



# Roots of the World

## Lesson Plan

### Overview

In this lesson, students will learn that plants are more than meets the eye—they consist not only of shoots (stems, trunks, and leaves), but also of all-important roots. Students will first learn about different types of roots by observing and comparing photographs. Then, they will observe the growth of a lima bean plant and document changes in root and shoot size by creating scaled drawings or taking digital photos. By the end of the lesson, students will have an understanding of the important shapes and functions of the often “unseen side” of plants—their roots.

Suggested Lesson Sequence	Please see the <a href="#">Foundations: Plants and Soils</a> module description.
Lesson Level	<a href="#">Entry</a>
Science Connections (Keywords in <b>BOLD</b> )	<ul style="list-style-type: none"> <li>• Students will learn about <b>variations in root system shapes and sizes</b></li> <li>• Students will learn that plant roots are essential for <b>anchoring plants</b> as well as <b>water and nutrient absorption</b></li> </ul>
Math Connections	<ul style="list-style-type: none"> <li>• Students will estimate the time and length of plant growth.</li> <li>• Students will draw root growth to scale.</li> </ul>
Technology Connections	<ul style="list-style-type: none"> <li>• Students may use a digital camera to document root growth.</li> <li>• Students may use a computer to view root systems and document plant growth.</li> </ul>
Lesson Assessment Tools	<ul style="list-style-type: none"> <li>• Assessment and Standards Table (<a href="#">Word</a>)</li> <li>• <a href="#">Assessment Activity Description (below)</a></li> <li>• <a href="#">Authentic Assessments (below)</a></li> </ul>

### Materials

- Interactive slide show ([Powerpoint](#))
- Lima bean seeds
- Small clear plastic cups

- Potting soil
- Digital camera (optional)
- Plant Growth Chart ([Word](#))
- Art supplies (e.g. paper, colored pencils, crayons)

## Vocabulary Words

Note: In addition to the words defined below, students will likely be unfamiliar with other vocabulary presented in this lesson. This is done intentionally, to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about words they may be unfamiliar with.

- **Root:** The part of a plant that absorbs water and nutrients, stabilizes the plant, and usually grows underground.
- **Shoot:** The part of a plant that grows above ground, includes stems, trunks, and leaves.
- **Nutrient:** Organic matter that provides living organisms with what is needed for growth and development.
- **Absorption:** The process of taking something in, soaking it up.
- **Anchor:** To hold in one place.
- **Estimate:** A rough calculation; an educated guess based on evidence or (non-exact) information

## Procedure

### I. Assessing Prior Knowledge

To begin the lesson, ask students to describe a plant. After several students have offered their descriptions, draw a simple picture of a plant on the board, incorporating their descriptions. It is most likely that the students will first describe the shoots, or aboveground, portion of the plant. If none of the students mention the roots of the plant, prompt them by asking a question such as, "Is there any part of a plant that we cannot see?" (You might also want to have a branch or clipping from a plant available to talk about differences between it and a complete plant.) Then, ask the students to predict what they think the root growth of a plant will look like, and draw the root portion of the plant according to their descriptions. Ask them to describe what they know about the purpose of plant roots. Make a list of student's ideas on the board or chart paper.

### II. Contextual Preparation: Roots of the World Activity

Show students the [Roots of the World](#) Photo Essay Slide Show using a computer system. Students will learn about several different kinds of roots and will match descriptions of

various kinds of roots with photos of roots. Discuss the different roots with the class, and ask the students why different plants might have developed different root systems, as seen in the photos. If necessary prompt them with questions such as the following: In what type of soil are these plants growing? Do these plants continue to grow all year long? How big are the roots? How big is the part of the plant we can see above ground?

### III. Student Activities - Planting and Observing

1. In the next portion of this lesson, students will grow lima bean plants and observe and record root and shoot growth over the next two or three weeks. Present the seeds to the class, and tell them that they will be growing plants of their own. Ask the following types of questions of the class:

What do you think the root growth of a lima bean seed will look like?

How fast do think the roots will grow?

How long do you think the root will be?

How high do you think the green shoot will be?

Why do you think plants grow roots?

Do you think the roots will be bigger or smaller than the shoots?

2. Demonstrate how to plant the seeds and then have students plant their own. Students may work alone, in pairs, or small groups. To begin, add potting soil to a small plastic cup. Plant a lima bean seed about 1 centimeter under the soil and close to the edge of the cup. It is a good idea to plant a few extra seeds, as not all will germinate. Water regularly to keep soil moist, yet not waterlogged.

3. After a few days, the seed will germinate and students should begin to observe root and shoot growth. Use the [Plant Growth Chart](#) to document growth. Have students take digital photos of their plants, or if a camera is not available, have students draw the growth they observe (The use of small pieces of graph paper that can be glued to the growth chart will help students to keep their drawings to scale). If photos are taken - either print them out and glue to growth chart or upload the photos to the computer for observation.

Note: Teachers may want to save the bean plants, as they will be used in the [Plants to Soil](#) lesson.

### IV. Assessment

Students should understand that roots provide an anchor for plants in the soil and a means for plants to absorb water and nutrients. This will be demonstrated by their discussion and documentation of plant growth through digital photos or drawings. Students should also recognize that even though they can usually only see the shoots of plants, there is a very large

amount of plant material that cannot be seen underground - roots - that is vital to the survival of the plant.

### Questions for Class Discussion and Assessment

1. Why do you think plants grow roots?

*(Roots grow to provide an "anchor" for plants in the soil. Roots are also essential for water and nutrient uptake in the soil. Nutrients are like "vitamins" for the plants.)*

2. Compare the sizes of the parts of the plant that are beneath soil (the roots) with the parts of the plant above the soil. Why do you think the roots spread in many directions?

*(Even though we cannot usually see them, roots are often more extensive than the shoots of a plant. This is partly because the roots need to spread out broadly in the soil to absorb water and nutrients, and depending on the plant and the soil, to provide stability for the growing plant.)*

3. Why might some plants want deep tap roots, but other plants might want shallower fan roots?

*(Deep tap roots can access deeper water, but shallow fan roots can access more water and nutrients near the surface if the water table is shallow enough.)*

### **Lesson Extensions for Authentic Assessment**

1. To demonstrate how roots absorb water and nutrients, teachers can involve students in a kinesthetic activity. First, place several small cups of water and several pieces of nutritious food (or pictures of nutritious food) to represent nutrients around the room. The teacher, representing the stem and leaves of the plant, should then stand in the front of the room. Students, representing the root growth, should one-by-one connect to the teacher and then to each other by holding each other with one hand. (Ideally, students should spread out like a fan from the teacher. However, it may be necessary for students to form a "tap root" in order to reach a far-away cup of water or nutrient source). Using the second hand to represent root hairs, students will grab hold of the water or nutrients and pass them to the "teacher plant." The class should then discuss how this activity represents how roots absorb water and nutrients in soil.



2. Lead a class discussion around the fact that some plants have special root systems that connect many shoots together. One example of such a plant is the



aspen tree grove. Did you know that aspen tree groves have been shown to be one of the largest organisms in the world? The reason is that one aspen grove spanning a large area can be entirely connected by the same root system. (As a result, the genetic makeup (DNA) of one aspen shoot (tree) is often exactly the same as another aspen shoot (tree) hundreds of meters away!) Share this story with your students, and have them draw an

aspen grove so that the above-ground and interconnected below-ground portions can be seen. Why might it be advantageous to have such a root system? One reason is that new "shoots" can be easily produced without the need for producing seeds. Another reason is that if water dries out in one portion of the grove, the root system is extensive enough to locate water for the entire grove. Finally, such a root system allows aspen to regenerate quickly after fires, because their roots are protected from the heat of the fire by being safely tucked underground.