Lesson 4.2 – The Radicle Root

Preface

As simple as plants appear to be, each major part has very specialized anatomical features and physiological processes. Lesson 4.1 Cells: Life’s Smallest Units introduced students to plant cell anatomy and physiology. Lesson 4.2 The Radicle Root will build on previous knowledge in order to aid students in learning about each major part of a plant through exploring specific functions that plant tissues perform.

Lesson 4.2 The Radicle Root is a lesson designed to ensure students have an understanding of the four major parts of a plant, such as roots, stems, leaves, and flowers, and the function each respective part contributes. From this brief introduction, specific root structures and processes are examined. Students will learn the anatomical features of the root and how the cells, which make up those features, are different from one another.

SAE Connections

Many commercial crops are harvested for the value of their roots, such as sugar beets, sweet potatoes, and carrots. Production of root crops provides students many Supervised Agricultural Experience entrepreneurship, placement, or research opportunities.

Below are some examples of SAE activities connected to this lesson of study:

- Produce root crops for retail sales at a roadside stand or farmer’s market.
- Work with local university crop Extension Agents on producing research varieties of root crops.
- Research production and management strategies of root crops in your local area.
- Work for local agricultural producers of root crops in harvesting and marketing commercial crops.

For more information regarding opportunities related to a Supervised Agricultural Experience, view the webpage at the following URL:
http://wwwffaorg/indexcfm?method=c_programs.SAE

FFA Connections

This lesson will provide conceptual and procedural knowledge required for participation in the following FFA activities:

- **Agricultural Proficiency**
  - Agricultural Sales
Specialty Crop Production  
Vegetable Production

For more information about the National FFA Organization, visit the following website: [http://www.ffa.org/](http://www.ffa.org/).

**LifeKnowledge Connections**

This lesson provides LifeKnowledge® Connections to Precept D1 - “Live with integrity” and D2 – “Accurately assess my values”.

Strong personal values and integrity create a strong foundation for personal development and success just as roots are essential for anchoring the plant in the soil. Help students take inventory of their personal values to ensure they are anchored firmly in life.

A variation of “Show Me What You Know” E-Moment® is incorporated in Activity 4.2.1 Show Me What You Know about Plant Parts as an assessment strategy to check for students’ previous knowledge and possible misconceptions related to major plant parts and functions.

For more about LifeKnowledge® and E-Moments® review the information found at the following URL: [http://www.ffa.org/ageducators/lifeknowledge/index.html](http://www.ffa.org/ageducators/lifeknowledge/index.html).

**Concepts**

1. The four major parts of a plant are the root, stem, leaves, and flower; and their functions are vital for plant health and growth.

2. The root has specific anatomical features responsible for anchoring the plant in the soil.

3. Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients.

4. Specialized plant cells have unique anatomical features, such as a root hair that serve very specific functions.

5. Plants use the process of osmosis for the uptake of water and dissolved nutrients required for plant growth.

6. Water uptake through plant roots is influenced by the turgidity of plant tissues.

**Standards and Benchmarks Addressed**

*AFNR Career Cluster – Plant Systems Career Pathway Content Standard*

Lesson 4.2 will address parts of the following performance elements:

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.
National Science Education Standards

Unifying Concepts and Processes: As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- Form and function

Life Science – Content Standard C: As a result of their activities in grades 9-12, all students should develop understanding of

- The cell

Standards for the English Language Arts

Standard 12

Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

Performance Objectives

It is expected that students will

- Identify the four major parts of plant structure.
- Describe the function of the major plant parts.
- Examine a root structure and sketch representations of the structural form for a root.
- Examine cell differentiation as it relates to root cells.
- Conduct an experiment to simulate the osmosis process of plant root hairs.

Critical Thinking and Application Extensions

Explanation

1. Students will develop an extension service bulletin. The bulletin will include an emphasis on root health and will be designed as an information pamphlet used by home gardeners to ensure healthy roots are maintained in their plants.

Interpretation

2. Students will design and conduct an experiment to demonstrate the concept of osmosis between soil water and root cells. This experiment will be entered into the FFA Agriscience Fair.

Application

3. Students will create a PowerPoint® presentation of how the root functions, which includes details related to each type of root structure and present it to a middle school science class.

Essential Questions

1. What are the four major parts of a plant?
2. What are three functions for each of the major plant parts?
3. What is a root system?
4. What is a root hair?
5. How do roots grow?
6. What are the three kinds of root systems?
7. How does a root absorb water and nutrients from the soil?
8. What part of the root absorbs water from the soil?
9. What are differentiated cells?
10. What are turgid cells and why are they important to plant life?
11. How is knowledge about root anatomy and physiology important in the management of plants?

Key Terms

<table>
<thead>
<tr>
<th>Absorption</th>
<th>Biennial</th>
<th>Bud</th>
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<tbody>
<tr>
<td>The intake of water, gases, nutrients or other substances by plants.</td>
<td>A plant that lives for two years and then dies.</td>
<td>A protuberance containing miniature leaves or flowers, located terminally or laterally on a stem.</td>
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<thead>
<tr>
<th>Cambium</th>
<th>Cell</th>
<th>Cortex</th>
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<td>The actively growing cells between the bark and the wood in a tree or shrub. They give rise to secondary xylem and phloem of dicotyledonous stems.</td>
<td>The ultimate functional unit of an organic structure, plant, or animal. It consists of a microscopic mass of protoplasm which includes a nucleus surrounded by a membrane. In most plants, it is surrounded by a cell wall.</td>
<td>The outer layer or region of any organ.</td>
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<thead>
<tr>
<th>Differentiation</th>
<th>Epidermis</th>
<th>Fibrous Root System</th>
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<td>The development or growth of a cell, organ, or immature organism into a mature organism.</td>
<td>The cellular layer of an organism; the outer skin.</td>
<td>A root system that is comprised of profusely branched roots with many lateral rootlets.</td>
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<tr>
<td><strong>Flower</strong></td>
<td><strong>Leaf</strong></td>
<td><strong>Membrane</strong></td>
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<td>The reproductive structure of a seed-bearing plant, consisting of the male and/or female organs that are surrounded by one or two series of outer coverings.</td>
<td>A flattened outgrowth from a plant stem, varying in size and shape, usually green, which is concerned primarily with the manufacture of carbohydrates by photosynthesis.</td>
<td>A thin, flexible sheet of vegetable or animal tissue; the thin protoplasmic tissue connecting, covering, or lining a structure, such as a cell of a plant or animal.</td>
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<tr>
<th><strong>Meristem</strong></th>
<th><strong>Osmosis</strong></th>
<th><strong>Perennial</strong></th>
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<td>Plant tissue capable of cell division and therefore responsible for growth.</td>
<td>The flow of a fluid through a semi permeable membrane separating two solutions, which permits the passage of the solvent but not the dissolved substance. The liquid will flow from a weaker to a stronger solution, thus tending to equalize concentrations.</td>
<td>A plant that lives for more than two years.</td>
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<tr>
<th><strong>Phloem</strong></th>
<th><strong>Primary Root</strong></th>
<th><strong>Root Cap</strong></th>
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<td>Inner bark; the principle tissue concerned with the translocation of elaborated food produced in the leaves, or other areas, downward in the branches, stems, and roots.</td>
<td>The main descending axis of a plant; the pole of the embryo opposite the shoot.</td>
<td>The extreme tip of the root consisting of a group of cells that slough off and are replaced as the tip moves through the soil. It protects the growing region of the root.</td>
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<tr>
<th><strong>Root Crops</strong></th>
<th><strong>Root Hair</strong></th>
<th><strong>Secondary Root</strong></th>
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<td>Any of a number of field and garden crops whose underground roots are used as food for people and animals, as turnips, beets, carrots, and sweet potatoes.</td>
<td>A hair like growth on an epidermal cell of the root. It absorbs water and mineral nutrients for the plant.</td>
<td>A lateral branch of a primary or main root.</td>
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### Stem
Stalk, trunk, branch of a plant. Can be vertical or horizontal.

### Taproot
The primary descending root, usually conical, of a plant from which lateral branching roots may develop; e.g., as in carrots and alfalfa.

### Turgid
Swollen, or tightly drawn, said of a membrane or covering expanded by pressure from within; e.g., growing plants have turgid cells.

### Turgor
The distension of the cell wall and protoplasmic layer of plants by fluids. It is essential to growth.

### Vascular Tissues
The fluid-conducting tissues of a plant including both xylem (water conducting) and phloem (food-conducting) tissues.

### Wilt
The temporary or transient loss of turgidity in a plant, caused by a rate of transpiration in excess of the rate of absorption of water.

### Xylem
The “plumbing” system that conducts water and dissolved mineral up the stems from the roots.

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### Day-to-Day Plans
**Time: 6 days**

*The teacher should refer to the Teacher Resources section for specific information on teaching this lesson, in particular, Lesson 4.2 Teacher Notes, Plant Glossary, Lesson 4.2 Materials List, and other support materials.*

#### Day 1:
- The teacher will present **Concepts, Performance Objectives, Key Terms**, and **Essential Questions** in order to provide a lesson overview.
- The teacher will provide students with a copy of **Activity 4.2.1 Show Me What You Know about Plant Parts**.
- Students will work individually to complete **Activity 4.2.1 Show Me What You Know about Plant Parts**.
- The teacher will provide students **Presentation Notes** pages to be used throughout the presentation to record notes and reflections. These pages are to be added to the *Agriscience Notebook*.
- The teacher will present PowerPoint® **Major Parts of the Plant**.
- Students will take notes using the **Presentation Notes** pages provided by the teacher.
- Students will complete the Conclusion questions for **Activity 4.2.1 Show Me What You Know about Plant Parts**.

#### Day 2:
• The teacher will review major plant parts discussed from the previous day.
• The teacher will provide students additional Presentation Notes pages as needed for use throughout the presentation to record notes and reflections.
• The teacher will present PowerPoint® Exploring the Root in More Detail.
• Students will take notes using the Presentation Notes pages provided by the teacher.
• The teacher will provide students with a copy of Activity 4.2.2 Root Exam.
• The teacher will demonstrate proper procedures for completing the tasks included in the activity – stressing the safety procedures for the activity.
• Students will work individually to complete Activity 4.2.2 Root Exam.

Day 3:
• The teacher will provide students with a copy of Activity 4.2.3 Root Cell Differentiation.
• Students will work in pairs to complete Activity 4.2.3 Root Cell Differentiation.

Day 4 – 5:
• The teacher will review student work completed for activities to this point in the lesson.
• The teacher will provide students additional Presentation Notes pages as needed to use throughout the presentation to record notes and reflections.
• The teacher will present PowerPoint® Root Absorption.
• Students will take notes using the Presentation Notes pages provided by the teacher.
• The teacher will provide students with a copy of Activity 4.2.4 Just Passing Through.
• Students will work in pairs to complete Activity 4.2.4 Just Passing Through.
• The teacher will lead a discussion summarizing the steps and key points of the activity.

Day 6:
• The teacher will distribute Lesson 4.2 Check for Understanding.
• Students will complete Lesson 4.2 Check for Understanding and submit for grading.
• The teacher will assess student work and understanding using Lesson 4.2 Check for Understanding Key.

Instructional Resources
PowerPoint® Presentations
   Major Parts of the Plant
   Exploring the Root in More Detail
   Root Absorption
Student Support Documents

Presentation Notes

Activity 4.2.1 Show Me What You Know about Plant Parts
Activity 4.2.2 Root Exam
Activity 4.2.3 Root Cell Differentiation
Activity 4.2.4 Just Passing Through

Teacher Resources

Lesson 4.2 Teacher Notes
Lesson 4.2 Materials List
Lesson 4.2 Check for Understanding

Answer Keys and Assessment Rubrics

Lesson 4.2 Check for Understanding Key

Reference Sources


