



Plants to Soil

Lesson Plan

Overview

In this lesson, students will learn that plants and soils have a close relationship. Not only do soils provide essential nutrients for plants, but plant decomposition (breakdown) is also an important process that replenishes nutrients in soils. After growing a bean plant, students will document the decomposition process of the plant with drawings or digital photos. Students will begin to learn that materials such as nutrients (plant "vitamins") are continually shared between plants and soils.

Suggested Lesson Sequence	Please see the Greenlinks module description.
Lesson Level	Intermediate
Science Connections (Keywords in BOLD)	<ul style="list-style-type: none"> - Students will learn that plants and soils are closely connected throughout the cycle of growth and decomposition. - Students will learn that plants need nutrients to grow and that healthy plant leaves contain vitamins. - Students will learn that when plants die and drop their leaves, nutrients within the plants replenish the soil. - Students will make predictions and observations regarding nutrient cycles
Math Connections	<ul style="list-style-type: none"> - Students will draw and compare image patterns of plants as viewed from space with plants on the ground.
Technology Connections (Keywords in BOLD)	<ul style="list-style-type: none"> - Optional use of digital camera to document decomposition of bean plant. - Use of computer to view photos and satellite images of plant leaves turning from green to brown during the fall.
Human Connections (Keywords in BOLD)	<ul style="list-style-type: none"> - Students may recycle plants in school compost piles.
Lesson Assessment Tools	<ul style="list-style-type: none"> - Assessment and Standards Table (Word) - Assessment Activity Description (below) - Extensions for Authentic Assessment (below)

Materials

- Plants from "Roots and Shoots" lesson *or* Lima bean seeds, clear plastic cups, and potting soil
- Digital camera (optional)
- Art supplies (e.g. colored pencils, crayons)
- [Plants to Soil Observation Sheet \(Word\)](#)
- [Nutrient Cycling](#) activity sheet (Word)
- [Plants from Space](#) activity sheet (Word)
- Ability for students to see color photos (computer screen or projected image is preferred)

Vocabulary Words

- **Nutrient:** Minerals and vitamins that provide nourishment for living organisms to grow and development.
- **Absorption:** The process of taking something in, soaking it up.
- **Decompose:** The breaking down of animal or plant matter by various organisms such as bacteria or fungi.

Vocabulary Note: During this lesson, students will read passages of text on the activity sheets. Students may be unfamiliar with some of the vocabulary presented in this lesson. This is done intentionally, to build reading skills and to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about words they may be unfamiliar with that occur in the readings.

Procedure

I. Assessing Prior Knowledge

To begin the lesson, engage students in a conversation about plants and their leaves. Introduce the idea that plant leaves are nutritious and contain vitamins (nutrients). Questions to ask during this discussion may include: Do you eat any leaves? (*Common examples include lettuce, spinach, other salad greens, sprouts.*) Why do you eat leaves like lettuce and spinach? (*Leaves provide the body with vitamins to help it grow; leafy green vegetables contain large amounts of Vitamin C and E.*) Where do these vitamins come from? (*They come primarily from the soil, absorbed through plant roots.*) Now, ask students to predict what happens to the vitamins in a plant (specifically its leaves) after the plant dies or after the leaves drop to the ground. Make a list of students' ideas on the board or chart paper.

II. Contextual Preparation

Growing bean plants: Teachers may use bean plants grown in the [Roots and Shoots](#) lesson or grow plants from lima bean seeds in small cups. To grow lima beans plants from seeds, add potting soil to a small clear plastic cup, and plant a lima bean seed about 1 centimeter under the soil, close to the edge of the cup. Water regularly to keep the soil moist and place near a window if possible. After a few days, the seeds will germinate.

As the plants are growing, remind students to think about how the plants are getting the water they need (through their roots). Introduce the idea that the plants are also receiving vitamins, or nutrients, from the soil -- through their roots -- as they grow.

III. Student Activity

1. After the plants are about 5-10 cm tall, stop watering them. Have students take a digital photo or draw a picture of the healthy plant to begin the process of documenting their observations of the process of plant decomposition. Teachers may distribute the [Plants to Soil Observation Sheet](#) for students to record observations if desired. (The photos or scanned images of drawings may be uploaded to a computer for closer observation.)

Eventually, the plant will wilt, fall over, and begin to decompose into the soil. *(This may be difficult for young students who become attached to their plants. Therefore, the teacher may choose to grow plants specifically designed for this activity and let the students know that they are doing an "experiment" to see what happens when the plant is no longer living.)* Have the students document the decomposition process by having them continue to draw colored sketches and/or take digital photographs of the plant at regular intervals. Point out that as the plant decomposes, it becomes more and more "blended" with the soil. Discuss with the students that the nutrients in the decomposing plant are being returned to the soil as various organisms (i.e. bacteria and fungi) feed on and break down the dead plant material. This is an important process in the cycle of life as these nutrients may eventually be used again by new plants.

Teacher information: The two main nutrients being cycled through plant decomposition are nitrogen and phosphorous. Carbon is also cycled to a lesser degree, but new plants get most of their carbon from the air. Note: To speed the decomposition process, it helps to: 1) keep the cup in a warm place, 2) place the dead plant in direct contact with the soil, and 3) keep the soil slightly moist.

2. As a part of this lesson, the students should complete the [Nutrient Recycling](#) and [Plants from Space](#) activity sheets. These activities contain color photos that are best viewed on a computer or projection screen. The image in Plants from Space is of the New England region of the United States. The intent of these activities is to connect the decomposition experiment to wider natural processes on a global scale. Students will see that what occurred with the bean plant happens on larger scales too (plant browning and decomposition happens to

trees, whole forests/croplands/grasslands, and across broad geographic regions of the world).

Answers to activity sheets:

Nutrient Recycling.

1. Lettuce, spinach, sprouts, etc.
2. Answers will vary. Nutrients may go to animals (if they eat the leaves) or to the soil (if the leaves fall).
3. The green tree on the left has more nutrients in its leaves.
4. Answers will vary. Students will likely notice that some bugs eat dead leaves, and may note that the bugs are in the soil, where the nutrients ultimately end up.
5. Answers will vary.
6. Answers will vary.

Plants from Space

1. United States and Canada (point out on map of the New England region)
2. Summer; green = plant leaves; blue = ocean; white = clouds
3. Fall
4. Clouds are in different locations; brown/orange; plant leaves turning color
5. September
6. October; leaves will soon be dropping

3. Using the students' observations and drawings (or photos) from the decomposition experiment, as well as the photos and satellite images from the activity sheets, the teacher should lead the class in a discussion that includes references to the students' original predictions and prior knowledge about plant decomposition. Discussion questions might include the following.

Questions for Class Discussion

1. What did you observe from your drawings or digital photos of the bean plant after it died?
(Answers will vary; although students should be able to share observations of plants wilting, turning yellow/brown, and decomposing in the soil)
2. What do you think happens to bean plants after they are no longer alive?
(The bean plants eventually die and decompose, providing nutrients to the soil. Small animals or organisms in the soil help to decompose the plant. Nutrients can be absorbed by new plants).
3. When you looked at the satellite photos, what did you observe happening to green plants during the fall?

(The green vegetation on a large scale turned brown/orange in the fall. This indicates that green leaves or plants were decomposing and providing nutrients to the soil.)

IV. Assessment

Students should understand that when plants decompose, they return nutrients to the soil. Their understanding will be confirmed through their participation in discussion and documentation of plant decomposition through digital photos or drawings, as well as by their responses on the activity sheets.

Extensions for Authentic Assessment

1. Composting at School: To engage students in learning more about plant decomposition, start a compost pile on the school playground. Using plant-based food scraps from the cafeteria or grass clippings and other organic matter from the playground, start a pile in a sunny location. Add a thin layer of soil and leaves to the top of the pile. Make sure the pile doesn't dry out and turn with a shovel every week or two. This could also be done on a smaller scale using a small, aerated bucket in the classroom (if in the classroom, several earthworms should be added to the compost to help with the decomposition process). Students can record the progress of the plant composting with a digital camera or drawings. Discuss the benefits of composting in your own yard, reminding students about the plant nutrients. Where would the nutrients from the plant scraps go if they didn't go into the compost? *(Probably into the city dump, or down the drain and into a sewage treatment plant.)*



2. For students to see direct evidence of how materials (such as nutrients) may be carried back into a plant, do a "carnation coloring" experiment. Purchase two or three fresh white carnations and place them in separate, clear cups. Next, add food coloring to the water (use a different color for each carnation). Within a few days, the white carnation will begin to show the color of the food coloring in the water. Discuss how the food coloring is similar to nutrients in that they are both brought in to the plant by being absorbed.



3. Explain that there are many ways in which plant nutrients can be returned to the soil. In some cases, insects help to speed this process. Tropical insects are especially creative in how they use leaves and the nutrients contained within. The photos below show "leaf cutter ants" carrying pieces of freshly cut green leaves from the tree to their nests. When back in

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their nests, they make a bed of leaves. As the leaves begin to decompose and release their nutrients, a fungus begins to grow on them.



The ants then use this fungus to eat--feeding the entire colony. So, these amazing ants are actually tiny fungus farmers! Share this story with your students, and write a class story about a day in the life of a leaf cutter ant. Also, have the students think about how the nutrients in the plant leaves move from one living thing to another (e.g. leaf > fungus > ant > soil > plant roots > another leaf), and draw a picture of this cycle on the board.

Remind the students that leaf cutter ants are acting to return nutrients to the soil, as with the leaves that fall to the ground on their own.

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