

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Importance of Plants
<b>Estimated Time</b>	50 minutes

### Student Outcome

The student will be able to identify the importance of plants.

### Learning Objectives

1. Describe why plants are important.
2. Describe the role that plants play in the environment.
3. Identify where the common crop plant species originated.
4. Explain how plants are used.

### Grade Level Expectations

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

#### Supplies & Equipment

- Dried ear of corn used for either feed or food crop seed

#### Supplemental Information

1. Internet Sites
  - Introduction to the Story of Corn. Camp Silos, Silos and Smokestacks National Heritage Area. Accessed January 18, 2008, from <http://www.campsilos.org/mod3/index.shtml>.
  - Story of Corn Resources and Webliography. Camp Silos, Silos and Smokestacks National Heritage Area. Accessed January 18, 2008, from <http://www.campsilos.org/mod3/teachers/r2c.shtml>.
2. Print
  - Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.

## Interest Approach

Bring into the classroom a dried ear of corn that is used for either feed or food crop seed. Remove the grain from the ear and ask the class how people benefit from the grain. Explore every benefit that grain provides. Examples include food for livestock that in turn provides people more food, food for humans in many forms (canned, raw, ground, popped, etc.), stalks left in the field to protect against soil erosion, starch from the corn to be used in biodegradable plastic products, and ethanol for alternative fuels.

## Communicate the Learning Objectives

1. Describe why plants are important.
2. Describe the role that plants play in the environment.
3. Identify where the common crop plant species originated.
4. Explain how plants are used.

Instructor Directions	Content Outline
<p><b>Objective 1</b></p> <p><i>Most plants can survive on their own without any assistance from humans. However, people depend on plants every day. List examples of each type of plant.</i></p>	<p><b>Describe why plants are important.</b></p> <ol style="list-style-type: none"><li>1. Production of food crops (human and livestock)</li><li>2. Production of fiber crops</li><li>3. Beneficial to the environment</li></ol>
<p><b>Objective 2</b></p> <p><i>A common misconception about plants and their benefits is that they only provide food. Fortunately, plants do much more.</i></p>	<p><b>Describe the role that plants play in the environment.</b></p> <ol style="list-style-type: none"><li>1. Production of oxygen</li><li>2. Reservoir for carbon compounds (carbon sinks)</li><li>3. Prevention of soil erosion (windbreak)</li><li>4. Increase soil organic matter and soil quality</li><li>5. Beautification (trees and flowers)</li><li>6. Sound barriers</li><li>7. Recreational surfaces (turf)</li><li>8. Visual barriers</li></ol>
<p><b>Objective 3</b></p> <p><i>A variety of crops are produced in the U.S. and exported to many parts of the world. However, many plants originated from other countries.</i></p>	<p><b>Identify where the common crop plant species originated.</b></p> <ol style="list-style-type: none"><li>1. Corn – Mexico</li><li>2. Soybeans – China</li><li>3. Wheat – Southwestern Asia (Euphrates and Tigris Valleys)</li><li>4. Oats – Eastern Europe or Western Asia</li><li>5. Barley – Abyssinia and Southeastern Asia</li><li>6. Potatoes – South America</li><li>7. Rice – Southeast Asia</li><li>8. Peanuts – Brazil</li></ol>

Instructor Directions	Content Outline
	9. Cotton – India, Mexico 10. Sorghums – Africa and India 11. Flax – Mesopotamia, Assyria, Egypt
<b>Objective 4</b>  <i>Researchers in plant science continue to work to discover new information about plants and how they grow and reproduce. New methods, processes, and products have been the result of the work of plant scientists.</i>	<b>Explain how plants are used.</b>  1. Production of food, feed, and fiber crops (including lumber and pulp) 2. Research (biotechnology and crossbreeding) 3. Nonfood products (medicines, clothing, rubber, perfumes, and spices) 4. Beautification
<b>Application</b>	<b>Other activities</b> 1. Have students choose one crop plant species from an instructor-generated list and prepare a written and/or oral report. Include the following information in the report. a. History b. Origin c. Production areas in the world d. Botanical characteristics e. Varieties f. Products from species g. Economical importance 2. Bring in an assortment of common crop plant species from the local area to discuss in class. Possibly demonstrate grinding corn or wheat.  <b>Note:</b> It may be necessary to begin an early collection of these plants during specific harvest times in order to have them available for class.
<b>Closure/Summary</b>	For as long as people have been aware of their existence, plants have provided a source of food for human survival. From feeding multitudes to protecting the environment, plant research continues to play a vital role in the world.
<b>Evaluation: Quiz</b>	<b>Answers:</b> 1. True 2. False 3. True 4. False 5. A

Instructor Directions	Content Outline
	6. A 7. B 8. A 9. A 10. A 11. A 12. B 13. A 14. C

Unit: Plant Science

Name \_\_\_\_\_

Lesson 1: Importance of Plants

Date \_\_\_\_\_

### Evaluation

**True/False (Place the correct response in the blank provided.)**

- T 1. Plants are a vital part in the agricultural food chain.
- F 2. Nylon is a plant fiber product.
- T 3. Plants produce oxygen.
- F 4. Animals can produce their own energy.

**Matching (Write the letter indicating the type of crop in the blank before each crop listed.)**

- |   |              |                 |
|---|--------------|-----------------|
| A | 5. Corn      | Food Crop = A   |
| A | 6. Wheat     | Fiber Crop = B  |
|   |              | Forage Crop = C |
| B | 7. Flax      |                 |
| A | 8. Sorghum   |                 |
| A | 9. Peanuts   |                 |
| A | 10. Rice     |                 |
| A | 11. Soybeans |                 |
| B | 12. Cotton   |                 |
| A | 13. Barley   |                 |
| C | 14. Alfalfa  |                 |

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Classification of Plants
<b>Estimated Time</b>	Two 50-minute blocks

### Student Outcome

The student will be able to list and describe methods to classify plants.

### Learning Objectives

1. Identify how plants can be classified.
2. Describe the botanical system of classification.
3. Explain why the botanical classification system is important.
4. Describe how monocots and dicots differ.
5. Describe what a legume is.
6. Explain how the life cycles of plants differ.

### Grade Level Expectations

SC/LO/1/E/09-11/a      SC/LO/1/E/09-11/b

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. PowerPoint Slides
  - PPT 1 – Botanical Classification (Wheat and Barley Example)
  - PPT 2 – Dicots vs. Monocots
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

- Several different types of plants
- Examples of plants with different common names

#### Supplemental Information

1. Internet Sites
  - Classification of Plants. Access Excellence at the National Health Museum. Accessed January 22, 2008, from <http://www.accessexcellence.org/RC/Ethnobotany/page3.html>.
  - Monocots and Dicots. The Backyard Nature Website. Accessed January 22, 2008, from <http://www.backyardnature.net/monodico.htm>.
  - Monocots vs. Dicots. Center for the Study of Digital Libraries, Texas A&M University. Accessed January 22, 2008, from <http://www.cSDL.tamu.edu/FLORA/201Manhart/mono.vs.di/monosvsdi.html>.
  - Plants and Their Structure II. Estrella Mountain Community College, Arizona. Accessed January 22, 2008, from <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPLANTANATII.html>.

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- ❑ Root Development in Young Corn. Corny News Network Articles, Department of Agronomy, Purdue University. Accessed January 22, 2008, from <http://www.agry.purdue.edu/ext/corn/news/timeless/Roots.html>.
2. Print
- ❑ Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.
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## Interest Approach

1. Bring into the classroom several different types of plants (e.g., vines, grasses, woody, herbaceous, and flowering plants). Have students identify the characteristics of each sample. Organize and list on the board the characteristics and uses that students identify. When completed, ask students whether their notes would be understood if copied and sent to another country. If not, why? Relate this entire exercise to the topic of early methods of classification.
2. Bring in examples of plants with different common names. Examples include butterprint (velvetleaf, buttonweed), alfalfa (lucerne), and redroot (pigweed). Point out how using the botanical name can avoid confusion when identifying plants.

## Communicate the Learning Objectives

1. Identify how plants can be classified.
2. Describe the botanical system of classification.
3. Explain why the botanical classification system is important.
4. Describe how monocots and dicots differ.
5. Describe what a legume is.
6. Explain how the life cycles of plants differ.

Instructor Directions	Content Outline
<p><b>Objective 1</b></p> <p><i>Plants have many forms and functions. Classification is a means of grouping plants according to their similarities.</i></p>	<p><b>Identify how plants can be classified.</b></p> <ol style="list-style-type: none"><li>1. Botanical – a classification system that identifies plant species and groups them according to their physical characteristics</li><li>2. Descriptive – a classification system that identifies plants by such things as their use (e.g., food crops, feed crops, ornamental crops) and their life cycle (e.g., annual, perennial)</li></ol>
<p><b>Objective 2</b></p> <p><i>Continued research with plants is vital. There are approximately 500,000 different species in the plant kingdom. Classification systems help eliminate confusion among researchers. Botanical classification plays a beneficial role in international research. Refer to Ppt 1.</i></p> <p><input type="checkbox"/> Ppt 1 – Botanical Classification (Wheat and Barley Example)</p>	<p><b>Describe the botanical system of classification.</b></p> <ol style="list-style-type: none"><li>1. An internationally accepted system that places plants into discrete categories</li><li>2. It uses a system of eight categories:<ol style="list-style-type: none"><li>a. Kingdom</li><li>b. Division</li><li>c. Class</li><li>d. Subclass</li><li>e. Order</li><li>f. Family</li><li>g. Genus</li><li>h. Species</li></ol></li></ol>



Instructor Directions	Content Outline
<p><b>Objective 3</b></p> <p><i>There are hundreds of thousands of plants on this planet. Humans depend on many of these plants for survival.</i></p>	<p><b>Explain why the botanical classification system is important.</b></p> <ol style="list-style-type: none"> <li>1. It clearly identifies plant species.</li> <li>2. It identifies how plant species differ from other members of the plant kingdom.</li> <li>3. It is a universal language.</li> </ol>
<p><b>Objective 4</b></p> <p><i>Plants that are produced as food for humans or feed for livestock are called crop plants. To better understand crop plants, their parts, and their functions, they have been divided into two groups: monocotyledons and dicotyledons. Refer to Ppt 2.</i></p> <p><input type="checkbox"/> Ppt 2 – Dicots vs. Monocots</p>	<p><b>Describe how monocots and dicots differ.</b></p> <ol style="list-style-type: none"> <li>1. Monocots (e.g., corn, wheat) <ol style="list-style-type: none"> <li>a. One cotyledon in a seed</li> <li>b. Leaves with parallel veins</li> <li>c. Vascular bundles scattered throughout stems, no vascular cambium</li> <li>d. Root system composed of many fibrous roots with many root hairs</li> <li>e. Flower parts in threes or multiples of three</li> </ol> </li> <li>2. Dicots (e.g., soybeans, alfalfa) <ol style="list-style-type: none"> <li>a. Two cotyledons in each seed</li> <li>b. Leaves with network of veins</li> <li>c. Vascular bundles forming a ring around outside of stem</li> <li>d. Root system composed of primary tap root and many root hairs</li> <li>e. Flower parts in fours or fives or multiples of four or five</li> </ol> </li> </ol>
<p><b>Objective 5</b></p> <p><i>All crop plants need nutrients for proper growth and development. Nitrogen (N), phosphorus (P), and potassium (K) are the three primary nutrients that are needed. As a rule, primary nutrients are supplied to plants through the application of commercial fertilizers. However, legumes are quite different.</i></p>	<p><b>Describe what a legume is.</b></p> <ol style="list-style-type: none"> <li>1. A family of plants whose seeds are formed in fruit and the fruits are formed in pods</li> <li>2. Some have the ability to obtain nitrogen from the soil air</li> </ol>
<p><b>Objective 6</b></p> <p><i>Throughout the life of a plant there are several stages of plant growth. The first stage begins when the seed is planted and the</i></p>	<p><b>Explain how the life cycles of plants differ.</b></p> <ol style="list-style-type: none"> <li>1. Annuals – complete life cycle occurs in one growing season <ol style="list-style-type: none"> <li>a. Summer: seeded in spring, harvested in fall (corn, etc.)</li> </ol> </li> </ol>

Instructor Directions	Content Outline
<p><i>last stage involves the production of more seed. This process is called a life cycle. Life cycles differ depending on the plant.</i></p>	<p>b. Winter: seeded in late summer, harvested the following summer (winter wheat, etc.)</p> <ol style="list-style-type: none"> <li>2. Biennials – complete life cycle occurs over two growing seasons (sugar beets, carrots)</li> <li>3. Perennials – live year after year (many forage and pasture crops, shrubs, and some flowers)</li> </ol>
<p><b>Application</b></p>	<p>Other activities</p> <ol style="list-style-type: none"> <li>1. Have the class start a collection of dried beans that can be classified by genus and species. (This can be done in small, clear, baby food jars.)</li> <li>2. Have students select, from a teacher-generated list, one plant and do a report on its origin and botanical classification.</li> </ol>
<p><b>Closure/Summary</b></p>	<p>Botanical and descriptive classification systems can be used to classify plants. Both methods help us understand more about the plant world. With continued research, a better understanding of plants will continue to enable farmers to provide food that humans need for survival.</p>
<p><b>Evaluation: Quiz</b></p>	<p>Answers:</p> <ol style="list-style-type: none"> <li>1. False</li> <li>2. False</li> <li>3. True</li> <li>4. Division (2)</li> <li>5. Kingdom (1)</li> <li>6. Class (3)</li> <li>7. Subclass (4)</li> <li>8. Family (6)</li> <li>9. Order (5)</li> <li>10. Species (8)</li> <li>11. Genus (7)</li> <li>12. D</li> <li>13. M</li> <li>14. M</li> <li>15. D</li> <li>16. B</li> <li>17. WA</li> <li>18. B</li> <li>19. P</li> <li>20. SA</li> </ol>

Unit: Plant Science

Name \_\_\_\_\_

Lesson 2: Classification of Plants

Date \_\_\_\_\_

### Evaluation

**True/False (Place the correct response in the blank provided.)**

- F 1. Botanists use the descriptive system of classification.
- F 2. Descriptive classification involves genus and species levels of identification.
- T 3. Descriptive classification deals mainly with crop plants.

**Number the classification levels in correct order (1 being the broadest level and 8 being the most specific level).**

- (2) 4. Division
- (1) 5. Kingdom
- (3) 6. Class
- (4) 7. Subclass
- (6) 8. Family
- (5) 9. Order
- (8) 10. Species
- (7) 11. Genus

**Identify the following plant characteristics as either monocot (M) or dicot (D).**

- D 12. Two cotyledons
- M 13. Leaves with parallel veins
- M 14. Stems without vascular cambium and with scattered vascular bundles
- D 15. Flower parts in fours or fives or multiples of four or five

**Identify the following statements with the correct plant life cycle:  
Summer Annual = SA; Winter Annual = WA; Biennial = B; Perennial = P.**

B 16. Requires 2 years to complete their life cycles

WA 17. Seeded in the late summer or early fall, harvested the following summer

B 18. Develops flowers the second year only

P 19. Returns each year without replanting

SA 20. Seeded in the spring, harvested in the fall

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Plant Growth Factors
<b>Estimated Time</b>	50 minutes

### Student Outcome

The student will be able to describe factors that affect plant growth and development.

### Learning Objectives

1. Identify the factors which affect plant growth.
2. Explain how light affects the processes of plant growth.
3. Identify the role water plays in plant growth.
4. Identify the elements which are necessary for plant growth.
5. Explain the methods which are used by plants to obtain nutrients.
6. Explain how plant growth is affected by temperature.

### Grade Level Expectations

SC/ME/1/B/09-11/b

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

SC/LO/2/B/09-11/c

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

#### Supplies & Equipment

- Two small flats
- Bean seeds

#### Supplemental Information

1. Internet Sites
  - Environmental Factors Affecting Growth: Light, Temperature, Water, Nutrition. Oregon State University Extension. Accessed January 22, 2008, from <http://extension.oregonstate.edu/mg/botany/heat.html>.
  - Photosynthesis. Estrella Mountain Community College, Arizona. Accessed January 22, 2008, from <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPS.html>.
  - Plant Growth and Development as the Basis of Forage Management. West Virginia University Extension Service. Accessed January 22, 2008, from <http://www.caf.wvu.edu/~forage/growth.htm>.
  - Temperature Effect on Plants. North Carolina Cooperative Extension. Accessed January 22, 2008, from <http://www.ces.ncsu.edu/depts/hort/consumer/weather/tempeffect-plants.html>.

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2. Print

- ❑ Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.

## Interest Approach

Using two small flats (horticultural container for planting seed), plant bean seeds to germinate. Water one flat and place it in a sunny spot for warmth. The other flat should not be watered and should be placed away from the sun in a cooler spot. Have students keep a record of the time it takes the seeds in each flat to germinate. Discuss possible problems and solutions to this demonstration, and relate the demonstration to the topic.

## Communicate the Learning Objectives

1. Identify the factors which affect plant growth.
2. Explain how light affects the processes of plant growth.
3. Identify the role water plays in plant growth.
4. Identify the elements which are necessary for plant growth.
5. Explain the methods which are used by plants to obtain nutrients.
6. Explain how plant growth is affected by temperature.

Instructor Directions	Content Outline
<b>Objective 1</b>  <i>Plant growth is an irreversible process during a plant's life that increases plant volume or dry weight or both. The growth process of a plant is dependent on several factors.</i>	<b>Identify the factors which affect plant growth.</b>  <ol style="list-style-type: none"><li>1. Light</li><li>2. Water</li><li>3. Nutrients</li><li>4. Temperature</li></ol>
<b>Objective 2</b>  <i>Of the factors that affect plant growth, light is one that controls other processes within the plant.</i>	<b>Explain how light affects the processes of plant growth.</b>  <ol style="list-style-type: none"><li>1. Photosynthesis: In the presence of light, plants manufacture food using water and carbon dioxide.</li><li>2. Phototropism: Light stimulates the longitudinal growth in plant stems through this process.</li><li>3. Photoperiodism: In some plants, light triggers the development of flowers.</li></ol>
<b>Objective 3</b>  <i>Plants require water. Some plants, namely desert-type plants, can survive with very little water.</i>	<b>Identify the role water plays in plant growth.</b>  <ol style="list-style-type: none"><li>1. Makes up a large percentage of the plant's fresh weight</li><li>2. Transports nutrients throughout the plant</li><li>3. Involved in many chemical reactions</li></ol>
<b>Objective 4</b>  <i>Humans need certain vitamins and minerals in their diets for proper growth and development of</i>	<b>Identify the elements which are necessary for plant growth.</b>  <ol style="list-style-type: none"><li>1. Elements from air<ol style="list-style-type: none"><li>a. Carbon</li><li>b. Hydrogen</li></ol></li></ol>

Instructor Directions	Content Outline
<p><i>bones, muscles, and skin and also to heal the body after an injury. Plants also need nutrients for growth and development.</i></p>	<ul style="list-style-type: none"> <li>c. Oxygen</li> <li>2. Primary macronutrients               <ul style="list-style-type: none"> <li>a. Nitrogen</li> <li>b. Phosphorus</li> <li>c. Potassium</li> </ul> </li> <li>3. Secondary macronutrients               <ul style="list-style-type: none"> <li>a. Calcium</li> <li>b. Magnesium</li> <li>c. Sulfur</li> </ul> </li> <li>4. Micronutrients               <ul style="list-style-type: none"> <li>a. Iron</li> <li>b. Manganese</li> <li>c. Boron</li> <li>d. Copper</li> <li>e. Zinc</li> <li>f. Molybdenum</li> <li>g. Chlorine</li> </ul> </li> </ul>
<p><b>Objective 5</b></p> <p><i>Nutrients that aid in the proper growth and development of plants must be available to the plant.</i></p>	<p><b>Explain the methods which are used by plants to obtain nutrients.</b></p> <ul style="list-style-type: none"> <li>1. Absorption is the process through which plant roots absorb nutrients and water from the soil.</li> <li>2. Translocation is the movement of nutrients and water throughout the plant.</li> </ul>
<p><b>Objective 6</b></p> <p><i>Heat can influence plant growth both positively and negatively.</i></p>	<p><b>Explain how plant growth is affected by temperature.</b></p> <p>Temperatures above or below the optimum will reduce plant growth.</p> <ul style="list-style-type: none"> <li>1. Temperatures <u>below</u> optimum cause a decrease in gaseous exchanges; diffusion and osmosis slow down because the permeability of membranes is more difficult.</li> <li>2. As the temperature rises <u>above</u> optimum, enzymes become less stable and break down causing plant inactivity.</li> </ul>
<p><b>Application</b></p>	<p>Other activities</p> <ul style="list-style-type: none"> <li>1. Have students place a plant in the window and observe how the plant moves towards the light over the period of a few days. Discuss with students phototropism and its causes.</li> <li>2. Obtain white carnations. Allow the carnations to sit without water for a few hours. Then, place them in</li> </ul>



Instructor Directions	Content Outline
	<p>water dyed with food coloring (red, blue). Discuss with students phloem and xylem tissues. Explain how water helps transport needed nutrients throughout the plant.</p>
<b>Closure/Summary</b>	<p>Understanding the factors involved in plant growth enables scientists, agronomists, and farmers to produce crops. Factors such as light, water, nutrients, and temperature all play a vital role in plant growth and development.</p>
<b>Evaluation: Quiz</b>	<p>Answers:</p> <ol style="list-style-type: none"> <li>1. False</li> <li>2. True</li> <li>3. False</li> <li>4. True</li> <li>5. d</li> <li>6. b</li> <li>7. b</li> <li>8. Nitrogen, Phosphorus, Potassium (can be in any order)</li> <li>9. Calcium, Magnesium, Sulfur (can be in any order)</li> <li>10. Boron, Manganese, Copper, Zinc, Iron, Chloride, Molybdenum (can be in any order)</li> </ol>

Unit: Plant Science

Name \_\_\_\_\_

Lesson 3: Plant Growth Factors

Date \_\_\_\_\_

### Evaluation

**True/False (Place the correct response in the blank provided.)**

- F 1. Environment has very little effect on plant growth.
- T 2. Photosynthesis requires sunlight, water, and carbon dioxide.
- F 3. Colder temperatures increase plant growth.
- T 4. Plant growth is related to temperature.

**Circle the letter that corresponds to the best answer.**

5. Which process changes carbon dioxide and water into sugar?
- a. Osmosis
  - b. Phototropism
  - c. Diffusion
  - d. Photosynthesis

**Correct answer is d.**

6. In which process does the growing part of the plant move toward the sunlight?
- a. Absorption
  - b. Phototropism
  - c. Photosynthesis
  - d. Photoperiodism

**Correct answer is b.**

7. The plant's reaction to light in stimulating flower development is related to
- a. Photosynthesis
  - b. Photoperiodism
  - c. Phototropism
  - d. Osmosis

**Correct answer is b.**

Essential elements can be categorized depending upon the amount needed by the plant. Place the correct element in the blanks beneath each category.

8. Primary macronutrients

- a. Nitrogen
- b. Phosphorus
- c. Potassium

NOTE: Answers to 8, 9, and 10 can be in any order.

9. Secondary macronutrients

- a. Calcium
- b. Magnesium
- c. Sulfur

10. Micronutrients

- a. Boron
- b. Manganese
- c. Copper
- d. Zinc
- e. Iron
- f. Chloride
- g. Molybdenum

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Weeds, Diseases, Insects
<b>Estimated Time</b>	50 minutes

### Student Outcome

The student will be able to describe how pests affect plant growth.

### Learning Objectives

1. Identify the pests which cause problems with plants.
2. Explain how weeds affect plant growth.
3. Explain how diseases affect plant growth.
4. Identify the three conditions that must be present for a disease to develop.
5. Explain how insects inhibit plant growth.

### Grade Level Expectations

SC/LO/2/B/09-11/c

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

#### Supplies & Equipment

- Plants injured by insects
- Leaves or a branch that is infested with aphids

#### Supplemental Information

1. Internet Sites
  - Crops Publications: Weed Control and Other Crops. University of Missouri Extension. Accessed January 22, 2008, from <http://extension.missouri.edu/explore/agguides/crops/#Other>.
  - Insects and Diseases Publications: Livestock and Crops. University of Missouri Extension. Accessed January 22, 2008, from <http://extension.missouri.edu/explore/agguides/pests/#Livestock>.
  - Integrated Crop Management Newsletter: Indices of Past Issues on Crop Production. Iowa State University Extension. Accessed January 22, 2008, from <http://www.ipm.iastate.edu/ipm/icm/indices/cropproduction.html>.
  - Plant Pest Identification Aid. Vegetable IPM, Departments of Entomology and Horticultural Sciences, Texas A&M University. Accessed January 22, 2008, from <http://vegipm.tamu.edu/imageindex.html>.

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- ❑ Weed ID Guide. Weed Science Program, College of Agriculture, Food and Natural Resources, University of Missouri. Accessed January 22, 2008, from <http://weedid.missouri.edu/>.
2. Print
- ❑ Greenwood, P., A. Halstead, A. R. Chase, and D. Gilrein. *American Horticultural Society Pests and Diseases: The Complete Guide to Preventing, Identifying, and Treating Plant Problems*. New York: Dorling Kindersly Publishing, Inc., 2000.
  - ❑ Parker, R. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.
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## Interest Approach

Bring into class several examples of plants injured by insects. Find some leaves or a branch that is infested with aphids, and discuss why the insects are on the plant. Relate this to the millions of dollars spent every year to control pests in food and fiber crops.

## Communicate the Learning Objectives

1. Identify the pests which cause problems with plants.
2. Explain how weeds affect plant growth.
3. Explain how diseases affect plant growth.
4. Identify the three conditions that must be present for a disease to develop.
5. Explain how insects inhibit plant growth.

Instructor Directions	Content Outline
<b>Objective 1</b>  <i>For as long as humans have been growing plants for food, pests have caused problems with plant growth.</i>	<b>Identify the pests which cause problems with plants.</b>  <ol style="list-style-type: none"><li>1. Weeds</li><li>2. Diseases (pathogens)</li><li>3. Insects (predators - insects and larger animals)</li></ol>
<b>Objective 2</b>  <i>A weed can be defined as any unwanted plant. Weeds may be unsightly in a lawn or field; however, they also compete with desirable plants in many ways.</i>	<b>Explain how weeds affect plant growth.</b>  <ol style="list-style-type: none"><li>1. Compete for light</li><li>2. Compete for water</li><li>3. Compete for nutrients</li></ol>
<b>Objective 3</b>  <i>Plant growth depends on many external factors and processes inside the plant. Diseases that infect plants can inhibit plant growth in many ways.</i>	<b>Explain how diseases affect plant growth.</b>  <ol style="list-style-type: none"><li>1. Interfere or inhibit photosynthesis</li><li>2. Stunt plant growth</li><li>3. Cause structural damage</li><li>4. Reduce crop yields</li><li>5. Reduce crop quality</li></ol>
<b>Objective 4</b>  <i>Much research has been conducted to reduce disease problems in plants. Many plant diseases can be prevented by using good management practices. Disease prevention or control measures should focus on eliminating one or more of the</i>	<b>Identify the three conditions that must be present for a disease to develop.</b>  <ol style="list-style-type: none"><li>1. Susceptible host - a weakened plant</li><li>2. Virulent pathogen - a disease carrying organism capable of attacking a susceptible host</li><li>3. Favorable environment - an environment that enhances contact between the susceptible host and virulent pathogen</li></ol>

Instructor Directions	Content Outline
<i>three conditions necessary for a disease to develop.</i>	
<p><b>Objective 5</b></p> <p><i>Insects damage plants and disrupt the plant's growth and development. Through a better understanding of how insects damage plants, more efficient techniques of control can be used.</i></p>	<p><b>Explain how insects inhibit plant growth.</b></p> <ol style="list-style-type: none"> <li>1. Physical damage <ol style="list-style-type: none"> <li>a. Eating plant tissue</li> <li>b. Sucking plant juices</li> </ol> </li> <li>2. Physiological damage <ol style="list-style-type: none"> <li>a. Transmitting viruses to plant</li> <li>b. Depositing eggs into plant and disrupting natural processes</li> </ol> </li> </ol>
<p><b>Application</b></p>	<p>Other activities</p> <ol style="list-style-type: none"> <li>1. Have each student select an insect from an instructor-generated list and prepare a written report on its life cycle and its effect on plants.</li> <li>2. Have each student select one plant disease from an instructor-generated list and prepare a written report on its effect on plant growth.</li> <li>3. Depending on the time of year (warm weather), take a field trip around the school campus and locate insects that are on plants. Observe the eating habits of these insects.</li> </ol>
<p><b>Closure/Summary</b></p>	<p>Food is a vital commodity that all humans need. Plants and their ability to grow are greatly affected by pests. Weeds, diseases, and insects continue to damage food and fiber crops each year. By understanding how pests can damage plants, more efficient and successful techniques to control and prevent damage can be used.</p>
<p><b>Evaluation: Quiz</b></p>	<p>Answers:</p> <ol style="list-style-type: none"> <li>1. False</li> <li>2. True</li> <li>3. True</li> <li>4. True</li> <li>5. True</li> <li>6. d</li> <li>7. b</li> <li>8. a</li> </ol>

Unit: Plant Science

Name \_\_\_\_\_

Lesson 4: Weeds, Diseases, Insects

Date \_\_\_\_\_

### Evaluation

**True/False (Place the correct response in the blank provided.)**

- F 1. Plant pests are limited to only insects that damage crops.
- T 2. Grass in a corn field is considered a pest.
- T 3. Insects can transmit diseases to plants.
- T 4. Diseases may disrupt healthy plant growth.
- T 5. Damaged or weakened plants are more susceptible to disease.

**Circle the letter that corresponds to the best answer.**

6. Why are weeds considered pests?
- a. They are plants also.
  - b. They can produce their own food through photosynthesis.
  - c. They are immune to many crop diseases.
  - d. They steal needed nutrients from crops.

**Correct answer is d.**

7. What three conditions must be present for a disease to develop?
- a. Soil nutrient deficiency, environmental condition, susceptible host
  - b. Susceptible host, favorable environmental conditions, virulent pathogen
  - c. Virulent pathogen, cold climate, soil nutrient deficiency
  - d. Hot, dry conditions, virulent pathogen, soil nutrient deficiency

**Correct answer is b.**

8. What does physiological damage to plants by insects refer to?
- a. Disrupting the internal natural processes of the plant
  - b. Damaging the root structure of the plant
  - c. Damaging the plant's leaves
  - d. Entering into the inside of the stem and eating the tissue

**Correct answer is a.**



<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Germination
<b>Estimated Time</b>	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
<p><b>Objective 1</b></p> <p><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></p>	<p><b>Explain what a seed is.</b></p> <p>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:</p> <ol style="list-style-type: none"><li>1. Embryo</li><li>2. Food supply</li><li>3. Ovary wall or seed coat (protection)</li></ol>
<p><b>Objective 2</b></p> <p><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></p>	<p><b>Identify the requirements for germination.</b></p> <ol style="list-style-type: none"><li>1. Favorable temperature – varies depending on crop species</li><li>2. Sufficient moisture</li><li>3. Air (or oxygen)</li><li>4. Presence or absence of light (depending on the plant species)</li></ol>
<p><b>Objective 3</b></p> <p><i>The process of germination involves several steps.</i></p>	<p><b>Explain how a seed germinates.</b></p> <ol style="list-style-type: none"><li>1. The seed absorbs water.</li><li>2. The seed's proteins are activated, which activates the enzyme system.</li><li>3. The seed's root (radicle) emerges.</li><li>4. The seed's plumule or embryonic shoot begins to emerge.</li></ol>

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

Instructor Directions	Content Outline
<ul style="list-style-type: none"> <li><input type="checkbox"/> PPt 3 – Stages in Germination and Emergence of a Monocot Seed (Corn)</li>   <li><input type="checkbox"/> PPt 4 – Stages in Germination and Emergence of a Dicot Seed (Bean)</li> </ul>	<ol style="list-style-type: none"> <li>2. Dicot – bean           <ol style="list-style-type: none"> <li>a. Seed swells as moisture is absorbed, and seed coat ruptures.</li> <li>b. Radicle grows down.</li> <li>c. Hypocotyl elongates and forms an arch that breaks the soil surface.</li> <li>d. When hypocotyl reaches light, elongation ceases and hypocotyls straightens up, pulling cotyledons out of the soil.</li> <li>e. Cotyledons turn green and manufacture food until new leaves develop.</li> <li>f. As new leaves develop, the cotyledons die, dry up, and fall off.</li> </ol> </li> </ol>
<b>Application</b>	<p>Other activities</p> <ol style="list-style-type: none"> <li>1. Split open several different types of monocot and dicot seeds and identify the parts.</li> <li>2. Germinate corn and bean seeds to observe differences in their emergence. (Use a view box for this if possible.)</li> </ol>
<b>Closure/Summary</b>	<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>
<b>Evaluation: Quiz</b>	<p>Answers:</p> <ol style="list-style-type: none"> <li>1. False</li> <li>2. True</li> <li>3. False</li> </ol> <p>Monocot Identification</p> <ol style="list-style-type: none"> <li>4. Endosperm</li> <li>5. Cotyledon</li> <li>6. Epicotyl</li> <li>7. Hypocotyl</li> <li>8. Radicle</li> <li>9. Seed coat</li> <li>10. Embryo</li> </ol> <p>Dicot Identification</p> <ol style="list-style-type: none"> <li>11. Epicotyl</li> </ol>

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

**Evaluation**

**True/False (Place the correct response in the blank provided.)**

- F 1. All seeds will germinate if sufficient moisture is present.
- T 2. Many kinds of seeds are eaten as food throughout the world.
- F 3. The monocot seed contains two cotyledons that store food for the young plant.

**Identify the following parts:**

**Monocot Seed (Corn)**

Parts

Seed coat

Endosperm

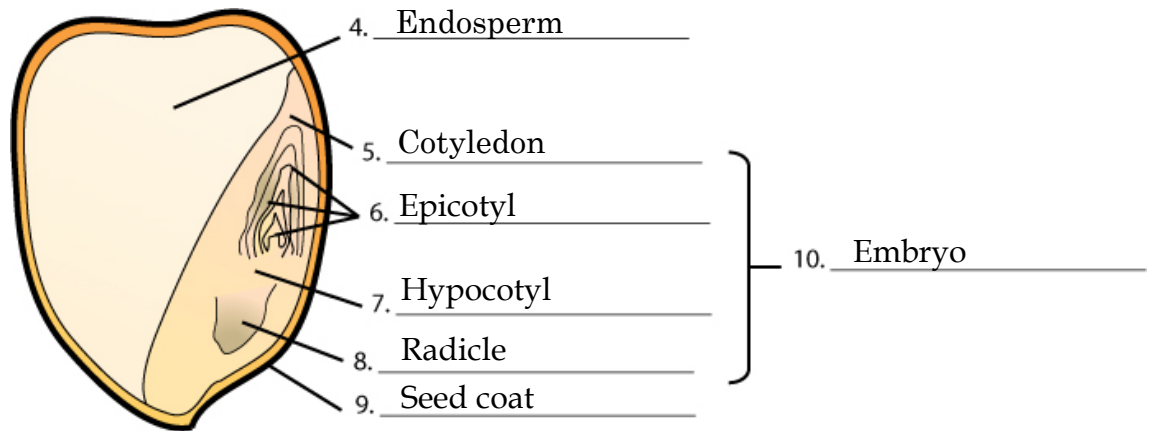
Embryo

Radicle

Cotyledon

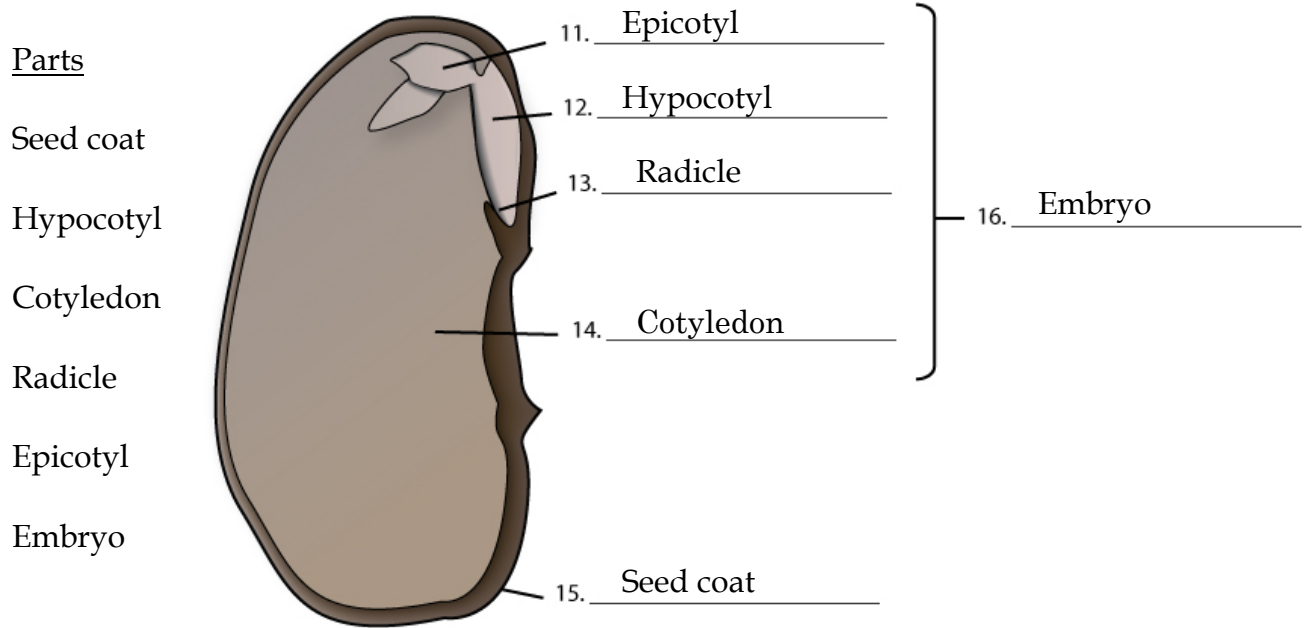
Epicotyl

Hypocotyl



Identify the following parts:

**Dicot Seed (Bean)**



<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Photosynthesis and Respiration
<b>Estimated Time</b>	50 minutes

### Student Outcome

The student will be able to describe basic plant processes.

### Learning Objectives

1. List the five basic plant processes.
2. Explain how nutrients and water are moved through a plant.
3. Explain how plants manufacture food.
4. Explain how plants use food that they manufacture.
5. Describe the role plants play in improving air quality.

### Grade Level Expectations

SC/ME/1/I/09-11/b	SC/ME/2/A/09-11/b	SC/LO/1/C/09-11/a
SC/LO/1/C/09-11/b	SC/LO/2/A/09-11/a	SC/LO/2/A/09-11/b
SC/LO/2/A/09-11/c	SC/LO/2/B/09-11/a	SC/LO/2/B/09-11/b
SC/LO/2/B/09-11/c	SC/LO/2/D/09-11/a	SC/LO/2/D/09-11/c
SC/LO/2/F/09-11/a	SC/LO/2/F/09-11/c	SC/LO/2/F/09-11/d

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

#### Supplies & Equipment

- White carnation or stalk of celery
- Red or blue food coloring

#### Supplemental Information

1. Internet Sites
  - Photosynthesis. Estrella Mountain Community College, Arizona. Accessed January 23, 2008, from <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookPS.html>.
  - Photosynthesis. University of Cincinnati Clermont College. Accessed January 23, 2008, from <http://biology.clc.uc.edu/Courses/bio104/photosyn.htm>.
  - Translocation: Transport of Organic Solutes in Plants. Gresham High School, Oregon. Accessed January 23, 2008, from <http://ghs.gresham.k12.or.us/science/ps/sci/ibbio/plants/notes/transloc.htm>.



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- ❑ Ritter, Michael E. "Transpiration." In *The Physical Environment: An Introduction to Physical Geography*. 2006. Online textbook, Department of Geography and Geology, University of Wisconsin-Stevens Point. Accessed January 23, 2008, from <http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/biogeography/transpiration.html>.

2. Print

- ❑ Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.
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### Interest Approach

Using a white carnation, cut off the tip of the stem (1/4" to 3/8") and place it down in a jar of water that has been colored with red or blue food coloring. This can also be done with a stalk of celery. Discuss with the class just what the plant is doing while the solution is being drawn up into the plant material. Use this to lead into the lesson.

### Communicate the Learning Objectives

1. List the five basic plant processes.
2. Explain how nutrients and water are moved through a plant.
3. Explain how plants manufacture food.
4. Explain how plants use food that they manufacture.
5. Describe the role plants play in improving air quality.

Instructor Directions	Content Outline
<p><b>Objective 1</b></p> <p><i>Proper plant growth is directly related to five basic processes that occur in plants.</i></p>	<p><b>List the five basic plant processes.</b></p> <ol style="list-style-type: none"><li>1. Photosynthesis</li><li>2. Respiration</li><li>3. Water absorption</li><li>4. Translocation</li><li>5. Transpiration</li></ol>
<p><b>Objective 2</b></p> <p><i>Plants require nutrients for proper growth and development. In order for the nutrients to benefit the plant, they must be distributed throughout the plant. The movement of nutrients and water in a plant involves three processes: transportation, translocation, and absorption.</i></p>	<p><b>Explain how nutrients and water are moved through a plant.</b></p> <ol style="list-style-type: none"><li>1. Transpiration – loss of water by evaporation through the leaf surface, causes tension on the xylem tissues which triggers the root hairs to absorb more water</li><li>2. Translocation – movement of water and organic compounds within the plant<ol style="list-style-type: none"><li>a. Xylem tissues transport water and dissolved minerals <u>upward</u> from the roots.</li><li>b. Phloem tissues transport compounds from the leaves to the rest of the plant.</li></ol></li><li>3. Absorption – water and dissolved minerals are absorbed by plant root hairs through the process of osmosis</li></ol>
<p><b>Objective 3</b></p> <p><i>Every living organism needs food to produce energy so essential activities within the cells can take place.</i></p>	<p><b>Explain how plants manufacture food.</b></p> <p>Through the process of photosynthesis, green plants convert carbon dioxide and water in the presence of light into simple sugar (food).</p>

Instructor Directions	Content Outline
	$6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \xrightarrow[\text{light energy}]{\text{chlorophyll}} \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$ <p>(carbon dioxide) (water) (glucose) (oxygen)</p>
<p><b>Objective 4</b></p> <p><i>Energy from the sun enables plants to produce food through the process of photosynthesis.</i></p>	<p><b>Explain how plants use food that they manufacture.</b></p> <ol style="list-style-type: none"> <li>To produce the energy necessary to perform various plant processes</li> <li>To build new plant tissue resulting in plant growth</li> <li>To store food in the form of carbohydrate substances</li> <li>Respiration – uses energy to release carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) into the atmosphere</li> </ol>
<p><b>Objective 5</b></p> <p><i>Air (oxygen) is important to sustain animal life. Plants improve air quality through the process of photosynthesis.</i></p>	<p><b>Describe the role plants play in improving air quality.</b></p> <p>Plants produce oxygen as a by-product of photosynthesis and they use carbon dioxide from the air.</p>
<p><b>Closure/Summary</b></p>	<p>The five basic plant processes needed for proper plant growth and development are respiration, photosynthesis, water absorption, translocation, and transpiration. Plants play a vital role in improving air quality by producing oxygen as a by-product of photosynthesis.</p>
<p><b>Evaluation: Quiz</b></p>	<p>Answers:</p> <ol style="list-style-type: none"> <li>c</li> <li>d</li> <li>a</li> <li>b</li> <li>e</li> <li>c</li> <li>d</li> <li>c</li> </ol>

**Evaluation**

**Correctly match the appropriate plant process with the description of that process.**

- |   |   |                     |
|---|---|---------------------|
| C | 1. The process through which water containing dissolved minerals enters the plant's hair roots  | a. Photosynthesis   |
| D | 2. The movement of water and organic materials within the plant   | b. Respiration      |
| A | 3. The process through which green plants convert carbon dioxide and water in the presence of light into simple sugar (food)                  | c. Water absorption |
| B | 4. The breakdown of glucose, releasing energy for plant growth, and other metabolic processes or chemical reactions occurring within the cell | d. Translocation    |
| E | 5. The loss of water by evaporation primarily from the leaf surface   | e. Transpiration    |

**Circle the letter that corresponds to the best answer.**

6. In the process of manufacturing food, plants require water, light energy, and
- a. Oxygen
  - b. Glucose
  - c. Carbon dioxide
  - d. Energy

**Correct answer is c.**

7. Respiration produces carbon dioxide, water, and
- a. Oxygen
  - b. Glucose
  - c. Carbon dioxide
  - d. Energy

**Correct answer is d.**

8. Plants contribute to air quality because they
- a. Provide a source of carbohydrates to humans
  - b. Use light energy to produce food
  - c. Produce oxygen as a by-product
  - d. Have chlorophyll in their cells

**Correct answer is c.**

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Reproduction – Sexual and Asexual
<b>Estimated Time</b>	Two 50-minute blocks

**Student Outcome**

The student will be able to describe how plants reproduce sexually and asexually.

**Learning Objectives**

1. Explain the difference between sexual and asexual propagation.
2. Explain what a flower is.
3. Identify the parts of complete and incomplete flowers.
4. Explain what is involved in pollination and fertilization.
5. List the conditions that can influence pollination and fertilization.
6. Identify the plant parts which may be used for asexual propagation.
7. Describe the methods of asexual propagation.

**Grade Level Expectations**

SC/LO/3/A/09-11/a	SC/LO/3/B/09-11/a	SC/LO/3/B/09-11/b
SC/LO/3/B/09-11/d	SC/LO/3/B/09-11/e	SC/LO/3/C/09-11/a
SC/LO/3/D/09-11/c	SC/LO/3/E/09-11/a	SC/LO/3/E/09-11/b
SC/EC/3/B/09-11/a		

**Resources, Supplies & Equipment, and Supplemental Information**

**Resources**

1. PowerPoint Slide
  - Ppt 1 – Parts of a Complete Flower
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**

- Two germination trays (flats) and soil or growing medium
- Package of seeds for a fast germinating flowering annual
- Potted geranium plant
- Propagation knife
- Rooting hormone

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## Supplemental Information

### 1. Internet Sites

- ❑ Flower Parts. FloridaGardner.com. Accessed January 24, 2008, from <http://www.floridagardener.com/misc/flowersparts.htm>.
- ❑ Plant Morphology: The Parts of a Flower. American Museum of Natural History, New York City. Accessed January 24, 2008, from [http://www.amnh.org/learn/biodiversity\\_counts/ident\\_help/Parts\\_Plants/parts\\_of\\_flower.htm](http://www.amnh.org/learn/biodiversity_counts/ident_help/Parts_Plants/parts_of_flower.htm).
- ❑ Plant Propagation. Basics of Organic Fertilizers. Accessed January 24, 2008, from <http://www.basic-info-4-organic-fertilizers.com/plantpropagation.html>.
- ❑ Plant Propagation. Master Gardener, Ohio State University Extension. Accessed January 24, 2008, from <http://hcs.osu.edu/mg/manual/prop.htm>.
- ❑ Pollination. Biology of Plants, Missouri Botanical Garden, St. Louis. Accessed January 24, 2008, from <http://mbgnet.net/bioplants/pollination.html>.

### 2. Print

- ❑ Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.
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### Interest Approach

Before class, prepare two germination trays (flats) with soil (or growing medium) in them. Purchase a package of seeds (select a fast germinating flowering annual) and a potted geranium plant. In front of the class, cut up the geranium plant and place the pieces in one flat (asexual propagation). Sow the seeds in the other flat (sexual propagation). Ask students what they think you did. Relate this demonstration to the topic.

### Communicate the Learning Objectives

1. Explain the difference between sexual and asexual propagation.
2. Explain what a flower is.
3. Identify the parts of complete and incomplete flowers.
4. Explain what is involved in pollination and fertilization.
5. List the conditions that can influence pollination and fertilization.
6. Identify the plant parts which may be used for asexual propagation.
7. Describe the methods of asexual propagation.

Instructor Directions	Content Outline
<p><b>Objective 1</b></p> <p><i>The process of a plant reproducing another plant is called reproduction. The controlled reproduction of plants is called plant propagation. Plant propagation can be accomplished either by sexual or asexual means. Some plants can only reproduce by sexual means. Others will only reproduce by asexual means. Still others can be propagated by either sexual or asexual methods.</i></p>	<p><b>Explain the difference between sexual and asexual propagation.</b></p> <ol style="list-style-type: none"><li>1. Sexual plant propagation uses seeds to produce new plants.</li><li>2. Asexual plant propagation involves the use of a vegetative part of the plant to produce another plant.</li></ol>
<p><b>Objective 2</b></p> <p><i>Flowers vary depending on the type of plant. Some flowers are very bright and colorful while other flowers are quite small and almost unnoticeable. Use PPT 1 to identify the parts described.</i></p> <p><input type="checkbox"/> PPT 1 – Parts of a Complete Flower</p>	<p><b>Explain what a flower is.</b></p> <p>The flower is the sexual reproductive part of a plant. A complete flower has four parts.</p> <ol style="list-style-type: none"><li>1. Sepals – the outer, scale-like covering around the flower bud<ol style="list-style-type: none"><li>a. All the sepals together are called the calyx.</li><li>b. The function of the sepals is to protect the petals, stamens, and pistils when the flower is in the bud stage.</li></ol></li></ol>

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> <li>2. Petals – usually brightly colored to attract pollinators (usually insects)               <ol style="list-style-type: none"> <li>a. All of the petals together are called the corolla.</li> <li>b. The petals protect the stamens and pistils in the bud stage.</li> </ol> </li> <li>3. Stamens – the male reproductive part (Each stamen consists of two parts: the anther and the filament.)               <ol style="list-style-type: none"> <li>a. The anther produces pollen grains.</li> <li>d. The filament supports the anther.</li> </ol> </li> <li>4. Pistil – the female reproductive part (The pistil consists of the ovary, stigma, and style.)               <ol style="list-style-type: none"> <li>a. The ovary is the enlarged portion at the base of the pistil. The function of the ovary is to produce ovules. Ovules that are fertilized become seeds.</li> <li>b. The stigma receives and holds the pollen grains.</li> <li>c. The style connects the stigma with the ovary. Pollen grains travel through the style to reach the ovary. The style supports the stigma.</li> </ol> </li> </ol>
<p><b>Objective 3</b></p> <p><i>Plants produce flowers as part of their life cycle. Some plants produce complete flowers while others produce incomplete flowers. Refer to PPt 1 again.</i></p> <p> PPt 1 – Parts of a Complete Flower</p>	<p><b>Identify the parts of complete and incomplete flowers.</b></p> <ol style="list-style-type: none"> <li>1. A complete flower contains all four main parts of a flower: sepals, petals, stamens, and pistils.</li> <li>2. An incomplete flower is missing one or more of the main parts of the flower.</li> </ol>
<p><b>Objective 4</b></p> <p><i>Sexual plant reproduction involves pollination and fertilization.</i></p>	<p><b>Explain what is involved in pollination and fertilization.</b></p> <ol style="list-style-type: none"> <li>1. Pollination is the transfer of pollen from the anther to the stigma.</li> <li>2. Fertilization is the union of male and female cells to form the first embryonic cell.</li> </ol>
<p><b>Objective 5</b></p> <p><i>Plants require proper environmental conditions for sexual reproduction to take place.</i></p>	<p><b>List the conditions that can influence pollination and fertilization.</b></p> <ol style="list-style-type: none"> <li>1. Favorable weather conditions</li> <li>2. Wind</li> <li>3. Pollinators (insects, birds)</li> </ol>



Instructor Directions	Content Outline
<p><b>Objective 6</b></p> <p><i>Asexual plant reproduction involves using parts of a plant to produce a new plant without seed.</i></p>	<p><b>Identify the plant parts which may be used for asexual propagation.</b></p> <ol style="list-style-type: none"> <li>1. Stems</li> <li>2. Leaves</li> <li>3. Roots</li> </ol>
<p><b>Objective 7</b></p> <p><i>There are several methods of asexual propagation and the choice of method depends on the plant and the desired objectives of the propagator.</i></p>	<p><b>Describe the methods of asexual propagation.</b></p> <ol style="list-style-type: none"> <li>1. Cuttings – a piece cut from the parent plant and rooted</li> <li>2. Division – separating clumps of plants into smaller groups</li> <li>3. Layering – rooting a new plant part while it is still attached to the parent plant</li> <li>4. Grafting – inserting buds, twigs, or shoots from one plant onto the stem of another plant</li> <li>5. Budding – inserting a bud(s) of one plant into the bark of another variety</li> <li>6. Tissue culture – using a single cell or a small piece of plant tissue (explant) to produce a new plant.</li> </ol>
<p><b>Application</b></p>	<p><b>Other activities</b></p> <ol style="list-style-type: none"> <li>1. Instructor can bring to class a selection of flowers for students to dissect, locate, and label parts. Hibiscus is excellent for this activity.</li> <li>2. Instructor can provide the opportunity for students to do several methods of asexual propagation: grafting, air-layering, leaf cutting, etc.</li> </ol>
<p><b>Closure/Summary</b></p>	<p>Plant reproduction can occur in two ways. Sexual reproduction involves the production of seed through the union of two specific cells. The seeds are then used to start new plants. Asexual propagation involves the use of selected plant parts to develop a new plant.</p>
<p><b>Evaluation: Quiz</b></p>	<p>Answers:</p> <ol style="list-style-type: none"> <li>1. False</li> <li>2. True</li> <li>3. True</li> <li>4. True</li> <li>5. Stamen</li> </ol>

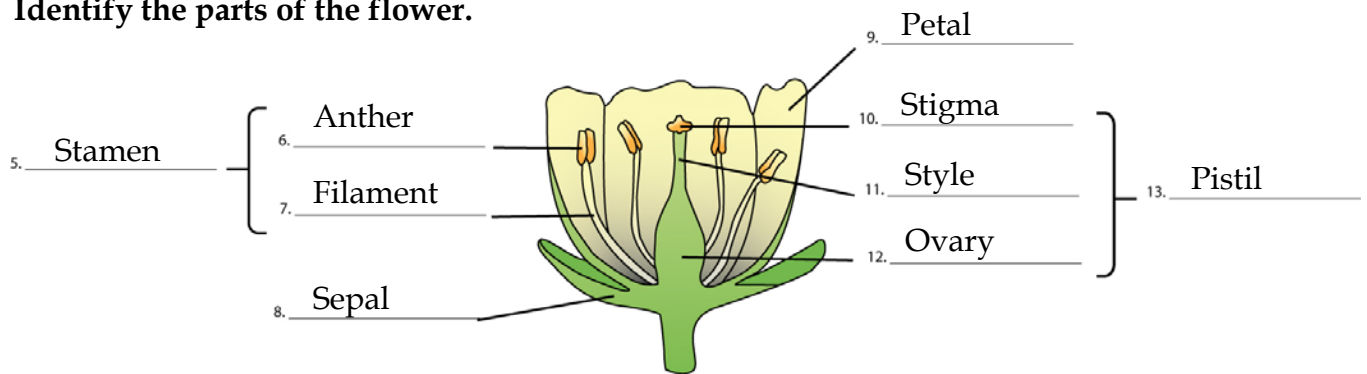
Instructor Directions	Content Outline
	<ol style="list-style-type: none"><li>6. Anther</li><li>7. Filament</li><li>8. Sepal</li><li>9. Petal</li><li>10. Stigma</li><li>11. Style</li><li>12. Ovary</li><li>13. Pistil</li><li>14. c</li><li>15. b</li><li>16. a</li><li>17. e</li><li>18. f</li><li>19. d</li></ol>

**Evaluation**

**True/False (Place the correct response in the blank provided.)**

- F 1. Sexual plant reproduction involves the use of vegetative plant parts to produce another plant.
- T 2. Asexual plant reproduction involves the use of plant parts to produce another plant.
- T 3. Pollination and fertilization are part of sexual plant reproduction.
- T 4. Complete flowers contain the pistil.

**Identify the parts of the flower.**



**Match the correct method with its description.**

- |   |  |                   |
|---|--|-------------------|
| c | 14. Plant pieces that are cut from the parent plant and rooted to form new plants            | a. Layering       |
| b | 15. Separating clumps of plants into small groups  | b. Division       |
| a | 16. Rooting a new plant while the stem is still attached to the parent plant                 | c. Cuttings       |
| e | 17. Method of inserting buds, twigs, or shoots from one plant onto the stem of another plant | d. Budding        |
| f | 18. The production of another plant from a meristematic tissue cell                          | e. Grafting       |
| d | 19. Inserting a single bud into the bark of another variety                                  | f. Tissue culture |

<b>Course</b>	Agricultural Science II
<b>Unit</b>	Plant Science
<b>Lesson</b>	Plant Genetics
<b>Estimated Time</b>	50 minutes

### Student Outcome

The student will be able to describe how genetics influence plant growth.

### Learning Objectives

1. Explain what is meant by the term inheritance.
2. Explain how genetics influence plant growth.
3. Define a gene.
4. Explain why DNA is important.
5. Define genetic engineering.
6. Explain how crop production benefits from biotechnology.
7. Identify some ethical considerations in genetic engineering.

### Grade Level Expectations

SC/LO/2/E/09-11/a      SC/LO/3/B/09-11/e

### Resources, Supplies & Equipment, and Supplemental Information

#### Resources

1. *Plant Science* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Plant Science Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

#### Supplies & Equipment

- Large world map

#### Supplemental Information

1. Internet Sites
  - Genetically Modified Foods and Organisms. Human Genome Project, Oak Ridge National Laboratory, Tennessee. Accessed January 24, 2008, from [http://www.ornl.gov/sci/techresources/Human\\_Genome/elsi/gmfood.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml).
  - Genetically Modified Foods: Harmful or Helpful? CSA, Bethesda, Maryland. Accessed January 24, 2008, from <http://www.csa.com/discoveryguides/gmfood/overview.php>.
2. Print
  - Parker, Rick. *Introduction to Plant Science*, rev. ed. Clifton Park, NY: Delmar Learning, 2003.

### Interest Approach

Using a large world map in front of the class, point out every body of water that is considered salt water. Then explain how some plants can survive salt water while most cannot. Easter lilies, for example, are fairly salt tolerant. Ask students what benefit it would be if other plants (e.g., corn and wheat) could be grown using salt water for irrigation. Ask students if plants could be produced that were not hurt by salt water, how would this affect world food production.

### Communicate the Learning Objectives

1. Explain what is meant by the term inheritance.
2. Explain how genetics influence plant growth.
3. Define a gene.
4. Explain why DNA is important.
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6. Explain how crop production benefits from biotechnology.
7. Identify some ethical considerations in genetic engineering.

Instructor Directions	Content Outline
<b>Objective 1</b>  <i>Children inherit specific characteristics such as hair and eye color from their parents. Plants also inherit characteristics from parent plants.</i>	<b>Explain what is meant by the term inheritance.</b>  Inheritance is the transmission of genes (i.e., traits, characteristics) from one generation to the next.
<b>Objective 2</b>  <i>Research conducted in the area of inheritance of specific traits involves the study of genetics (the biology of heredity). Researchers have begun to manipulate the genetic makeup of plants to develop improved varieties.</i>	<b>Explain how genetics influence plant growth.</b>  The genetic makeup of a plant determines the expression of traits (e.g., yield potential, flower color, size of plant, resistance to disease, etc.).
<b>Objective 3</b>  <i>The nucleus of each plant cell contains chromosomes. Chromosomes are a sequence of DNA (deoxyribonucleic acid) molecules which contain genetic information (genes).</i>	<b>Define a gene.</b>  Genes are the parts of a chromosome that determine the individual plant characteristics. Genes are the smallest unit of inheritance.

Instructor Directions	Content Outline
<p><b>Objective 4</b></p> <p><i>Each plant species has specific characteristics. These characteristics are directly related to the plant's DNA (deoxyribonucleic acid).</i></p>	<p><b>Explain why DNA is important.</b></p> <ol style="list-style-type: none"> <li>1. It serves as the coding mechanism for heredity (genes).</li> <li>2. It contains information to control the synthesis of enzymes and other proteins that control the basic metabolic processes of all cells.</li> </ol>
<p><b>Objective 5</b></p> <p><i>Research in plant genetics provides a clearer understanding of the transmission of specific characteristics. These characteristics can be altered through the process of genetic engineering.</i></p>	<p><b>Define genetic engineering.</b></p> <p>Genetic engineering is the process of transferring genes from one organism to another.</p>
<p><b>Objective 6</b></p> <p><i>Discuss with the class what biotechnology means and what biotechnology has done in the area of crop production.</i></p>	<p><b>Explain how crop production benefits from biotechnology.</b></p> <ol style="list-style-type: none"> <li>1. Increase of production levels (yields)</li> <li>2. New plant development (somatic hybrids)</li> <li>3. Possible increase of specific beneficial characteristics (salt tolerance, disease resistance, etc.)</li> </ol>
<p><b>Objective 7</b></p> <p><i>Public perception about biotechnology and the use of genetic engineering may be a result of a combination of factors. The average U.S. citizen may not understand all the scientific terminology, but they still desire to be informed as to what the scientific community is doing.</i></p>	<p><b>Identify some ethical considerations in genetic engineering.</b></p> <ol style="list-style-type: none"> <li>1. Motives for research</li> <li>2. Safety</li> <li>3. Application of findings</li> <li>4. Social and consumer acceptability</li> <li>5. Environmental impact</li> <li>6. Costs versus benefits</li> </ol>
<p><b>Application</b></p>	<p><b>Other activities</b></p> <ol style="list-style-type: none"> <li>1. Have students do written reports in the area of genes, DNA, genetic engineering related to plants, and how research in this area has benefitted the world's population.</li> <li>2. Take a field trip to Monsanto in St. Louis or another agribusiness that is involved with biotechnology.</li> <li>3. Have students read and report on magazine or newspaper articles on genetic engineering.</li> </ol>

Instructor Directions	Content Outline
Closure/Summary	Plant genetics involves many areas of research. Studies on the inheritance of traits, DNA, genes, and genetic engineering continue to open new doors into the plant world to provide better ways to produce food for a growing world population.
Evaluation: Quiz	Answers: 1. b 2. c 3. a 4. d 5. a 6. c

Unit: Plant Science

Name \_\_\_\_\_

Lesson 8: Plant Genetics

Date \_\_\_\_\_

### Evaluation

**Circle the letter that corresponds to the best answer.**

1. The transmission of characteristics from one generation to another is referred to as

- a. Plant growth
- b. Inheritance
- c. Reproduction
- d. Genetics

**Correct answer is b.**

2. The part of a chromosome that determines individual plant characteristics is called

- a. Trait
- b. Pollen
- c. Gene
- d. Enzyme

**Correct answer is c.**

3. Which of the following contains information that controls the metabolic processes of a plant cell?

- a. DNA
- b. Characteristics
- c. Inheritance
- d. Enzyme activity

**Correct answer is a.**

4. Somatic hybrid plants are produced through

- a. Self-pollination
- b. Sexual reproduction
- c. Enzyme activity
- d. Genetic engineering

**Correct answer is d.**



5. The genetic information that is passed from generation to generation is found in

- a. DNA
- b. Characteristics
- c. Pollination
- d. Genetic engineering

**Correct answer is a.**

6. The manipulation of specific characteristics of a plant is known as

- a. Metabolic activity
- b. Enzyme activity
- c. Genetic engineering
- d. Chromosomes

**Correct answer is c.**