving size information provided on Nutrition Facts food labels.

ACTIVITY 4

SERVING SIZES

Food labels and other guides often use "serving size" to describe a recommended single portion of a food. Serving sizes are different for various kinds of food (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.

Frequently, the serving sizes listed on Nutrition Facts labels of food packages are larger than the serving sizes listed by other guides to healthy eating, such as the USDA Food Pyramid (shown on p. 22). Serving sizes listed on food labels are designed to make it easier to compare the calorie, carbohydrate and fat content of similar products, and to identify nutrients present in a food. Used appropriately, the information on food labels can help consumers make better food choices.

This activity introduces students to solid and liquid measures and to the concept of "serving size."

CONCEPTS

- **Objects have observable properties that can be measured.**
- **Serving sizes on Nutrition Facts labels can help guide food choices.**

SCIENCE, HEALTH & MATH SKILLS

- **Estimating dry and liquid measures of volume**
- **Estimating appropriate portion sizes**

TIME

15 minutes for setup; 45 minutes to conduct activity

MATERIALS

- 3 large containers for dry sample foods
- 2-liter bottle of regular soft drink
- 2 identical packages of each of the following: frozen peas, dry breakfast cereal, popped popcorn

Note. Remove and save Nutrition Facts labels from all items (see Setup).

Each group will need:

- 6 paper plates (for dry foods)
- 2 large cups or containers (for liquids)
- 2 measuring cups (one for solids, one for liquids)
- Permanent marker
- Copy of "Estimates and Labels" page
- Copy of "Nutrition Facts Labels" page (see Setup)
- Copy of "What Is A Serving Size?" page

SETUP & MANAGEMENT

Create a "Nutrition Facts Labels" page by pasting all of the labels saved from the food items above onto a sheet of paper (eliminating duplicates). Display the three dry food items and the bottle of soft drink at a food station within the classroom. Place all materials in a central location for Materials Managers to collect. Have students work in groups of four.

Labels Are Important

The Nutrition Facts labels on packaged foods can help people make better choices. Labels list the amounts of nutrients present in each food in grams or as a percentage of the Recommended Dietary Allowance (RDA). The Nutrition Facts label is designed to help consumers select foods that will meet their dietary guidelines.

Food Labels & Fats

If an ingredient list on a food label includes the words "shortening," "partially hydrogenated vegetable oil," or "hydrogenated vegetable oil," the food contains trans fats and might not be a healthy choice. Diets high in trans fats may increase the risks of heart disease and stroke. (See sidebars, pp. 6 and 17 for more information on fats and trans fats.)

Equivalent Measures

1 tbs = 3 tsp
4 tbs = 1/4 cup
8 tbs = 1/2 cup
12 tbs = 3/4 cup
16 tbs = 1 cup

Liquid Measures

1 oz = 2 tbs
2 oz = 1/4 cup
4 oz = 1/2 cup
6 oz = 3/4 cup
8 oz = 1 cup
16 oz = 2 cups
32 oz = 4 cups

Dry Measures

4 oz = 1/4 lb
8 oz = 1/2 lb
12 oz = 3/4 lb
16 oz = 1 lb

PORTIONS VERSUS SERVINGS*

Food Item	Normal Portion	No. of Servings Represented
Bagel	1 whole (4 oz)	4
Muffin	1 large (5 oz)	5
Cinnamon bun	1 large (3 oz)	3
Flour tortilla	1 burrito-sized (10 in.)	3
Tortilla chips	1 individual bag (9–13 chips)	2
Popcorn	Movie theatre medium (16 cups)	8
Baked potato	One large (3–4 1/4 in. diameter)	4
French fries	Medium order (5 oz)	4
Fried chicken	3 pieces (7–8 oz)	3
Steak	1 large (13 oz)	5
Sliced ham or roast beef	Amount in typical deli sandwich (5 oz)	2

* Portions of many common foods consist of more than one "serving size."

PROCEDURE

1. Ask students, *What is a serving size?* Use students' answers to guide them into a discussion of food portions. Explain that food portions frequently are measured in terms of "cups," pieces or other units. Show students the measuring cups that they will be using to measure dry and liquid foods. Point out to students that each unit commonly used in cooking can be translated to standard international (metric) units, such as liters or grams.
2. After students have discussed food portions and serving sizes, challenge them to predict serving sizes for liquid and solid foods.
3. Have Materials Mangers pick up the materials for each group. Give each group a copy of the "What Is A Serving Size?" page. Have students follow the instructions on their activity sheets to label the plates and cups, and predict appropriate portion sizes for each of the four foods.
4. Once students have completed their predictions, allow each group to measure and place the corresponding amounts of each food into the cup and on the plates labeled "Estimate."
5. After students have measured out the amounts of food representing their predicted serving sizes, give each group a copy of the "Nutrition Facts Labels" page.
6. Help students find the manufacturers' suggested serving sizes for each food on the labels. Have students measure and place one serving (as indicated on the label) into the cup and on the plates marked "Food Label." Have students observe and compare the amounts they estimated as one serving size with the amounts actually listed on the food labels.
7. Allow each group to share its findings with the rest of the class.
8. Distribute a copy of the "Estimates and Labels" student sheet to each student. Help students find other relevant information on the label, such as total calories needed and amounts of important nutrients. Point out the Quick Hand Measures of portion sizes on the sheet. Ask, *Do you think food labels can help you make better decisions about what and how much to eat?*

EXTENSIONS

- In order to learn about "hidden sugar" in different foods and drinks, have students compare the amounts of sugar listed on the labels of fruit juices, soft drinks, cookies, cereal, baked goods and other foods (4g of sugar = 1 tsp).

ACTIVITY 4

WHAT IS A SERVING SIZE?

Have you ever wondered what are appropriate serving sizes of different foods? You will be investigating serving sizes of the foods displayed in your classroom.You will need six plates and two cups. Label three of the plates and one cup as "Estimate." Mark the other three plates and cup as "Food Label."

Serving Size: Estimates

1. Write the name of each food under the Food Name column on Table 1.
2. For each food, decide how many cups (or fractions of cups) make up one serving size. Record your estimates on the table.

Table 1. Estimates

Food Name	Estimate one serving of this food. Use cups as a measure.

3. Take the plates and cup labeled "Estimate" to the station where the foods are displayed. Also bring this sheet with your serving size estimates. Measure out what you recorded (estimated) for one serving size of each food on a plate or in the cup. Take a look at the amounts you measured. Are they more or less than you expected?

Serving Size: Nutrition Facts Labels

1. Look at the copy of the Nutrition Facts labels of the foods. Write the name of each of the foods under the Food Name column on Table
2. Find the serving size recommendations on each Nutrition Facts label. Write the recommended serving size listed on the Nutrition Facts label for each food in the appropriate space.

Table 2. Nutrition Facts Label Recommended Serving Size

Food Name	Nutrition Facts label serving size. Use cups as a measure.

2. Take the plates and cup marked "Food Label" to the food station. Measure out the appropriate amounts of each food, based on the Nutrition Facts labels. Put each portion on a plate or in the cup.
3. Compare your serving size estimates to the serving sizes recommended by the Nutrition Facts labels. Describe any differences below.

_____

_____

_____

_____

4. Based on the information you collected, why do you think it might be important to look at the serving sizes listed on food labels? Record your answer on the back of this sheet.

ACTIVITY 4

Estimates and Labels

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

Look for low levels of saturated, hydrogenated and trans fats. These 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. Foods with high amounts of saturated fats or sugars may not represent the best choices.

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	
Trans Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 490mg	**20%**
Total Carbohydrate 24g	**8%**
Dietary Fiber 7g	**28%**
Sugars 0g	**0%**
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 palm = Single serving of meat

Tip of thumb = Teaspoon of butter

OVERVIEW

Students will document their individual eating habits and learn whether their eating patterns meet their needs.

ACTIVITY 5

SERVINGS AND CHOICES

Food provides us with the energy we need for our daily activities. However, to maintain an appropriate weight, we must balance the foods we eat with the energy we spend. In other words, Calorie intake must match Calorie expenditure. Many teenagers and children do not realize the importance of this balance. As a result, their diets often include too many Calories.

When the body takes in too many Calories, part of the excess is stored as fat. When more Calories are used than are consumed, stored fat is burned to make up the energy difference.

This activity is designed to make students aware of the Calories they consume each day and to give them opportunities to compare their Calorie intakes and expenditures.

CONCEPTS

- **A person's daily Calorie intake should match his or her daily Calorie needs and Calorie expenditures.**
- **Nutritional requirements vary with body weight, age, gender, activity level and body functioning.**

SCIENCE, HEALTH & MATH SKILLS

- **Calculating**
- **Comparing**
- **Modeling**
- **Drawing conclusions**

TIME

10 minutes for setup; 45–60 minutes for activity

MATERIALS

Each student will need:

- Calculation of daily Calorie needs from Activity 3, "Total Energy Needs" student sheet
- Writing paper and pen or pencil
- Copies of "Serving Savvy" and "Serving Sizes and Calories" student sheets

SETUP & MANAGEMENT

Students will need their estimates of daily Calorie needs from Activity 3. They will work individually on this activity.

PROCEDURE

1. Distribute copies of the "Serving Savvy" student sheet. On a separate sheet of paper, have each student list everything he or she would eat in a typical day, using the food items on the chart. OR have students write down everything that they eat in a 24-hour period. This list should designate meals: breakfast, lunch and/or dinner, plus snacks. Students should record both the type and amount of food, based on serving sizes given on the chart.
2. Once students have listed their food intake for a day, ask them if they think their consumption will meet daily Calorie requirements for a typical boy or girl, as calculated in Activity 3.

Everyone has unique nutritional and health care needs. The information in this unit is not intended as a replacement for professional medical advice. Before beginning any diet, supplement or exercise program, discuss it with a doctor or qualified health care provider.

Whenever possible, choose the following.

- Whole grains over white bread or white flour
- Olive, canola or flaxseed seed oils instead of solid fats such as lard, margarine or shortening
- Fresh fruits and vegetables over manufactured cookies, cakes, crackers and pies
- Low-fat or fat-free dairy products instead of those made with whole milk or cream

Guide to Fats

The properties of fats are related to their chemical makeups. Not all fats are "bad." Some fats are important for good health.

- Omega-3 fats may help protect against cardiovascular disease. Fatty fish, such as salmon, trout and herring, and flaxseed oil are good sources of omega-3s.
- Unsaturated fats like olive, peanut, canola, soybean or corn oils are healthier choices.

Some fats can contribute to an increased risk of coronary heart disease.

- Saturated fats, which often are solid at room temperature, are less healthy. Animal-based fats (such as lard and butter) are highly saturated. Saturated fat should not exceed 10% of a person's total daily calories.
- The process of hydrogenation turns oils into solid fats. Hydrogenization also provides a class of fats known as "trans fats." Diets high in trans fats are unhealthy.

Dr. Peggy A. Whitson, Flight Engineer, NASA ISS Expedition 5, makes a hamburger. *Notice the floating tomato!*

When astronauts live and work in space, their dietary needs change. About five months before flight, astronauts create their own menus from a selection of food items, and may choose a few foods not on the list. Once their menus are finished, NASA nutritionists analyze the menus for nutritional content. If needed, any nutrient deficiencies are corrected so that each astronaut receives the right kind and right amount of nutrients and calories they need to stay as healthy as possible during and after their mission.

Photo courtesy of NASA.

3. Distribute copies of the "Serving Sizes and Calories" student sheet. Tell students they will use the chart to estimate how many Calories are in each item on their lists. Point out that the Calories listed are for specific amounts of each food item. If students have recorded more than one serving of an item, they should multiply the Calories for that item by the number of servings.
4. Finally, have students add all the Calorie values they calculated for the day. Ask, *Is this value higher or lower than you expected?*
5. Have students compare the daily Calorie needs, obtained from Activity 3, "Total Energy Needs" sheet, to the total number of Calories calculated from their food lists. Ask, *How many of you had the same number of Calories in your food list as the daily Calorie requirement? What food items had the most Calories? Were you surprised at the Calorie contents of any of the foods?*
6. Discuss with students the importance of balancing Calorie intake and expenditure. Ask students to think about how they could achieve this balance. Point out that it is not only what students eat, but also how much they eat, that determines their Calorie intake.
7. Conclude by asking students, *Are there any ways to improve your eating habits?* Discuss changes they could make in either their daily activities or daily food intake. Collect or have students save their lists to use with Activity 6.

"SUPER-SIZING" PORTIONS

In many fast food restaurants, options are given to "Super Size" portions. Below are the Calorie counts for some common fast foods.

French Fries	
Small	210
Large	450
Super	540
Eggrolls	
3 pieces	400
5 pieces	665
Chicken Nuggets	
4 pieces	190
6 pieces	290
9 pieces	430

EXTENSIONS

- Have students access the "USDA National Nutrient Database for Standard Reference" for Calorie values corresponding to foods not listed in the chart, at www.nal.usda.gov/fnic/foodcomp/search/.

ACTIVITY 5

SERVING SAVVY

On a separate sheet of paper, use the information below to list or create a "typical" one-day menu for yourself. Include all meals and snacks and the amount you would eat of each food.

Item (amount)	Item (amount)	Item (amount)
Apple, fresh (1 medium)	Egg (1 medium)	Pizza, pepperoni (1/8 of 12-in. pie)
Apple juice (1 cup)	Egg roll, fried (1 roll, 3.5 oz)	Pocket sandwich, chicken (1 pocket)
Applesauce, sweetened (1/2 cup)	Enchilada, cheese (1 enchilada, 5.7 oz)	Popcorn, air popped (1 cup)
Asparagus, fresh (1/2 cup)	Fish, catfish, fried (3 oz portion)	Popcorn, microwave butter (3 cups)
Avocado, mashed (1/2 cup)	Fish, flounder, baked (3 oz portion)	Pork, chop (3 oz portion)
Bacon, cooked (1 slice)	Grapes, fresh (1 cup)	Pork, ham (1 cup chopped)
Bagel, plain (4 in.)	Grapefruit (1 medium)	Potato, baked, plain (1 large)
Banana, fresh (1 medium)	Gravy (1/4 cup)	Potato, french fried (20 pieces)
Beans, baked (1/2 cup)	Green beans, cooked (1/2 cup)	Potato, mashed (1/2 cup)
Beans, refried (1/2 cup)	Hot dog (1 hot dog)	Potato, tater tot style (9 pieces)
Beef, ground, broiled (3 oz portion)	Ice cream, regular (1/2 cup)	Potato, sweet (1 small)
Beef, pot roast, roasted (3 oz portion)	Ice cream, rich (1/2 cup)	Pretzel snack mix (1/2 cup)
Beef, steak, broiled (3 oz steak)	Jelly or jam (1 tablespoon)	Pudding cup, any flavor (1/2 cup)
Bread, hamburger bun (1 medium)	Ketchup (1 tablespoon)	Raisins (1/4 cup)
Bread, hot dog bun (1 medium)	Lettuce, iceberg, fresh (1 cup)	Ravioli, beef (1 cup)
Bread, pita, wheat or white (1/2 pocket)	Macaroni and cheese (1 cup)	Ravioli, cheese (1 cup)
Bread, sandwich, wheat or white (1 slice)	Margarine (3 teaspoons or 1 tablespoon)	Rice cake (1 cake)
Broccoli, fresh (1 cup)	Mayonnaise (1 tablespoon)	Rice, brown or white, cooked (1/2 cup)
Brownie (1 piece)	Milk, 2% (1 cup)	Rice, fried (3/4 cup)
Burrito, bean and cheese (6 oz burrito)	Milk, whole (1 cup)	Salad dressing, ranch (2 tablespoons)
Butter (3 teaspoons or 1 tablespoon)	Milk drink, chocolate (1 cup)	Salad dressing, fat-free (2 tablespoons)
Cake, chocolate, frosted (1 cupcake-size)	Milk drink, hot chocolate/cocoa (1 cup)	Salsa, con queso (2 tablespoons)
Candy, chocolate bar (2 fun size)	Milk drink, milkshake (1 cup)	Salsa, picante (2 tablespoons)
Candy, hard (1 piece)	Muffin, any flavor (1 medium)	Snacks, cheese puffs, baked (3/4 cup)
Candy, jelly beans (10 small)	Mushrooms, cooked (1 cup)	Snacks, Cheetos-style (26 pieces)
Carrots, cooked (1/2 cup)	Nachos with cheese (8 chips)	Soft drink, cola (12-oz can)
Cauliflower, cooked (1/2 cup)	Noodles, egg, cooked (1 cup)	Soft drink, diet cola (12-oz can)
Celery, fresh (1 stalk)	Noodles, chow mein, cooked (1 cup)	Soup, cream style (1 cup)
Cereal, sweetened, dry (1 cup)	Noodles, rice, cooked (1 cup)	Soup, noodle style (1 cup)
Cereal, unsweetened, dry (1 cup)	Oatmeal, plain, cooked (1/2 cup)	Soup, vegetable (1 cup)
Cheese, American (1 slice)	Oil, cooking (1 tablespoon)	Soup, vegetable with meat (1 cup)
Cheese, Swiss (1 slice)	Olives, green (4 medium)	Sour cream (2 tablespoons)
Chicken, thigh, fried (1 piece)	Onion, fresh (1/2 cup, chopped)	Spaghetti sauce, vegetable (1/2 cup)
Chicken, thigh, roasted (1 piece)	Onion rings, fried (9 rings)	Spaghetti sauce, meat flavored (1/2 cup)
Chicken, breast, fried (1 piece)	Orange, fresh (1 medium)	Spinach, cooked (1/2 cup)
Chicken, breast, roasted (1 piece)	Orange juice (1 cup)	Squash, cooked and mashed (1/2 cup)
Chicken, nuggets (6 pieces)	Pancake, plain (1 4-in. pancake)	Strawberries, fresh (1/2 cup)
Chicken, deli sandwich (2 slices)	Pasta, cooked (1 cup)	Sugar, white (1 tablespoon)
Chili, with or without beans (1 cup)	Pastry, toaster-type, no icing (1 pastry)	Sunflower seeds (1/4 cup)
Cookie, chocolate chip (1 cookie)	Peach, fresh (1 medium)	Sushi, California or tuna roll (1 piece)
Cookie, chocolate sandwich (3 cookies)	Peaches, canned (1/2 cup)	Syrup, pancake (1/4 cup)
Cookie, oatmeal (2 cookies)	Pear, fresh (1 medium)	Syrup, pancake, lite (1/4 cup)
Cookie, vanilla wafer (8 cookies)	Peanuts (1/4 cup)	Tofu (1-in. slice or 3 oz)
Corn, cooked (1/2 cup)	Peanut butter (2 tablespoons)	Tortilla, corn or flour (1 tortilla)
Chips, any style (1 oz or about 15 chips)	Peas, canned (1/2 cup)	Taco, beef, prepared (1 small)
Corn dog, cooked (1 corn dog)	Peas, black-eyed with bacon (1/2 cup)	Taco salad (1 1/2 cups)
Cottage cheese (1/2 cup)	Peppers, banana or jalapeno (3 peppers)	Tamales, beef (3 small)
Cracker, graham (8 small squares)	Pickles, dill hamburger chips (5 pieces)	Tomato, fresh (1 cup sliced)
Cracker, saltine (1 cracker)	Pickles, sweet (3 small)	Tuna, canned in water (2 oz)
Cracker, wheat with peanut butter (1 pkg)	Pie, apple (1 slice or 1/6-slice of pie)	Turkey, without skin (1 cup)
Cream cheese (2 tablespoons)	Pineapple, canned (1/2 cup)	Yogurt, plain, low-fat (1 cup)
Doughnut, plain (1 medium)	Pizza, cheese (1/8 of 12-in. pie)	Yogurt, low-fat with fruit (1 cup)

ACTIVITY 5

Serving Sizes and Calories

Use the values below to figure out how many Calories are in each of the items on your menu. For foods not listed, search the USDA National Nutrient Database online at www.nal.usda.gov/fnic/foodcomp/search/.

Item (amount)	Cal	Item (amount)	Cal	Item (amount)	Cal
Apple, fresh (1 medium)	91	Egg (1 medium)	77	Pizza, pepperoni (1/8 of 12-in. pie)	180
Apple juice (1 cup)	117	Egg roll, fried (1 roll, 3.5 oz)	176	Pocket sandwich, chicken (1 pocket)	300
Applesauce, sweetened (1/2 cup)	97	Enchilada, cheese (1 enchilada, 5.7 oz)	356	Popcorn, air popped (1 cup)	31
Asparagus, fresh (1/2 cup)	20	Fish, catfish, fried (3 oz portion)	194	Popcorn, microwave butter (3 cups)	234
Avocado, mashed (1/2 cup)	184	Fish, flounder, baked (3 oz portion)	99	Pork, chop (3 oz portion)	213
Bacon, cooked (1 slice)	35	Grapes, fresh (1 cup)	58	Pork, ham (1 cup chopped)	369
Bagel, plain (4 in.)	227	Grapefruit (1 medium)	80	Potato, baked, plain (1 large)	280
Banana, fresh (1 medium)	120	Gravy (1/4 cup)	164	Potato, french fried (20 pieces)	235
Beans, baked (1/2 cup)	157	Green beans, cooked (1/2 cup)	22	Potato, mashed (1/2 cup)	160
Beans, refried (1/2 cup)	183	Hot dog (1 hot dog)	145	Potato, tater tot style (9 pieces)	160
Beef, ground, broiled (3 oz portion)	238	Ice cream, regular (1/2 cup)	130	Potato, sweet (1 small)	118
Beef, pot roast, roasted (3 oz portion)	284	Ice cream, rich (1/2 cup)	290	Pretzel snack mix (1/2 cup)	140
Beef, steak, broiled (3 oz steak)	185	Jelly or jam (1 tablespoon)	40	Pudding cup, any flavor (1/2 cup)	180
Bread, hamburger bun (1 medium)	180	Ketchup (1 tablespoon)	16	Raisins (1/4 cup)	112
Bread, hot dog bun (1 medium)	116	Lettuce, iceberg, fresh (1 cup)	10	Ravioli, beef (1 cup)	260
Bread, pita, wheat or white (1/2 pocket)	71	Macaroni and cheese (1 cup)	320	Ravioli, cheese (1 cup)	220
Bread, sandwich, wheat or white (1 slice)	70	Margarine (3 teaspoons or 1 tablespoon)	102	Rice cake (1 cake)	40
Broccoli, fresh (1 cup)	25	Mayonnaise (1 tablespoon)	100	Rice, brown or white, cooked (1/2 cup)	120
Brownie (1 piece)	160	Milk, 2% (1 cup)	120	Rice, fried (3/4 cup)	190
Burrito, bean and cheese (6 oz burrito)	350	Milk, whole (1 cup)	150	Salad dressing, ranch (2 tablespoons)	150
Butter (3 teaspoons or 1 tablespoon)	202	Milk drink, chocolate (1 cup)	238	Salad dressing, fat-free (2 tablespoons)	50
Cake, chocolate, frosted (1 cupcake-size)	188	Milk drink, hot chocolate/cocoa (1 cup)	147	Salsa, con queso (2 tablespoons)	90
Candy, chocolate bar (2 fun size)	190	Milk drink, milkshake (1 cup)	288	Salsa, picante (2 tablespoons)	10
Candy, hard (1 piece)	24	Muffin, any flavor (1 medium)	250	Snacks, cheese puffs, baked (3/4 cup)	140
Candy, jelly beans (10 small)	40	Mushrooms, cooked (1 cup)	77	Snacks, Cheetos-style (26 pieces)	150
Carrots, cooked (1/2 cup)	35	Nachos with cheese (8 chips)	345	Soft drink, cola (12-oz can)	150
Cauliflower, cooked (1/2 cup)	14	Noodles, egg, cooked (1 cup)	219	Soft drink, diet cola (12-oz can)	0
Celery, fresh (1 stalk)	10	Noodles, chow mein, cooked (1 cup)	237	Soup, cream style (1 cup)	130
Cereal, sweetened, dry (1 cup)	220	Noodles, rice, cooked (1 cup)	191	Soup, noodle style (1 cup)	70
Cereal, unsweetened, dry (1 cup)	110	Oatmeal, plain, cooked (1/2 cup)	73	Soup, vegetable (1 cup)	90
Cheese, American (1 slice)	95	Oil, cooking (1 tablespoon)	120	Soup, vegetable with meat (1 cup)	134
Cheese, Swiss (1 slice)	105	Olives, green (4 medium)	15	Sour cream (2 tablespoons)	60
Chicken, thigh, fried (1 piece)	162	Onion, fresh (1/2 cup, chopped)	21	Spaghetti sauce, vegetable (1/2 cup)	100
Chicken, thigh, roasted (1 piece)	153	Onion rings, fried (9 rings)	275	Spaghetti sauce, meat flavored (1/2 cup)	140
Chicken, breast, fried (1 piece)	218	Orange, fresh (1 medium)	60	Spinach, cooked (1/2 cup)	25
Chicken, breast, roasted (1 piece)	193	Orange juice (1 cup)	105	Squash, cooked and mashed (1/2 cup)	25
Chicken, nuggets (6 pieces)	290	Pancake, plain (1 4-in. pancake)	83	Strawberries, fresh (1/2 cup)	50
Chicken, deli sandwich (2 slices)	45	Pasta, cooked (1 cup)	200	Sugar, white (1 tablespoon)	45
Chili, with or without beans (1 cup)	300	Pastry, toaster-type, no icing (1 pastry)	200	Sunflower seeds (1/4 cup)	186
Cookie, chocolate chip (1 cookie)	78	Peach, fresh (1 medium)	38	Sushi, California or tuna roll (1 piece)	25
Cookie, chocolate sandwich (3 cookies)	170	Peaches, canned (1/2 cup)	100	Syrup, pancake (1/4 cup)	210
Cookie, oatmeal (2 cookies)	110	Pear, fresh (1 medium)	98	Syrup, pancake, lite (1/4 cup)	100
Cookie, vanilla wafer (8 cookies)	140	Peanuts (1/4 cup)	219	Tofu (1-in. slice or 3 oz)	50
Corn, cooked (1/2 cup)	67	Peanut butter (2 tablespoons)	188	Tortilla, corn or flour (1 tortilla)	140
Chips, any style (1 oz or about 15 chips)	150	Peas, canned (1/2 cup)	60	Taco, beef, prepared (1 small)	370
Corn dog, cooked (1 corn dog)	330	Peas, black-eyed with bacon (1/2 cup)	90	Taco salad (1 1/2 cups)	279
Cottage cheese (1/2 cup)	120	Peppers, banana or jalapeno (3 peppers)	11	Tamales, beef (3 small)	280
Cracker, graham (8 small squares)	120	Pickles, dill hamburger chips (5 pieces)	5	Tomato, fresh (1 cup sliced)	32
Cracker, saltine (1 cracker)	13	Pickles, sweet (3 small)	21	Tuna, canned in water (2 oz)	70
Cracker, wheat with peanut butter (1 pkg)	190	Pie, apple (1 slice or 1/6-slice of pie)	270	Turkey, without skin (1 cup)	238
Cream cheese (2 tablespoons)	100	Pineapple, canned (1/2 cup)	100	Yogurt, plain, low-fat (1 cup)	154
Doughnut, plain (1 medium)	150	Pizza, cheese (1/8 of 12-in. pie)	140	Yogurt, low-fat with fruit (1 cup)	250

Note. Calorie counts on prepared foods may be higher or lower depending on how the food is prepared and the different ingredients that may be added. Check package labels for specific information on prepared foods.

OVERVIEW

Students will compare their own eating habits to standard recommendations for a healthy diet.

ACTIVITY 6

YOUR NUTRITION NEEDS

Food provides more than just energy. It also supplies nutrients important for growth, repair and the maintenance of good health. There are five major types of nutrients: carbohydrates, proteins, fats, vitamins and minerals. Three of these—carbohydrates, proteins and fats—are known as macronutrients, because they provide energy and are consumed in larger quantities. Vitamins and minerals are needed in much smaller amounts. The body needs appropriate amounts of each nutrient to operate at its best.

- **Carbohydrates** are a major source of energy found in fruit, vegetables, grains and milk. Fiber, starches and sugars are carbohydrates. The best kinds of carbohydrates are digested slowly and provide an even supply of energy. Whole fruit, vegetables and whole grain products, such as breads, cereals and pastas, are good carbohydrate choices.
- **Fats** are rich sources of energy. Certain kinds of fats and oils are healthier than others. Fats that are solid at room temperature, such as shortening, margarine and lard, should be avoided. Healthier choices include monounsaturated and polyunsaturated oils found in fish, nuts and vegetable oils. Foods that contain large amounts of unhealthy fats include some red meats, whole milk dairy products and cream, chocolate, cakes, cookies and crackers.
- **Proteins** are building blocks for the body. Muscles, hair, skin and nails are mostly protein, as is the flexible collagen network within bones. Proteins help carry out essential reactions within each cell. Meats, fish, poultry, eggs, dairy products, beans and nuts are good sources of protein.
- **Vitamins**, needed by the body in small amounts, are essential for the functioning of cells, but they cannot be manufactured by our bodies.
- **Minerals** have a number of roles. Calcium, the most abundant mineral in the body, makes bones hard and is needed by the nervous system and muscles.

The USDA recognized that one size does not fit all and created an online interactive food guidance system which provides an individual approach to making healthy food choices that consider

CONCEPTS

- **Nutrition is essential to health.**
- **Good nutrition includes eating a variety of foods, and eating less sugar and unhealthy fat.**

SCIENCE, HEALTH & MATH SKILLS

- **Comparing**
- **Interpreting information in charts and tables**
- **Modeling**
- **Appropriate Internet searching**

Water for Life

Water makes up three-fourths of the brain and muscles. Every cell in the body is packed with water. Water transports nutrients and wastes, helps control temperature, and makes many chemical reactions possible. The body loses almost three liters of water every day. Some of it is replaced with food, such as fruits and vegetables, but drinking six to eight glasses of liquid each day to maintain the body's water supply is recommended.

During space flight, there is no light source to provide vitamin D, which is necessary for calcium absorption. Therefore, astronauts' dietary vitamin D must come from fish oil or supplements.

Eating Disorders

Sometimes girls, women and, increasingly, men become worried about the amount of food they eat and what they weigh. This worry can lead to eating disorders that can cause serious physical and emotional health problems. In a recent study, 70% of 6th grade girls said they began worrying about their weight when they were between 9 and 11 years old! Eating disorders include anorexia nervosa, bulimia nervosa and binge eating.

Anorexia nervosa is an excessive concern with being thin. Bulimia nervosa involves binging and then purging what is eaten (by throwing up, using laxatives or overexercising) Binge eating is overeating that cannot be controlled. Researchers say that almost 5% of young women in the US have an eating disorder and that as many as 15% have unhealthy attitudes toward themselves and food. Eating disorders are treatable. The sooner the treatment starts, the better.

an individual's calorie need based on age, gender and physical activity level.

This activity allows students to learn about food selections and to compare their own diets to the USDA recommendations for a healthier diet.

TIME

10 minutes for setup; 45–60 minutes to conduct the activity

MATERIALS

Each student will need:

- Completed food list from Activity 5
- Copies of "Serving Sizes and Calories (Activity 5), "My Pyamid," "Daily Amounts" and "My Plan" student sheets

SETUP & MANAGEMENT

Students will need their daily food lists from Activity 5. They may work alone or in teams.

PROCEDURE

1. Begin with a class discussion. Ask, *Are calories the only important part of what someone eats? Would it be healthy to eat only chocolate? How about lettuce? Or hamburgers? Why do you think it's important to eat different kinds of foods?*
2. Distribute copies of the My Pyramid page to each student. Tell students that the different sections on the pyramid represent the five food groups (fruits, vegetables, grains, meat and beans, and milk), with one additional section representing oils (fats).
3. Give students time to read the My Pyramid page. Ask them to highlight or underline any statements or foods that are surprising or interesting. Encourage students to use resources available on the Internet (such as www.MyPyramid.gov) to learn more about foods that are new to them.
4. Next, distribute the Daily Amounts and My Plan student sheets. Tell students that, first, they will figure out how much food they should be eating from each food group, based on age and activity level. This information can be determined from the tables on the Daily Amounts sheet and entered in the first column of the My Plan sheet.
5. Once students have filled in the amounts they ideally should eat from each food group, have them use the menus or food lists they created in Activity 5 and all available information to estimate the amounts from each food group that are represented in their menus. This information should be written in the second column on the My Plan page.

   Make students aware that some items on their lists may fall into more than one food category. For example, a large portion of lasagna might count as two grain servings (noodles), one milk serving (cheese), one-half vegetable serving (tomato sauce), and one meat and beans serving (ground beef or sausage).
6. Ask, *How do your selections compare to your recommended daily amounts? Are there any foods that you need to increase or decrease?*
7. Finally, have students create a healthier eating plan based on what they learned. The healthier eating plan should be outlined in the third column on the My Plan sheet.

EXTENSIONS

- Have students access the Internet and go to www.MyPyramid.gov. Students can use the interactive features to calculate the number of servings they should have from each food group and use this information fill in the first column of the My Plan sheet.
- Students also can use additional resources on www.MyPyramid.gov to learn more about the food groups and appropriate portion sizes.

ACTIVITY 6

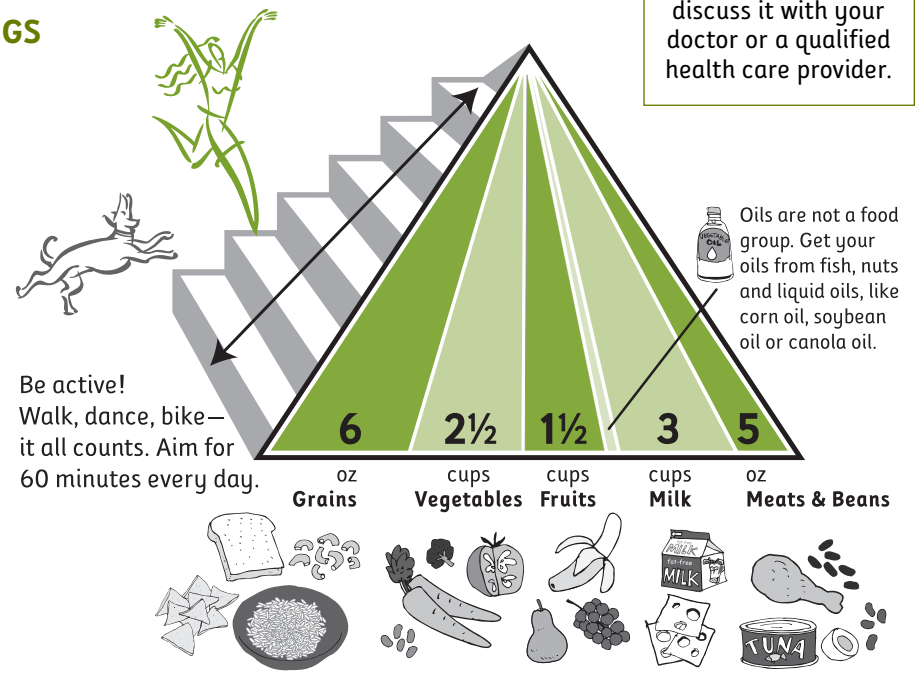
My Pyramid

Safety Note

Before beginning any diet, supplement or exercise program, discuss it with your doctor or a qualified health care provider.

RECOMMENDED DAILY SERVINGS

The wide base of the pyramid means that you should eat more foods with little or no solid fat and added sugar. The narrow top area stands for foods containing solid fat or added sugars (like most cookies and chips, for example) that you should eat less often.



GRAINS

Any food made from wheat, rice, oats, cornmeal, barley or another cereal grain is a grain product. Bread, pasta, oatmeal, breakfast cereals, tortillas, and rice are grain products. One oz from the grains group equals 1 slice of bread, 1 cup of ready-to-eat cereal, 1/2 cup of cooked rice, cereal, or pasta, 1 small tortilla, or 1 mini-bagel.

At least half (3 oz) of all the grains eaten in one day should be whole grains. Whole grain foods include brown rice, oatmeal, popcorn (3 cups plain = 1 oz), whole wheat breads, pastas, tortillas and crackers, and whole grain barley and cornmeal.

VEGETABLES

Any vegetable or 100% vegetable juice is in the vegetable group. One cup of vegetables equals 1 cup of raw or cooked vegetables, 1 cup of 100% vegetable juice, 1 large baked sweet potato (plain), 1 medium baked potato (plain), or 2 cups of raw leafy green vegetables.

FRUITS

Any fruit or 100% fruit juice counts as part of the fruit group. One cup of fruit equals 1 medium apple, banana or orange, 1 cup of sliced fruit, 1 cup of cooked or canned and drained fruit, 1 cup of fruit juice (make sure it's 100% juice), or 1/2 cup of dried fruit (raisins, etc.). Avocados are part of the fruit group.

MILK

Milk products include milk, yogurt, cheese, pudding, and cottage cheese. One cup from the milk group equals 1 cup of milk or yogurt, 2 oz of American cheese, or 1 cup of pudding made with milk. Choose fat-free or low-fat milk, yogurt and cheese most often. Low-fat milk products are good sources of protein and calcium.

MEATS & BEANS

Meat, poultry, fish, eggs, dry beans or peas, tofu and soybeans, nuts, and seeds are part of this group. One oz equals 1 oz of meat, poultry, or fish, 1/4 cup cooked dry beans, 1 egg, 1 tablespoon of peanut butter, 1/4 cup of tofu, or 1/2 oz of nuts or seeds (12 almonds). Generally, one small, lean chicken breast equals 3 oz, and 1 small can of drained tuna equals 3–4 oz.

OILS

Oils are fats that are liquid at room temperature, like the vegetable oils used in cooking. The recommended daily allowance for oils is measured in teaspoons. Oils occur naturally in nuts and seeds, peanut butter, fish, avocados, and in food products like olives, cooking oil, and salad dressings. Check the Nutrition Facts label to find products with 0 grams of trans fat. One tbs of margarine or mayonnaise equals 2 1/2 tsp of oil. One-half of a medium avocado (fruit), or 12 almonds (meats & beans) equals 3 tsp of oils in addition to what they count in each food group.

DISCRETIONARY CALORIES

Discretionary calories are "extra" calories that may be used to consume fats, added sugars, and alcohol, or any foods. Recommended calories range from 100–300, depending on an individual's estimated calorie needs. For example, a person who needs 2,000 calories per day will need about 1,735 calories for essential nutrients, leaving 265 discretionary calories. These calories could be used to consume sweets, sauces, or beverages, such as soft drinks.

PHYSICAL ACTIVITY

Physical activity is represented by the steps on the pyramid. It should be moderate or vigorous for at least 30 minutes per day to use energy and help you achieve and maintain a healthy weight and lower your risk for chronic disease. Moderate physical activity includes brisk walking, hiking or dancing. Vigorous activity includes running or jogging, bicycling, swimming or a fast walk.

ACTIVITY 6

DAILY AMOUNTS

Use the information on this page to figure out the amounts you should eat from each food group.

1. On Table 1, find the amount of Calories you need, based on your age, gender and level of physical activity. Write your estimated daily calorie needs here.

   Calories per day: _____

2. Find the column in Table 2 that matches your daily Calorie needs. Use this information to complete column one on the My Plan activity sheet.

If you have access to the Internet, you can visit http://www.MyPyramid.gov and use the interactive My Pyramid Plan box to calculate the amounts you should eat from each food group.

"Discretionary Calories" are Calories that can be used for extra treats or snacks.

The chart to the right gives an estimate of individual calorie needs based on age, gender and physical activity level (sedentary or active).

Sedentary: A lifestyle that includes only the light physical activity associated with typical day-to-day life.

Active: A lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3–4 miles per hour, in addition to the light physical activity associated with typical day-to-day life.

Table 1.

Estimated Daily Calorie Needs		
	Sedentary Calorie Range	**Active Calorie Range**
Children	—	—
2–3 years	1,000	1,400
Females	—	—
4–8 years	1,200	1,800
9–13	1,600	2,200
14–18	1,800	2,400
19–30	2,000	2,400
31–50	1,800	2,200
51+	1,600	2,200
Males	—	—
4–8 years	1,400	2,000
9–13	1,800	2,600
14–18	2,200	3,200
19–30	2,400	3,000
31–50	2,200	3,000
51+	2,000	2,800

Table 2.

Recommended Daily Amount of Food from Each Food Group at Different Calorie Needs												
Calorie Need	1,000	1,200	1,400	1,600	1,800	2,000	2,200	2,400	2,600	2,800	3,000	3,200
Fruits	1 cup	1 cup	1.5 cups	1.5 cups	1.5 cups	2 cups	2 cups	2 cups	2 cups	2.5 cups	2.5 cups	2.5 cups
Vegetables	1 cup	1.5 cups	1.5 cups	2 cups	2.5 cups	2.5 cups	3 cups	3 cups	3.5 cups	3.5 cups	4 cups	4 cups
Grains	3 oz	4 oz	5 oz	5 oz	6 oz	6 oz	7 oz	8 oz	9 oz	10 oz	10 oz	10 oz
Meat & Beans	2 oz	3 oz	4 oz	5 oz	5 oz	5.5 oz	6 oz	6.5 oz	6.5 oz	7 oz	7 oz	7 oz
Milk	2 cups	2 cups	2 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups	3 cups
Oils	3 tsp	4 tsp	4 tsp	5 tsp	5 tsp	6 tsp	6 tsp	7 tsp	8 tsp	8 tsp	10 tsp	11 tsp
Discretionary Calories	165	171	171	132	195	267	290	362	410	426	512	648

Safety Note. Before beginning any diet, supplement or exercise program, discuss it with your doctor or a qualified health care provider.

ACTIVITY 6

My Plan

1. If you have not done so already, fill in the "My Recommended Amounts" column using information from the Daily Amounts sheet.
2. Look at the food list for one day that you created previously as part of Activity 5. In the "My Selections" column, record the foods on your list corresponding to each food group. Amounts of foods are given on the "Serving Sizes and Calories" page. Use a separate sheet of paper to calculate amounts, if necessary. Additional information about foods and amounts can be found on the My Pyramid sheet and at http://www.MyPyramid.gov.
3. Compare the amounts of foods in the "My Recommended Amounts" and "My Selections" columns.
4. Now, based on your results, come up with a new plan to meet your recommended amounts better. Write your selections in the "My Healthier Plan" column. For example, many people need to consume fewer foods from the grains or oils groups and more from the vegetables or fruits groups.

	My Recommended Amounts	My Selections	My Healthier Plan
Fruits			
Vegetables			
Grains			
Meats and Beans			
Milk			
Oils			
Discretionary Foods			

Nutrition Research

NSBRI Web site: http://www.NSBRI.org

Scientists and researchers work constantly to find ways to improve people's health. Scientists associated with the **National Space Biomedical Research Institute** (NSBRI) are conducting studies to help astronauts stay healthy in space. Findings of these studies can benefit people on Earth.

One such study is being conducted by NSBRI scientist, Dr. Robert Wolfe, at The University of Texas Medical Branch at Galveston. Dr. Wolfe and his team are looking for ways to counteract some of the changes that occur in the bodies of astronauts after they have been in space for a while.

In space, astronauts' muscles don't have to work as hard as they do on Earth, because there is almost no gravity. Also, astronauts are confined in a small space, so it is difficult for them to get enough exercise. After a while, their bodies adjust to the space environment and astronauts begin to lose muscle, especially in their legs. Though astronauts exercise at least twice a day while in space, muscle loss is still a problem. Dr. Wolfe and his team are trying to find out if nutritional supplements can help prevent some of the muscle loss (or atrophy).

Doctors and researchers know that people here on Earth experience similar muscle loss when they are confined to bed for long periods of time due to illness or other circumstances. Dr. Wolfe enlisted the help of healthy people (subjects) to stay in bed for 28 days. The subjects could get up only briefly to use a bedside commode. They ate and bathed from their beds, and their daily physical activities were limited to watching television, reading books or using a computer—all done while in lying or sitting in bed.

Everyone has unique nutritional and health care needs. The information provided here is not intended as a replacement for professional medical advice. Before beginning any supplement, diet or exercise program, discuss it with your doctor or qualified health care provider.

During the study, some of these subjects received nutritional supplements of amino acids (the raw materials of protein, which makes up muscle) three times a day. Other subjects in the study received a similar drink, but without any supplements. None of the subjects knew if they were receiving the drink with the amino acid supplements.

Each subject's muscles were measured before and after the bed-rest study. Halfway through the study, researchers also measured the muscles and function of all subjects by testing their strength and body composition.

Photo by John Glowczwski © 2006 NSBRI.

Through an NSBRI bed-rest study, an amino acid and carbohydrate supplement is being studied to determine its value as a nutritional countermeasure to muscle loss.

The researchers also looked at the role of stress in muscle loss. Under stress, the body breaks down proteins (muscles are made of protein). Conditions in space elevate the body's level of the stress hormone, cortisol, which increases the rate at which proteins—and therefore muscles—break down.

To study this process further, Dr. Wolfe's team gave stress hormones to some of the subjects in order to mimic the cortisol concentrations found in astronauts' bodies during space flight. The scientists hoped to learn whether the amino acid supplement was effective under conditions experienced by astronauts during space missions.

Early results from this NSBRI study suggest that nutritional supplements may lessen muscle loss brought on by space travel, prolonged bed confinement or immobility.

Muscle loss is common in many populations on Earth, as well as in astronauts working in space. The elderly, children with burns, patients in intensive care, some physically challenged individuals, and people who have had major operations often suffer from muscle loss. Though the study was begun to keep astronauts healthy while they work in space, the results also may benefit many people here on Earth.

The NSBRI, funded by NASA, is a consortium of institutions studying the health risks related to long-duration space flight. The Institute's 95 research and education projects take place at 75 institutions across the U.S.

OVERVIEW

Students will learn about healthy eating habits to meet special needs, such as for athletes, persons with diabetes and vegetarians.

ACTIVITY 7

NUTRITIONAL CHALLENGES

The MyPyramid diagram can help people make healthy food choices and be active every day. It promotes physical activity, variety in food selection, appropriate portion sizes, gradual improvement and personalization. Healthy food choices include eating at least three ounces of whole-grain cereal, rice or pasta every day and choosing low-fat or fat-free milk, yogurt or other milk products. Limit the consumption of fats and sugars added to foods (butter, margarine, gravy, etc.) and choose fewer foods that are high in sugars (soft drinks, candy and deserts).

MyPyramid.gov has been adapted in a variety of ways to reflect ethnic preferences, personal beliefs and health needs. This activity allows students to consider the nutritional needs of people with specific dietary requirements and to create a full-day menu for these individuals.

CONCEPTS

- **Nutritional requirements vary with body weight, age, gender, activity level and body functioning.**
- **Diet consists of all the foods that someone eats. Sometimes people must adjust their diets.**

SCIENCE, HEALTH & MATH SKILLS

- **Using printed material**
- **Inferring**
- **Communicating**

TIME

10 minutes for setup; 30–45 minutes for students to plan menus; 30–45 minutes for presentations of menus

MATERIALS

Each group will need:

- Copy of "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets from previous activities.
- Copy of one "Challenging Choices" sheet photocopied, trimmed and folded in half vertically to make a card. Students will complete the inside of the card with their menus. If possible, each group should receive a different card.

Optional:

Provide copies of the "Menu Plan" student sheet for students to use as a preliminary worksheet. OR photocopy the sheet on the back of each "Challenging Choices" sheet (prior to making a folded card) so that students have a complete menu.

SETUP & MANAGEMENT

Have students work in groups of four.

PROCEDURE

1. Ask students, *Should all of us follow the same guidelines for choosing foods to eat? Why or why not? What about people with special requirements?* Mention athletes, vegetarians and astronauts as examples of people who follow different eating plans by choice and because of their activities.

Food Challenges for Astronauts

Astronauts need special eating plans because they usually lose weight while in space due to the following.

- Boredom with foods provided.
- Busy schedules, which lead to skipped meals.
- Poor appetite because fluid in the upper body and head during microgravity causes a runny nose and simulates a cold.
- Difficulty eating in microgravity. For example, foods and utensils float and astronauts must stand and float while eating.
- Nausea and motion sickness, especially early in a space flight, which make eating less desirable during the first few days in space.

Dietary Fiber

Dietary fiber is a type of carbohydrate found in plants. It differs from other carbohydrates (sugars, starches) because it cannot be digested by the body. Fiber has been shown to help prevent heart disease, colon cancer and type 2 Diabetes. It also is important for maintaining health of the digestive system and may help with weight control.

Good sources of fiber include fruits and vegetables, bran and some cereals. The fiber content of foods can be found on the Nutrition Facts label. Some whole grains are good sources of fiber. In addition, whole grains have vitamins and minerals that provide benefits beyond the fiber content alone.

It is recommended that at least three of your servings of carbohydrates each day be from whole grains. Remember that foods labeled "multi-grain" or "cracked wheat" or "100% wheat" may not actually contain whole grains. Look in the ingredient list and make sure the word "whole" is listed with the first ingredient (for example, "whole" wheat or "whole" oat).

Follow by asking, *What about people who need to make different dietary choices for health reasons?* Mention people with diabetes (who must restrict sugar intake), people with lactose intolerance (who cannot digest the sugars in milk) and pregnant women as examples of persons who must pay special attention to what they eat.

2. Distribute a Specialty Menu card to each group of four students. Explain that each group has a different card that describes specific challenges for making a daily menu. Have each group plan a menu for breakfast, lunch, dinner and snacks that meets the particular dietary needs described on the card, and write the menus on the inside of the cards. Students should follow the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" student sheets, making substitutions where necessary to accommodate the dietary and caloric requirements outlined on the card, and to provide a balanced diet.
3. Have each group of students come up with a skit or other way to present their menus to the rest of the class. Each group's presentation should explain how their food choices meet the specific nutritional needs of the dietary type they considered.

Photo courtesy of NASA.

Eileen M. Collins, Shuttle Commander, STS-114, and **James M. Kelly,** Pilot, at lunch. Kelly has discovered that a tortilla makes for better sandwich-building than other type breads which are prone to creating troublesome crumbs in the weightless environment.

EXTENSIONS

- Have students consider other special circumstances that might require different eating programs. Have them design menus to meet the needs they identify.
- Personal fitness, particularly cardiovascular fitness, also is essential for good health. Have students create exercise programs for each of the categories described on the Specialty Menu cards, using information from the library or the Internet.
- Eating in space has changed considerably from the earlier days of the US Space Program. Have students investigate how space foods and dietary provisions for astronauts have been modified over time.

SERVINGS COMPARISONS FOR THREE CALORIE LEVELS

	Children Sedentary Women Some Older Adults	Mildly Active Women Sedentary Men Teen Girls	Active Men Active Women Teen Boys
Food Group, Oils & Discretionary Calories	**1,600 Calories**	**2,200 Calories**	**2,800 Calories**
Grains	5 oz	7 oz	10 oz
Vegetables	2 cups	3 cups	3.5 cups
Fruits	1.5 cups	2 cups	2.5 cups
Meat & Beans	5 oz	6 oz	7 oz
Milk	3 cups	3 cups	3 cups
Oils	5 tsp	6 tsp	8 tsp
Discretionary Calories	132	290	426

ACTIVITY 7

CHALLENGING CHOICES

PERSON WITH HYPERTENSION

Senior Adult - Male
Age: 65
Height: 69 in.
Weight: 180 lbs (10 lbs overweight)
Energy Level: Low

Total daily Caloric intake need:
2,119 calories

Hypertension is the medical term for high blood pressure. It affects about one out of every three American adults. High blood pressure makes the heart work too hard and increases the risk of heart disease and stroke. It also can cause other problems, such as kidney disease and blindness. People who have diabetes or are overweight are at an increased risk for high blood pressure.

Reducing the amount of salt in the diet can help lower and control high blood pressure. People with hypertension should limit their consumption of processed foods that contain a lot of salt, such as cereals, soups, canned goods, frozen dinners, ketchup and pickles. Some foods that can help to reduce high blood pressure are shown (with recommended daily servings) below.

- Whole grains and grain products: 6 oz
- Vegetables: 2 1/2 cups (especially calcium-rich leafy green vegetables)
- Fruits: 2 cups
- Low-fat or nonfat dairy foods: 3 cups
- Meats, poultry or fish: 2 or fewer (trim away visible fat and skin from meat and broil, roast or boil, instead of frying)
- Nuts, seeds and legumes: 4 oz (per week)

SPECIALTY

MENU

HIGH BLOOD PRESSURE

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of an inactive person who suffers from hypertension (high blood pressure) and who is slightly overweight. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this person and the special needs of other people with hypertension may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

STRICT VEGETARIAN

Teenager - Male
Age: 14
Height: 65 in.
Weight: 118 lbs
Energy Level: Medium

Total daily Caloric intake need:
2,459 calories

There are several types of vegetarians. A strict vegetarian eats only plant-based foods and doesn't eat any form of animal foods. However, there are many variations on a vegetarian diet. Some vegetarians avoid meat, fish and poultry, but include dairy products and/or eggs in their diets. Others exclude only red meat. People may choose to follow a vegetarian diet for religious, political, personal or health reasons.

It is very important that a vegetarian eat a wide variety of foods and the right amount of foods to meet calorie needs. Teenage vegetarians must be particularly careful to get sufficient amounts of protein, calcium, iron and vitamin B12. Vitamin B12, which helps in the formation of red blood cells and in the functioning of the nervous system, is not naturally present in plants. But lots of breakfast cereals, veggie burgers and nutritional yeast are fortified with B12, as are some brands of soymilk.

Vegetarians also have to pay attention to the kinds of proteins in their diets. Most plant foods do not contain all of the amino acids (building blocks of proteins) and must be combined to obtain the right balance. Examples of combinations include: peanut butter and bread, rice or corn and beans, and lentils and pasta. Beans and nuts are the best plant sources of protein. Other sources of protein include peas and soy products (tofu and tempeh), milk products and eggs.

SPECIALTY

MENU

VEGETARIANS

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of a moderately active person who follows a strict vegetarian diet. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this person and the special needs of different types of vegetarians may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

PREGNANT WOMAN

Adult - Female
Age: 27
Height: 64 in.
Weight: 125 lbs
Energy Level: Medium

Total daily Caloric intake need:
2,350 calories

When a woman is pregnant, a healthy diet is important because everything she eats or drinks affects her baby's development. A pregnant woman needs increased daily servings of proteins and dairy products. She also may need to eat smaller meals more often (for example, six small meals instead of three large ones). Her diet should include the following.

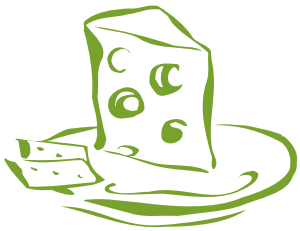
- 5–6 oz of high protein foods, such as beans, meat, fish, tofu and nuts
- 3–4 cups of milk and dairy products
- 3–5 cups of vegetables, especially green leafy ones
- 2–3 cups of vitamin C-rich foods, like citrus fruits, tomatoes, peppers and potatoes
- 8 cups of non-caffeinated fluids every day. Fluids are important to help maintain proper body temperature, transport nutrients and to cushion and protect the baby.

A pregnant woman should avoid certain foods and beverages. These include the following items.

- Alcohol
- Undercooked or raw meat
- Raw eggs (found in uncooked dough or batter)
- Soft, unpasteurized cheese
- Fish that often are high in mercury (shark, swordfish, king mackerel and other fish)
- Empty Calories (food and drinks that have little nutrition, such as soft drinks and candy)

SPECIALTY

MENU



PREGNANT WOMEN

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of a moderately active woman who is in her sixth month of pregnancy. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this woman and the special needs of pregnant women in general may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

LACTOSE INTOLERANT PERSON

Adult - Male
Age: 22
Height: 72 in.
Weight: 185 lbs
Energy Level: High

Total daily Caloric intake need:
3,784 calories

Lactose is a kind of sugar found in milk. Some people have difficulty digesting lactose and may have symptoms, such as nausea, cramps, gas and diarrhea, when they eat foods containing milk products. Young children with lactose intolerance should not eat milk products. Most older children and adults differ in the amounts of lactose they can handle. Lactose intolerance is very common in adults and is not dangerous.

The most important nutrient in dairy products is calcium, which is essential for the growth and repair of bones. It can be difficult for people with lactose intolerance to get enough calcium. However, lactose-reduced milk and other products are available at many supermarkets. Also, many nondairy foods are high in calcium. Green vegetables, such as broccoli and collard or turnip greens, and fish with soft, edible bones, such as salmon and sardines, are excellent sources of calcium.

Lactose intolerant people may have to avoid many prepared foods that contain milk, such as bread and other baked goods; processed breakfast cereals and drinks; instant potatoes; soups; margarine; lunch meats; salad dressings; candies and other snacks; mixes for pancakes, biscuits, and cookies; and some products labeled nondairy, such as powdered coffee creamer and whipped toppings.

SPECIALTY MENU

LACTOSE INTOLERANCE

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of an active person who cannot eat foods containing lactose. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and " My Plan" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this person and the special needs of others who are lactose intolerant may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

PERSON WITH TYPE 2 DIABETES

Teenager - Female
Age: 16
Height: 63 in.
Weight: 172 lbs
Energy Level: Low

Total daily Caloric intake need:
2,125 calories

Cells of the body receive energy from sugar dissolved in the bloodstream. The hormone, insulin, allows cells to take glucose, a kind of sugar, from the blood. Type 2 Diabetes makes it harder for cells to take in glucose. Over time, diabetes can result in damage to the eyes, kidneys, nerves, heart, teeth and gums.

People with diabetes should eat about the same amount of food at the same times each day and avoid eating too much at one time. Regular exercise under a doctor's supervision also is beneficial. An overweight person with diabetes can safely lose weight by lowering his/her daily Caloric intake by 300–500 calories/day. People with diabetes should do the following.

- Eat less sugar (regular soft drinks and sugary foods) and refined carbohydrates (processed, white foods, like white bread, white rice, and white potatoes). They should eat high-fiber foods that contain whole grains (whole wheat bread, whole grain pasta, brown rice and beans).
- Reduce the fat in their diets by eating lean meats, grilled foods and part-skim or low-calorie cheeses. They also can eat more fish and poultry (without the skin) but only 3–4 eggs per week. In addition to lean meats, grains and vegetables are good sources of protein.

SPECIALTY MENU

TYPE 2 DIABETES

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of an inactive person diagnosed with Type 2 Diabetes. This person also is overweight and needs to reduce his or her daily Caloric intake safely. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this person and the special needs of people with diabetes in general may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

ATHLETE IN TRAINING

Teenager - Female
Age: 16
Height: 62 in.
Weight: 105 lbs
Energy Level: High

Total daily Caloric intake need:
2,541 calories

To perform at the highest level, athletes must have proper nutrition, as well as exercise and practice. The main differences between an athlete's diet and a non-athlete's diet are that an athlete needs more Calories and fluids. Athletes must consume more Calories than most people do to replace energy consumed during physical exertion. Nutrients also need to be replenished. Athletes should drink water before, during and after exercise and physical activity. They should drink water even when they are not thirsty to maintain adequate fluid levels in their bodies and prevent dehydration.

It is usually recommended that athletes eat three to four hours before a competition. Allowing enough time between eating and competing gives enough time for food to digest and makes maximum energy available from food when it is needed most.

- High fat foods (products with whole milk or cream, for example) can take longer to digest and may interfere with athletic performance.
- Carbohydrate-rich foods, such as pasta, breads and cereal, are popular choices before competition because they provide energy, as well as fiber, vitamins and minerals.

SPECIALTY

MENU

HIGH PERFORMANCE ATHLETES

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of an athlete in training for an upcoming competition. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this athlete and the special needs of athletes in general may be found on the back of this card.

ACTIVITY 7

CHALLENGING CHOICES

ASTRONAUT ON SPACE STATION

Adult - Male
Age: 39
Height: 70 in.
Weight: 180 lbs
Energy Level: High

Total daily Caloric intake need:
3,457 calories

The gravity felt by astronauts in orbit is about one-millionth of the gravity we feel on Earth. Without the pull of gravity, fluids distribute themselves equally throughout the body (instead of being pulled toward the legs and feet), leading to changes in the circulatory system. At the same time, muscles and bones become smaller and weaker because they do not have to work as hard in space.

The body uses about the same amount of energy in space as it does on Earth. Menus for space meet each individual's daily nutritional requirements based on age, body weight and activity. The portions of fats and proteins consumed by astronauts may be slightly higher because fats are energy dense (so less volume is needed to meet energy needs). Fats also improve the taste of foods in space, while increasing protein intake helps to offset changes to muscles.

All foods are selected for easy handling in space (some foods could float into equipment or be inhaled). Liquids are served in plastic bags and sipped with straws. Space food favorites include tortillas (stay fresh longer and have fewer crumbs than bread) and beef steaks. Spicy food also is preferred, because microgravity and head congestion dull astronauts' sense of taste. Fruits and vegetables are important because they may help protect astronauts' bodies from damage by cancer-causing radiation in space.

SPECIALTY MENU

ASTRONAUTS

1. You will plan a one-day menu that includes breakfast, lunch, dinner and snacks to meet the particular dietary needs of an active person who is working onboard a space station orbiting Earth. Record the menu on the inside of this card. Use an additional sheet of paper if necessary.
2. Review and refer to the guidelines on the "Serving Sizes and Calories," "My Pyramid" and "Daily Amounts" sheets to make substitutions, if needed, to provide this person with a balanced diet.
3. Information regarding this person and the special needs of other astronauts may be found on the back of this card.

Activity 7

Menu Plan

DAY | DATE

WATER: Eight cups (or 8-oz glasses) per day

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			SERVINGS						
			Grains	Vegetables	Fruits	Oils	Milk	Meats & Beans	Discretionary
TIME	**FOOD ITEM & AMOUNT** (List major ingredients for prepared foods.)	**CALORIES**	**G**	**V**	**F**	**O**	**M**	**M-B**	**D**
		DAILY TOTALS							
			G	**V**	**F**	**O**	**M**	**M-B**	**D**

PHYSICAL ACTIVITY

Calories ____________

A UNIQUE PARTNERSHIP: NASA AND THE NSBRI

Teaming with Benefits

by Dr. Jeffrey P. Sutton, M.D., Ph.D., Director, National Space Biomedical Research Institute

Space is a challenging environment for the human body. With long-duration missions, the physical and psychological stresses and risks to astronauts are signif cant. Finding answers to these health concerns is at the heart of the National Space Biomedical Research Institute's program. In turn, the Institute's research is generating benefits for medical care on Earth.

The NSBRI, a unique partnership between NASA and the academic and industrial communities, is advancing biomedical research with the goal of ensuring a safe and productive long-term human presence in space. By developing new approaches and countermeasures to prevent, minimize and reverse critical risks to health, the Institute plays an essential, enabling role for NASA and the Vision for Space Exploration. The NSBRI bridges the research, technological and clinical expertise of the biomedical community with the scientific, engineering and operational expertise of NASA.

With approximately 80 science, technology and education projects, the NSBRI engages investigators at leading institutions across the nation to conduct goal-directed, peer-reviewed research in a team approach. Key working relationships have been established with end users, including astronauts and flight surgeons at Johnson Space Center, NASA scientists and engineers, other federal agencies, industry and international partners. The value of these collaborations and revolutionary research advances that result from them is enormous and unprecedented, with substantial benefits for both the space program and the American people.

For current, indepth information on NSBRI cutting-edge research and innovative technologies, visit www.NSBRI.org.

Through our strategic plan, the NSBRI takes a leadership role in countermeasure development and space life sciences education. The results-oriented research and development program is integrated and implemented using focused teams, with scientific and management directives that are innovative and dynamic. An active Board of Directors, External Advisory Council, Board of Scientific Counselors, User Panel, Industry Forum and academic Consortium help guide the Institute in achieving its goals and objectives.

It will become necessary to perform more investigations in the unique environment of space. The vision of using extended exposure to microgravity as a laboratory for discovery and exploration builds upon the legacy of NASA and our quest to push the frontier of human understanding about nature and ourselves.

The NSBRI is maturing in an era of unparalleled scientific and technological advancement and opportunity. We are excited by the challenges and our collective ability to enhance human health and well-being in space, as well as on Earth.

NSBRI Research Areas

BONE LOSS

Astronauts' bones become weak and porous because they are not working against the Earth's gravity. For different reasons, many people on Earth, particularly older women, also develop weak bones that fracture easily with little or no trauma.

CARDIOVASCULAR PROBLEMS

The amount of blood in the body is reduced when astronauts are in microgravity. The heart grows smaller and weaker, which makes astronauts feel dizzy and weak when they return to Earth. Heart failure and diabetes, experienced by many people on Earth, lead to similar problems.

HUMAN PERFORMANCE AND SLEEP

It is hard for astronauts in space to get enough sleep because they lose the day/night cycle of Earth and there are many distractions. This loss of sleep affects their concentration and physical response time—much as it does for people on Earth who work at night or have irregular schedules.

MUSCLE CHANGES AND ATROPHY

When muscles do not have to work against gravity, they weaken and begin to waste away. Special exercises and other strategies to help astronauts' muscles stay strong in space also may help older and bedridden people, who experience similar problems on Earth, as well as people whose work requires intense physical exertion, like firefighters and construction workers.

NEUROBEHAVIORAL/STRESS FACTORS

To ensure astronaut readiness for space flight, preflight prevention programs are being developed to avoid as many risks as possible to individual and group behavioral health during flight and post flight. People on Earth can benefit from relevant assessment tests, monitoring and intervention.

NUTRITION AND PHYSICAL FITNESS

Research that uncovers ways to reduce space-related health problems through diet, exercise or rehabilitation will contribute to the development of prevention and treatment programs for diseases on Earth.

RADIATION EFFECTS AND CANCER

Living and working in space may make it easier for astronauts to become sick or develop diseases. Learning how the body's defense system changes in response to adverse conditions such as radiation will help us to understand illnesses and fight their effects on the immune system. Astronauts are exposed to many kinds of damaging radiation that can lead to cell damage and increase astronauts' chances of developing tumors. Learning how to keep astronauts safe from radiation may improve cancer treatments for people on Earth.

SENSORIMOTOR/BALANCE ISSUES

During their first days in space, astronauts can become dizzy and nauseous. Eventually they adjust, but once they return to Earth, they have a hard time walking and standing upright. Finding ways to counteract these effects could benefit millions of Americans with balance disorders.

SMART MEDICAL SYSTEMS

Portable medical care systems that monitor, diagnose and treat major illness and trauma during flight may help people in remote locations on Earth get the medical care they need.

TECHNOLOGY DEVELOPMENT

Technology developed to meet the needs of exploration missions will have an overlap into clinical medicine, such as for environmental monitoring, nanotechnology and radiation monitoring.