



STEMsational Ag: The Virtual Farm

MIDDLE TENNESSEE STATE UNIVERSITY



Module 11: My Own Garden UNIT 4: FROM SEED TO SPROUT Grades 3 – 5



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE



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Module 11: My Own Garden
UNIT 4: FROM SEED TO SPROUT
Grades 3 – 5



3rd – 5th Grade:

Introduction to the Unit: Think about the things you need each day to stay healthy. What are they? Food, air, water, nourishment, and rest are likely answers. Plants are not too different from us in what they need. How they get it, however, is quite different. In this lesson you will learn what a plant needs to grow!

Pre-assessment:

Draw or write down your answers.

1. What are the parts of a plant?
2. What does a plant need to grow?

Purpose:

- ▶ To help students understand the natural resources and nutrients plants need to grow.

Student Learning Outcomes for the Unit:

- ▶ Students learn about the natural resources plants need to grow and how these elements work together in photosynthesis.
- ▶ Students can explain how the availability of soil nutrients affects plant growth



and development.

- ▶ Students learn how fertilizers are used to replace soil nutrients when soil uses up the nutrients in the soil.

National Agricultural Literacy Outcomes:

Plants and Animals for Food, Fiber, and Energy Outcomes

- ▶ T2.3-5 C. Explain how the availability of soil nutrients affects plant growth and development.

Vocabulary Words:

- ▶ **Commercial fertilizer:** commercially prepared mixtures of plant nutrients that include nitrogen, phosphorus, and potassium applied to the soil to restore fertility and increase crop yields. Commercial fertilizers contain nutrients in known amounts that plants can immediately use.
- ▶ **Fertilizer:** substance used to increase the level of nutrients in soil
- ▶ **Nutrient:** any of 17 essential mineral and non-mineral elements necessary for plant growth
- ▶ **Nutrient deficiency:** a condition where the amount of a nutrient essential to the health of an organism is lacking or present in an insufficient amount
- ▶ **Phosphorus:** a chemical present in plant and animal cells and is vital to all plants for harvesting the sun's energy and converting it into growth and reproduction
- ▶ **Nitrogen:** used by plants for leaf growth and green color. It is also a major component of amino acids, the building blocks of proteins found in the roots to help regulate water and nutrient uptake
- ▶ **Potassium:** helps plants make strong stems and keep growing fast. It is also used to help fight disease
- ▶ **Organic fertilizer:** a fertilizer that undergoes little or no processing and includes plant, animal, and/or mineral materials
- ▶ **Photosynthesis:** the process within a plant that converts light, oxygen, and water into carbohydrates (energy)

Materials Needed:

- ▶ Paper and writing utensil



Activity 1:

- ▶ Write down a list of all the foods you ate last night.
- ▶ Have you ever seen plants or trees eating these foods? (Of course not!)
- ▶ How do plants get the food they need to grow?
- ▶ They get food through a process called "photosynthesis."

Photosynthesis for Kids: Learn how plants MAKE their own food

Also available online at: www.youtube.com/watch?v=lln136eMl4g



Clarendon learning explores the world of science!

Photosynthesis



All living things must eat...

they must eat food to live.



Plants are living things!

How do you think a plant eats?



Can I feed a plant like this?



I don't think a plant could eat like that.



People and other animals must eat food...



birds must eat food



reptiles gotta have food

and fish also must eat, eat something!



And plants,
plants are living things
and must have food.



How do people eat
food?

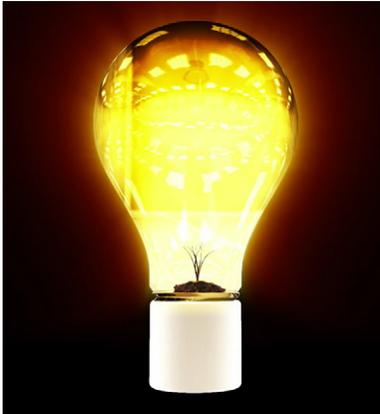
I think most people
eat food through
their mouth.



How do you think a plant
eats food? Through its
mouth?



Maybe if the plant is a
Venus Flytrap!



If the plant is NOT a Venus Flytrap...
then it gets its food through a process called:

PHOTOSYNTHESIS

Photosynthesis... that's a big word, say it with me;
PHOTO - SYN - THE - SIS



Say it with me a little faster: PHOTO - SYNTHESIS

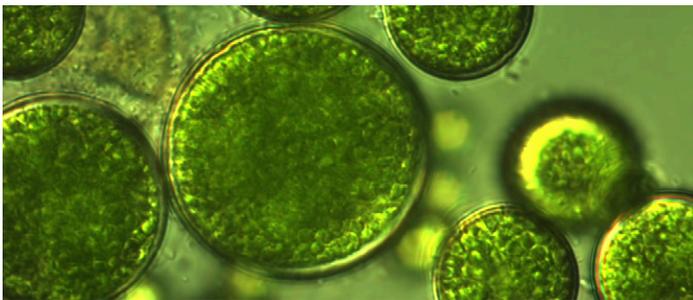


Now say it faster
and all together,
PHOTOSYNTHESIS

Excellent! I knew you
could say it!



Photosynthesis is the
process that enable
green plants,



algae and



some bacteria to
make their own food.



WAIT! Hold the phone! Did I say MAKE THEIR OWN FOOD?

Yes!
I meant what I said!



Trees,



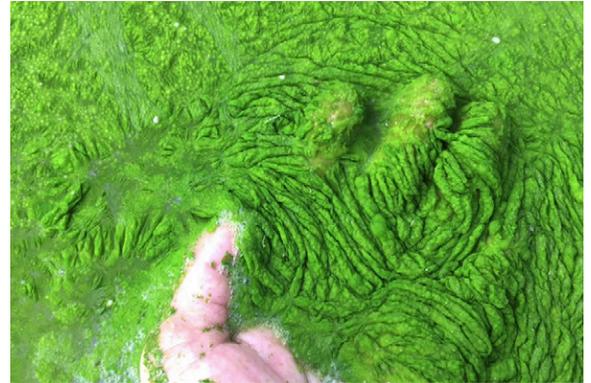
Plants,



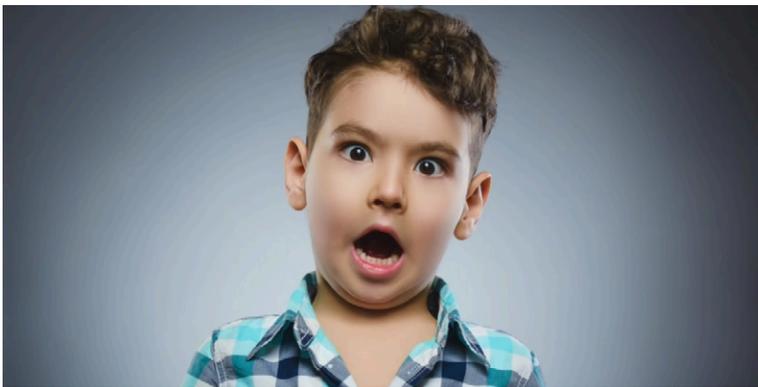
Shrubs,



Grass,



Algae ...



Ewe!
What's algae?



These organisms make their own food,



and the way they do it is
AMAAAZING!



And it's called
Photosynthesis.



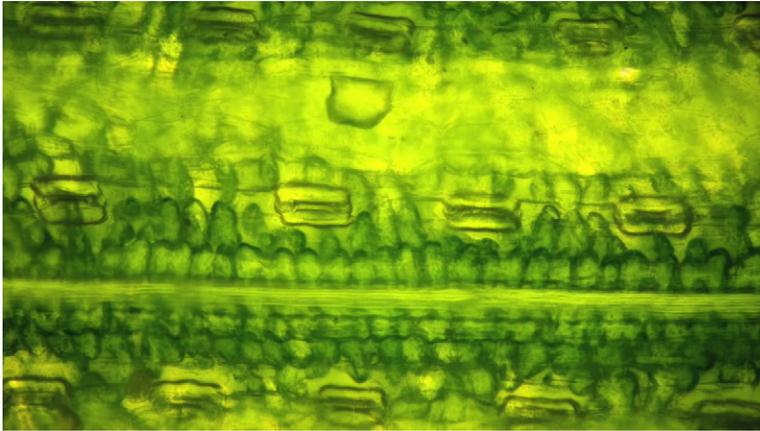
People cannot
magically make their
own food...right?



It takes shopping and time
and preparation, it takes
work...



I'm hungry just thinking
about it.



But watch how plants do it.

The word Photosynthesis comes from two words



Photo... which means "light,"



and Synthesis which means "to make."



Plants use light to manufacture their food which gives the plant energy.

What's the best source of light?

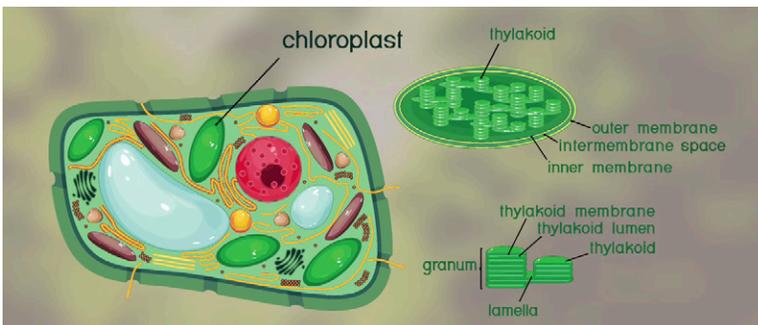


Yup, you're right!

It's the Sun. Let's explore the process of Photosynthesis!



Photosynthesis occurs in the leaves of trees and plants;



in microscopic structures of the leaves called chloroplasts



which contain chemical molecules of chlorophyll
chlorophyll is the element that gives leaves its green color.



3 elements are required for a plant to perform Photosynthesis.

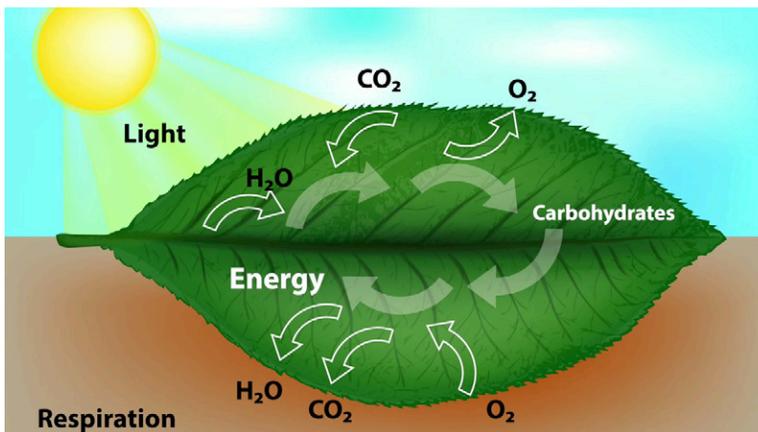
Number 1...

Carbon dioxide is required.

Carbon dioxide is a gas in the air.

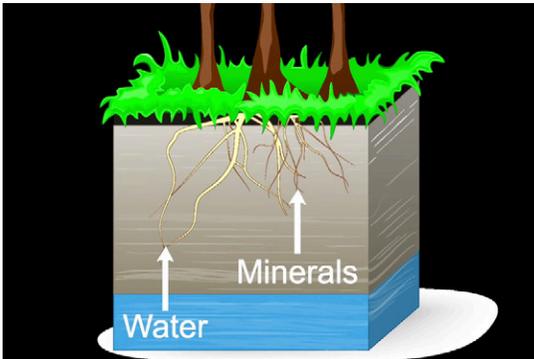


All animals expel carbon dioxide when they breathe out.



Plants like that!

Plants need carbon dioxide. Carbon dioxide is absorbed into the leaves of the plant.

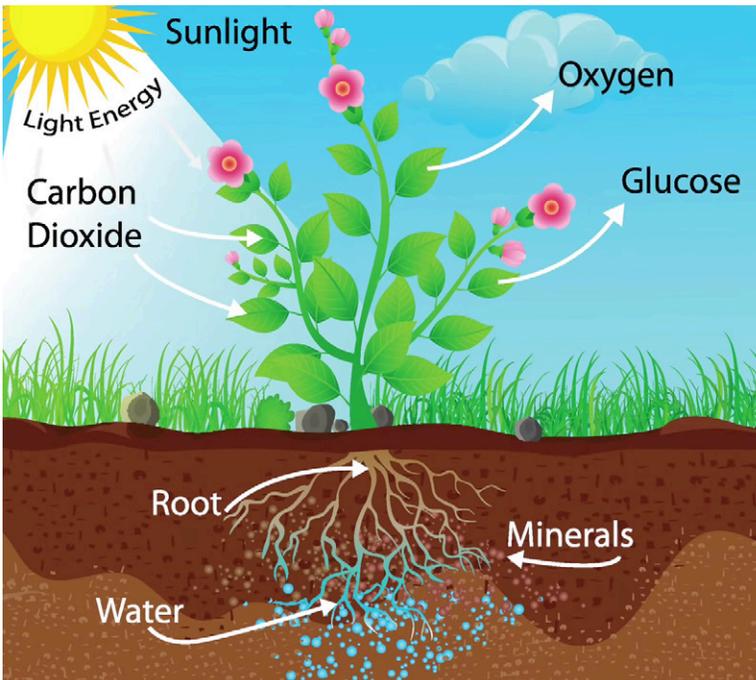


Number 2...
Plants need water.



All living things need water.

You need water just like
plants!



The water in the soil
is absorbed into the
roots of the plant
and travels up into
the leaves of the
plant.



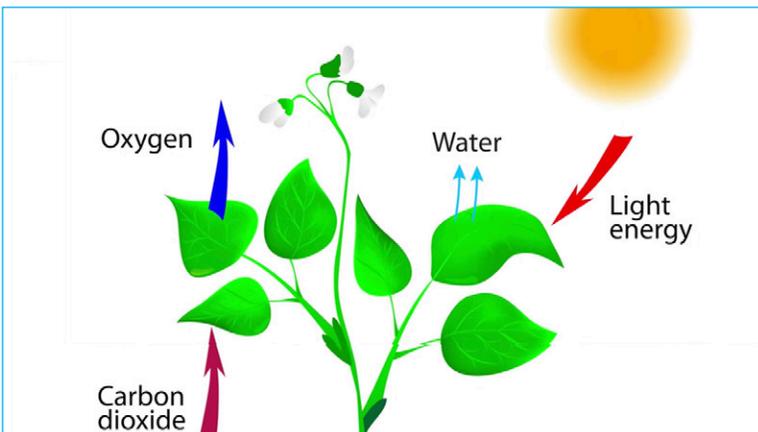
What do you think Number 3 is?

What is the third thing that plants need? Hmmmmmm
We mentioned it before.

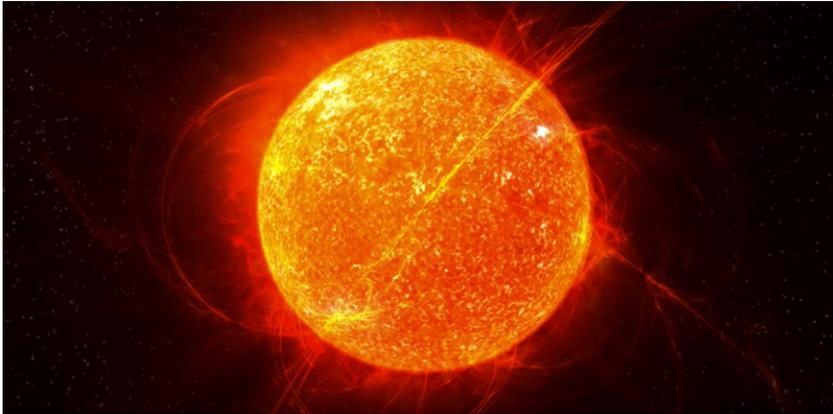


Remember what Photo means in Photosynthesis?

If you said LIGHT...
you would be right!



Light energy is also absorbed into the leaves of the plant.



And what is the best source of light?

You got it, the Sun!



Some plants can be grown indoors... they still need light energy,

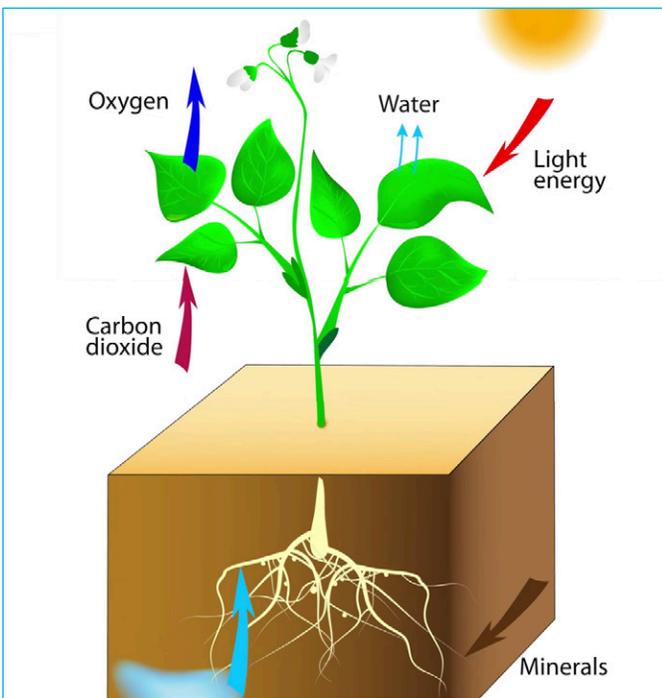


It takes a special lamp to produce the right kind of light that plants need to perform Photosynthesis.



Now that you know the three things necessary...

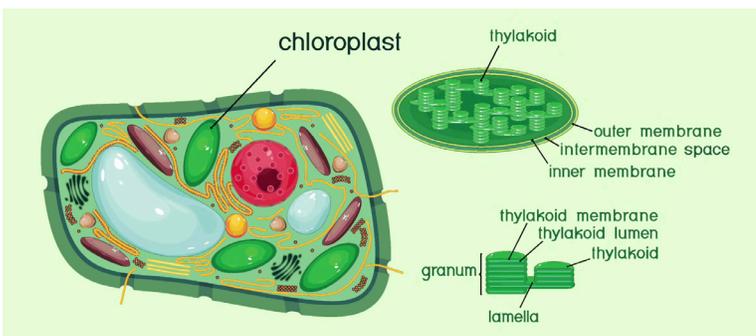
Let's see how they all work together.



Water in the form of moisture reaches the leaves of trees and plants through the root system,

light energy falls upon the leaves and is absorbed by the chlorophyll,

and carbon dioxide is also being absorbed into the leaves



and into the chloroplasts.



And when all the ingredients come together...



BAM!



The chemical reaction known as Photosynthesis has just occurred

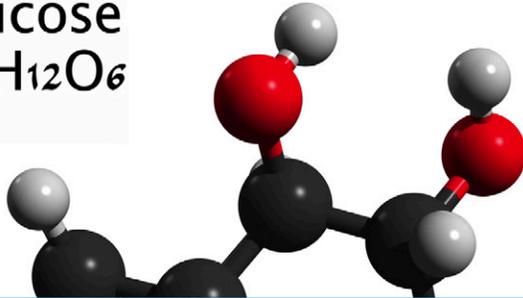


and the plant has made its own...

food!



Glucose
 $C_6H_{12}O_6$



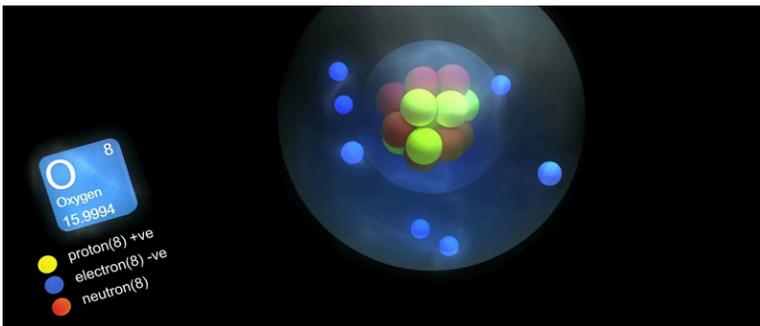
Food in the form of glucose which is a type of sugar.



Plants and trees use these sugars to grow and make flowers, and fruit and vegetables.



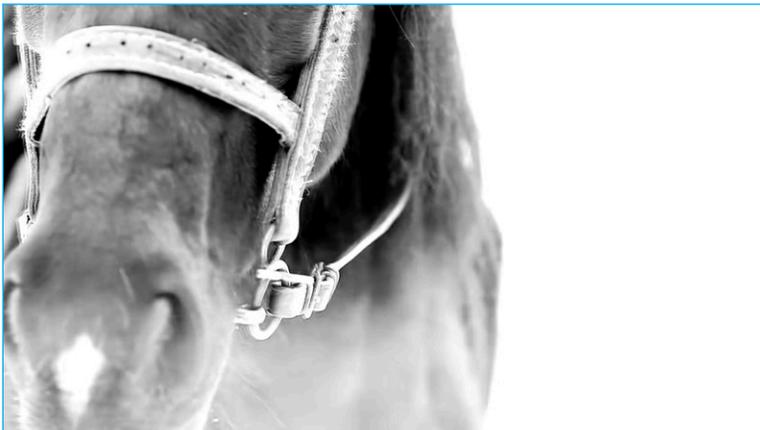
the things we need to live.



Another by-product of Photosynthesis is oxygen!



Plants give off oxygen during Photosynthesis and we need to breathe oxygen!



Look how neat this is; we (people and animals) breathe OUT carbon dioxide which plants need to grow



AND plants GIVE OFF oxygen which WE need to grow!

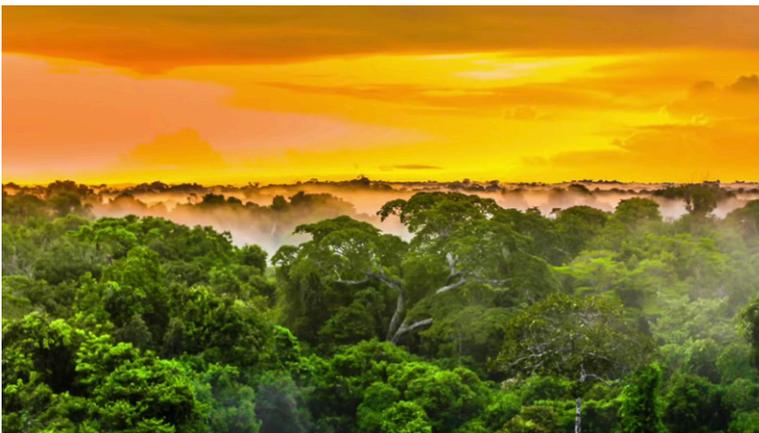
What a beautiful relationship!



All living things on earth rely on plants and trees and grasses of all kinds all over the world



we rely on the process of Photosynthesis, so they can be healthy and continue to grow!



Let's protect our forests!



Review: Natural resources that are needed by plants:

- ▶ **LAWN** (Light, air, water, nutrients)
- ▶ **Light:** differing amounts depending on the plant, needed to convert oxygen and water into energy.
- ▶ **Air:** plants need carbon dioxide from the air to complete the process called photosynthesis. Plants take in CO₂ (carbon dioxide) from the air and combine it with water absorbed through their roots. They use energy from sunlight to turn these ingredients into carbohydrates (sugars) and oxygen, and they release extra oxygen to the air. For this reason, the forests of the planet are important sources of the oxygen in the atmosphere.
- ▶ **Nutrients:** 3 key nutrients needed by plants are phosphorus, potassium, and nitrogen. When plants use up these nutrients in the soil, you have to replace the nutrients with a substance called fertilizer.

Activity 2: Plants, Soil, Nutrients, and Fertilizer

* This lesson has been adapted from the National Agricultural Literacy Curriculum Matrix website (www.agclassroom.org/matrix/lesson/205/).

1. Write the following words on the board or chart paper:

NITROGEN
PHOSPHORUS
POTASSIUM

- Help the students pronounce the words and explain that these nutrients are important for plant health. Remind the students that they can't see these nutrients in the soil, just like they can't see the vitamins in the food they eat.
2. Read through the information on Master 4.1 (page 26) with the class, and use the example to teach students how to analyze this type of data. Explain to the students that, after working through the asparagus example, they will work with partners to analyze similar information on other plants.
 3. Help the students understand that the horizontal line marked "starting amount" represents the level of the nutrient before plants were grown in the soil. The bars indicate whether the amount of a nutrient in the soil either increased (more in the soil) or decreased (less in the soil) after the plants grew. If there isn't a bar visible on the graph for a particular nutrient, the level in the soil didn't change. (These numbers represent 50 pounds of crop



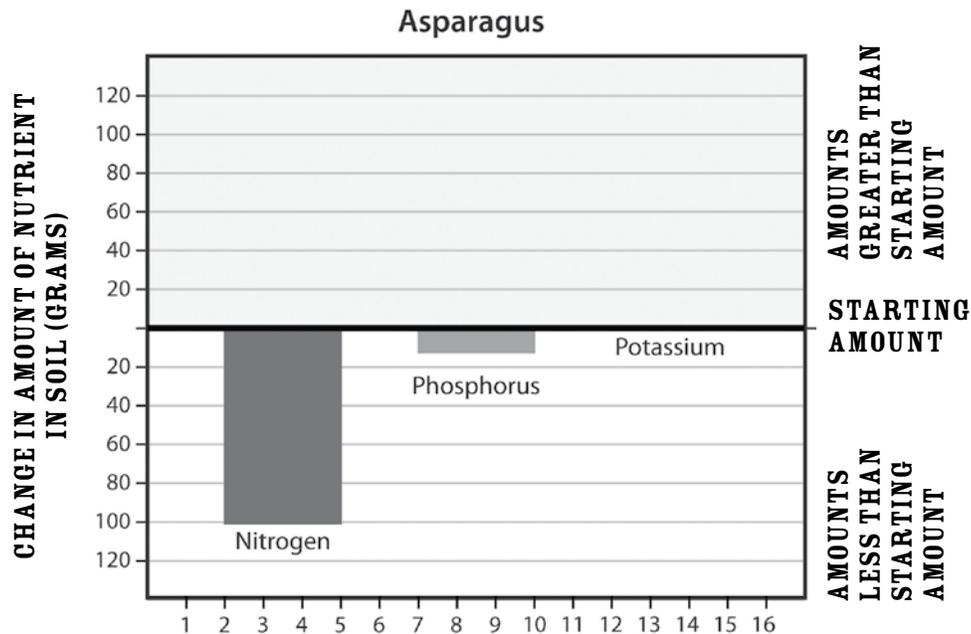
harvest from an acre of soil.) Remember, the graph shows the change in the amount of these three nutrients after plants have grown in the soil compared with the amount before the plants grew. The graph does not show the specific amount of the nutrients in the soil.

4. Ask the class to fill in the blanks of the statements at the bottom of Master 4.1. The students should observe that the amount of each nutrient removed from the soil was different.
 - ▶ There was **LESS** nitrogen in the soil after the plants grew.
 - ▶ There was **LESS** phosphorus in the soil after the plants grew.
 - ▶ There was **THE SAME AMOUNT OF** potassium in the soil after the plants grew.



MASTER 4.1

HOW DO PLANTS AFFECT THE SOIL?—AN EXAMPLE



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.

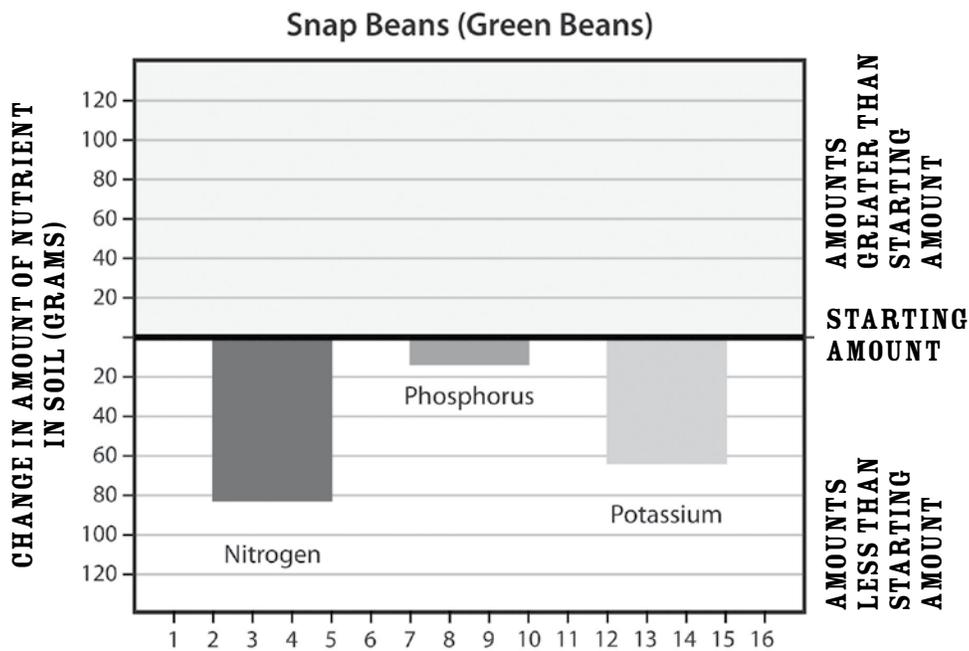


5. Organize the students into groups of two. Give each pair of students a different page from Master 4.2 (pages 28-41). Explain that each group will look at data for a different plant to determine if there are changes in the soil after plants grow. As students work, circulate among the groups to assess their progress, answer questions, or help students that are struggling. Note: Because of the differences in data for particular vegetables, some of the y-axes have a different scale. An extreme example is the y-axis for the graph for peanuts. You may want to point out the scale as students are reporting their results. Including the larger values may make comparing the graphs slightly more challenging for students, but it is also an opportunity to point out details they should look at on graphs and to see how there are differences in plants and their effects on soil.
6. After the students have had a chance to analyze their data, hold a class discussion to summarize the data. Ask the teams to report which vegetable they analyzed and what conclusions they made from the data. The main conclusion for students to draw from the data is that nutrients (nitrogen, phosphorus, and potassium) are removed from the soil when plants are grown. There is less of the nutrient in the soil after plants have grown than there was before (or no change for some nutrients). There are no examples given in which the nutrient level is higher after plants grow.
7. After the students conclude that the soil contains fewer nutrients after plants grow, ask them to consider the following questions. You can refer to the answer key on page 45.
 - ▶ What happened to the nutrients that were removed from the soil?
 - ▶ Where do these nutrients go when the plants are harvested and taken away from the soil?
 - ▶ If there are fewer nutrients in the soil after plants grow, and the nutrients are taken away with the harvest, what do you predict will happen the next year when someone plants a new crop in that soil?



MASTER 4.2, A

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

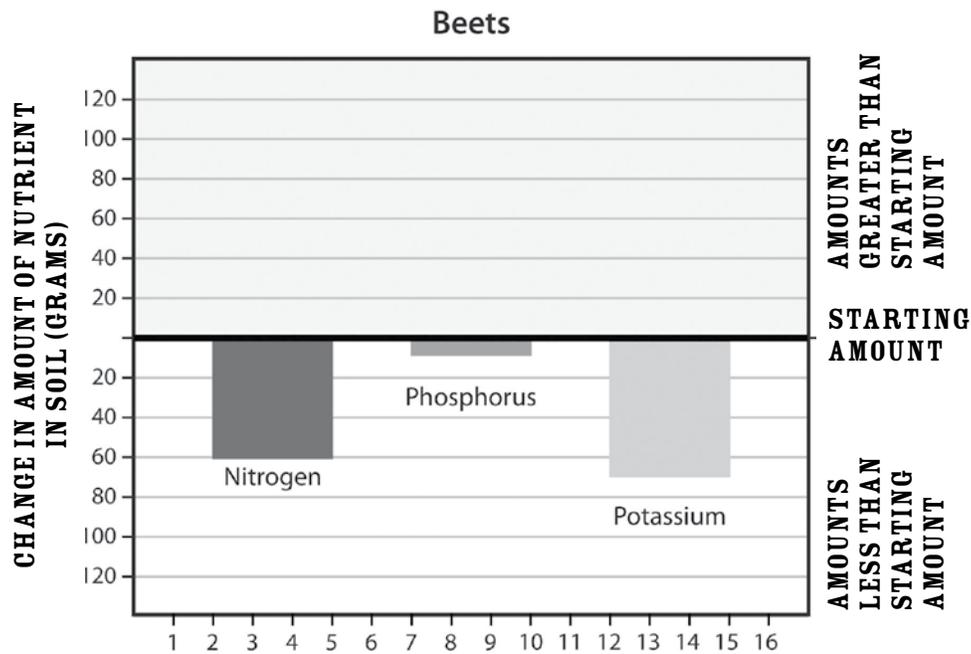
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, B

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

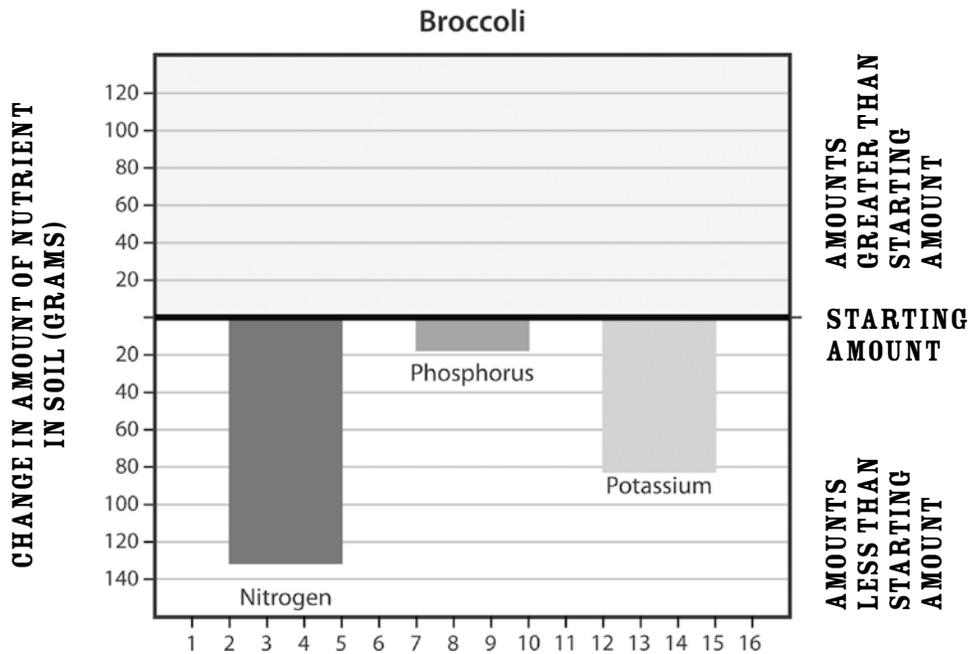
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, C

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

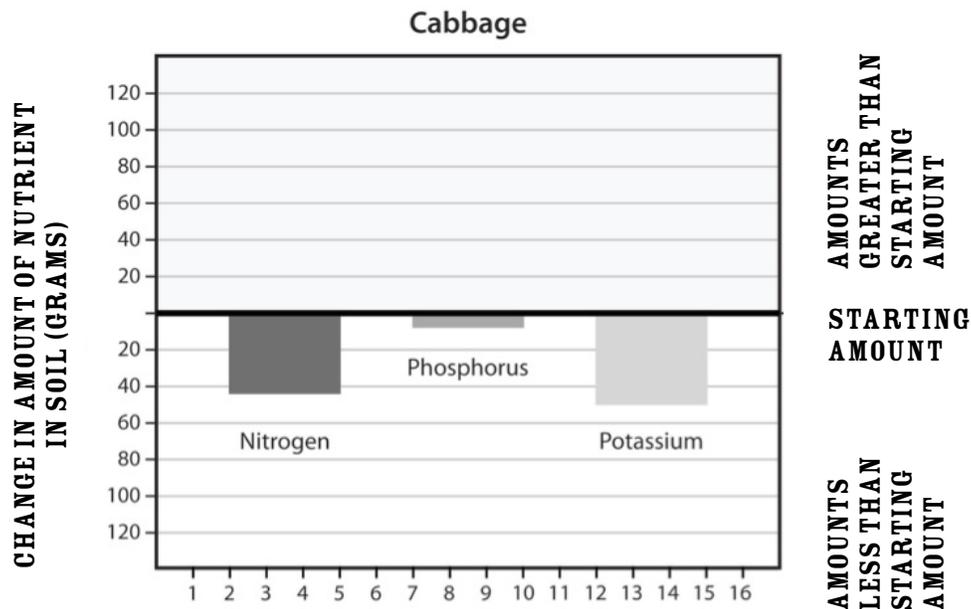
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, D

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

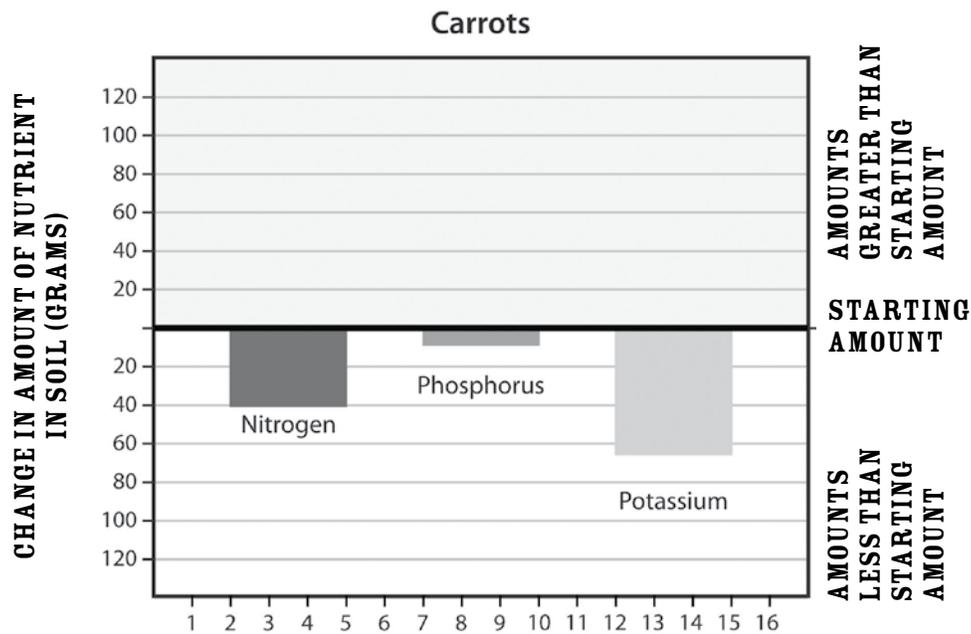
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, E

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

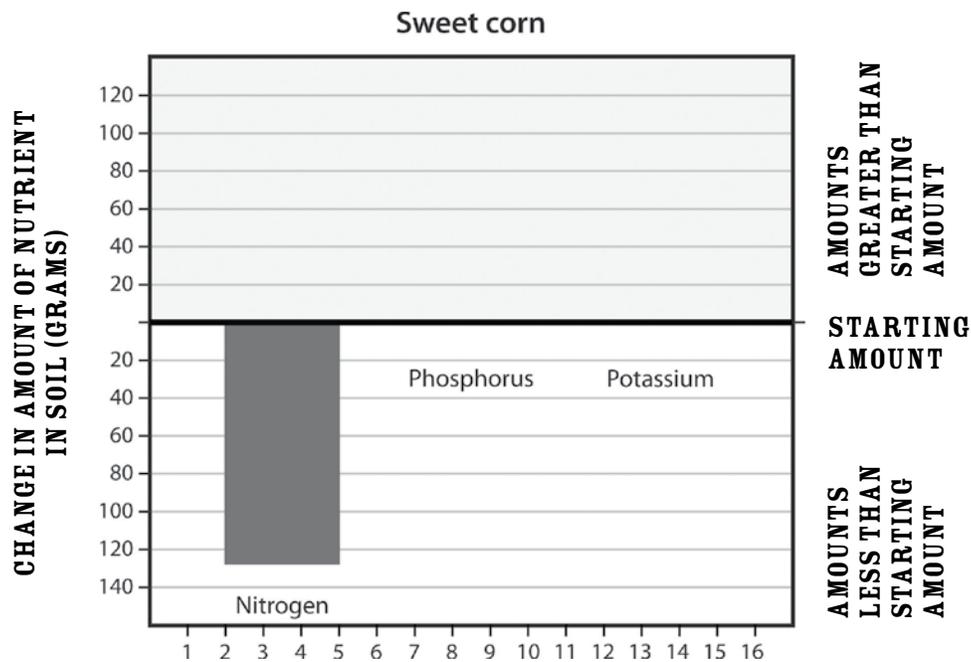
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, F

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

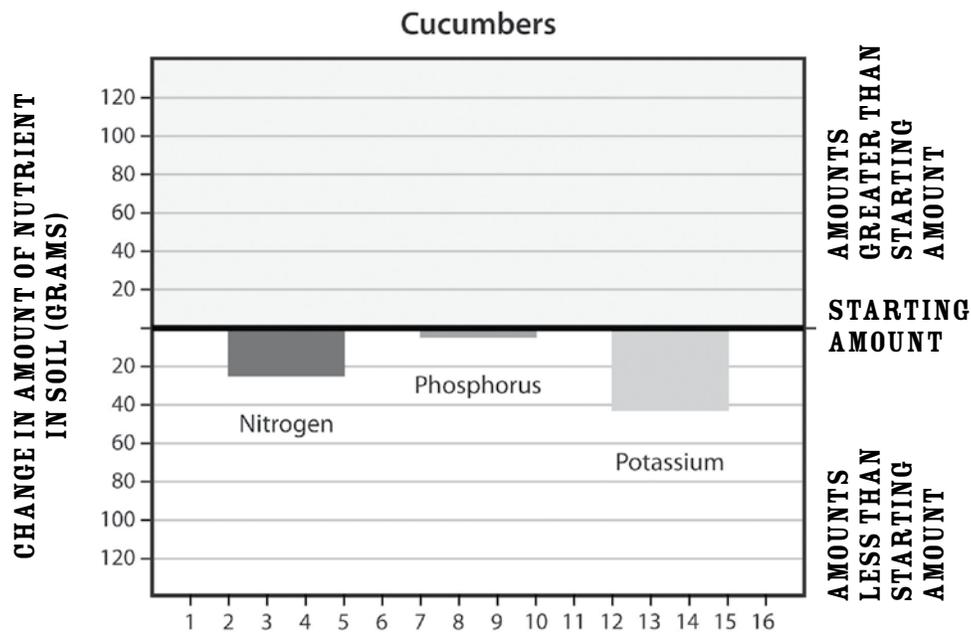
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, G

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

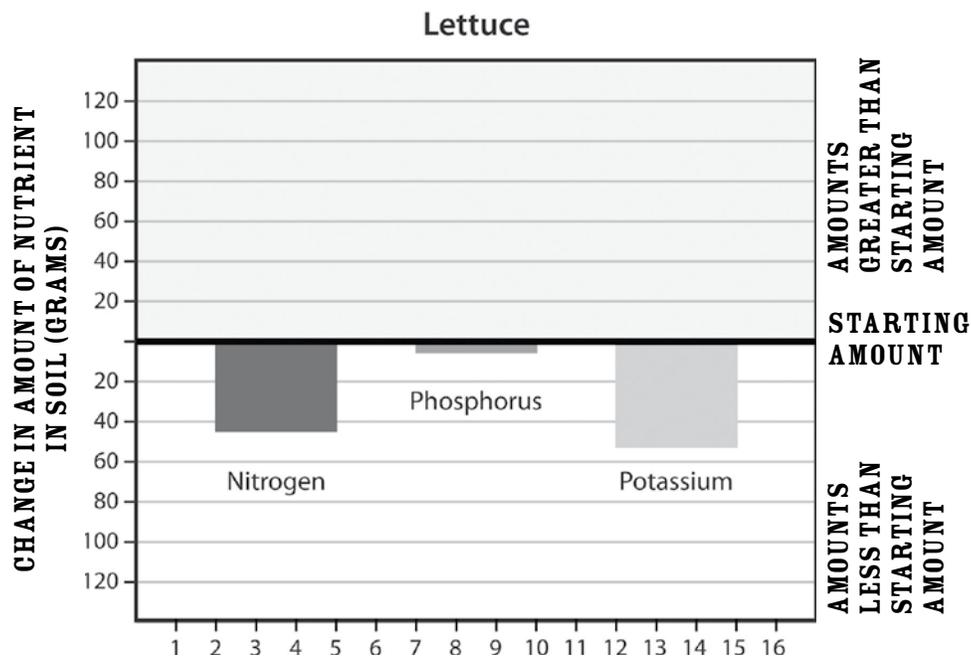
There was _____ nitrogen in the soil after the plants grew.

There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, H HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

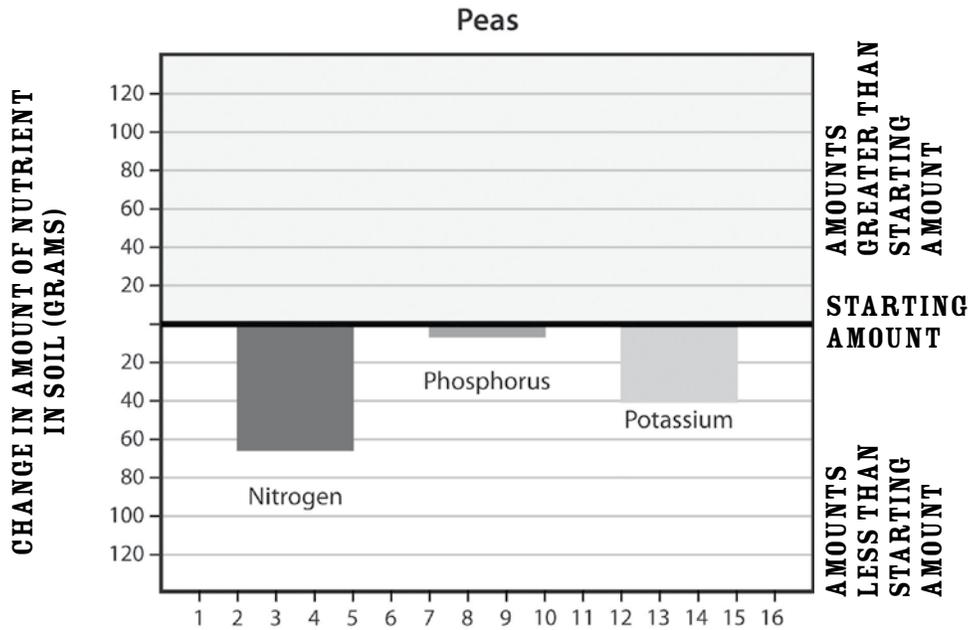
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, I

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

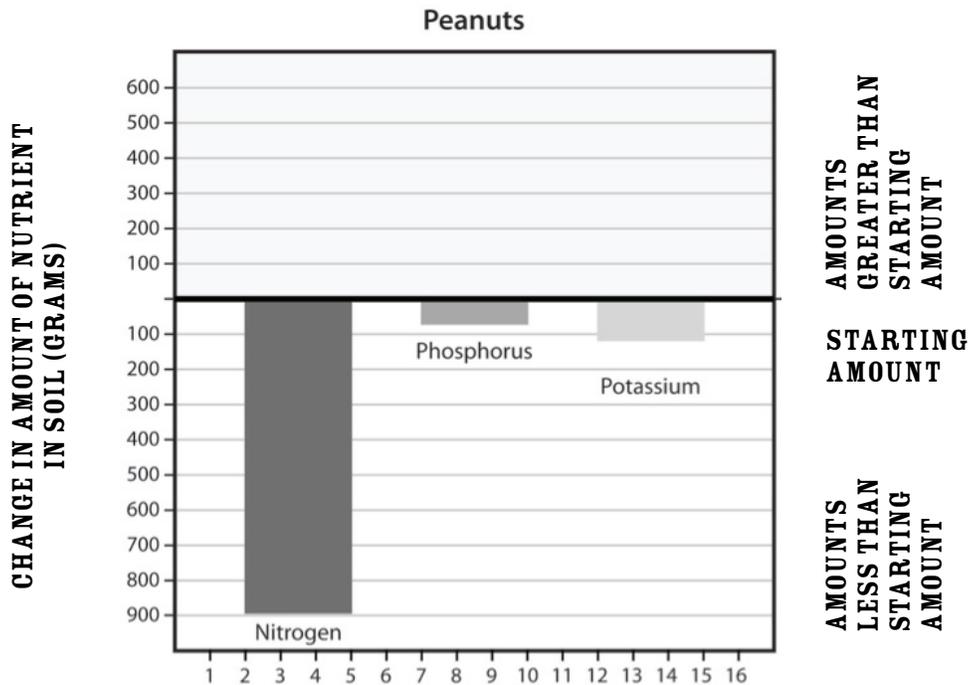
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, J

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

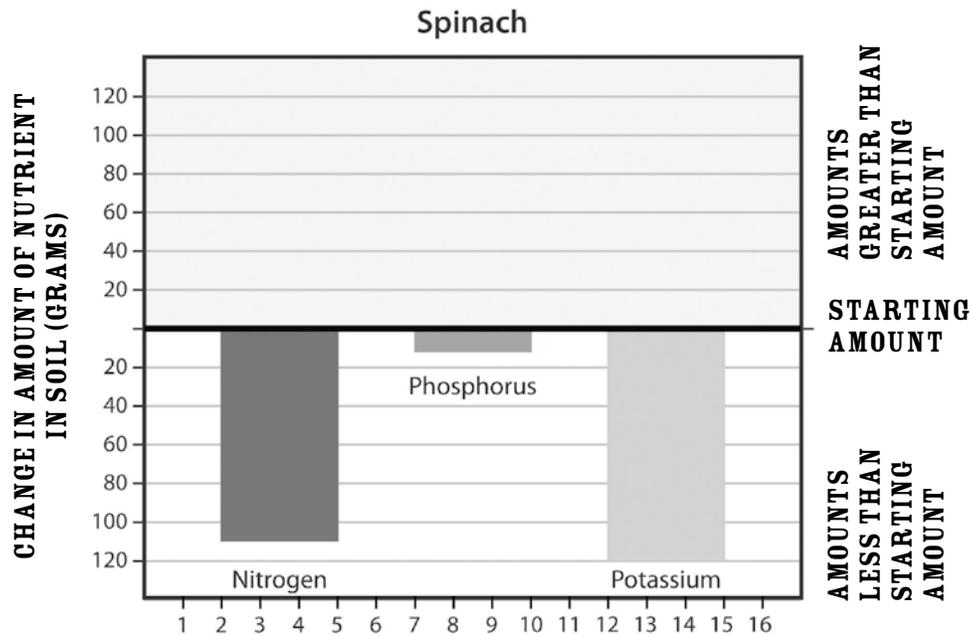
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, K

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

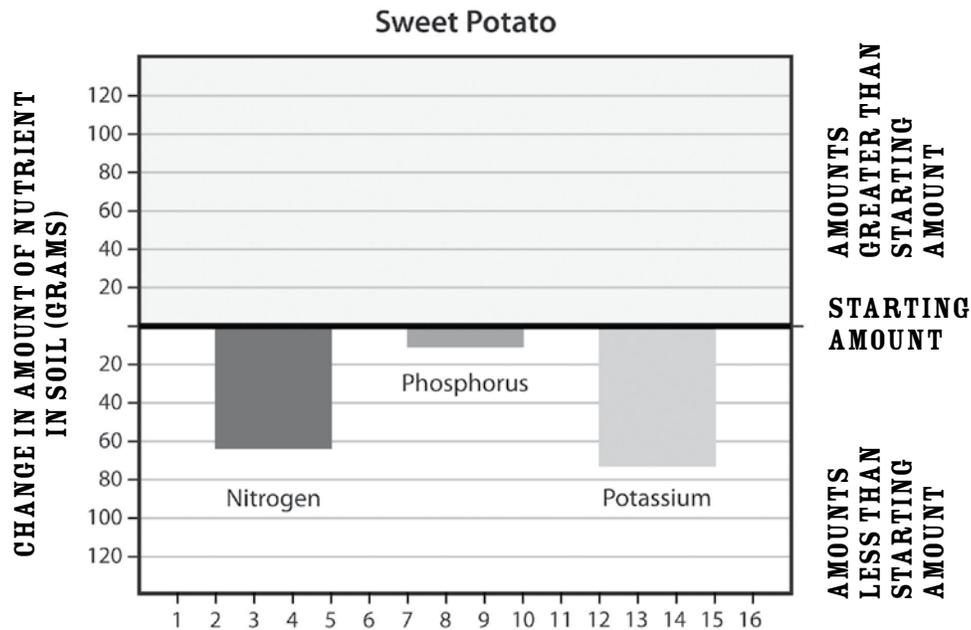
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, L

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

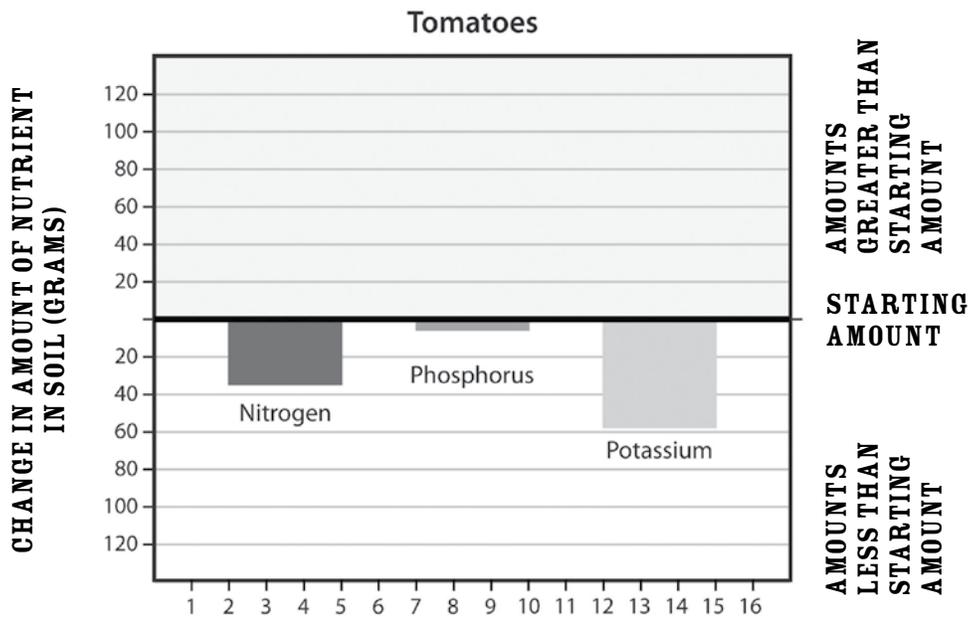
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, M

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

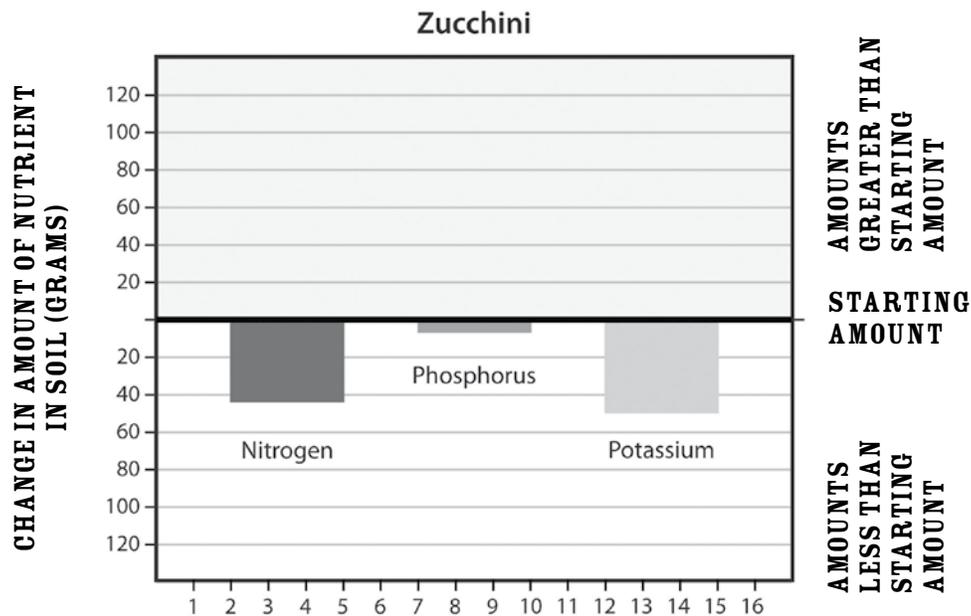
There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



MASTER 4.2, N

HOW DO PLANTS AFFECT THE SOIL?



The starting amount is the amount of the nutrient in the soil before plants grew there.

Use the information on the graph to fill in the blanks in the following sentences. State whether there was more, less, or the same amount of nutrient in the soil.

There was _____ nitrogen in the soil after the plants grew.

There was _____ phosphorus in the soil after the plants grew.

There was _____ potassium in the soil after the plants grew.



8. Ask for volunteers to read the information in the chart on Master 4.3 (page 43) aloud to the class. Ask the students, "Can you draw a conclusion about what happens to plants when they don't get enough of a specific nutrient?" (Crops don't grow well and aren't healthy when they are missing nutrients.)
9. Continue the discussion by asking the students if they think there is anything that can be done to put nutrients back into the soil. Use the following information to guide the discussion:
 - ▶ One way to replace the nutrients that come out of the soils is to use fertilizers. Fertilizers add nutrients back to the soil.
 - ▶ The main nutrients in most fertilizers are nitrogen, phosphorus, and potassium. Different types of fertilizers have different amounts of each of these nutrients.
 - ▶ Fertilizer is not plant "food." This is not a scientifically accurate analogy, even though the term gets used this way in some popular media. A more appropriate analogy would be vitamins that humans take. People may take vitamins to replace nutrients that they don't always get in their food.
10. Ask the students to consider a scenario in which a farmer plants a crop in soil that is low in important nutrients. His plants aren't doing very well so he puts fertilizer on the ground. Ask the students to predict what effect this might have on the plants. (The crop plants would get healthier after the fertilizer is applied to the land. Plants don't distinguish between the nutrients that are natural in the soil and the ones added as fertilizer. Soils may be thought of as a "nutrient bank" that holds a limited amount of nutrients. Fertilizers put more "money" in the bank by restoring nutrient balance to farmed soils. The farmer needs to be careful not to use too much fertilizer. If the amount of a nutrient is too high, plants may not grow well.)
11. Explain to the students that farmers and gardeners often do soil tests to find out which nutrients are present in the soil and what may be lacking. Ask the students to think of reasons why a soil test is helpful to farmers and gardeners. (A soil test gives the farmer or gardener specific information about whether the soil has low levels or high levels of certain nutrients, such as nitrogen, potassium, and phosphorus. This gives the farmer or gardener information that will help them make decisions about whether they need to use fertilizer, how much fertilizer to use, and what kind of fertilizer to use. It can also help them make decisions about which crop plants may grow best in their soil.)



MASTER 4.3

NUTRIENTS AND PLANT HEALTH

NUTRIENT	WHY DO PLANTS NEED THIS NUTRIENT?	WHAT HAPPENS IF THERE IS NOT ENOUGH OF THE NUTRIENT?
Nitrogen	Plants need nitrogen to grow and for photosynthesis.	When there is not enough nitrogen, the leaves of the plant turn yellow. The plant may be small and spindly.
Phosphorus	Phosphorus is important for seed germination and for use of water by the plant.	When there is not enough phosphorus, plants may grow slowly and are more likely to be affected by disease or water shortage. The leaves and stems may look purple or red.
Potassium	Potassium is important for water use in plants and for strong stalks.	When there is not enough potassium, the edges of leaves may be yellow or brown. The stems are weak and break easily. The roots do not form well.



Post Assessment

Draw or write down your answers.

1. What are the parts of a plant?
2. What does a plant need to grow?
3. Match the parts of the plant with the correct definition:

Plant Parts:

1. Root
2. Stem
3. Leaf
4. Flower
5. Fruit
6. Seed

Definitions:

- A. Part of the plant that supports the leaves, flowers, and fruits.
- B. Food that grows on the plant.
- C. Found inside of fruit, it can be used to make new fruit plants.
- D. Typically, green in color and grow off the stem of a plant.
- E. Connected to the plant and grows under the soil.
- F. Part of a plant that is often brightly colored.



Activity 2: Answer Key (from page 27)

7. After the students conclude that the soil contains fewer nutrients after plants grow, ask them to consider the following questions:
 - ▶ What happened to the nutrients that were removed from the soil? **(The plants took the nutrients up through their roots.)**
 - ▶ Where do these nutrients go when the plants are harvested and taken away from the soil? **(The nutrients the plants take up through their roots are taken away with the plant.)**
 - ▶ If there are fewer nutrients in the soil after plants grow, and the nutrients are taken away with the harvest, what do you predict will happen the next year when someone plants a new crop in that soil? **(The plants will not be as healthy and will not grow as well. Even though the amount of nutrients removed from the soil seems very small, if plants are grown year after year in the same soil, the soil can become depleted.)**