

Course	Agricultural Science II
Unit	Plant Science
Lesson	Germination
Estimated Time	Two 50-minute blocks
Student Outcome	

The student will be able to identify the steps in germination of monocot and dicot seeds.

Learning Objectives

1. Explain what a seed is.
2. Identify the requirements for germination.
3. Explain how a seed germinates.
4. Identify the parts of a monocot seed and explain their functions.
5. Identify the parts of a dicot seed and explain their functions.
6. Explain the processes of germination and emergence in monocot and dicot seeds.

Grade Level Expectations

SC/LO/1/B/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - ☐ PPt 1 – Monocot Seed (Corn) and Its Parts
 - ☐ PPt 2 – Dicot Seed (Bean) and Its Parts
 - ☐ PPt 3 – Stages in Germination and Emergence of a Monocot Seed (Corn)
 - ☐ PPt 4 – Stages in Germination and Emergence of a Dicot Seed (Bean)
2. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
3. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- ☐ Popcorn in a jar or bag, salted pumpkin seeds, salted sunflower seeds, roasted peanuts, a can of pinto beans, and a bag of dried beans
- ☐ Seeds to germinate on wet paper towels

Supplemental Information

1. Internet Sites
 - ☐ Monocots Versus Dicots: The Two Classes of Flowering Plants. University of California Museum of Paleontology. Accessed January 23, 2008, from <http://www.ucmp.berkeley.edu/glossary/gloss8/monocotdicot.html>.
 - ☐ Seed Germination Database. Backyard Gardner. Accessed January 23, 2008, from <http://www.backyardgardener.com/tm.html>.
2. Print
 - ☐ Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.

Interest Approach

1. Bring into class examples of seeds: popcorn in a jar or bag, salted pumpkin seeds, salted sunflower seeds, roasted peanuts, a can of pinto beans, and a bag of dried beans. Discuss with students the importance of seeds as a food source. Also discuss the role of seeds in food production.
2. A few days before this lesson begins, place several seeds on wet paper towels. The number of days will depend on the kind of seeds. As seeds begin to germinate, dissect them and identify their parts.

Communicate the Learning Objectives

1. Explain what a seed is.
2. Identify the requirements for germination.
3. Explain how a seed germinates.
4. Identify the parts of a monocot seed and explain their functions.
5. Identify the parts of a dicot seed and explain their functions.
6. Explain the processes of germination and emergence in monocot and dicot seeds.

Instructor Directions	Content Outline
Objective 1 <i>Seeds are very important in providing food for the world. Seeds are the beginning of the food production process. Discuss with the class what they think a seed is and record their responses on the chalkboard.</i>	Explain what a seed is. A seed is a young embryonic plant in a dormant or resting stage with a supply of food and one or more seed coats. Basic parts include: <ol style="list-style-type: none">1. Embryo2. Food supply3. Ovary wall or seed coat (protection)
Objective 2 <i>Germination does not just happen without cause. A viable seed in the dormant or resting stage is able to begin growth only when certain environmental conditions are present.</i>	Identify the requirements for germination. <ol style="list-style-type: none">1. Favorable temperature – varies depending on crop species2. Sufficient moisture3. Air (or oxygen)4. Presence or absence of light (depending on the plant species)
Objective 3 <i>The process of germination involves several steps.</i>	Explain how a seed germinates. <ol style="list-style-type: none">1. The seed absorbs water.2. The seed's proteins are activated, which activates the enzyme system.3. The seed's root (radicle) emerges.4. The seed's plumule or embryonic shoot begins to emerge.

Instructor Directions	Content Outline
	5. Leaves form and food production via photosynthesis starts.
<p>Objective 4</p> <p><i>Monocotyledonous and dicotyledonous seeds are different in their parts and functions. Use PPt 1-2 to describe the differences.</i></p> <p><input type="checkbox"/> PPt 1 – Monocot Seed (Corn) and Its parts</p> <p><input type="checkbox"/> PPt 2 – Dicot Seed (Bean) and Its Parts</p>	<p>Identify the parts of a monocot seed and explain their functions.</p> <ol style="list-style-type: none"> 1. Seed coat – protection 2. Endosperm – a source of starch or energy (food) for the young plant during germination 3. Embryo – miniature plant containing: <ol style="list-style-type: none"> a. Cotyledon or scutelum – helps break down the starch in the endosperm for feeding the embryo b. Epicotyl – shoot above cotyledon – above ground c. Hypocotyl – part of stem below cotyledon d. Radicle – the primary root, which dies soon after the permanent roots grow; absorbs water; supports the seedling
<p>Objective 5</p> <p><i>Monocotyledonous and dicotyledonous seeds are different in their parts and functions. Use PPt 1-2 to describe the differences.</i></p> <p><input type="checkbox"/> PPt 1 – Monocot Seed (Corn) and Its parts</p> <p><input type="checkbox"/> PPt 2 – Dicot Seed (Bean) and Its Parts</p>	<p>Identify the parts of a dicot seed and explain their functions.</p> <ol style="list-style-type: none"> 1. Seed coat – protection 2. Embryo – miniature plant containing: <ol style="list-style-type: none"> a. Two cotyledons – seed leaves, food storage b. Epicotyl – first true leaves, shoot, and everything above cotyledon c. Hypocotyl – first true stem between root and first node of the stem, pulls the seed upward d. Radicle – forms the root system, absorbs water
<p>Objective 6</p> <p><i>When planning what seeds to plant, germination requirements and seed emergence need to be considered. Some dicot seeds, like peanuts and peas, have hypogeal emergence but most dicot seeds have epigeal emergence. The steps for epigeal emergence are given. Use PPt 3-4 to help illustrate the differences between monocot and dicot germination and emergence.</i></p>	<p>Explain the processes of germination and emergence in monocot and dicot seeds.</p> <ol style="list-style-type: none"> 1. Monocot – corn <ol style="list-style-type: none"> a. Seed swells as moisture is absorbed, and seed coat ruptures. b. Radicle (temporary root) grows down. c. First internode and epicotyl grow upward. d. After epicotyl emerges, new leaves form and food production starts. e. New root system develops above the first internode just beneath the soil. f. Temporary root system ceases to function and dies.

Instructor Directions	Content Outline
<p><input type="checkbox"/> PPt 3 – Stages in Germination and Emergence of a Monocot Seed (Corn)</p> <p><input type="checkbox"/> PPt 4 – Stages in Germination and Emergence of a Dicot Seed (Bean)</p>	<p>2. Dicot – bean</p> <ol style="list-style-type: none"> Seed swells as moisture is absorbed, and seed coat ruptures. Radicle grows down. Hypocotyl elongates and forms an arch that breaks the soil surface. When hypocotyl reaches light, elongation ceases and hypocotyls straightens up, pulling cotyledons out of the soil. Cotyledons turn green and manufacture food until new leaves develop. As new leaves develop, the cotyledons die, dry up, and fall off.
Application	<p>Other activities</p> <ol style="list-style-type: none"> Split open several different types of monocot and dicot seeds and identify the parts. Germinate corn and bean seeds to observe differences in their emergence. (Use a view box for this if possible.)
Closure/Summary	<p>Seeds are vital for food production. Germination will occur when a viable seed is exposed to favorable temperature, sufficient moisture, and oxygen. Monocot and dicot seed requirements for germination are the same; however, the type of emergence for each is quite different. The differences in emergence will dictate the optimum time for planting.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> False True False <p>Monocot Identification</p> <ol style="list-style-type: none"> Endosperm Cotyledon Epicotyl Hypocotyl Radicle Seed coat Embryo <p>Dicot Identification</p> <ol style="list-style-type: none"> Epicotyl

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> 12. Hypocotyl 13. Radicle 14. Cotyledon 15. Seed coat 16. Embryo