Activity from *The Science of Food Teacher’s Guide: From Ecosystems to Nutrition* and for *The Mysterious Marching Vegetables*

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living things often are classified as producers or consumers, depending on how they obtain energy and nutrients. Producers typically are able to use solar energy to make the molecules they need from relatively few substances present in the air, water and soil. On land, green plants are the primary producers. In water, some plants and many varieties of algae, bacteria and other one- to many-celled organisms (Protists) are producers. All other organisms are consumers, which live directly or indirectly on food provided by producers.

Almost all producers make the molecules they need through photosynthesis. During photosynthesis, producers absorb energy from the sun and use it to combine carbon from carbon dioxide with water to make sugars and other carbohydrates. Thanks to this amazing process, light energy from the sun is converted into chemical energy stored in the bonds between atoms that hold molecules together. Plants use the energy stored in these molecules to build other compounds necessary for life. Likewise, consumers, who cannot trap energy directly from sun, must rely on molecules manufactured by plants for food.

The general sequence of who 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. Along the way, much energy is given off as heat. In fact, about 85–90% of the total usable energy is released as heat at every step in a food chain. Most organisms have more than one source of food. The relationship among all the energy flow interactions that happen in an ecosystem usually are described as a food web.

### PRODUCERS AND CONSUMERS

- **HERBIVORES**, such as giraffes and caterpillars, are primary consumers. They feed on plants and other producers.
- **CARNIVORES**, such as anteaters and spiders, are secondary consumers. They feed on primary consumers. Most secondary consumers are animals, but a few are plants, like the pitcher plant.
- **OMNIVORES** eat plants and animals. Humans, pigs, dogs and cockroaches all are omnivores.
- **DECOMPOSERS** live off waste products and dead organisms. Many kinds of bacteria and fungi (molds and mushrooms) are decomposers. The decomposers themselves are important food sources for other organisms in soil, such as worms and insects. Litterfeeders, such as termites and earthworms, feed on partially broken down bits of plant and animal matter.
- **SCAVENGERS** feed on dead organisms that have been killed by another animal or that have died naturally. Vultures, flies and crows are examples of scavengers.
Plant Parts You Eat

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 choose 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, brussel 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 squash, 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.

SETUP
You will need to bring enough different fruits, vegetables and grains to class to provide a different one to each group of 2–4 students. Try to include at least one representative from each of the categories listed below. Fresh, whole examples are best.

- Roots: examples include carrot, beet, radish, or sweet potato
- Leaves: lettuce, spinach or scallions (students can observe that the fleshy bulb of the scallion or green onion is made up of overlapping leaf bottoms)
- Stems: asparagus (potato is a confusing example, except to discuss with students afterwards) or celery stalks (leaf stem)
- Flowers: broccoli, cauliflower or artichoke
- Fruits: apple, orange, peach, tomato or zucchini (example should have observable seeds)
- Seeds: dried beans, peas or lentils
- Whole grains: popcorn or wheat berries (white rice has most of the grain removed)

Soak examples of grains and dried seeds overnight, so that they will be soft enough for students to split open.

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 (see illustration, sidebar, p. 3).

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.

**Variations**

- Push toothpicks into the side of a potato and suspend it in a glass of water. Students will be able to observe the formation of stems, leaves and roots.
- Food crops have originated in many different parts of the world. Scientists estimated where each crop originated by using archeological evidence and locating where wild relatives of the food crop still grow. Have students use the library to investigate the places of origin of some common foods.