

Is It Food for Plants?

Organisms, including plants, need food to survive.
Put an X next to the things you think plants
use as food.

☐ sunlight

☐ plant food from a garden store

☐ sugar

☐ carbon dioxide

☐ minerals

☐ fertilizer

☐ soil

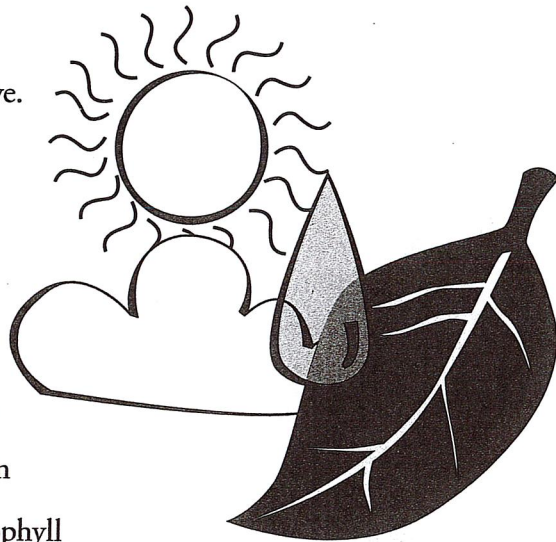
☐ water

☐ leaves

☐ oxygen

☐ chlorophyll

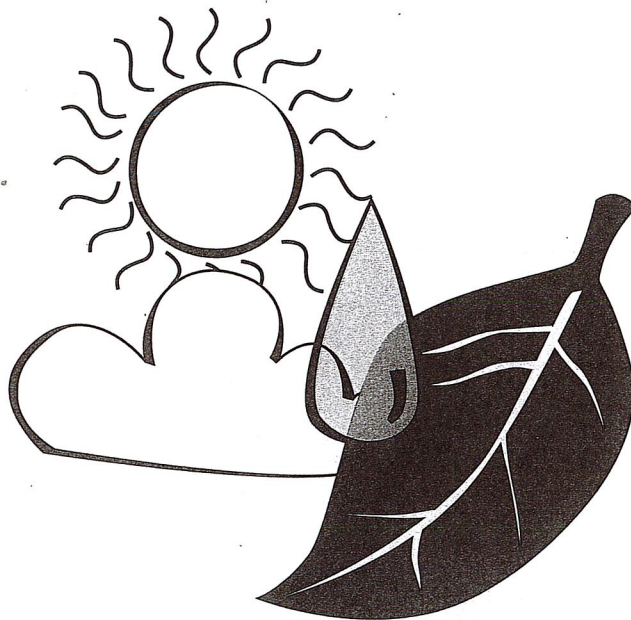
☐ vitamins



Explain your thinking. How did you decide if something on the list is food
for plants?

Is It Food for Plants?

Teacher Notes



Purpose

The purpose of this assessment probe is to elicit students' ideas about food and plants. The probe is designed to reveal whether students use a biological concept of food to identify what plants use for food.

Related Concepts

food, photosynthesis, plants

Explanation

The best response is sugar. Sugars, such as glucose, are simple carbohydrates made and used by plants as food. Plants differ from animals in that they are able to use the energy from

sunlight to transform inorganic carbon dioxide and water, which they take in from their environment, into food. This process is called photosynthesis. Part of the confusion among children and adults is due to how we define the word *food* and use the words *food* and *nutrients* interchangeably. Nutrients are substances that organisms require to carry out their life processes; they can be organic or inorganic. Not all nutrients provide energy. Examples of inorganic nutrients that do not provide energy are vitamins, minerals, and water. Examples of organic nutrients that provide energy are carbohydrates (including simple sugars), lipids (fats), and proteins. Food is a nutrient that contains energy, and it may contain inorganic

nutrients as well. Food provides energy and the building blocks for growth and tissue repair; it can be used immediately or stored for later use. For example, many plants store food in the form of starch.

All foods can be considered nutrients, but not all nutrients are considered food. To be considered food in a biological sense, the substance must contain energy that can be released during cellular respiration. Inorganic nutrients such as water and minerals are essential to metabolic processes but do not provide energy. The “plant food” commonly sold in stores is not food in a biological sense. It provides a source of inorganic nutrients that may not be present in the soil. Likewise, soil is not food but rather a source of plant nutrients such as minerals and water. Leaves are plant structures in which photosynthesis takes place and sugars are made. The leaves and other plant structures are then food for animals that eat plants. Sunlight is the form of energy used by the plant during photosynthesis, but it is not a substance and does not provide the building blocks needed to grow or repair plant structures. Chlorophyll is a substance contained in the plant’s chloroplasts that is involved in photosynthesis. Fats, oils, and proteins are also foods. The only item on the list that is considered food for a plant is sugar.

Curricular and Instructional Considerations

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Elementary Students

In the elementary grades students learn about

the needs of organisms.

Through a variety of instructional opportunities, students learn that

animals take their food in

from the environment by

eating plants, animals, or

both. Students wonder about the differences

between plants and animals and ask questions

such as “How do plants get food?” (NRC 1996,

p. 128). They learn that plants need nutrients

and may be introduced to the idea that plants

make their own food, but the ideas related to

the process of photosynthesis are not developed

until middle school. Elementary students also

learn about food groups and nutrients in the

context of human nutrition. Identifying sugar

as the food plants use exceeds grade-level

expectations for elementary students. However,

the probe is useful in identifying ideas that form

early about food for plants, particularly the

notion that plants get their food from the soil.

Middle School Students

In middle school, students are introduced to

the basic process of photosynthesis. They learn

that plants make sugar from carbon dioxide

and water using energy from sunlight and that

the sugar can be used by the plant as a source

of energy and as material for growth and

repair or can be stored for later use. Middle

school is the time when students need to

develop a scientific conception of food different

from the common, everyday use of the word.

Even though the basic process of photosynthesis—including the idea that sugars are plants’

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only food—has been taught, middle school students may hold tenaciously to the misconception that plants get their food from the environment, particularly from nutrients in the soil or commercial plant food.

High School Students

In high school, students deepen their understanding by connecting their growing understanding of chemistry to the biological process of photosynthesis. The understanding that food is a source of energy is expanded to include the idea of energy from sunlight stored in the chemical bonds that form between the sugar's carbon atoms. This probe is useful at the high school level because it will often reveal that even after students have learned about photosynthesis, the idea that energy is released when chemical bonds are broken, and the biological concept of food, they may revert to their prior conceptions about where plants get their food.

Administering the Probe

This probe can be used with elementary students by removing unfamiliar words such as *chlorophyll* and substituting *air* for *carbon dioxide* and *oxygen*. For high school students the word *sugar* can be added to or substituted with *simple sugar* or *glucose*. High school teachers may also add *starch*, *oils*, and *protein* to the list. This probe may also be used as a card sort.

Related Ideas in National Science Education Standards (NRC 1996)

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K-4 The Characteristics of Organisms

- Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light.

5-8 Populations and Ecosystems

- ★ For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis.

9-12 The Cell

- ★ Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital connection between the Sun and the energy needs of living systems.

9-12 Matter, Energy, and Organization in Living Systems

- ★ The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between atoms of carbon containing (organic) molecules. These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars, and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes.

★ Indicates a strong match between the ideas elicited by the probe and a national standard's learning goal.

Related Ideas in Benchmarks for Science Literacy (AAAS 1993)

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K-2 Cells

- Most living things need food, water, and air.

K-2 Flow of Matter and Energy

- Plants and animals both need to take in water, and animals need to take in food. In addition, plants need light.

3-5 Flow of Matter and Energy

- Some source of “energy” is needed for all organisms to stay alive and grow.

6-8 Flow of Matter and Energy

- ★ Food provides molecules that serve as fuel and building material for all organisms. Plants use the energy in light to make sugars out of carbon dioxide and water. This food can be used immediately for fuel or materials, or it may be stored for later use.

Related Research

- Much of the research on students’ ideas about food for plants was conducted in the 1980s and still applies to students’ ideas today. Universally the most persistent notion is that plants take their food from the environment, particularly the soil. Students also believe that plants have multiple sources of food (Driver et al. 1994).
- Children appear to consider food as anything useful taken into an organism’s body,

including water, minerals, and, in the case of plants, carbon dioxide or even sunlight. Typically, students do not consider starch as food for plants. Their reasoning is that starch is something plants make, not something they eat (Driver et al. 1994).

- Students often give a nonfunctional explanation about why plants and animals need food. They say it is needed to keep them alive, rather than describing the role of food in metabolism (Driver et al. 1994).
- In a study by Wandersee (1983) that surveyed 1,405 students ages 10–19 about the product of photosynthesis, most students selected proteins, relating them to food for growth, rather than energy. Some students in this study also mentioned plants getting vitamins from the soil.
- In a study by Tamir (1989), some students thought sunlight, associated with energy, was the food for plants. Many students also considered minerals taken in from the soil as food or believed that minerals had a direct role in photosynthesis.
- The everyday reference to fertilizers as “plant food” may promote the idea of fertilizer as being the food for plants (Driver et al. 1994).
- The idea that plants take their food in from the environment, rather than making it internally, is a common misconception that is highly resistant to change. Even when taught how plants make food by photosynthesis, students still hold on to the notion that food is taken in from the outside (AAAS 1993).

★ Indicates a strong match between the ideas elicited by the probe and a national standard’s learning goal.