Lesson C4–9

Propagating Plants Sexually

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 4. Identifying Basic Principles of Plant Science

Lesson 9. Propagating Plants Sexually

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: **I:** Apply principles of anatomy and physiology to produce and manage plants in both a domesticated and natural environment.

Benchmark: **I-C:** Explain and use basic methods for reproducing and propagating plants.

Performance Standard: **1.** Determine the role of genetics in plants. **2.** Describe he components and functions of plant reproductive parts. **3.** Identify and practice methods of asexual/sexual propagation. **4.** Describe the principles of plant micro-propagation. **5.** Apply principles and practices of biotechnology to plant propagation.

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

1. Explain sexual reproduction of plants and its importance in plant survival.
2. Explain how pollination occurs and describe the different types of pollination.
3. Explain fertilization in flowering plants.
4. Explain the structures and formation of seeds.
5. Describe the conditions for seed germination.

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. (Textbook and Activity Manual, Chapter 4)

Lee, Jasper S. and Diana L. Turner. *AgriScience,* Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 8)

Other Resources. The following resources will be useful to students and teachers:

Reiley, H. Edward and Shry, Carroll L. Jr. *Introductory Horticulture.* Albany, New York: Delmar Publishers, 1997. (Textbook and Lab Manual, Unit 6)

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2002. (Textbook and Activity Manual, Chapter 5)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheet
Flower samples
Corn and soybean seeds

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

Chromosomes
Cotyledons
Cross-pollination
Deoxyribonucleic acid (DNA)
Diploid
Disseminate
Double fertilization
Embryo
Endosperm
Fruit
Genes
Germination
Haploid
Hybrid

Pollination
Scarification
Seed
Seed coat
Self-pollination
Sexual reproduction
Stratification
Viable
Zygote

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.

Bring a couple of samples of perfect flowers, such as from a Hibiscus or a Lily plant, to class. Use them to show the students the various parts of a flower. Dissect the flower and demonstrate to students how the pollen gets from the anther to the stigma and then grows the pollen tube down through the style to fertilize the egg. Students should be able to see how the various parts of the flower interact for pollination to occur.

Summary of Content and Teaching Strategies

Objective 1: Explain sexual reproduction of plants and its importance in plant survival.

Anticipated Problem: What is sexual reproduction in plants and how is it important in the survival of plants?

I. Sexual reproduction involves flowers, fruits, and seeds.

   A. In ***sexual reproduction***, sperm carried in the pollen from the male flower fuses with the egg in the female part of the flower. Both contribute to the genetic makeup of the new plant.

   B. Each time sexual reproduction occurs, there is a recombining of genetic material. As a result, some changes will occur. Some may be beneficial and some may not. As conditions of the environment change over time, the beneficial changes in plant genetics will allow the plant to survive. As plants continue to reproduce, they pass genes onto their offspring, which enables them to survive.

Have students read the section about Sexual Reproduction on page 57 in Introduction To Plant And Soil Science And Technology text. Use the notes above to explain sexual reproduction in plants. Discuss how plants are able to gradually evolve or adapt over time as various gene combinations serve to be beneficial or detrimental to the life of plants.

Objective 2: Explain how pollination occurs and describe the different types of pollination.

Anticipated Problem: How does pollination occur and what are the different types of pollination?

II. ***Pollination*** is the transfer of pollen from the male to the female part of a plant.

A. Pollination occurs in many different ways:

1. Birds, insects, bats, and other animals are attracted to colorful, scented flowers. As they visit various flowers for food, they unintentionally pick up pollen and carry it from flower to flower.
2. Wind moves pollen from one flower to another. Plants that rely on wind generally do not produce colorful flowers with scents or nectar.

B. Pollination of plants may occur in one of two ways:

1. ***Self-pollination*** occurs when pollen from a plant pollinates a flower on the same plant.
2. ***Cross-pollination*** occurs when pollen from a plant pollinates a flower on a different plant.

C. Once pollen lands on the stigma, it grows a pollen tube down the style to the ovary. The cell within the grain of pollen divides to form two sperm nuclei, which travel down the pollen tube to the embryo sac, fertilizing the egg.

Use the notes above and TM: C4–9A to discuss how pollination occurs. Use examples of local plants to explain the difference between self-pollination and cross-pollination. Seed corn is a good example to explain how cross-pollination is carefully used to develop hybrid seed. This should serve as a good lead-in to the next objective where hybrids are discussed. Explain how self-pollination is used to develop various parent types, which are later crossed to develop desired hybrids in the seed corn industry.

Objective 3: Explain fertilization in flowering plants.

Anticipated Problem: How does fertilization occur in flowering plants?

III. Fertilization is necessary in flowering plants in order for the seed to develop.

A. Fertilization in flowering plants is different from fertilization in any other living organism. In plants, both sperm nuclei in the pollen grain are involved in fertilization, resulting in a ***double fertilization***.

1. The first fertilization occurs when one sperm fuses with the egg, resulting in a ***zygote***. The resulting seed contains genetic information from both the male and female part of the flower.
2. The second fertilization occurs when the second sperm nucleus fuses with the two nuclei in the embryo sac. This will develop into the endosperm. The ovule of the flower will become the seed.

B. When fertilization occurs and the parents are genetically different, the resulting offspring is said to be a ***hybrid***. The advantage of hybrids is that the best traits of each parent, such as more vigorous growth, insect and disease resistance, or uniformity, may be expressed in the offspring.

C. Genetic information is stored in every cell of a plant in long molecular chains made of ***Deoxyribonucleic acid (DNA)***. Segments of DNA, called ***genes***, establish the code for life processes and the appearance of a plant. The genes are arranged in a set of ***chromosomes***. Normal cells contain a double set of chromosomes and are said to be ***diploid***. Reproductive cells, sperm and egg cells, have a single set of chromosomes and are said to be ***haploid***. When fertilization occurs, the single sets of chromosomes are combined into the double set, one from each parent, resulting in traits from each parent being passed on to the offspring.

Have students read section about Fertilization on pages 58–60 in Introduction To Plant And Soil Science And Technology text. Use TM: C4–9B and the notes above to discuss how fertilization occurs in the flower. Continue using the notes to discuss genetics and the arrangement of chromosomes.

Objective 4: Explain the structures and formation of seeds.

Anticipated Problem: What is the structure of seeds and how are they formed?

IV. The function of the ***seed*** is to grow and develop into a mature plant that will produce more seeds.

A. Seeds of flowering plants have several parts.

1. The ***seed coat*** is a protective shell surrounding the embryo and endosperm. It protects the seed from drying and from physical injury. The seed coat helps in determining when conditions for ***germination*** or the beginning of growth are right.
2. The ***embryo*** is a little plant that eventually grows and develops into the mature plant. It remains dormant within the seed. It has a stem, root, and one or two seed leaves called ***cotyledons***. Monocot embryos have one seed leaf and dicot embryos have two seed leaves.
3. The ***endosperm*** is the food storage tissue in the seed, particularly in monocots. Dicots store their food in the two cotyledons. The food storage is necessary for the young seedling until it is able to manufacture its own food.

B. After fertilization, the ovary wall enlarges and forms the ***fruit***. The fruit may be fleshy or dry.

1. Fleshy fruit prevents the seeds from drying until they are mature. They also serve to help disperse the seeds. Animals are attracted to fruit, eat it with the seeds, and disperse or ***disseminate*** the seeds somewhere away from the parent plant. Examples of fleshy fruit include tomatoes, apples, pears, etc.
2. Dry fruit is found on plants such as the dandelion and maple trees. It does not depend on animals for dissemination, but may depend on wind or other methods of dissemination.

Use TM: C4–9C to show the various parts of monocot and dicot seeds. Use the notes above to assist in the discussion of the parts of seeds. Discuss the purpose of each of the major parts of a seed and why each part is necessary for the plant to survive. Finally, discuss the differences between fleshy and dry fruits. Ask students to identify various examples of each type. Discuss methods of seed dispersal and how the type of fruit plays an important role in determining how the seed will be dispersed.

Objective 5: Describe the conditions for seed germination.

Anticipated Problem: What conditions are necessary for seed germination?

V. Seeds are designed to wait for favorable conditions to begin growth. They may lay dormant for many years before conditions allow them to begin to grow.

   A. Several environmental factors play key roles in seed germination.

      1. Moisture or water is necessary for germination.
      2. Air, particularly oxygen, is required for germination.
      3. Warm temperatures, between 40 and 104 degrees F, are necessary for germination.
      4. Some plants require light or total darkness for germination.

   B. ***Stratification*** is when the seed must go through a period of cold temperatures before it will germinate.

   C. ***Scarification*** is the breaking down of the seed coat. Some seeds have such a hard, thick seed coat that they prevent the absorption of water to enable germination to occur.

   D. The germination process begins with the absorption of water. The seed swells and the embryo changes from a dormant state to an actively growing plant. The embryo draws energy from starches stored in the endosperm or cotyledons. The embryo's root emerges from the seed and develops into the primary root. Then, the stem of the embryo sprouts upward.

   E. The quality of seed used is very important in production agriculture. ***Viable***, or live, seed is important to ensure a high percentage of seed germination. Seed companies test seed to determine its germination percentage, which must be printed on the seed bag. Proper humidity and temperature during storage of the seeds help maintain seed viability.

Use TM: C4–9D to discuss the environmental factors necessary for germination to occur. Have students refer to figure 4–9 on page 62 of Introduction To Plant And Soil Science And Technology text. Discuss the process of germination as outlined in figure. Discuss the importance of stratification and scarification for some seeds. Use examples of plants that may require stratification and scarification. Complete LS: C4–9A to determine germination percentages and to see the development of seeds into seedlings during germination, and the difference between monocot and dicot seedlings.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different perspective. Questions

at the end of chapters of textbooks covering this material may also be used in the review/summary.

Application. Application may involve the following student activity using attached lab sheet:

Germination of monocot and dicot seeds—LS: C4–9A

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample test is attached.

Answers to Sample Test:

Part One: Matching

1=d, 2=a, 3=c, 4=h, 5=f, 6=b, 7=e, and 8=g

Part Two: Completion

1=pollination
2=haploid
3=cotyledons
4=embryo
5=stratification
6=cross-pollination
7=genes
8=scarification

Part Three: Short Answer

1=any 3 any order	a=moisture
	b=favorable temperature
	c=oxygen
	d=light or darkness
2=any 3 any order	a=wind
	b=birds
	c=insects
	d=bats

3=Animals are attracted to fruit, eat it with the seeds, and disperse or disseminate the seeds away from the parent plant

Sample Test Name _____

Test

Lesson C4–9: Propagating Plants Sexually

Part One: Matching

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

a. germination
b. seed coat
c. endosperm
d. zygote
e. chromosomes
f. viable
g. deoxyribonucleic acid (DNA)
h. hybrid

_____ 1. Cell produced by union of sperm and egg.

_____ 2. Growth of a new plant from a seed or the beginning of growth of the seed.

_____ 3. Stored nutritive material in seed; source of energy for the seed.

_____ 4. Offspring from genetically different parents.

_____ 5. Seed capable of germination.

_____ 6. Protective shell surrounding the embryo and endosperm of a seed.

_____ 7. Arrangement of genes; made of proteins and nucleic acid and controls cell activity.

_____ 8. Long molecular chains that store genetic information in a cell.

Part Two: Completion

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

1. _____ is the transfer of pollen from the male to the female part of a plant.
2. Reproductive cells, such as sperm and egg cells, have a single set of chromosomes and are said to be _____.
3. A plant may have one or two seed leaves, which are referred to as _____.
4. The _____ is the young immature plant found within the seed.
5. Some seeds must go through a period of cold temperatures before they will germinate. This process is referred to as _____.
6. _____ occurs when pollen from a plant pollinates a flower on a different plant.

7. Small segments of DNA, called _____, establish the code for life processes and the appearance of a plant.
8. _____ is the breaking down of the seed coat.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are three of the four environmental requirements for seed germination to occur?

   a.

   b.

   c.

2. Identify three ways or organisms that enable pollination to occur.

   a.

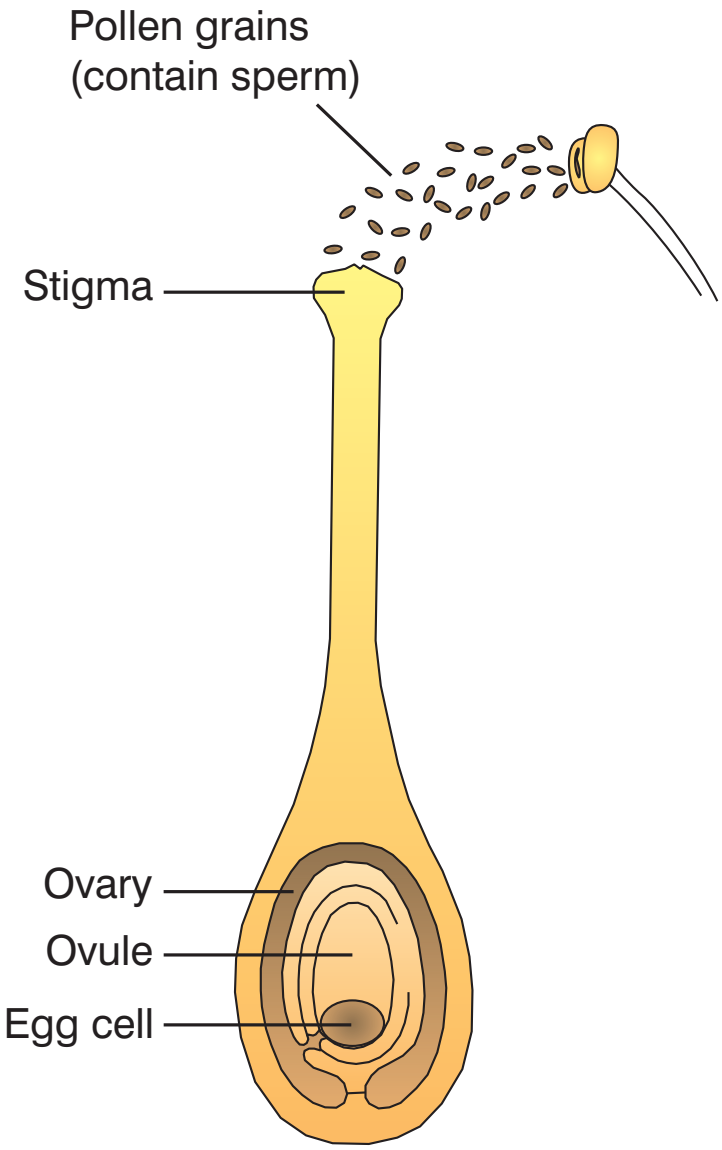
   b.

   c.

3. Explain how fleshy fruit contributes to the dissemination and/or dispersement of seeds.

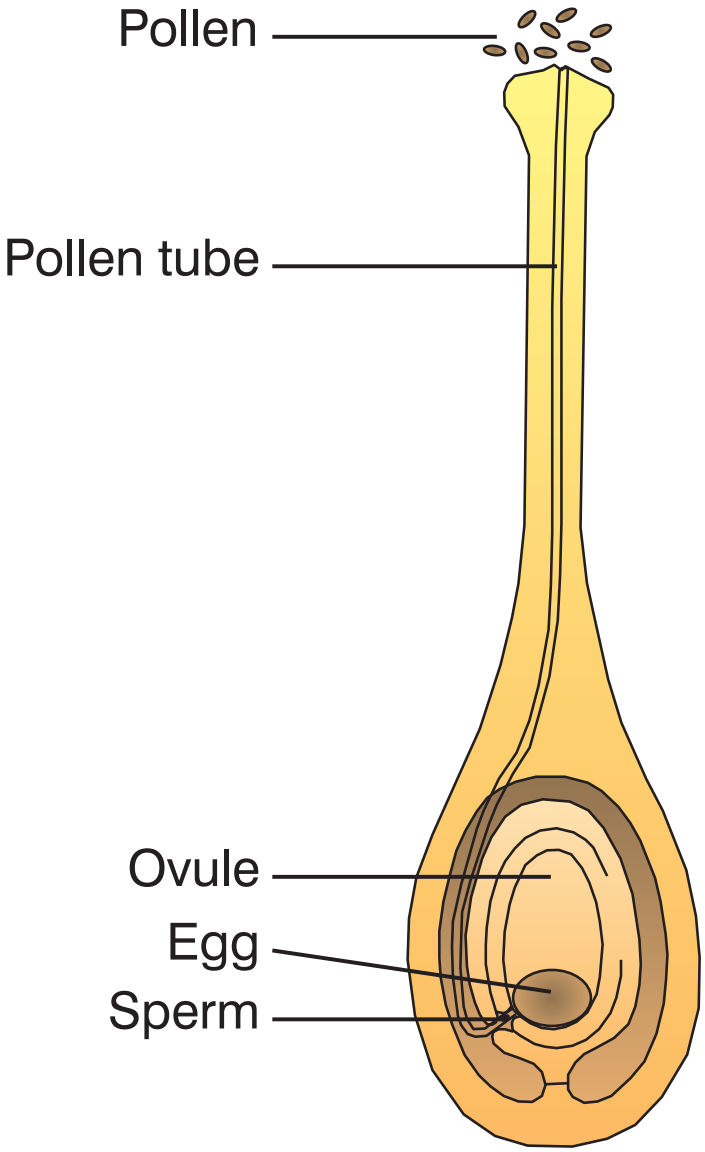
TM: C4–9A

Pollination of a Flower



POLLINATION

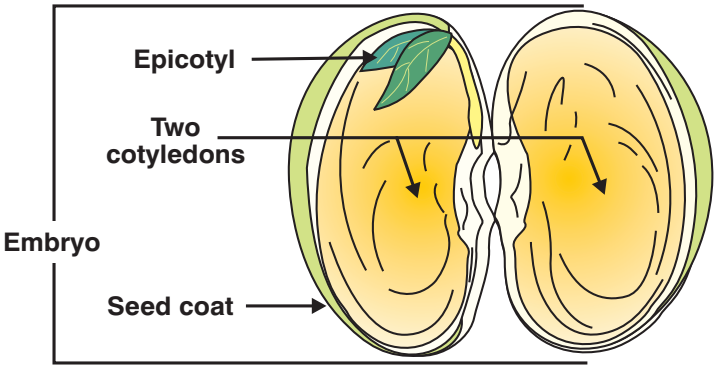
Fertilization of a Flower



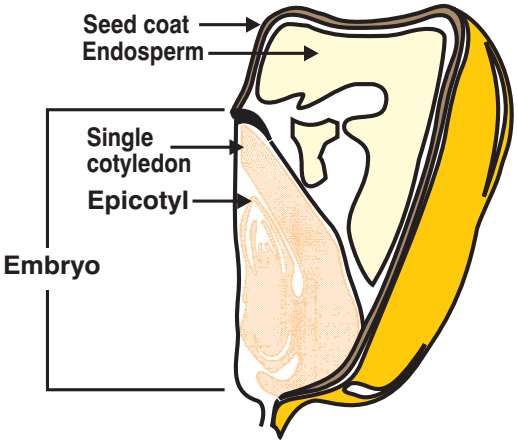
FERTILIZATION

TM: C4–9C

Parts of a Bean Seed and Corn Seed



Bean Seed



Corn Seed

TM: C4–9D

Environmental Factors Necessary for Germination

1. Moisture
2. Oxygen
3. Favorable temperatures
4. Light or darkness for some plants

Name _____

Lab Sheet

Germination of Monocot and Dicot Seeds

Purpose:

To determine the germination percentages of both monocot and dicot seeds and observe the difference in seedlings of monocots and dicots.

Materials

Pen or pencil
Corn seeds (monocot)
Bean seeds (dicot)
Flat or tray
Potting soil
Water
Introduction To Plant And Soil Science And Technology textbook

Procedure

1. Fill flat with potting soil.
2. Place 20 corn seeds ½ inch deep in the soil, evenly spaced on one end of the flat.
3. Place 20 bean seeds ½ inch deep in the soil, evenly spaced on the other end of the flat.
4. Water the flat thoroughly. It should be checked daily to determine if further watering is necessary and to observe the seedlings as they grow.
5. Label the flat with the date, name, and the seeds used.
6. Remove at least one corn seed and one bean seed each day to observe the stages of germination. Replant seed after observations are taken.

Answer the following questions.

1. How many days did it take for the corn seeds to germinate? _____

2. How many days did it take for the bean seeds to germinate? _____

3. What was the germination percentage for the corn seeds? (Divide the number of seeds that germinated by the number seeds planted.) _____

4. What was the germination percentage for the bean seeds? (Divide the number of seeds that germinated by the number seeds planted.) _____

5. Draw and label the various parts of the monocot (corn) seedling.

6. Draw and label the various parts of the dicot (soybean) seedling.

7. How are the two seedlings different from each other?

8. Which part of the seedling emerged from the seed first in the corn seed?

9. Which part of the seedling emerged from the seed first in the bean seed?

10. What environmental conditions were present that enabled the seeds to germinate?