

THE SCIENCE OF

FOOD AND

FITNESS



*by*

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## 7. Nutritional Challenges

### RESOURCES

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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](http://www.BioEdOnline.org).

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# 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
<b>Food Group, Oils &amp; Discretionary Calories</b>	<b>1,600 Calories</b>	<b>2,200 Calories</b>	<b>2,800 Calories</b>
<b>Grains</b>	5 oz	7 oz	10 oz
<b>Vegetables</b>	2 cups	3 cups	3.5 cups
<b>Fruits</b>	1.5 cups	2 cups	2.5 cups
<b>Meat &amp; Beans</b>	5 oz	6 oz	7 oz
<b>Milk</b>	3 cups	3 cups	3 cups
<b>Oils</b>	5 tsp	6 tsp	8 tsp
<b>Discretionary Calories</b>	132	290	426

# 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**

**H**ypertension 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.

# 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**

**T**here 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 soy milk.

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.

# 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**

**W**hen 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.

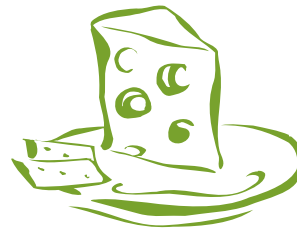
- 5–6 oz of high protein foods, such as beans, meat, fish, tofu and nuts
- 3–4 cups of milk and dairy products
- 3–5 cups of vegetables, especially green leafy ones
- 2–3 cups of vitamin C-rich foods, like citrus fruits, tomatoes, peppers and potatoes
- 8 cups of non-caffeinated fluids every day. Fluids 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.

# 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**

**L**actose 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.

# 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**

**C**ells 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.

# 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**

**T**o 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.

# 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.



# 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 significant. 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, in-depth information on NSBRI cutting-edge research and innovative technologies, visit [www.NSBRI.org](http://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.