

Lesson A2–2

Understanding Root Anatomy

Unit A. Horticultural Science

Problem Area 2. Plant Anatomy and Physiology

Lesson 2. Understanding Root Anatomy

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: II: Address taxonomic or other classifications to explain basic plant anatomy and physiology.

Benchmark: II-A: Examine unique plant properties to identify/describe functional difference in plant structures including roots, stems, flowers, leaves and fruit.

Performance Standard: 1. Identify plant structures (e.g., seeds). 2. Describe physiological functions of plants. 3. Describe germination process and conditions. 4. Explain the processes of photosynthesis and respiration.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. List the functions of roots in plants.
2. Identify the parts of a root.
3. Identify the two major types of root systems.
4. Recognize a healthy root system.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003.

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2000.

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheet

Small, rootbound plant(s) from store or greenhouse. Recommended: Spider Plant or Wandering Jew

Stereoscopic Microscope or Quality Hand Lens

Terms. The following terms are presented in this lesson (shown in bold italics):

Apical meristem

Epidermis

Fibrous root system

Primary root

Root cap

Root hairs

Secondary roots

Taproot system

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Begin the lesson by knocking a plant which has been growing for several weeks in a small container (and is rootbound) out of its pot. Students love to see and perform this simple act.

Ask students to make observations about what they see with the naked eye. Start a discussion by asking questions such as: How is the soil being held in place? What can you see in the soil and on the roots? If you have enough plants, break the students into groups and give each group a plant to knock out and observe. Use hand lenses or stereoscopic microscopes to observe roots closely. You may ask students to draw a picture of what they see. Ask students why the roots are so hairy.

Summary of Content and Teaching Strategies

Objective 1: List the functions of roots in plants.

Anticipated Problem: What are the functions of a plant's roots?

- I. A plant's health is very closely tied to its roots. When roots are weak or diseased, the whole plant has difficulties. The roots need to be constantly growing in order to stay healthy. This is one reason that a plant growing in one pot for a long time tends to become rootbound. The following are functions of the root system.
 - A. The roots must absorb all of the water and minerals that a plant needs to live.
 - B. The root must anchor the plant to the ground and support the above ground part of the plant.
 - C. The roots store food that has been made through photosynthesis. This food can be used later when a plant needs it to grow or survive.

Many techniques can be used to help students master this objective. Students should use a textbook to help understand the purpose of a root. TM: A2–2A can be used to highlight the information for the students.

Objective 2: Identify the parts of a root.

Anticipated Problem: What are the parts of a root?

- II. When a plant seed germinates, the first structure to emerge from the seed is a root.
 - A. This root becomes the **primary root** and on some plants the most important root in the whole root system.
 - B. Other roots eventually branch out from the primary root. These are called **secondary roots**.
 - C. At the tip of the root, there is an area where new cells develop, called the **apical meristem**. The apical meristem is easily damaged and so it has a **root cap** over the top of it to protect it from damage as it grows through the large and sometimes coarse soil particles.
 - D. The surface of the root is covered with a skin of cells called the **epidermis**. This epidermis is where the water and minerals enter the root through osmosis and diffusion. The larger the surface area of the epidermis, the better able the plant is to bring in water and minerals. So, the epidermis cells begin to elongate and grow hairlike projections. These projections, called **root hairs**, greatly increase the surface area of the root and allow much more water and minerals to enter the plant.

Many techniques can be used to help students master this objective. Students should use a textbook to help understand the parts of a root.

Objective 3: Identify the two major types of root systems.

Anticipated Problem: What are the two types of root system?

- III. Plants root systems are organized in two basic ways. The two ways have a lot to do with primary and secondary roots.
 - A. A root system which is composed of one main primary root and many secondary roots branching off of the primary root is called a **taproot system**.
 - B. A system which has no dominant primary root but is made of many primary and secondary roots of similar size is called a **fibrous root system**.

Many techniques can be used to help students master this objective. Students should use a textbook to help understand the two types of systems. Plants with both types of root systems can be shown to the students.

Objective 4: Recognize a healthy root system.

Anticipated Problem: What does a healthy root system look like?

- IV. A healthy root system is white or nearly white in color and smells fresh. If roots are black, brown, or dark orange and smell rotten or sour, the root system is having some problems. Although a plant growing outside has a majority of roots in only the top two feet of soil, a plant in a pot should have its roots evenly dispersed throughout the soil in the pot. Watering a plant properly is one of the most important ways to keep the root system healthy. Proper watering for most plants involves growing the plants in pots with proper drainage holes in the bottom of the pot. The pot is soaked with water until it is dripping out of the drainage holes. This encourages roots to grow through the entire pot. The plant's soil is usually allowed to dry slightly before watering again. If plants have adequate drainage, over-watering of plants is not a matter of *how much* water, but of *how often* watering occurs.

Many techniques can be used to help students master this objective. Students should use a textbook to help understand the characteristics of a healthy root. Expand on the things that can be done to keep a root system healthy in a class discussion with the students.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain content associated with each objective. Ask students to distinguish between the different root systems and identify root parts. Student responses can be used to determine which objectives need to be reviewed or repeated.

Application. Use LS: A2–2A to help students apply their knowledge of the objectives.

Evaluation. Evaluation should be based on student comprehension of the learning objectives. This can be determined using the attached sample written test.

Answers to Sample Test:

Part One: Matching

1. b 2. d 3. c 4. a

Part Two: Completion

primary root
taproot system
fibrous root system
secondary root

Part Three: Short Answer

1. a) Roots should be white.
b) Roots should smell fresh.
c) Roots should be evenly dispersed throughout soil.
2. a) Storage of food
b) Absorption of water and minerals
c) Anchorage and/or support of the plant

Test

Lesson A2-2: Understanding Root Anatomy

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|--------------------|--------------|
| a. apical meristem | c. root cap |
| b. epidermis | d. root hair |

- _____ 1. Cells that make up the skin of the root.
- _____ 2. These increase the surface area of the root.
- _____ 3. This protects the tip of the root.
- _____ 4. This is where new cells divide in the root.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. The first root to come out of a seed is called the _____.
2. A root system which has one large primary root and many secondary roots branching from that root is called a _____.
3. A root system in which all of the roots are about the same size is called a _____.
4. The root which branches off of a primary root is called a _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. Name three characteristics of a healthy root system.
 - a.
 - b.
 - c.

Name three functions of roots.

a.

b.

c.

FUNCTION OF ROOTS

- **Absorption of Water and Minerals**
- **Anchor plant to the ground**
- **Storage of food**

