The Science of Food

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Center for
Educational Outreach

Baylor College of Medicine

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The Science of Food

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Introduction

This slide set is designed for use with *The Science of Food Teacher's Guide,* which contains lessons that enable students to examine soil and plant growth, photosynthesis, edible parts of parts, food webs, digestion, bioaccumulation in food, bacteria, food labels, nutrition, food safety, as well as pre- and post-assessments. *The Science of Food Teacher's Guide* may be used alone or with the following integrated educational components.

- The *Mysterious Marching Vegetables* (student storybook)
- *Explorations* (student magazine)
- *The Reading Link* (language arts supplement)
- *The Math Link* (mathematics activities supplement)

Activities are organized into the following science areas.

- Physical Science (soil, components of soil, soil texture)
- Life Science (seeds, plants, plant growth, photosynthesis, edible plant parts, food webs, ecosystems, herbivore, carnivore, omnivore, decomposer, nutrients, digestion)
- Environmental Science and Health (pollution in food, bacteria, food labels, food safety, bioaccumulation, food chain)

Reference

Moreno, N., and Tharp, B. (2011) *The Science of Food Teacher's Guide*. Baylor College of Medicine: Houston. ISBN: 978-1-888997-76-7

Image Reference

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Key Words

ecosystem, food, food chain, food group, food label, food poisoning, food safety, producers and consumers, food web, carnivore, herbivore, omnivore, decomposer, scavenger, bacteria, fungi, microbe, microorganism, bioaccumulation, diet, calorie, digestion, nutrient, nutrition, carbohydrates, cholesterol, trans fat, fiber, sugar, fats, protein, minerals, vitamins, sodium, salt, saturated fat, calorie, calories, serving size, calcium, fruit, vegetable, grains, meat, fish, nuts, cereal, dairy, portion size, photosynthesis, plant, flower, leaf, leaves, root, seed, stem, soil, pesticide, cholesterol, carbohydrate, fiber, sugar, fats, trans fat, saturated fat, minerals, vitamins, sodium, salt, water, serving size,

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What's That Food?

- Food gives the body energy to move, think and grow.
- The energy you get from food is measured in calories.

- The amount of calories you need depends on the activities you perform.
- It is important to balance the food you select and eat with physical activity.

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What's That Food?

Pre-assessment

Background

Food gives your body the fuel and raw materials it needs each day. Just like a car needs gasoline, your body needs energy to move, think and grow. The usable energy you get from food is measured in calories. The more calories a food has, the more energy it can supply. The amount of calories a person needs depends on his or her activities. The body stores extra calories as fat.

However, food provides more than just energy. It supplies the building materials, such as proteins and minerals (like calcium), for muscles, bones and other body parts. Food also has small amounts of other minerals and vitamins that help make energy available for muscles and the brain, and make other body functions possible.

No matter what your age or lifestyle, eating the right foods can contribute to good health. The U.S. Department of Agriculture (USDA) recommends that people select a diet that includes a variety of foods in the proportions indicated on the student page. In addition, it is important to balance the food you eat with physical activity; consume plenty of grain products, vegetables and fruits; choose a diet low in fat, saturated fat

and cholesterol; and moderate your intake of sugars and salt.

This activity can be used as a pre-assessment of students' knowledge about nutrition and food needs.

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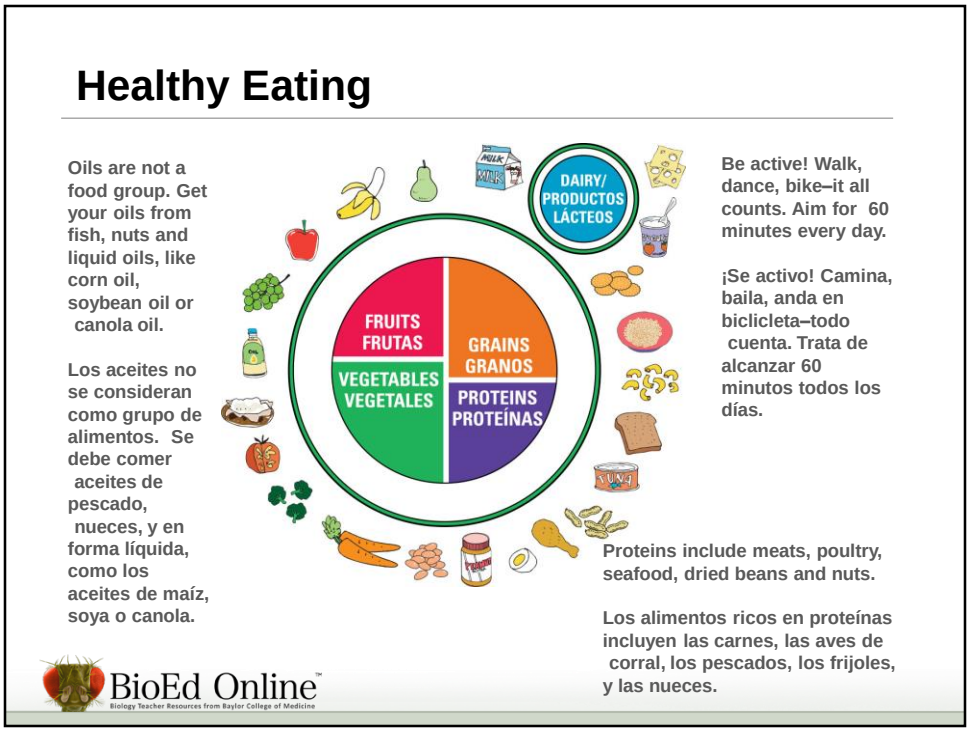

Healthy Eating

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Procedure

1.Divide students into groups of four. Explain that each group will be responsible for examining and reporting on a specific food item.

2.Distribute a set of bags to each group, explaining that although students may recognize the food, they should not call the name out loud. It will be a mystery food for other groups to identify, based on their observations and prior knowledge.

3.Ask students to observe the food in their bags, using all their senses except taste. Encourage use of the hand lens for closer observation. Questions to ask students include: *How does it feel, sound, look, and smell? Do you recognize this food? Do you eat this food? Do you think it is good for you? How much of this type of food would*

you need to eat daily? Where does it come from?

4.Have each student write down his or her observations and anything specific that he or she knows about the food being observed. However, students should not name the food.

5.Students should share their observations within their groups. The groups' Reporters should make a list of the observations on construction paper. A good way for the group to share responsibilities is to have the members take turns giving one observation at a time for the Reporter to record. Once an observation has been shared, any other group member with the same observation should check it off his or her list. This will continue until all, or at least most, of the observations are listed.

6.Have the Materials Managers place their charts on the wall where all students can view them.

7.Student groups should view each of the charts and decide, based on the recorded observations, what food is being described and whether or not they have additional observations or information about that food.

8.Lead a discussion, based on the information on the charts, with the entire group. Explain that all the foods observed and discussed are necessary, but that different amounts of each are recommended for optimum health.

9.Conclude by using the "Healthy Eating page." Ask students to identify the group to which each of the foods examined belongs. Have students work in their groups to create a menu for one day that includes appropriate numbers of servings from each of the food groups.

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What Is Soil Made Of?

- Soil is a combination of both living and non-living components.
- Soil provides raw materials needed by all living things.

- Water and nutrients in soil are important for plant growth.
- Most soils are enriched by decomposed plant and animal material.
- Soil is home to many kinds of organisms and things. What might those be?

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What Is Soil Made Of? – Physical Science

What is in soil and how does it contribute to plant growth?

Background

Carbon, oxygen and hydrogen are the building blocks of the molecules that make up our bodies, our foods and even the fuels we burn. These elements are combined during photosynthesis to make energy-rich materials, such as sugars and other carbohydrates (starches). Plants obtain hydrogen from liquid water (H_2O). They obtain carbon from carbon dioxide (CO_2) gas in air. Oxygen is part of both water and carbon dioxide, and is present as oxygen gas (O_2) in air. However, all living things, including plants, require additional materials to carry out the chemical processes necessary for life.

Where do these other materials come from? Most of them are released into water from soil. Plants and plant-like organisms, such as algae, absorb nutrients dissolved in water. Examples of these nutrients include nitrogen, phosphorous and potassium. Non-photosynthetic organisms obtain the minerals and more complex molecules that they need by consuming plants and other living things. Thus, the nutrients in soil are important not only for supporting plant growth, but also for assuring that other organisms are able to grow and survive.

Soil has both living and non-living components. It constantly changes through the action of weather, water and organisms. Soil formation takes a very long time—up to 20,000 years to make 2.5 cm of topsoil! This is only as deep as a quarter standing on its side!

The non-living parts of soil originated as rocks in the Earth's crust. Over time, wind, water, intense heat or cold, and chemicals gradually break rocks into smaller pieces, a process known as weathering. The size and mineral composition of the tiny rock particles determine many of the properties of soil.

Most soils are enriched by decomposed plant and animal material. Soil is home to many kinds of organisms: bacteria; fungi; algae (plant-like organisms that live in water or moist environments); earthworms; insect larvae; and plant roots, to name a few. Soil also contains many tiny air spaces. Typical garden soil is 25% water, 45% minerals, 5% material from living organisms and 25% air.

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Image Reference

Photo courtesy of Argonne National Laboratory. http://www.anl.gov/

Key Words

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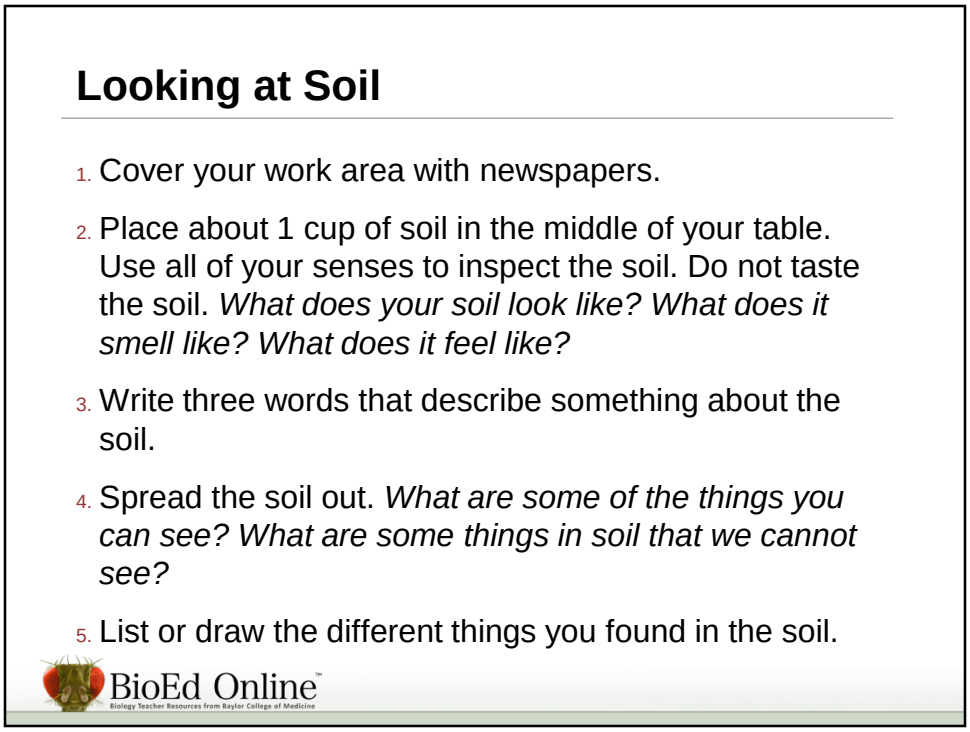

Looking at Soil

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Procedure

Session 1

Direct students to cover their work areas with newspapers. Have the Materials Manager from each group measure about 2 cups of soil onto a paper plate and bring the soil back to their group.

1.Have students place about 1/2 of their group's soil in the center of their work area. Have them take turns describing the soil, using all of their senses, except taste. Ask, *What does the soil look like? How does it smell? How does it feel?*

2.Ask each student to write three words that describe some aspect of the soil sample on his or her student sheet.

3.Next, direct students to spread out the sample (using toothpicks, popsicle sticks, etc.) and to observe the different components of the soil sample. Ask, *What are some of the things that you can see in the soil?* Possibilities include twigs, pieces of leaves, plant roots, insects, worms, small rocks and particles of sand. Ask, *What are some things in soil that we can't see?* Answers may include air, water and microorganisms.

4.Have students list or draw the different things they find in their soil samples. Suggest that they think about and classify the different components of soil as coming from living or non-living sources.

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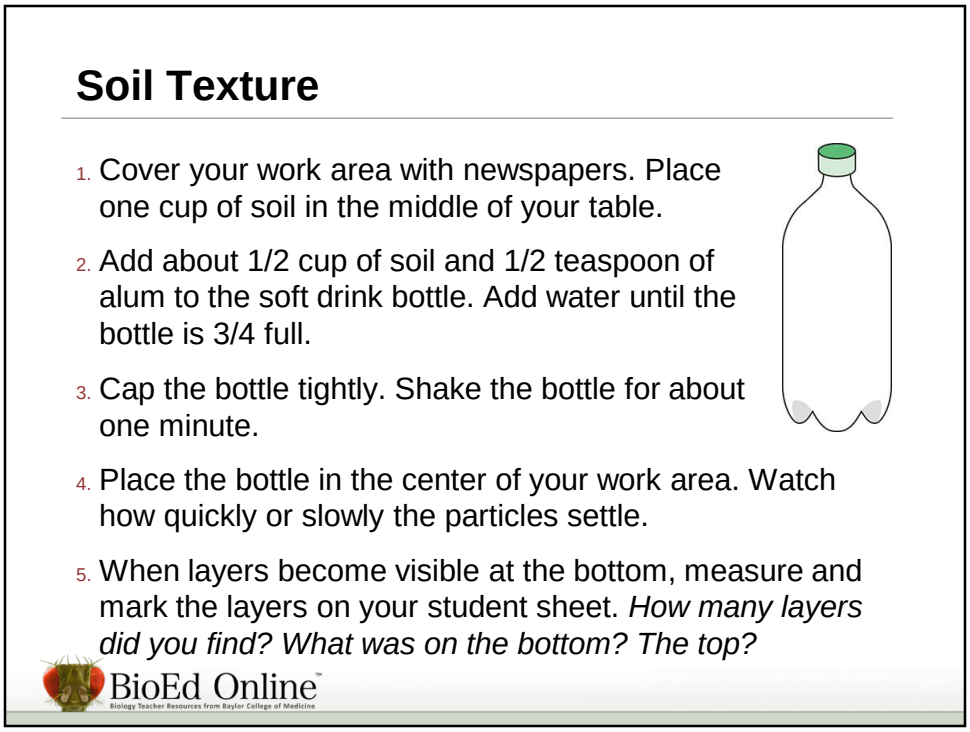

Soil Texture

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Procedure (cont.)

Session 2

Each group will need a soft drink bottle (with cap) and the other half of its soil sample. Ask students to describe the different components of the soil they investigated during the previous session. Tell them that now they are going to observe the make-up of soil in a different way.

1.Have each group add about 1/2 cup of soil and 1/2 teaspoon of alum to the soft drink bottle, then add water until the bottle is 3/4 full. If students have difficulty pouring soil into the bottle, have them make a paper funnel by rolling a sheet of paper into a cone shape.

2. Direct students to cap the bottles tightly and shake the bottles for about one minute.

3.Next, have students place the bottles in the centers of the groups' work areas and observe how quickly or slowly the different types of particles settle.

4.When layers are visible at the bottom of the bottle, have students measure and mark the layers and draw their observed results on their student sheets. To facilitate accurate measuring, you may want to instruct students to fold a sheet of paper lengthwise, hold it against the side of the bottle, and mark the boundaries of each layer on the paper.

5.After students have completed their observations, invite the groups to share their observations. Ask, *How many different layers did you find? What was on the bottom? What was on the top?* The heaviest particles, such as sand and rocks, usually will make up the bottom layer, followed by fine sand and silt. Some clay particles are so tiny that they will remain suspended in the water. Plant and animal material also may remain floating at the top of the water. You also might ask, *Of what do you think soil is mostly made?*

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Do Plants Need Light?

- All living things need energy and nutrients to grow, move and stay warm.

- Green plants capture and convert energy in a process called photosynthesis.
- Plants get water and nutrients from soil. They also need carbon dioxide and other nutrients, such as nitrogen and potassium or phosphorous.
- *Do green plants need light? Why or why not?*

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Do Plants Need Light? – Life Science

How do plants produce food through photosynthesis?

Background

Only producers, such as green plants, are able to make the molecules needed for life from simple compounds in the air, soil and water. Almost all producers use energy from the sun to make food through photosynthesis. During photosynthesis, light energy is trapped and transformed into chemical energy that can be used by cells. Very few raw materials are required. Green plants need only water (H_2O) and carbon dioxide (CO_2) in the presence of light to manufacture sugar molecules and other carbohydrates, such as starch. Plants use the energy held in carbohydrates to fuel chemical reactions and to make other molecules necessary for life. Other needed materials (such as nitrogen, phosphorous or potassium) are taken in through plant roots. This activity allows students to learn about the needs of plants and the role of light in plant growth.

Growing plants in the classroom can be a simple and rewarding process for students. Elaborate equipment is not necessary for growing plants indoors. If you do not have a window with bright light, place plants under a fluorescent lamp. Allow only about five inches from the tops of the pots or growing plants to the light source. Inexpensive

fluorescent lamps appropriate for growing plants often are sold in hardware stores as "shop lights."

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Image Reference

Photo courtesy of the National Science Foundation/Jeff King. http://www.nsf.gov/

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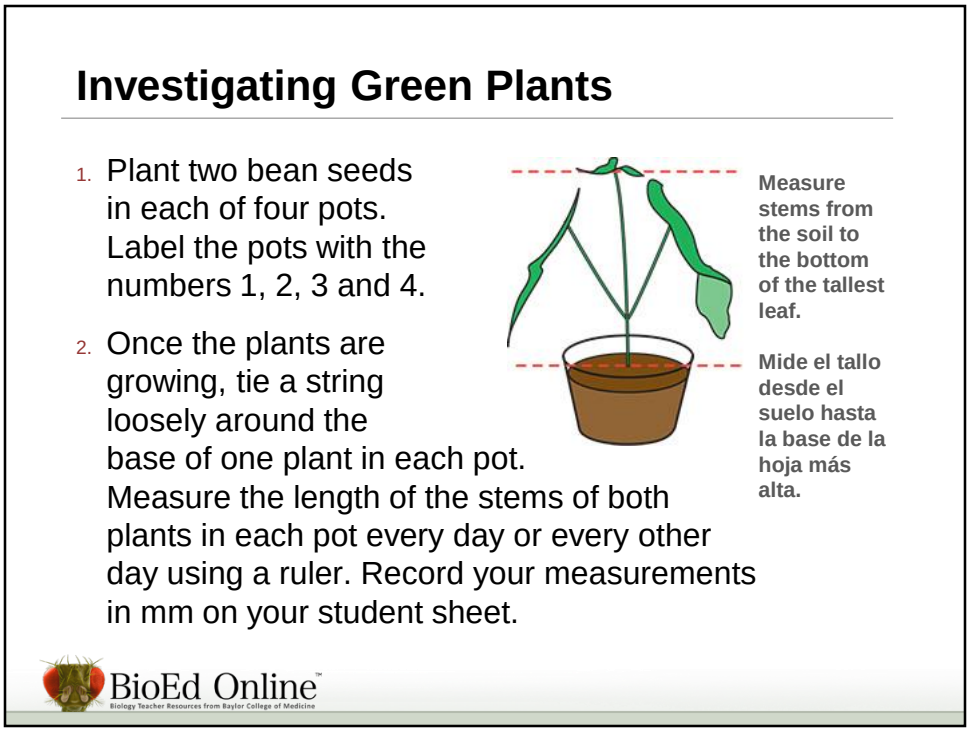

Investigating Green Plants

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Procedure

Session 1: Observing dry seeds

Give each student a dry bean and a magnifier. Have students use their magnifiers to observe the bean seeds, then draw a seed on his or her "Seeds and Seedlings" sheet. Make sure that each student is able to observe the seed coat and the dark indentation on one side of the seed, corresponding to where the new plant will emerge.

Session 2: Observing and planting soaked seeds

1.Before proceeding with planting, give each student a soaked seed (on a paper towel) for observation. The students should compare the soaked seed to a dry seed. Ask, *How is the soaked seed similar to the dry seed? How is it different?* Have students

remove the “skin” (seed coat) and spread apart the pieces of the tiny plant inside. They will be able to identify the cotyledons (seed leaves), other tiny leaves and the beginnings of what will become the plant root.

2.Have Materials Managers pick up 4 pots and 8 soaked seeds from a central location in the classroom. Direct the members of each group to pick a name for their group and to write it on the pots. They should number their pots: 1, 2, 3 and 4.

3.Have groups fill their pots about 3/4 full of soil.

4.Direct the students to make two indentations (about 1/2 cm deep) in the surface of the soil and to place one seed in each hole. Have them cover the seeds lightly with soil. Each group will have four pots, with two seeds in each pot.

5.Have students place the pots on trays near a bright, sunny window or under a fluorescent light. Over the next several days . . .

- Once the seeds sprout, have students “mark” one of the two plants within each pot by loosely tying a piece of string around its base. If a plant dies, students should continue to measure the remaining plant.

- Have students measure both plants in each pot every day or every other day and record the length of the stems in cm on their “Seeds and Seedlings” sheets.

- Let students water the plants every day or two with a squirt bottle. The soil should be moist but not wet.

Session 3: Light experiment

1.When most of the seedlings are approximately 10 cm tall, explain to the students that they will now investigate the effect of light on the growth of the bean plants. Ask, *What do you think will happen if we give some of the plants less light?*

2.Have each group move pots 3 and 4 to a new location that you have selected (in the back of the classroom or in a dark corner away from the windows or light source). Ask, *Do you think that the plants in the new place will have as much light as the*

others? Why or why not? What do you think will happen to the plants receiving less light? Have students discuss possible outcomes and make predictions.

3.Students should continue to measure the plants for another 3–5 days and record their measurements on their "Just Growing Up" student sheets.

Session 4: Looking at data

1.After making their final observations, have students complete the remaining questions on the their student sheets.

2.Discuss results as a class. They should be able to conclude that the difference in available light led to any observed differences between the two groups of plants. Ask, *Were the plants all about the same size before you moved pots 3 and 4 out of the bright light? Are all the plants still the same size? Why do you think that is so? Are there any differences other than size?* Help students to conclude that the differences in growth (the plants with less light will have grown less or will have developed tall, narrow stems) and in color (the plants with less light will be lighter green) were caused by the differences in the availability of light. Ask, *What is the only thing that was different about the two sets of pots?* (Only the amount of light changed; all other aspects of the experiment—water, soil, seedlings, pots, planting method—were unchanged for both groups.)

3.Ask students, *Where do you think the plants in pots 1 and 2 got the materials and energy to produce more stems and leaves? What were the plants in pots 3 and 4 missing? What do you think would happen if we put the plants in pots 3 and 4 back in the light?*

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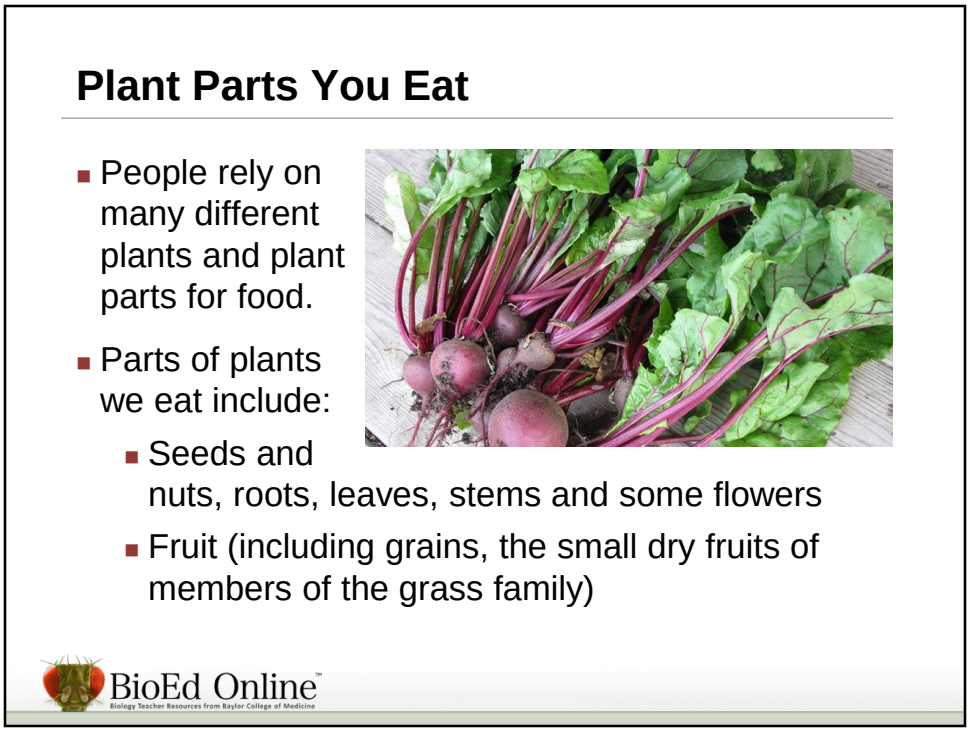

Plant Parts You Eat – Life Science

Where do everyday vegetables and fruits come from?

Background

Green plants and similar organisms produce food for all other living things on Earth. Food provides energy and nutrients for organisms, such as animals, that cannot trap energy from the sun through photosynthesis. Some animals, called primary consumers, eat only plants. Others, known as omnivores, eat plants and animals. Most humans are omnivores. However, some people chose to eat only foods that come from plants. Plant-based foods supply vital nutrients that our bodies cannot make for themselves. These nutrients include vitamins, which are chemicals necessary for the proper functioning of the body; sugars and other carbohydrates, which provide energy; amino acids, which are the building blocks of proteins; oils, another concentrated energy source; and minerals, such as potassium, magnesium and calcium.

Humans consume a remarkable variety of plants and plant parts. However, agriculture—the cultivation of plants—is a relatively recent innovation in human history. Many historians believe that the farming of plants began about 10,000 years ago in several different parts of the world. The plants we use as food today are very

different from their wild ancestors. Most food plants evolved through selection by many generations of farmers to produce larger fruits, grains and other edible parts, and to be easier to plant, harvest and process. The wide variety of foods we eat today originated in many different and geographically separate parts of the world.

Many foods come from plant roots. Important root crops include carrots, parsnips, beets, sweet potatoes, radishes, rutabagas and turnips. Potatoes, which develop underground, technically are stems that are specialized for the storage of starches. Other stems used as food include sugar cane and asparagus.

Leafy foods include chard, spinach, lettuce, brussels sprouts, cabbage, collards and kale. All of these look like leaves. However, foods that come from bulbs, such as onions, leeks and garlic, also are made of leaf parts (the enlarged bases of long, slender leaves). Celery and rhubarb stalks actually are the supporting stems (petioles) of leaves.

Flowers are not eaten frequently, but cauliflower, broccoli and artichokes all are made up of flowers. Fruits and seeds, which develop after flowers are pollinated, are important food sources. Fruits include familiar foods such as oranges, lemons, grapefruit, limes, apples, peaches, pears, grapes, melons, cherries, plums, tomatoes, all squashes, blueberries, green beans and chile peppers. Mangos, bananas, avocados, figs, breadfruit, eggplant, cucumbers, guava, pomegranates, dates, papaya, olives and zucchini also are fruits. As a general rule, keep in mind that anything with seeds is a kind of fruit.

Seeds often contain stored food resources (carbohydrates, oils, proteins) to fuel growth of the tiny plant each contains. Important seeds that we eat are beans, peas, lentils and chickpeas. All of these are members of the bean, or legume, family. Food in these seeds is stored in the fleshy leaves (cotyledons) of the plant embryo. Many nuts consist of seeds or parts of seeds. Examples are walnuts, pecans, almonds and peanuts.

Grains, considered to be among the first cultivated crops, are the small, dry fruits of members of the grass family. Grains look and behave very much like individual seeds. The commonly cultivated food grasses are called cereals, after the Greek goddess Ceres. Major grain crops include barley, millet, oats, rice, rye, sorghum, wheat and corn (maize). Rice, probably the most important grain, is the primary food source for more than 1.6 billion people.

Image notes

Did you know that all parts of a beet are edible? The red roots usually are cooked before eating. Baby beet leaves may be used in salads. Mature beet leaves are best steamed or sautéed. If not too fibrous, the leaf stalks can be eaten raw. Or they can be chopped up and cooked.

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Image Reference

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Key Words

ecosystem, food, food group, plants, seed, nut, leaf, leaves, stem, flowers, fruit, grains, grass, nutrient, nutrition,

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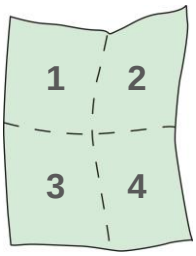
All About Plants

1. **Paper:** Fold the sheet of paper into fourths. Record the following information for each area.
2. **Area 1:** Record a description or draw a picture of your food.
3. **Area 2:** Cut the food in half or in pieces. Record a description or draw a picture of the inside of the food.
4. **Area 3:** Use your observations to record what plant part or parts are represented by the food.
5. **Area 4:** Record different ways to prepare and eat the food.



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Procedure

1.Help students remember basic plant parts by referring to a plant in the classroom or school yard as an example. Ask questions such as, *Why are green plants special?* (make food through photosynthesis); *Where do plants trap sunlight to make food?* (leaves and other green parts); *Where do plants take in the water and nutrients that they need?* (roots); *How can we get more plants?* (planting seeds or other reproductive parts of plants, such as stem sections); *Where do seeds come from?* (flowers, which develop fruits and seeds).

2.Follow by having students think about all the foods they have eaten that day that came from plants. Examples might include bread from wheat; cereals from oats, wheat and corn; juice from oranges and apples; etc. Ask, *Did you know that we eat many different parts of plants?*

3.Give each group of students a sheet of drawing paper, a plastic knife and one of the plant foods you have brought to class. Direct students to fold the sheet in fourths, creating four spaces in which to record information.

4.Give students an opportunity to observe and discuss their respective food items briefly before continuing.

5.Have groups provide the following information in the four squares on their sheets. In the first square, students should write a description of and/or draw the outside of the food. Before they fill in the second square, direct students to cut the food in half or in several pieces, so that they can observe the interior. Have them write a description of and/or draw the inside of the food in the second square.

6.Have students use their observations to describe in the third square what plant part or parts is/are represented by the food. They also should report the observations they used to reach their conclusions. For example, carrots have fine roots still attached to the large central root, and some students may have observed that carrots grow underground, etc.

7.In the final square, have students report different ways to prepare and eat the food. You may want to spend an extra class period on this step to allow students time to visit the library or to access the Internet to gather additional information.

8.Have each group share the information about its plant food with the rest of the class. You may want to contribute some fun facts about plant parts and food. For instance, we know that potatoes are stems, not roots (because a potato in water will produce leaves at the top and roots at the bottom); artichokes are similar to huge sunflower buds; and pineapples consist of the fleshy stems and flowers of a tropical plant.

Reference

Moreno, N., and Tharp, B. (2011) *The Science of Food Teacher's Guide*. Baylor College of Medicine: Houston. ISBN: 978-1-888997-76-7

Key Words

ecosystem, food, food group, plants, seed, nut, leaf, leaves, stem, flowers, fruit, grains, grass, nutrient, nutrition,

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Food Webs

- Different environments are homes to different communities of plants and animals.
- Different organisms have different needs.
- A food web depicts all of the different foods eaten by each animal in an ecosystem.

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Food Webs – Life Science

What happens to energy and nutrients in ecosystems?

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Background

Environments, such as oceans, forests, lakes and deserts, are homes to different communities of organisms. Within each distinct environment, plants, animals and other living things must find ways to obtain water, food and other necessary resources. Different kinds of organisms have different needs. As seen in the previous activities, plants need air, water, nutrients (usually from soil) and light. Animals need air, water and food.

All animals depend on plants and other producers. Some animals eat plants for food. Other animals eat animals that eat the plants, and so on. Some organisms even feed

on waste and dead material. The general sequence of whom eats whom in an ecosystem is known as a food chain. Energy is passed from one organism to another at each step in the chain. Most organisms, however, have more than one food source. Thus, a web, which depicts all of the different foods eaten by each animal, is a more accurate model of interactions within an ecosystem.

This activity lets students construct possible food webs for different ecosystems, as they learn about the roles of different kinds of living organisms.

Procedure

1.Remind students of the previous activity in which they explored plants that people eat. Ask, *Do people only eat one kind of food? What kinds of food do people eat?* Explain to students that most other animals also have several food sources, although not all animals are omnivores (eat plants and animals).

Reference

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Image Reference

Photo © Bridget Calip. Licensed for use.

Key Words

ecosystem, food, food chain, food group, animals, mammals, fish, birds, insects, crustaceans, reptiles, spiders, snails, worms, producers and consumers, food web, carnivore, herbivore, omnivore, decomposer, scavenger, bacteria, fungi, molds, microbe, microorganism, diet, nutrient, nutrition, plants, flower, fruit, leaf, leaves, root, seed, stem, grasses, primary consumer, secondary consumer,

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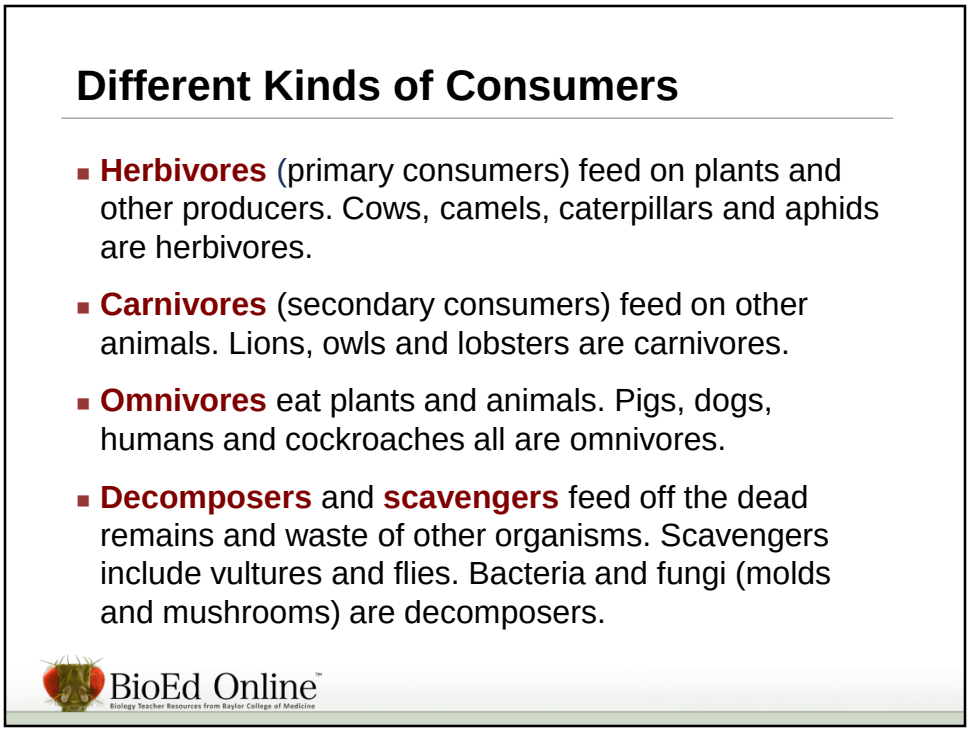

Different Kinds of Consumers

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Procedure (cont.)

2.Discuss with students the different kinds of consumers.

Herbivores (primary consumers) feed on plants and other producers. Cows, camels, caterpillars and aphids are herbivores.

Carnivores (secondary consumers) feed on other animals. Most consumers are animals, but a few are plants that trap and digest insects. There can be several levels of carnivores in a food chain. Lions, owls and lobsters are carnivores.

Omnivores eat plants and animals. Pigs, dogs, humans and cockroaches all are omnivores.

Decomposers and scavengers feed off the dead remains and waste of other organisms at any step along a food chain. Scavengers, such as vultures and flies, feed on remains of animals that have been killed or that die naturally. Decomposers live off waste products and parts of dead organisms. Many kinds of bacteria and fungi (molds and mushrooms) are decomposers. The decomposers themselves are important food sources for other organisms that live in soil, such as worms and insects.

Reference

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Key Words

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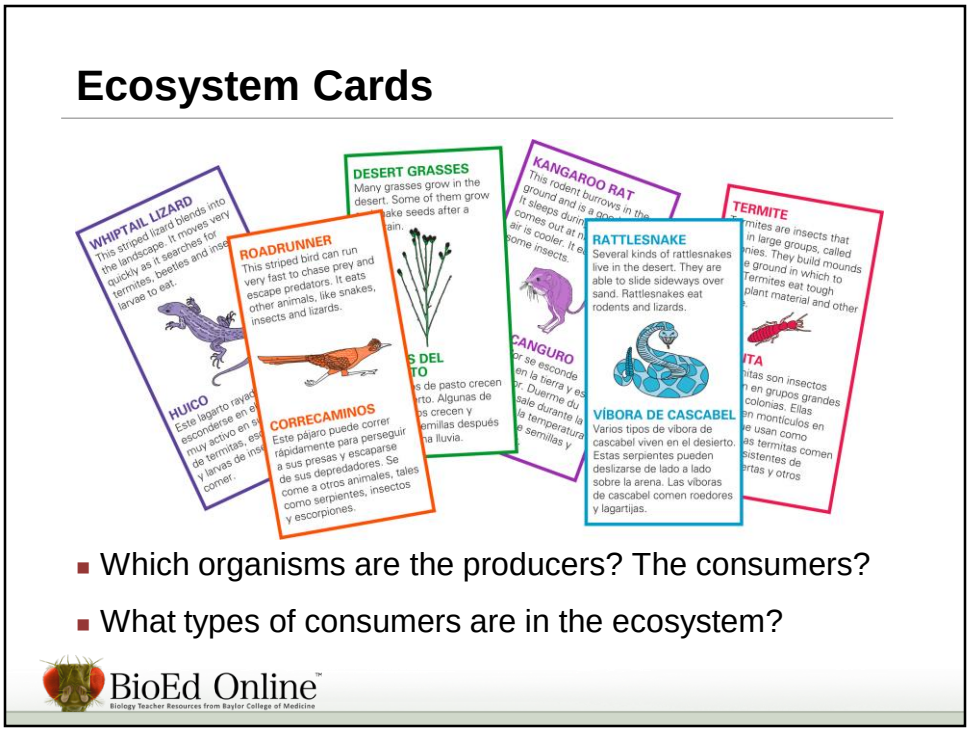

- Which organisms are the producers? The consumers?
- What types of consumers are in the ecosystem?

Ecosystem Cards

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Procedure (cont.)

3.Give each group of students a different set of Ecosystem Cards. Each set consists of six cards depicting producers and consumers typically found within a given environment.

4.Have students in each group read the information on the cards.

5.Ask students to identify which organisms are the producers in their ecosystems. Next, have the members of each group identify which cards represent different kinds of consumers (herbivores, carnivores and scavenger/decomposers).

6.Once students have identified the producers and different kinds of consumers in

their ecosystems, have them discuss “who might eat whom” among the organisms depicted on their cards. For example, in the Freshwater Pond set of cards, the bluegill fish (carnivore) might eat dragonfly nymphs and snails. The snail (decomposer/scavenger) might eat the green algae, as well as waste or dead body parts from all of the other organisms in the system. Have students consider possible food sources for each of the organisms in their ecosystem.

7.Give each group a sheet of drawing paper. Instruct students to write the names of each of the organisms in their ecosystems around the edges of the sheet. Have them write the names of the producers in green, the herbivores in yellow, the carnivores in blue and the decomposer and scavengers in red.

8.Next, have students draw lines to connect each consumer to all of its food sources. They will find that there are many ways to connect even as few as six organisms within an ecosystem.

9.Encourage students to think about the complex relationships within ecosystems by asking questions such as, *What would happen if there were no producers in your ecosystem? No decomposers? Where would humans fit in your food web? Do humans also depend on many different plants and animals?*

Reference

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Image Reference

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Key Words

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Digestion

- What happens to food when you eat it?
- Do you think that food stays the same inside your body?
- Let's explore what happens to one kind of food when digestion begins.

Green papaya fruit is used in powdered meat tenderizers to soften the fibers, making it easier to chew and digest.

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Digestion – Life Science

How does the body get nutrients from food?

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Background

Food must be broken down, both physically and chemically, before it can be used by the cells within an organism. The process of breaking food down into usable components is known as digestion. Within the human body, digestion begins in the mouth, where pieces of food are mechanically broken, by chewing, into smaller pieces. In addition saliva mixes with the food and begins to break it down. After food is swallowed, other components of the digestive system—stomach, small intestine, large intestine, liver and pancreas—continue the process of making food available for use by cells in the body.

The stomach serves as a powerful mixing machine in which food is combined with special chemicals (enzymes) that begin to break large food molecules into smaller ones. Food usually stays in the stomach for two to three hours, after which it passes into the small intestine, where it is combined with secretions from the liver and pancreas. These very important organs produces substances (bile from the liver and pancreatic fluid from the pancreas) that help break down fats, proteins and carbohydrates into smaller molecules. The small intestine is responsible for absorbing the nutrients released during digestion. The walls of the small intestine are covered with millions of tiny, finger-like projections called villi. These structures increase the surface area of the small intestine to facilitate the absorption of nutrients into the bloodstream.

Proteins and their building blocks (amino acids) are vital to every cell in the body. Humans are not able to make their own amino acids, so they must include protein (equivalent to 4 ounces of chicken white meat) in their daily diet. During digestion, proteins are broken down into the different amino acids of which they are made. Then the body builds new proteins from the amino acids. You might say that the amino acids are recycled!

This activity will allow students to observe how chemicals in the body begin to break down proteins.

Procedure

Session 1: Setting up

1.Let Materials Managers collect 1/2 slice of turkey luncheon meat, a plastic knife and two resealable plastic bags. Have the groups label their bags “1” and “2.” Ask students, *What happens to food when you eat it? Do you think that food stays the same inside your body?* Discuss students’ ideas about digestion. Mention that they will be able to explore what happens to one kind of food—turkey meat (protein)—when digestion begins.

Reference

Moreno, N., and Tharp, B. (2011) *The Science of Food Teacher’s Guide*. Baylor College of Medicine: Houston. ISBN: 978-1-888997-76-7

Image Reference

Photo courtesy of Hardyplants. Used with permission.
https://en.wikipedia.org/wiki/File:Fruit_of_papaya.jpg

Key Words
ecosystem, food, body, diet, digest, digestion, enzymes, mouth, teeth, saliva, stomach, small intestine, large intestine, liver, pancreas, nutrients, nutrition, protein, amino acids,

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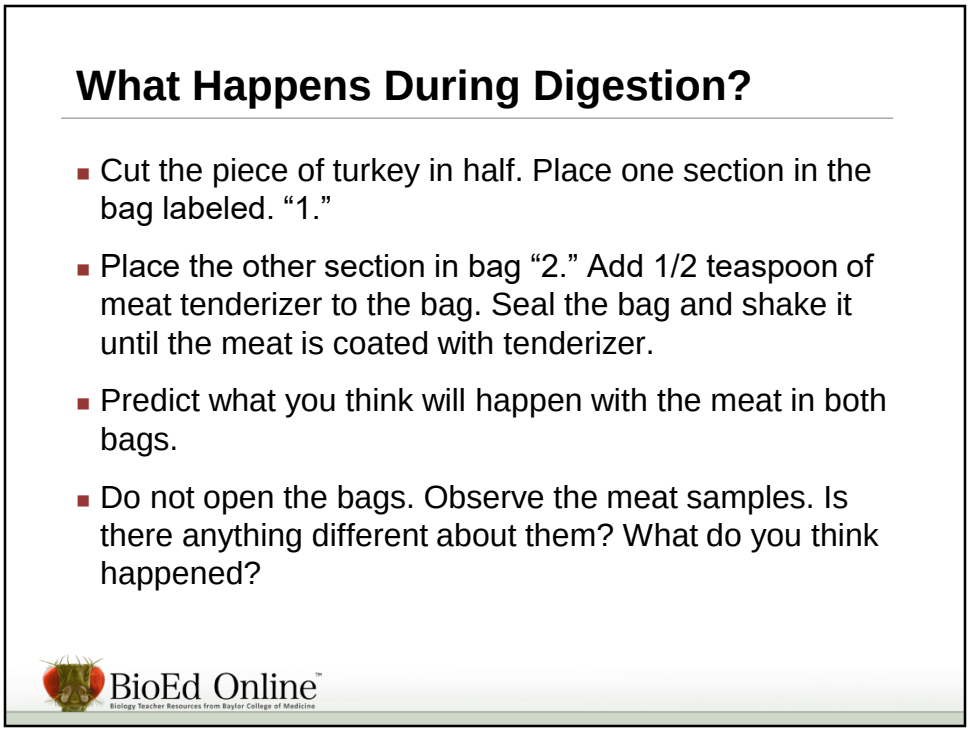

What Happens During Digestion?

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Procedure (cont.)

Session 1: Setting up

2.Have the students in each group cut the piece of turkey in half and place one section in the bag labeled “1.” Direct them to place the other section in bag “2” and to add 1/2 teaspoon of meat tenderizer to that bag. Have them seal the bag and shake the turkey slice within the bag so that it is well coated with the tenderizer.

3.Have the students place the bags to one side of the classroom for about an hour. (If students will be making observations the following day, refrigerate the bags to prevent spoilage.) Have students write, in their journals or on a sheet of paper, what they predict will happen to the slices of turkey.

Session 2: Making observations

1.Have students observe the texture and color of the meat samples without removing them from the plastic bags. Ask, *Is there anything different about the turkey that was combined with the meat tenderizer? What do you think happened?*

2.Ask students to think about the changes they observed in the meat with tenderizer. Mention that the substance they added was a chemical that helps soften the muscle fibers in meat by beginning to break them down into smaller pieces.

3.Help students understand that similar substances work within their stomachs and small intestines to break down the food they eat. Have students draw or write about their observations.

4.Mention that turkey meat is a muscle. Help students understand that protein is the building block for muscles and that it is used inside each muscle cell. Protein that we eat must be broken into smaller components before it can be used by our bodies. You may want to mention that the chemical meat tenderizer also is a kind of protein. It provides another example of the variety of roles that proteins play inside plants and animals.

Reference

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Bio Build-up

- What might happen if pollutants are taken up by producers?
- Would the pollutants be passed on to consumers? How about the next animal in the food chain?

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Bio Build-up – Environmental Science and Health

Why do pollutants become concentrated in some foods?

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Background

Many pollutants in the environment become introduced in very small amounts into organisms near the base of the food chain. These pollutants usually are present in the water or the soil in which producers, such as green plants and algae, or primary consumers, such as filter feeders in aquatic ecosystems, live and reproduce. Pesticides that are applied directly to plants also can be introduced into the food chain.

Some chemical substances, such as pesticides and heavy metals (like mercury and lead), persist within the bodies of the organisms that take them in with food. These

compounds are not broken down by the body, nor are they eliminated with other waste products. While most of these substances are not harmful in trace amounts, they can accumulate in the tissues of an organism over its lifetime. In addition, consumers near the top of the food chain tend to accumulate larger amounts of toxic substances in their bodies, because the pollutants become more concentrated at each step of the food chain. The actual amounts of toxins accumulated in the bodies of top consumers depend on their food sources and choices.

Procedure

1.Let the Materials Managers collect adhesive dots (or alternative items) for their group (approx. 80 dots per student). Each student should complete his or her own "Bio Build-up!" sheet.

2.Prompt students to think about what might happen to pollutants taken up by producers. Ask, *Would the pollutants be passed on to consumers? How about the next animal in the food chain? Would they have the pollutants too?* Tell the students that they will have an opportunity to find out what might happen to pollutants in a food chain.

3.Have students use a pair of scissors to separate 20 dots from the strip (or sheet) without removing the backing. Next, have them work through the steps described on the "Bio Build-up!" sheet, which depicts an aquatic ecosystem. The stickers or other markers will represent amounts of toxins consumed along each step of the food chain.

4.Once students have completed the activity, ask, *What happened to the pollutants at the last step of the food chain? Did the large fish have more or less pollutants than the plants at the beginning of the food chain? Did the amounts of pollutants in the plants at the beginning make a difference in the small and large fish? How could the amount of pollutants in the body of the eagle be reduced? In general, which kinds of organisms are most at risk of accumulating toxins in their bodies—producers or consumers?* Students will have observed that the eagle accumulated the most pollution dots.

Reference

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Image Reference

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Key Words
ecosystem, food, food chain, food poisoning, producers and consumers, food web, carnivore, herbivore, omnivore, decomposer, scavenger, bacteria, fungi, microbe, microorganism, bioaccumulation, diet, nutrient, nutrition, plant, flower, leaf, leaves, root, seed, stem, soil, pesticide, toxins,

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They're Everywhere: Bacteria

1. What do you know about bacteria?
2. Bacteria are a major source of food contamination. Can we see where bacteria are? How might we be able to find out where the most bacteria are in a room?

3. One way to study bacteria is to let them grow until they form a clump large enough to see. Let's grow some bacteria!

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They're Everywhere: Bacteria – Environmental Science and Health

Where do bacteria grow?

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Note: For more information about food and food safety, including free food safety charts, visit the "Keep Food Safe" section of the Foodsafety.gov website. http://www.foodsafety.gov

Background

Bacteria are the most numerous of all things living on our planet. However, they are so tiny that it is not possible to see one without the aid of a microscope. Most bacteria must be magnified at least 400 times before they can be observed. Each bacterium (a single bacteria) consists of one cell capable of reproducing very rapidly. In fact, one bacterium cell can produce millions of others in just one day.

Bacteria are essential in many ways. They are important decomposers in almost all ecosystems. Photosynthetic bacteria (also known as blue-green algae) are vital producers in aquatic ecosystems. Bacteria in the intestines of animals help break down some large food molecules during digestion.

Bacteria also can cause serious problems with food. Since bacteria are everywhere, it is easy for food to become contaminated by bacteria and begin to spoil. The slime you see on food that has been in the refrigerator too long is made of clumps of bacteria and, sometimes, fungi as well. Eating spoiled food can make humans and other animals sick.

Bacteria can be transferred to food when people do not wash their hands after using the bathroom, changing a diaper or playing with pets. Some foods, especially meats, can have bacteria on their outside surfaces. These bacteria can be transferred to other foods if knives, spoons and cutting boards used in preparing them are not washed with soap and water.

This activity allows students to observe bacteria and to compare relative amounts of bacteria living in different parts of the home, classroom or school.

Procedure

Session 1: Setting up

1.Tell students that they will be learning about bacteria—tiny microorganisms present everywhere. Ask students to mention what they know or have heard about bacteria. List their ideas on the board.

2.Point out that bacteria are a major source of food contamination, and that students will be investigating where bacteria might be present. Ask, *Can we see where bacteria are? How might we be able to find out where the most bacteria are in the room (school, etc.)?*

3.Tell students that one way to study bacteria is to let them grow until they form a clump that is large enough to see. Mention that they will be finding and growing bacteria.

Reference

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Image Reference
Photo courtesy of the CDC/Dr. Todd Parker. http://www.cdc.gov/

Key Words
ecosystem, food, food chain, bacteria, bacterium, cultures, fungi, microbe, microorganism, intestines, food-borne illness, e coli, food poisoning, food safety,

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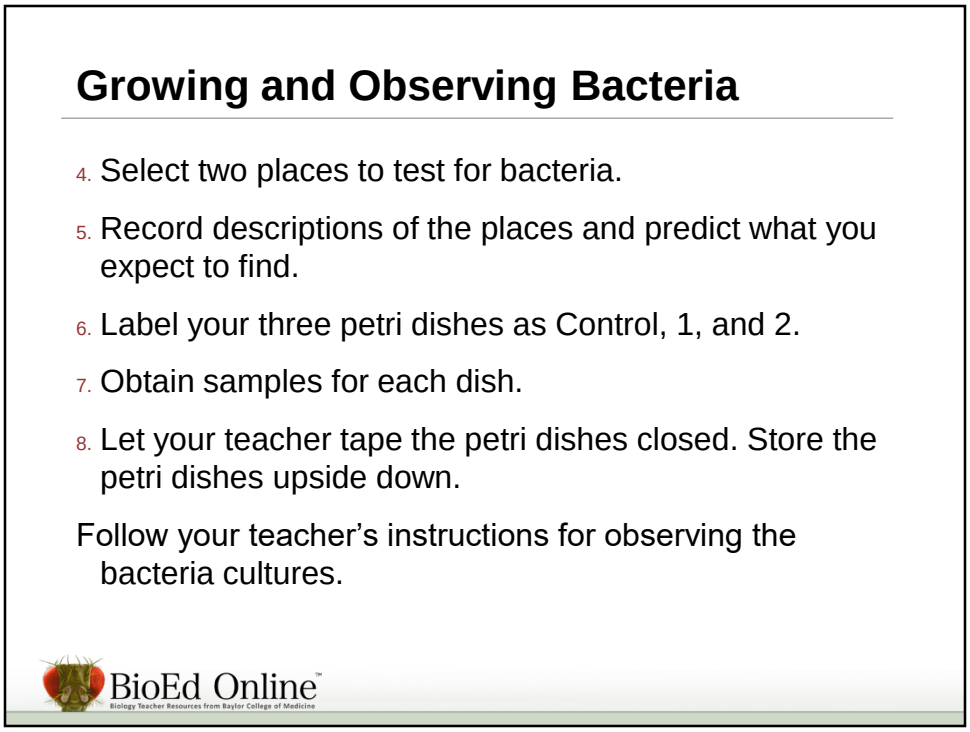

Growing and Observing Bacteria

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Note: For more information about food and food safety, including free food safety charts, visit the "Keep Food Safe" section of the Foodsafety.gov website. http://www.foodsafety.gov

Procedure (cont.)

Session 1: Setting up

4.Have students in each group select two places that they would like to test for the presence of bacteria. Possibilities include the floor, doorknob, unwashed hands, rinsed hands, hands washed with soap and water, etc.

5.Have the groups write descriptions of the places they plan to test and to write predictions about what they expect to find. For example, a group might predict that a

sample from unwashed hands will have more bacteria than from washed hands.

6.Give each group three petri dishes. One dish will be a control. The remaining two will be used for sampling. Students should label all three dishes.

7.Direct students to sample the areas they have chosen using clean cotton swabs dipped in distilled or boiled water. They should rub the swab several times over the area to be tested and then gently rub the swab in a zig-zag pattern over the surface of the gel mixture in the bottom of the petri dish. Instruct students to open the dishes only enough to swab the gel surface. The control dish should be rubbed (inoculated) with a clean, moist swab.

8.Tape the dishes closed for students. Store the dishes upside down.

Session 2: Observations

1.If possible, have students observe the cultures every day for 1–3 days. After about three days, have students make detailed observations. Ask, *What has changed inside the petri dishes?* Bacteria will discolor the surface of the gel and form smooth, wrinkly or slimy blotches (called colonies) of different colors. Fungi, which form fuzzy colonies, also may be present.

2.Have students decide how many different kinds of organisms might be growing on the gel, based on differences they can observe. Do not allow students to open the dishes.

3.Next, have students decide whether some sample sources had more bacteria than others by counting the number of colonies and/or by comparing the sizes of colonies. Have them record their observations and conclusions. Have the groups share their results with the rest of the class.

4.Based on the results, have students decide which locations have the most bacteria, and which the least. Ask, *If there are bacteria all around us, why aren't all of us sick? Do all bacteria make us sick? What about the gel in the petri dishes—would you want to eat it? Do you think that it is good to have bacteria growing in our food?*

5.Help students understand that contamination of food by bacteria can cause serious

health problems. Ask for suggestions on how to keep food clean. Possibilities include: using clean hands and utensils for food preparation, keeping food covered and refrigerated until used, and cooking food thoroughly to kill bacteria that might be present (see “Bacteria Busters!” PDF).

Reference

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Key Words

ecosystem, food, food chain, bacteria, bacterium, cultures, fungi, microbe, microorganism, intestines, food-borne illness, e coli, food poisoning, food safety,

Using Food Labels – Environmental Science and Health

How can we use the information on food labels?

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Background

Beginning in 1994, the US Government began requiring manufacturers to put information about nutritional value on food labels. This information helps people make better choices about which foods to buy and eat.

All food labels must present the same basic information in a standard format. This information includes, at minimum, the amount per serving of saturated fat, cholesterol, dietary fiber, and other nutrients known to be important for health. Labels also provide nutrient reference values, expressed as "% Daily Values," to help consumers see how a food fits into an overall daily diet. It is important to pay

attention to the serving sizes on any food label.

Packages also must list all ingredients in foods. This list is given in order, by weight, beginning with the ingredient that weighs the most. This information can be helpful when selecting foods.

Carbohydrates are the body's main source of fuel. Starchy foods like breads, spaghetti, rice, potatoes, corn and cereals are made up mostly of carbohydrates. Sweet foods like candy, jam and syrups also are carbohydrates. Some carbohydrates, called fiber or roughage, are hard to digest. They help move waste through the digestive system.

Fats include butter, margarine, lard, shortening and cooking oils. Meats, cheese, cream, chocolate and many desserts like cakes and cookies usually have a lot of fat. Fats are very concentrated sources of energy. Some kinds of fat (particularly fats that are solid at room temperature) have been linked to diseases of the heart and circulatory system. Most Americans eat too many high-fat foods.

Proteins are important for growth and repair of the body. Protein-rich foods include eggs, milk products, meat, dried beans, chicken, turkey and fish. The body also uses protein as fuel to provide energy for movement and growth.

Minerals are found in small amounts in foods. They are needed for many of the body's functions. For example, calcium is used to build bones and teeth and also is important for muscles and the nervous system. Iron goes into making red blood cells.

Vitamins are other chemicals found naturally in food that are needed in very small amounts by the body. Fruits and vegetables are valuable sources of vitamins and minerals.

All foods also contain some water.

Procedure

1.Remind students of the food guides they used at the beginning of this unit. Ask, *How can we be sure that the foods we eat each day contain the nutrients we need?*

Reference

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Image Reference

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Key Words

ecosystem, food, food group, food label, diet, nutrient, nutrition, ingredients, carbohydrates, cholesterol, trans fat, fiber, sugar, fats, protein, minerals, vitamins, sodium, salt, saturated fat, calorie, calories, serving size, calcium, fruit, vegetable, grains, meat, fish, nuts, cereal, dairy, portion size,

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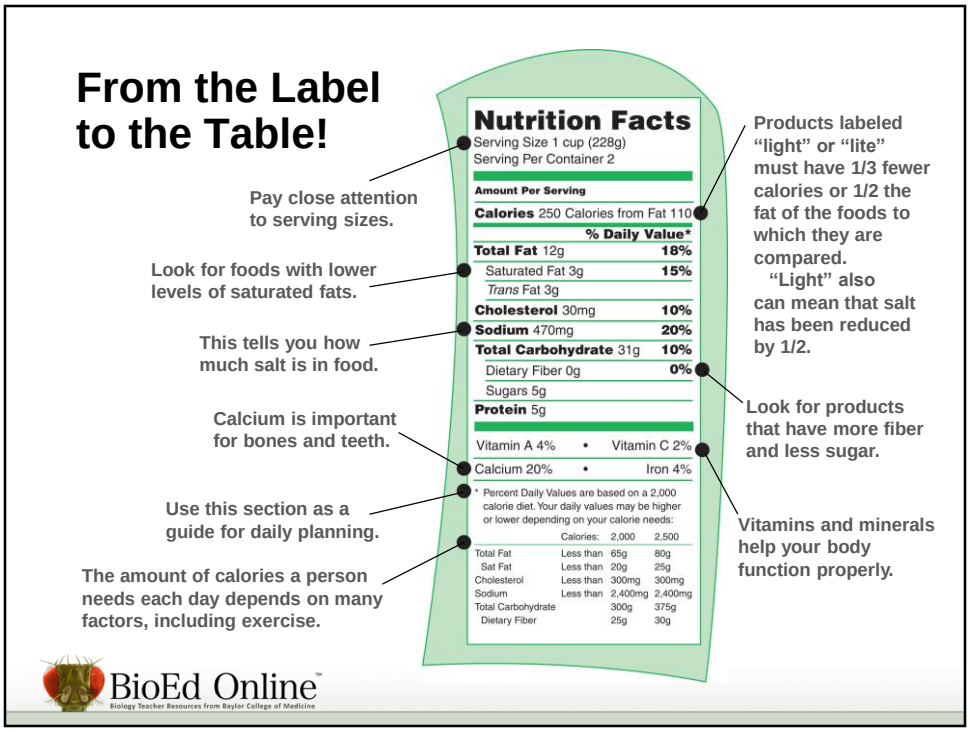

From the Label to the Table!

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Procedure (cont.)

2.Mention that packaged foods now have uniform labels that provide information about the nutritional value of foods. Distribute copies of the student page.

3.Have students read the label depicted on the student page out loud in their groups. Follow by helping them understand the concepts outlined in the box above.

4.Ask students, *What units of measure are mentioned on the label?* (cups and grams). Mention that they will be investigating these measures using sugar.

5.Have students, in their groups, follow the instructions on the "Sugar Measures Up" page. They will explore how much sugar is contained in a typical soft drink.

6.Afterwards, ask, *Were you surprised about the amount of sugar in one soft drink? How many soft drinks would you need to meet your daily total carbohydrate requirement? Do you think that that would be a good way to fuel your body?*

Reference

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Safe Food Preparation

- What things can we do to keep food safe to eat while we prepare the food?

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Safe Food Preparation – Environmental Science and Health

How can we reduce the risk of food contamination?

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Note: For more information about food and food safety, including free food safety charts, visit the "Keep Food Safe" section of the Foodsafety.gov website. http://www.foodsafety.gov

Background

Simple precautions during food preparation can help to keep foods free of bacteria, and also help to reduce the consumption of chemicals applied to fruits and vegetables. Some important food preparation tips include the following.

•Always rinse fruits and vegetables, and after handling raw meat, fish or poultry.

•Always wash hands before preparing any food.

•Always wash cooking utensils, such as knives and cutting boards, in hot, soapy water.

•Clean cutting boards and work surfaces with a 1:10 bleach and cold water solution to kill bacteria.

•Always wash cutting boards between preparing different food items.

•Cook all meats, fish, eggs and poultry thoroughly.

•Use ground meats within 24 hours of purchase (or freeze them) and cook thoroughly.

•In home gardens, use pesticides as sparingly as possible.

•Avoid eating fish and seafood from polluted water.

This activity will allow students to observe safe food preparation practices while making a fun treat—ice cream!

Procedure

1.Before beginning, have students talk about ways they can keep food clean during preparation. List their ideas on the board. If necessary, mention additional points listed above to complete the discussion.

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Image Reference

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Key Words

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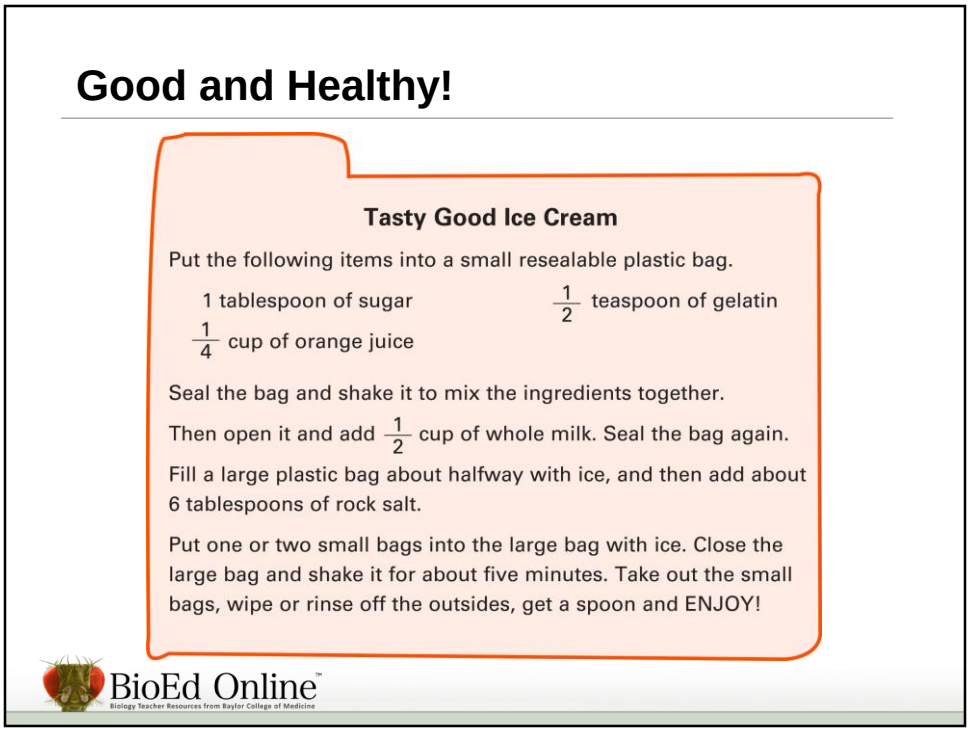

Good and Healthy!

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Note: For more information about food and food safety, including free food safety charts, visit the "Keep Food Safe" section of the Foodsafety.gov website. http://www.foodsafety.gov

Procedure (cont.)

2.Tell students that they will be making one of their favorite foods—ice cream. Go over the steps they will follow to make the ice cream, as listed on the "Good and Healthy!" sheet. Have students identify which steps will require care to keep their food clean.

2.Before beginning, have students wash their hands and work areas.

3. Have each student measure the following ingredients into a small freezer-weight resealable plastic bag: 1/4 cup of orange juice, 1/2 teaspoon of gelatin and 1 tablespoons of sugar. Have students seal, then shake the bags to mix these ingredients together. Have each student add 1/2 cup whole, unflavored milk to his or her bag.

4.Have each team of two students fill a gallon-size resealable plastic bag about halfway with ice, and then add about 6 tablespoons of rock salt.

5.Direct both members of each team to place their bags inside the gallon bag with ice and seal the large bag carefully. Have students take turns shaking the gallon bags until the mixture freezes.

6.Let students remove the smaller bags, wipe or rinse off the salt water and enjoy their sweet treat.

7.Later, have students write a paragraph describing the steps they followed to make the ice cream. Have them include descriptions of the ways they kept their food and work areas clean.

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Healthy Snacks

- What do you know about choosing healthy foods and food preparation?

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Healthy Snacks

Post-assessment

Complete instructions for conducting activities in this slide set, including materials needed, setup instructions, student sheets (in English and in Spanish), answer keys and extensions, can be found in *The Science of Food Teacher's Guide*, which is available free-of-charge at http://www.bioedonline.org/lessons-and-more/teacher-guides/food/

Background

This activity is designed to assess student learning of nutrition and food-related concepts presented in the unit. Examples of the unit topics are listed below. You also may want to repeat the pre-assessment as a post-assessment.

- Photosynthesis as the source of energy at the base of the food chain
- Food webs and the interrelatedness of components in ecosystems
- Where food comes from
- Choosing a healthy diet

•The persistence of certain contaminants (especially heavy metals and compounds, such as pesticides) in the food chain

•The contamination of food, especially by bacteria and other microorganisms

•Appropriate food-handling techniques to reduce the likelihood of exposure to food-borne parasites or bacterial infections, and to reduce contamination of food by pesticides and other chemicals

Procedure

1.Distribute a copy of the "What's Really In There?" student page to each group of students. Explain that they will be using their new knowledge about choosing healthy foods and food preparation.

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Key Words

ecosystem, food, food chain, food group, food label, food poisoning, food safety, producers and consumers, food web, carnivore, herbivore, omnivore, decomposer, scavenger, bacteria, fungi, microbe, microorganism, bioaccumulation, diet, calorie, digestion, nutrient, nutrition, carbohydrates, cholesterol, trans fat, fiber, sugar, fats, protein, minerals, vitamins, sodium, salt, saturated fat, calorie, calories, serving size, calcium, fruit, vegetable, grains, meat, fish, nuts, cereal, dairy, portion size, photosynthesis, plant, flower, leaf, leaves, root, seed, stem, soil, pesticide, cholesterol, carbohydrate, fiber, sugar, fats, trans fat, saturated fat, minerals, vitamins, sodium, salt, water, serving size,

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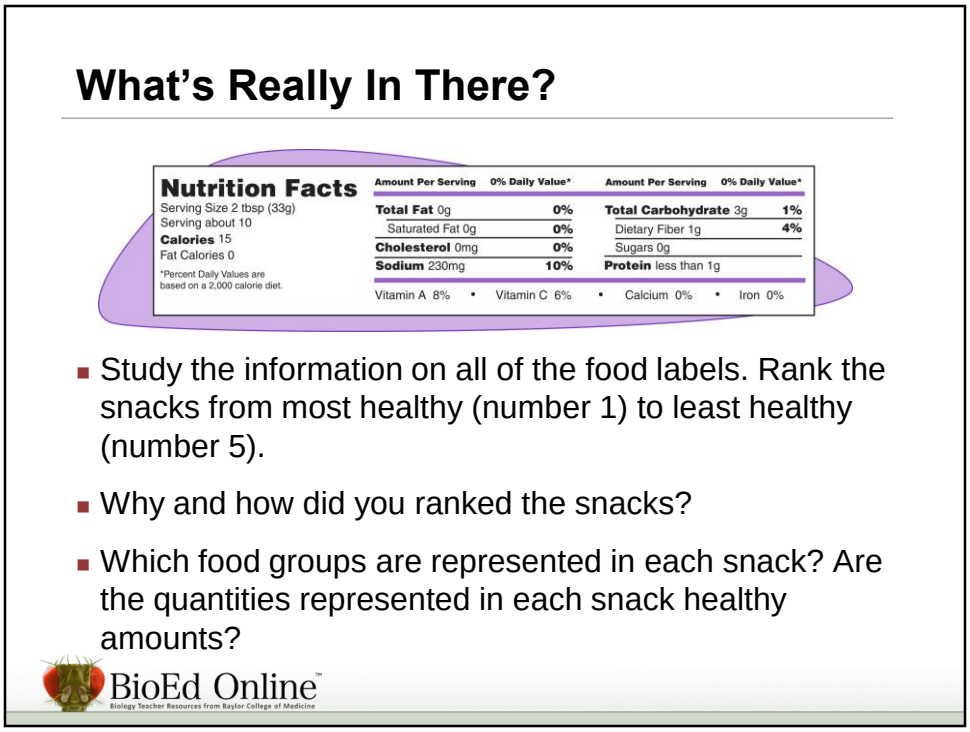

What's Really In There?

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Procedure (cont.)

2.Have groups discuss the contents of the foods described in each of the labels. Students should notice how many fats, carbohydrates, sugars, etc. are in each item.

3.After discussion, have each group rank the snacks in order from most healthy to least healthy. On a separate sheet of paper, students should write a short paragraph about the evidence they used to make their rankings. Each group should identify which food groups are represented in each snack, and whether the quantities are present in healthy amounts.

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