The student will be able to describe the economic importance of crop production.

Learning Objectives

1. Identify the major crops produced in Missouri.
2. Identify where Missouri is ranked in crop production in the U.S.
3. Identify the major crops produced in the world.
4. Describe the factors that affect which crops are grown.
5. Explain how crop production impacts international relationships.
6. Explain how crop production in other countries affects the U.S.
7. Explain how the efficiency of crop production has affected the development of society.

Grade Level Expectations


Resources, Supplies & Equipment, and Supplemental Information

Resources


Supplies & Equipment

- Agricultural food products or just the packages labeled AgriMissouri
- Display board for food products
- Large map of Missouri

Supplemental Information

1. Internet Sites
**Instructor Directions**

**Objective 1**

Missouri’s diverse geography allows for the production of a wide range of agricultural products. From flat land to rolling hills, from low delta land to forested mountains, Missouri is able to produce a variety of crops.

**Identify the major crops produced in Missouri.**

1. Soybeans
2. Corn
3. Wheat
4. Grain sorghum
5. Cotton
6. Rice
7. Fescue seed
8. Lespedeza
9. Hay

**Objective 2**

Crop production in Missouri plays an important part in the overall production of crops in the U.S. (Data at right is from the Missouri Farm Facts website for 2006.)

**Identify where Missouri is ranked in crop production in the U.S.**

1. 2nd in hay production (excluding alfalfa)
2. 4th in hay production (all)
3. 4th in rice
4. 5th in grain sorghum
5. 7th in soybeans
6. 8th in corn for grain
7. 9th in cotton

**Communicate the Learning Objectives**

1. Identify the major crops produced in Missouri.
2. Identify where Missouri is ranked in crop production in the U.S.
3. Identify the major crops produced in the world.
4. Describe the factors that affect which crops are grown.
5. Explain how crop production impacts international relationships.
6. Explain how crop production in other countries affects the U.S.
7. Explain how the efficiency of crop production has affected the development of society.

**Interest Approach**

The instructor should secure several agricultural food products labeled AgriMissouri (either the food product or just the package) and have a display ready to be used in introducing this lesson. A list of AgriMissouri products can be obtained from your local grocer. Using a large map of Missouri, have students locate where each finished, packaged product is from. Next, look at the agricultural ingredients in each product (e.g., wheat, corn, and pork). Using the information from the Missouri Farm Facts website (included in the Supplemental Information), locate the areas that produce the raw products.

Ask students to list the jobs that are involved in processing the products. Discuss the importance of the income received by those employed in processing and the importance of the products to the economy of each community and the state.
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
</table>
| Note: Farm Facts data is compiled annually. For the most recent information, consult the Missouri Farm Facts website. | 8. 9th in cottonseed  
9. 9th in winter wheat  
10. 10th in tobacco  
11. 10th in watermelon |

**Objective 3**

World trade in agricultural products is important to the U.S. economy. Spices were one of the first goods purchased from foreign lands. Before the new colonies in North America declared independence, crops like tobacco and potatoes were exported to England. Agricultural products were imported from other countries to meet the growing needs of the new colonies. Agricultural trade has increased since the early history of the U.S. and so has the production of agricultural crops by other countries.

Identify the major crops produced in the world.

1. Cereal grains (wheat, barley, oats, rye, corn, sorghum, rice)  
2. Oilseeds (cotton, soybeans, peanut, canola, rapeseed, sunflower, safflower)  
3. Sugar (sugar beets, some sugar cane)  
4. Fiber crops (cotton, hemp, flax, jute)

**Objective 4**

The U.S. has been richly endowed with much productive land and a temperate climate. American farmers are able to produce more than what is needed by the people of this nation. The efficient production of agricultural crops holds both benefits and disadvantages for farmers. Discuss what factors affect which crops are grown in a given area.

Describe the factors that affect which crops are grown.

1. Land capability and use  
2. Climate  
3. Resource availability  
4. Product demand  
5. International trade

**Objective 5**

Differences in natural conditions and economic structures lead to great differences in the cost of production of agricultural

Explain how crop production impacts international relationships.

1. Helps stimulate the U.S. economy  
2. Helps provide jobs in export/import industries  
3. Contributes to the U.S. trade balance  
4. Builds allies
### Objective 6

**Explain how crop production in other countries affects the U.S.**

1. Crops not produced in the U.S. may be imported (e.g., teas, coffees, other beverages, and fibers).
2. Excess foreign production may result in surpluses and lower prices.
3. Foreign countries with lower labor costs may make products cheaper for U.S. imports.

### Objective 7

**Explain how the efficiency of crop production has affected the development of society.**

1. People and resources are freed up to pursue other endeavors.
2. Less money is spent on food, leaving more money for other purchases.
3. Creation of jobs to meet the demand for other goods and services, which stimulates the economy.
4. Trade is encouraged, which makes other products and opportunities available.
5. Assists other societies to develop.

### Application

**Other activities**

1. Have students examine their community to discover how many agricultural products or ingredients are imported.
2. Locate a world map and identify countries that purchase crops from the U.S.

### Closure/Summary

Crop production in Missouri affects more than just the local economy. The economic value of crop production stimulates income and trade in the community, state, nation, and other countries. The U.S. owes its strength and greatness to the progressive, hardworking American farmer.
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluation: Quiz</strong></td>
<td><strong>Answers:</strong></td>
</tr>
</tbody>
</table>
| Note: Questions 8–18 are based on Missouri’s ranking among states as determined by the National Agricultural Statistics Service for 2006. Rankings are updated annually and are available on the Missouri Farm Facts website. | 1. True  
2. False  
3. False  
4. True  
5. True  
6. True  
7. False  
8. 8th  
9. 4th  
10. 7th  
11. 10th  
12. 2nd  
13. 9th  
14. 9th  
15. 5th  
16. 4th  
17. 9th  
18. 10th |
Evaluation

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

___ 1. Missouri’s geography encourages agricultural diversity.

___ 2. Missouri ranks last among other states for sorghum grain production.

___ 3. All rice is produced in Asian countries.

___ 4. Climate is an important factor to consider when choosing which crop to grow.

___ 5. The U.S. is richly endowed with fertile land.

___ 6. Agricultural trade builds allies.

___ 7. Agricultural trade limits social development.

How does Missouri rank in the U.S. in the production of each of the following crops?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Crop</th>
<th>Rank</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>___ Corn for grain</td>
<td>14</td>
<td>___ Cotton</td>
</tr>
<tr>
<td>9</td>
<td>___ Rice</td>
<td>15</td>
<td>___ Grain sorghum</td>
</tr>
<tr>
<td>10</td>
<td>___ Soybeans</td>
<td>16</td>
<td>___ Hay production (all)</td>
</tr>
<tr>
<td>11</td>
<td>___ Tobacco</td>
<td>17</td>
<td>___ Cottonseed</td>
</tr>
<tr>
<td>12</td>
<td>___ Hay production (excluding alfalfa)</td>
<td>18</td>
<td>___ Watermelon</td>
</tr>
<tr>
<td>13</td>
<td>___ Winter wheat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course: Agricultural Science II
Unit: Crop Science
Lesson: Crop Uses (Products and By-Products)
Estimated Time: 50 minutes

Student Outcome

The student will be able to identify how crops are used.

Learning Objectives

1. Identify the major uses of crops.
2. Identify the major crops in each of the major use categories.
3. Identify the products that are made from corn.
4. Identify the products that are made from soybeans.
5. Describe the characteristics which determine how a crop is used.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources


Supplies & Equipment

- Several samples of retail products made from one crop

Supplemental Information

1. Internet Sites
Content Outline

Objective 1

As the world population continues to grow, the demand and need for a continual supply of food and agricultural products increases. In order to meet the growing need, agricultural scientists through research and technology continue to develop new products and by-products from crops. Crop plants can be grouped according to how they are used.

**Identify the major uses of crops.**

1. Human and animal consumption (food or feed)
2. Production of various oils (human consumption/industrial use)
3. Medicines (pharmaceuticals)
4. Fibers (cloth, pulp)
5. Sugars/sweeteners
6. Alternative fuels
7. Shelter materials (lumber)
8. Ornamentals
9. Stimulants

<table>
<thead>
<tr>
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<th>Content Outline</th>
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<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td><strong>Identify the major uses of crops.</strong></td>
</tr>
</tbody>
</table>
| **As the world population continues to grow, the demand and need for a continual supply of food and agricultural products increases. In order to meet the growing need, agricultural scientists through research and technology continue to develop new products and by-products from crops. Crop plants can be grouped according to how they are used.** | 1. Human and animal consumption (food or feed)  
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<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 2</strong></td>
<td><strong>Identify the major crops in each of the major use categories.</strong></td>
</tr>
</tbody>
</table>
| **Write on the chalkboard the major uses of crop plants, and ask the students for suggestions of what crops would belong under each major use area. (List plants suggested by students and also the list found here.)** | 1. Crops for human and animal consumption (food or feed)  
   a. Cereal or grain crops – wheat, rye, barley, oats, rice, sorghum, corn  
   b. Legumes for seed – field beans, field peas, peanuts, cowpeas, soybeans  
   c. Fruits – apples, peaches, berries, cherries, etc.  
   d. Vegetables – tomatoes, cucumbers, squash, etc.  
   e. Nuts – pecans, walnuts, etc.  
2. Oil crops for human consumption and industrial use: soybeans, peanuts, castor beans, flax, sesame, cottonseed, corn, canola  
3. Medicine crops: digitalis, quinine, reserpine  
4. Fiber crops: cotton, flax, hemp  
5. Sugar crops: sugar cane, sugar beets  
6. Alternative fuels: crops that contain sugar or starch |
### Objective 3

Although corn is the most widely grown crop throughout the U.S., less than 10% is used for human consumption. Corn is used in a variety of products.

Identify the products that are made from corn.

1. Livestock feed
2. Cooking oils
3. Breakfast cereals
4. Corn on the cob
5. Corn starch
6. Cornmeal
7. Refined corn sugar
8. Flour
9. Popcorn
10. Adhesives
11. Dyes
12. Plastics
13. Ethanol
14. Others

### Objective 4

Soybean production has become very important to the U.S. and the world. Since World War II, soybean production has increased in the U.S.

Identify the products that are made from soybeans.

1. Cooking oil
2. Soybean meal
3. Soy-flour
4. Tofu (protein supplement)
5. Shortenings
6. Margarines
7. Inks for printing
8. Industrial oils in paints, varnishes, caulking compounds and linoleum
9. Soy sauces
10. Others

### Objective 5

Controlled production of plant crops plays a key role in the overall process of supplying food to the growing human population. However, not all plants are grown for food. Many plants are grown for specific products. Such plants

Describe the characteristics which determine how a crop is used.

1. Nutritive value (protein content, carbohydrate content, oil content, etc.) of the plant parts
2. Palatability of the plant for food or feed products
3. Use of the plant’s parts (stems, leaves, roots, seeds) for the processing of specific products other than food products
are produced because of the desirable characteristics they possess.

<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
<td>Other activities</td>
</tr>
<tr>
<td>1. Visit a processing plant in the area that uses plant products.</td>
<td></td>
</tr>
<tr>
<td>2. Divide students into groups and have them research a selected plant crop and list as many products or by-products from that crop as they can.</td>
<td></td>
</tr>
<tr>
<td>3. Using the lists generated in 2 above, write on the chalkboard all the plant products or by-products that the students would come in contact with on a daily basis.</td>
<td></td>
</tr>
<tr>
<td>4. Have each student write a paper on what everyday life would be like without plant products and by-products.</td>
<td></td>
</tr>
</tbody>
</table>

| Closure/Summary       | Plant crops have many uses. The production of human food, animal feed, various oils, pharmaceuticals, sugars, stimulants, and fibers have been brought about through the manipulation of specific plant characteristics. Researchers continue to broaden the list of products through research and technology. |

<table>
<thead>
<tr>
<th>Evaluation: Quiz</th>
<th>Answers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. True</td>
<td>2. True</td>
</tr>
<tr>
<td>3. False</td>
<td>4. True</td>
</tr>
<tr>
<td>5. FF</td>
<td>6. OC</td>
</tr>
<tr>
<td>7. OC, FC</td>
<td>8. MS</td>
</tr>
<tr>
<td>9. OC, FF</td>
<td>10. FF, OC, AF</td>
</tr>
<tr>
<td>11. OP</td>
<td>12. ST</td>
</tr>
<tr>
<td>13. FF</td>
<td>14. SC</td>
</tr>
<tr>
<td>15. ST</td>
<td>16. SC, AF</td>
</tr>
<tr>
<td>17. MS</td>
<td>18. OP</td>
</tr>
<tr>
<td>19. ST</td>
<td></td>
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<tr>
<td>Instructor Directions</td>
<td>Content Outline</td>
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<td>-----------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>20. FF</td>
<td></td>
</tr>
<tr>
<td>21. PH</td>
<td></td>
</tr>
<tr>
<td>22. FF</td>
<td></td>
</tr>
<tr>
<td>23. FC</td>
<td></td>
</tr>
</tbody>
</table>
Evaluation

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

T  1. Crops are used to produce products used by humans, livestock, and industry.
T  2. Corn and soybeans can produce both a grain product and an oil product.
F  3. Cotton is grown solely for the production of cottonseed oil.
T  4. Corn is the most commonly grown field crop in the U.S.

Place the two-letter code that corresponds to the use of the plant. Some plants have more than one use.

Foods and feeds for human and animal consumption = FF
Oil crops = OC
Fiber crops = FC
Sugar crops = SC
Stimulant crops = ST
Pharmaceuticals = PH
Alternative fuels = AF
Materials for shelter = MS
Ornamental plants = OP

Crop Plants

<table>
<thead>
<tr>
<th>Code</th>
<th>Plant</th>
<th>Code</th>
<th>Name</th>
<th>Code</th>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td>8. Oak tree</td>
<td>ST</td>
<td>15. Tea</td>
<td>FF</td>
<td>22. Cucumbers</td>
<td></td>
</tr>
<tr>
<td>FF, OC, AF</td>
<td>10. Corn</td>
<td>MS</td>
<td>17. Pine tree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Course: Agricultural Science II
Unit: Crop Science
Lesson: Plant and Seed Identification
Estimated Time: Four 50-minute blocks

Student Outcome
The student will be able to identify common plants and seeds in Missouri.

Learning Objectives
1. Describe how seeds are identified.
2. Describe the characteristics of selected crop and weed seeds.
3. Identify the three classes of weeds in Missouri.
4. Describe how plants are identified.
5. Describe the characteristics of selected crop and weed plants.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources
1. PowerPoint Slides
   - Ppt 1 – A Bean Seed
   - Ppt 2 – A Cereal Grain
   - Ppt 3 – Leaf Characteristics of Some Legumes
   - Ppt 4 – Parts of a Grass Plant
   - Ppt 5 – Parts of a Grass Leaf
   - Ppt 6 – Leaf Characteristics of Three Grass Species
2. Activity Sheets
   - AS 1 - Parts of a Bean Seed and Cereal Grain
   - AS 2 – Parts of a Grass Plant and Leaf
   - AS 3 – Characteristics of Selected Crop and Weed Plants
   - AS 4 – Seed Identification Score Sheet

Supplies & Equipment
- Packages of mixed seeds (e.g., corn, sunflower, and pinto bean)
Supplemental Information

1. Internet Sites

2. Print
**Interest Approach**

Divide the class into groups. Give each group a package of mixed seeds (e.g., corn, sunflower, and pinto bean). Have students separate and identify them. Discuss how they identified the seeds and why identification is important.

**Communicate the Learning Objectives**

1. Describe how seeds are identified.
2. Describe the characteristics of selected crop and weed seeds.
3. Identify the three classes of weeds in Missouri.
4. Describe how plants are identified.
5. Describe the characteristics of selected crop and weed plants.

<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td>Describe how seeds are identified.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
*While the students are divided into groups with the seeds separated, point out to them distinguishing characteristics of specific seeds. Use PPt 1-2 to aid in this discussion. Have students complete AS 1.* |

- P Pt 1 - A Bean Seed
- P Pt 2 - A Cereal Grain
- AS 1 - Parts of a Bean Seed and Cereal Grain

| **Objective 2**       | Describe the characteristics of selected crop and weed seeds. |
| Select some crop and/or weed seeds that you feel are important and prepare seed samples on paper plates. (NOTE: Seed samples are available through IML.) Have students use the crop and weed seed information in the student reference to identify the seeds. |

1. Crop seeds (student should use information in student reference)
2. Weed seeds (student should use information in student reference)

| **Objective 3**       | Identify the three classes of weeds in Missouri. |
| Weeds are plants. However, a weed is any plant that is growing |

1. Prohibited – weeds that are nearly impossible to control; Missouri law “prohibits” the sale of
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>where it is not wanted. Weeds can be classified into groupings for identification.</td>
<td>agricultural seeds which contain “prohibited” weed seeds.</td>
</tr>
<tr>
<td></td>
<td>2. Noxious – weeds that can be controlled with some difficulty; the presence of “noxious” weed seed in agricultural seeds is restricted in Missouri.</td>
</tr>
<tr>
<td></td>
<td>3. Common – weeds that are relatively easy to control, but reduce crop yields and increase production costs.</td>
</tr>
</tbody>
</table>

**Objective 4**

Identification of plants is important in crop production and weed control. There are several characteristics which can be used to identify crop and weed seeds. Refer to AS 2.

- AS 2 – Parts of a Grass Plant and Leaf

**Objective 5**

Select a few plants that you feel are important and prepare several samples of major field crop and weed plants of Missouri. Be sure to select those plants that display distinct characteristics (e.g., flowers, leaves, roots, and stolons). Use PPt 3-6 to discuss the differences of plant characteristics (e.g., pinnately or palmately structured leaves). Have students refer to information in the student reference and complete AS 3.

- PPt 3 – Leaf Characteristics of Some Legumes
- PPt 4 – Parts of a Grass Plant
- PPt 5 – Parts of a Grass Leaf

Describe how plants are identified.

1. Life cycle
2. Plant height
3. Leaves
4. Stems
5. Flower
6. Roots

Describe the characteristics of selected crop and weed plants.
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ppt 6 – Leaf Characteristics of Three Grass Species</td>
<td></td>
</tr>
<tr>
<td>AS 3 – Characteristics of Selected Crop and Weed Plants</td>
<td></td>
</tr>
</tbody>
</table>

**Application**

<table>
<thead>
<tr>
<th>AS 1 – Parts of a Bean Seed and Cereal Grain</th>
<th>Answers to AS 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Raphe (d)</td>
<td>1. Raphe (d)</td>
</tr>
<tr>
<td>2. Hilum (f)</td>
<td>2. Hilum (f)</td>
</tr>
<tr>
<td>3. Micropyle (g)</td>
<td>3. Micropyle (g)</td>
</tr>
<tr>
<td>4. Cotyledons (c)</td>
<td>4. Cotyledons (c)</td>
</tr>
<tr>
<td>5. Seed coat (a)</td>
<td>5. Seed coat (a)</td>
</tr>
<tr>
<td>6. Radicle (b)</td>
<td>6. Radicle (b)</td>
</tr>
<tr>
<td>7. Shoot (e)</td>
<td>7. Shoot (e)</td>
</tr>
<tr>
<td>8. Mid vein (b)</td>
<td>8. Mid vein (b)</td>
</tr>
<tr>
<td>9. Callus (d)</td>
<td>9. Callus (d)</td>
</tr>
<tr>
<td>10. Suture (f)</td>
<td>10. Suture (f)</td>
</tr>
<tr>
<td>11. Awn (a)</td>
<td>11. Awn (a)</td>
</tr>
<tr>
<td>12. Apex of palea (c)</td>
<td>12. Apex of palea (c)</td>
</tr>
<tr>
<td>13. Lemma (e)</td>
<td>13. Lemma (e)</td>
</tr>
<tr>
<td>14. Teeth of edge of palea (keel) (i)</td>
<td>14. Teeth of edge of palea (keel) (i)</td>
</tr>
<tr>
<td>15. Palea (g)</td>
<td>15. Palea (g)</td>
</tr>
<tr>
<td>16. Rachilla (h)</td>
<td>16. Rachilla (h)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AS 2 – Parts of a Grass Plant and Leaf</th>
<th>Answers to AS 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Culm (a)</td>
<td>1. Culm (a)</td>
</tr>
<tr>
<td>2. Leaf blade (e)</td>
<td>2. Leaf blade (e)</td>
</tr>
<tr>
<td>3. Ligule (b)</td>
<td>3. Ligule (b)</td>
</tr>
<tr>
<td>4. Sheath (d)</td>
<td>4. Sheath (d)</td>
</tr>
<tr>
<td>5. Auricles (c)</td>
<td>5. Auricles (c)</td>
</tr>
<tr>
<td>6. Inflorescence (e)</td>
<td>6. Inflorescence (e)</td>
</tr>
<tr>
<td>7. Culm (d)</td>
<td>7. Culm (d)</td>
</tr>
<tr>
<td>8. Sheath (b)</td>
<td>8. Sheath (b)</td>
</tr>
<tr>
<td>9. Roots (c)</td>
<td>9. Roots (c)</td>
</tr>
<tr>
<td>10. Leaf blade (h)</td>
<td>10. Leaf blade (h)</td>
</tr>
<tr>
<td>11. Node (g)</td>
<td>11. Node (g)</td>
</tr>
<tr>
<td>12. Stolon (f)</td>
<td>12. Stolon (f)</td>
</tr>
<tr>
<td>13. Rhizome (a)</td>
<td>13. Rhizome (a)</td>
</tr>
<tr>
<td>Instructor Directions</td>
<td>Content Outline</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
</tbody>
</table>
| AS 3 - Characteristics of Selected Crop and Weed Plants | Answers to AS 3  
Instructor needs to determine if answers are appropriate. |
| AS 4 - Seed Identification Score Sheet | Answers to AS 4  
Instructor needs to determine if answers are appropriate. |
| **Other activities** | |
| 1. During this lesson, have a daily display of selected seeds in a tray identified only by a number. Have students identify them. Do at least 5 a day until all seeds are identified. Develop a score chart to record student progress. (A classroom contest can be arranged for motivation.) Use AS 4. | |
| 2. Display pictures of selected crop and weed plants identified by only a number. Have students identify them. Do at least 5 a day until all crops and weeds in the lesson are identified. | |
| **Closure/Summary** | The presence of weeds in crops is costly to the producer. Proper plant identification plays a part in the process of reducing weeds and in turn reducing the damage to crops because of them. |
| **Evaluation: Quiz** | Answers:  
Correct answers need to be determined by the instructor. |
Parts of a Bean Seed

Directions: Place in the appropriate space the correct part.

Parts
a. Seed coat
b. Radicle
c. Cotyledons
d. Raphe
e. Shoot
f. Hilum
g. Micropyle
Parts of a Cereal Grain

Directions: Place in the appropriate space the correct part.

Parts
a. Awn
b. Mid vein
c. Apex of palea
d. Callus
e. Lemma
f. Suture
g. Palea
h. Rachilla
i. Teeth of edge of palea (keel)
Parts of a Grass Plant and Leaf

**Directions:** Place in the appropriate space the correct part.

A Grass Leaf

1. **Parts**
   - a. Culm
   - b. Ligule
   - c. Auricles
   - d. Sheath
   - e. Leaf blade

A Grass Plant

1. **Parts**
   - a. Rhizome
   - b. Sheath
   - c. Roots
   - d. Culm
   - e. Inflorescence
   - f. Stolon
   - g. Node
   - h. Leaf blade
Lesson 3: Plant and Seed Identification

Name ____________________________

Characteristics of Selected Crop and Weed Plants

**Directions:** Using the selected plants provided by the instructor and information found in the student reference, fill in the appropriate sections with the correct information describing the characteristics of the selected crop and weed plants.

**Plant #1**

- Common name __________________________
- Life cycle ____________________________
- Plant height (mature) __________________
- Type of leaves _________________________
- Type of stems _________________________
- Type of flowers _________________________
- Type of roots _________________________

**Plant #2**

- Common name __________________________
- Life cycle ____________________________
- Plant height (mature) __________________
- Type of leaves _________________________
- Type of stems _________________________
- Type of flowers _________________________
- Type of roots _________________________
Plant #3

Common name _________________________
Life cycle _________________________
Plant height (mature) __________________
Type of leaves _________________________
Type of stems _________________________
Type of flowers _________________________
Type of roots _________________________

Plant #4

Common name _________________________
Life cycle _________________________
Plant height (mature) __________________
Type of leaves _________________________
Type of stems _________________________
Type of flowers _________________________
Type of roots _________________________

Plant #5

Common name _________________________
Life cycle _________________________
Plant height (mature) __________________
Type of leaves _________________________
Type of stems _________________________
Type of flowers _________________________
Type of roots _________________________
Lesson 3: Plant and Seed Identification

Name ______________________

Seed Identification Sheet

<table>
<thead>
<tr>
<th>Date</th>
<th>Seed Number</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Total Correct: __________________
Evaluation

1. Crabgrass, which is relatively easy to control but can interfere with production, is an example of a _________.
   a. Crop plant
   b. Common weed
   c. Noxious weed
   d. Prohibited weed
   Correct answer is b.

Match each term below with its correct definition.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>h</td>
<td>2. Callus</td>
<td>a. The husk on the back, dorsal side of the grass seed</td>
</tr>
<tr>
<td>e</td>
<td>3. Culm</td>
<td>b. Underground creeping stem</td>
</tr>
<tr>
<td>j</td>
<td>4. Hilum</td>
<td>c. Above ground, horizontal stem</td>
</tr>
<tr>
<td>a</td>
<td>5. Lemma</td>
<td>d. The husk on the front, ventricle side of the grass seed</td>
</tr>
<tr>
<td>d</td>
<td>6. Palea</td>
<td>e. Stem</td>
</tr>
<tr>
<td>f</td>
<td>7. Pinnately trifolioate</td>
<td>f. Central-terminal leaflet borne on a conspicuous petiolule</td>
</tr>
<tr>
<td>i</td>
<td>8. Rachilla</td>
<td>g. Leaf-like structure from either side of the leaf base</td>
</tr>
<tr>
<td>b</td>
<td>9. Rhizome</td>
<td>h. Enlarged base at end of the lemma</td>
</tr>
<tr>
<td>g</td>
<td>10. Stipule</td>
<td>i. A small stem to which a grass seed is attached to the branch or stem</td>
</tr>
<tr>
<td>c</td>
<td>11. Stolon</td>
<td>j. The scar at the point of attachment of a seed to the pod</td>
</tr>
</tbody>
</table>
The student will be able to identify characteristics of quality seed.

Learning Objectives

1. Describe the characteristics of quality seed.
2. Identify the four classes of seed certification.
3. Describe the requirements for seed certification.
4. Describe the benefits of using certified seed.
5. Identify factors that should be considered in selecting a crop variety.

Grade Level Expectations

SC/EC/3/B/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheet
   - AS 1 – Seed Information and Germination Test

Supplies & Equipment

- Tin pie plate (need 1 for each student or group of students)
- Two paper towels (for each student/group of students)
- Twenty seeds (for each student/group of students) – instructor determines variety
- Seed tag information from the variety selected
- Masking tape

Supplemental Information

1. Internet Sites
**Interest Approach**

Use AS 1 (Seed Information and Germination Test) to generate interest in the process of seed quality testing and germination rates found on certified seed tags. Students will need to be responsible for their seed germination tests.

**Communicate the Learning Objectives**

1. Describe the characteristics of quality seed.
2. Identify the four classes of seed certification.
3. Describe the requirements for seed certification.
4. Describe the benefits of using certified seed.
5. Identify factors that should be considered in selecting a crop variety.

<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td>Describe the characteristics of quality seed.</td>
</tr>
</tbody>
</table>
| In order to ensure an adequate crop stand, quality seed should be used when planting the crop. Crop yields can be affected by the seed used. Agronomists estimate the yields from the use of good seed to be 10% to 20% greater than yields resulting from poor quality seed. There are several characteristics of quality seed. | 1. Good genetic potential  
2. Good germination  
3. Proper size and development  
4. Uniformity in size and shape  
5. Absence of seed-borne diseases and insects  
6. Absence of prohibited, noxious, and other weed seeds  
7. Absence of other crop seeds and other varieties  
8. Absence of inert materials |
| **Objective 2**       | Identify the four classes of seed certification. |
| The objective of seed certification is to ensure the quality of seed used by farmers. Seed certification also assures the buyer that genetic purity of the variety is maintained. There are four classes of certified seed. | 1. Breeder seed – this seed is used to produce foundation seed. Small quantities are produced by commercial seed companies.  
2. Foundation seed – Foundation seed is the parent line for registered seed and/or certified seed. (white tag)  
3. Registered seed – This seed is produced from foundation seed; it may be used to produce certified seed or sold directly to farmers. (purple tag)  
4. Certified seed – Certified seed is produced from foundation or registered seed; it is sold directly to farmers. (blue tag) |
<p>| <strong>Objective 3</strong>       | Describe the requirements for seed certification. |
| Many states have seed laws that are designed to control the quality | 1. The seed is grown from registered or foundation seed stock. |</p>
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
</table>
| of seed sold within the state. Seed associations work to produce quality seed with strict requirements. | 2. The crops produced pass an inspection for mixtures, weeds, and diseases in the field.  
3. The harvested crops attain the standard of quality set by the seed association. |

**Objective 4**

*Research has shown marked benefits from using certified seed. Although the cost of certified seed may be higher than uncertified seed, the benefits outweigh the cost difference.*

**Describe the benefits of using certified seed.**

1. Guaranteed to be the variety advertised  
2. Guaranteed minimum germination rate  
3. Guaranteed to meet weed, mechanical injury, disease, and insect contamination standards

**Objective 5**

*When selecting a crop variety, there are many factors to consider. Environmental factors such as growing season length, soil type, and annual precipitation are important considerations. However, many of these factors cannot be controlled by the farmer. One factor that the farmer can control is the choice of seed to be used.*

**Identify factors that should be considered in selecting a crop variety.**

1. Cost  
2. Adaptability of the variety to local growing conditions  
3. Yield potential  
4. Purity of variety  
5. Quality of crop (protein content, resistance to lodging)  
6. Disease and insect resistance  
7. Maturity date

**Application**

- **AS 1 – Seed Information and Germination Test**

  Answers will vary and should be determined by the instructor.

  **Other activities**
  1. Have students run some germination tests on different seed lots/varieties to see if the stated germination rate is met.  
2. If possible, visit a certified seed processing operation.  
3. Invite a certified seed producer to visit with the class about the production of quality seed.

**Closure/Summary**

Through the use of certified seed, farmers can be assured that the seed is guaranteed in yield ability, purity, quality, and ability to resist diseases and insects. The first step to ensuring a quality crop is selecting quality seed.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Evaluation: Quiz</td>
<td>Answers:</td>
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<td>1. a</td>
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</table>
Lesson 4: Certified Seed and Variety Selection

Name ____________________________

Seed Information and Germination Test

Materials:
1. Tin pie plate
2. Two paper towels
3. Twenty seeds (variety determined by instructor)
4. Information from seed tag
5. Masking tape

Procedure:
1. Transfer information from the seed tag onto the table below.
2. Label your pie plate by placing a piece of tape with your name on it on the pie plate.
3. Place one paper towel into the pie plate.
4. Place the 20 seeds in a rectangular pattern on the paper towel in the pie plate.

Example:

```
 Seeds
-------------
 Paper towel
```

5. Place second paper towel over seeds and gently dampen towels until completely damp.
6. Check pan daily (once or twice daily) to ensure that proper moisture is maintained.
7. After 5 days, check seeds for germination.
8. After 10 days, count the number of seeds germinated. Place in the box titled “% test germination” the percentage that germinated out of the 20 seeds tested.
9. Compare test germination percentage with stated germination percentage.

Note: This activity can be repeated with different varieties.

<table>
<thead>
<tr>
<th>Crop Variety</th>
<th>Crop Origin</th>
<th>Lot Number</th>
<th>% Purity</th>
<th>% Inert Matter</th>
<th>% of Other Crop Seed</th>
<th>% of Weed Seed</th>
<th>% Stated Germination</th>
<th>% Test Germination</th>
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<tbody>
<tr>
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</table>
Lesson 4: Certified Seed and Variety Selection

Evaluation

Circle the letter that corresponds to the best answer.

1. In addition to being free from disease organisms, insects, and weeds, good seed should be uniform in size and shape.
   a. True
   b. False
   Correct answer is a.

2. Why is certified seed superior to uncertified seed?
   a. It is guaranteed to contain inert matter.
   b. It is guaranteed to have varietal purity. (correct answer)
   c. It is guaranteed to have equal germination rate.
   d. It is guaranteed to be of equal cost.
   Correct answer is b.

3. What is certified seed produced from?
   a. Foundation seed
   b. Breeder seed
   c. Certified seed
   d. Either a, b, or c
   Correct answer is a.

4. What is the color of a “Registered Seed” tag?
   a. White
   b. Blue
   c. Purple
   d. No color
   Correct answer is c.

5. What is the purpose of certifying seed?
   a. Keep good tax records on quality seed
   b. Limit the number of seed producers
   c. Keep price controls on seeds produced
   d. Guarantee the quality of seed
   Correct answer is d.
The student will be able to explain the requirements for establishing a crop stand.

1. Describe the purpose of tillage.
2. Explain how different tillage methods affect the environment.
3. Explain why different seeding methods are used.
4. Identify the factors that affect the proper depth of planting.
5. Identify the major nutrient elements that are needed for stand establishment.
6. Identify the factors that influence the optimum seeding rate.

Resources, Supplies & Equipment, and Supplemental Information

Resources

Supplies & Equipment
- Ant farm or view box
- Eight seeds of any field crop

Supplemental Information
1. Internet Sites
**Interest Approach**

Use an ant farm (or view box) to show emergence of seeds. Plant seeds from 1/2 inch to 4 inches deep in 1/2-inch increments. Prepare the demonstration about 7 to 10 days before the anticipated date of presentation to the class.

**Communicate the Learning Objectives**

1. Describe the purpose of tillage.
2. Explain how different tillage methods affect the environment.
3. Explain why different seeding methods are used.
4. Identify the factors that affect the proper depth of planting.
5. Identify the major nutrient elements that are needed for stand establishment.
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<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td>Describe the purpose of tillage.</td>
</tr>
</tbody>
</table>
| *Proper preparation of a field for planting is vital to the success of the crop. Selecting the appropriate tillage method is dependent on the intended purpose.* | 1. To prepare a suitable seedbed  
2. To eliminate competition from weeds  
3. To improve the physical condition of the soil |
| **Objective 2**       | Explain how different tillage methods affect the environment. |
| *Soil is a precious natural resource. Each year over 1.6 billion tons of U.S. farm land soil is washed away due to soil erosion. The type of tillage used in crop production influences the amount of soil lost through erosion.* | 1. Conventional tillage leaves the soil surface relatively free of crop residue and vulnerable to erosion.  
2. Minimum tillage methods maintain crop residues on the soil surface and reduce soil erosion.  
3. No-till methods leave all crop residue on the soil surface and nearly eliminate soil erosion. |
| **Objective 3**       | Explain why different seeding methods are used. |
| *Seeding practices vary, and care must be taken when performing this task to ensure the proper seeding method is used.* | 1. Row method – for planting evenly spaced seeds in parallel rows, allows for mechanical cultivation  
2. Drill method – for planting seeds in narrow rows in high population rates, reduces need for mechanical cultivation  
3. Broadcast method – for scattering seeds in a random pattern across the top of the seedbed, does not allow for mechanical weed control, cheapest method, faster coverage for erosion control |
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 4</strong></td>
<td>Identify the factors that affect the proper depth of planting.</td>
</tr>
</tbody>
</table>
| Several factors should be considered when deciding on the appropriate rate and depth of planting. | 1. Type of soil  
2. Size of seed  
3. Type of emergence  
4. Soil moisture  
5. Soil temperature |
| **Objective 5** | Identify the major nutrient elements that are needed for stand establishment. |
| After planting, other factors affect the growth and establishment of the crop. Specific nutrients are needed to enable the plants to grow to their potential. | 1. Nitrogen  
2. Phosphorus  
3. Potassium |
| **Objective 6** | Identify the factors that influence the optimum seeding rate. |
| Proper stand establishment will increase the chances of a good yield, provided the weather is conducive to proper plant growth. The desired plant population is dependent on several factors, one of which is the seeding rate. | 1. Type of crop  
2. Use of crop  
3. Pure live-seed ratio or percent  
4. Seed quality  
5. Soil moisture  
6. Soil productivity  
7. Time of seeding  
8. Method of seeding  
9. Row width  
10. Expected average rainfall |
| **Application** | Other activities  
1. Take a field trip to a local farm to observe the process of seedbed preparation. Discuss the type of tillage used.  
2. Arrange for a demonstration of several methods of tillage on the school land laboratory.  
3. Conduct experiments with different seeds planted at different depths and calculate emergence time and rates. |
| **Closure/Summary** | Proper preparation of the seedbed and planting seed at the proper depth will increase the emergence rate. Tillage during stand establishment can influence the amount of soil lost due to erosion. Tillage, seeding methods, seeding |
depth, seeding rate, and nutrient availability are factors which greatly influence the crop yields.

<table>
<thead>
<tr>
<th>Evaluation: Quiz</th>
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<tbody>
<tr>
<td>Answers:</td>
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<tr>
<td>1. True</td>
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<td>2. False</td>
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<td>5. True</td>
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<td>9. b</td>
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<td>10. c</td>
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<td>11. a</td>
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</tbody>
</table>
Evaluation

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

T 1. Proper tillage improves seed germination.

F 2. Conventional tillage methods minimize soil erosion.

F 3. Conventional tillage results in less soil loss than does minimum tillage.

F 4. Broadcast seeding involves planting seeds in narrow rows.

T 5. Seed planting depth should be adjusted according to the soil type and seed size.

Select the tillage method on the right that corresponds best with the statement on the left. Answers may be used more than once.

<table>
<thead>
<tr>
<th></th>
<th>a. Leaves the soil smooth</th>
<th>b. Minimum till</th>
<th>c. No-till</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>a</td>
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<td>7</td>
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<table>
<thead>
<tr>
<th></th>
<th>a. Conventional</th>
<th>b. Minimum till</th>
<th>c. No-till</th>
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<tbody>
<tr>
<td>8</td>
<td>a</td>
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<tbody>
<tr>
<td>9</td>
<td>a</td>
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<table>
<thead>
<tr>
<th></th>
<th>a. Leaves the soil smooth</th>
<th>b. Minimum till</th>
<th>c. No-till</th>
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<tbody>
<tr>
<td>10</td>
<td>a</td>
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<th>a. Leaves the soil smooth</th>
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<tr>
<td>11</td>
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</tbody>
</table>
The student will be able to describe good crop production practices.

1. Identify the three nutrient elements that are applied to most crops.
2. Identify when fertilizer can be applied.
3. Describe why soil pH is important in crop production.
4. Describe how soil pH can be altered.
5. Explain how plant residues should be managed.
6. Explain how plant pests can be controlled.
7. Identify the irrigation methods that are used in crop production.


1. **Crop Science** (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1992.

1. Internet Sites

### Interest Approach

Ask students what the term “management decisions” means to them. Briefly discuss the effects of good and poor decisions on crop production. Describe how crop yields have changed over the past century due to commercial fertilizers, hybrid seeds, and other technological advances.

### Communicate the Learning Objectives

1. Identify the three nutrient elements that are applied to most crops.
2. Identify when fertilizer can be applied.
3. Describe why soil pH is important in crop production.
4. Describe how soil pH can be altered.
5. Explain how plant residues should be managed.
6. Explain how plant pests can be controlled.
7. Identify the irrigation methods that are used in crop production.

### Instructor Directions | Content Outline

<table>
<thead>
<tr>
<th>Objective 1</th>
<th>Identify the three nutrient elements that are applied to most crops.</th>
</tr>
</thead>
</table>
| In order for plants to grow properly and produce good yields, they need to have essential nutrient elements for proper growth and development. Ask students to identify the kinds of fertilizers and the amount that should be applied to locally grown crops. | 1. Nitrogen (N)  
2. Phosphorus (P)  
3. Potassium (K) |

<table>
<thead>
<tr>
<th>Objective 2</th>
<th>Identify when fertilizer can be applied.</th>
</tr>
</thead>
</table>
| The most common method of maintaining adequate levels of essential nutrients in the soil is through application of commercial fertilizers. After a soil test is taken, analyzed and recommendations are made, appropriate amounts and grades of fertilizers can be applied. | 1. At planting time, starter fertilizer  
2. After plants have emerged from soil, side dressing  
3. After plants are established, top dressing |
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 3</strong></td>
<td>Describe why soil pH is important in crop production.</td>
</tr>
<tr>
<td></td>
<td>1. Crops grow and produce the best within a pH range of 5.0 to 7.5.</td>
</tr>
<tr>
<td></td>
<td>2. Soil pH affects the availability of nutrients for plant uptake.</td>
</tr>
<tr>
<td></td>
<td><strong>Objective 4</strong> Describe how soil pH can be altered.</td>
</tr>
<tr>
<td></td>
<td>1. Application of lime reduces soil acidity.</td>
</tr>
<tr>
<td></td>
<td>2. Application of sulfur or aluminum sulfate will reduce soil alkalinity.</td>
</tr>
<tr>
<td></td>
<td><strong>Objective 5</strong> Explain how plant residues should be managed.</td>
</tr>
<tr>
<td></td>
<td>1. Mixed/tilled into the soil to provide organic matter</td>
</tr>
<tr>
<td></td>
<td>2. Left on the field surface to reduce soil erosion due to wind and water</td>
</tr>
<tr>
<td></td>
<td><strong>Objective 6</strong> Explain how plant pests can be controlled.</td>
</tr>
<tr>
<td></td>
<td>1. Mechanical pest control</td>
</tr>
<tr>
<td></td>
<td>2. Cultural pest control</td>
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<td></td>
<td>3. Biological pest control</td>
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<tr>
<td></td>
<td>4. Genetic pest control</td>
</tr>
<tr>
<td></td>
<td>5. Chemical pest control</td>
</tr>
<tr>
<td></td>
<td><strong>Objective 7</strong> Identify the irrigation methods that are used in crop production.</td>
</tr>
<tr>
<td></td>
<td>1. Aerial sprinkler systems (center pivot)</td>
</tr>
<tr>
<td></td>
<td>2. Surface (flood, drip, furrow)</td>
</tr>
</tbody>
</table>
### Instructor Directions

Potential yield. Water is vital for plant growth. Irrigation is a mechanical technique of supplying water to plants. Farmers use specialized techniques of irrigation to supply water for growing crops.

### Content Outline

Other activities

1. Using several examples of fertilizer bags (different grades), demonstrate to the students how to calculate the amount of nutrients in each bag.
2. Demonstrate or have students demonstrate a soil pH test. Then demonstrate how to alter the soil with agricultural lime, sulfur, or aluminum sulfate as needed.

### Application

Proper crop management involves taking a soil test to analyze and determine the nutrient needs and pH of the soil. Once these facts are known, more informed management decisions can be made. Decisions that involve pest control measures and the use of irrigation depend on factors such as the crop grown, geographical location, and soil type.

### Closure/Summary

Evaluation: Quiz

Answers:
1. False
2. True
3. False
4. True
5. a
6. b
7. b
8. c
True/False (Place the correct response in the blank provided.)

F 1. A complete fertilizer contains nitrogen, phosphorus, and manganese.
T 2. Taking a soil test is a good management practice.
F 3. Pest control has little impact on crop yields.
T 4. Most crop plants grow best between pH 5.0 and 7.5.

Circle the letter that corresponds to the best answer.

5. In order to reduce soil acidity
   a. Lime should be applied
   b. Sulfur should be applied
   c. Aluminum sulfate should be applied
   d. Crop residue should be plowed under
   Correct answer is a.

6. In order to reduce soil alkalinity
   a. Lime should be applied
   b. Sulfur should be applied
   c. Crop residue should be plowed under
   d. Crop residue should be left on soil surface
   Correct answer is b.

7. Soil erosion can best be controlled by
   a. Plowing all the plant residue into the soil
   b. Leaving all the plant residue on the soil surface
   c. Liming the soil before planting
   d. Adding animal manure to the soil
   Correct answer is b.
8. Furrow irrigation is a form of

   a. Pivot irrigation
   b. Aerial irrigation
   c. Surface irrigation
   d. Sprinkler irrigation

Correct answer is c.
<table>
<thead>
<tr>
<th>Course</th>
<th>Agricultural Science II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>Crop Science</td>
</tr>
<tr>
<td>Lesson</td>
<td>Harvesting and Storing Grains</td>
</tr>
<tr>
<td>Estimated Time</td>
<td>50 minutes</td>
</tr>
</tbody>
</table>

**Student Outcome**

The student will be able to explain factors related to harvesting and storing quality grain.

**Learning Objectives**

1. Identify the factors that determine the proper time to harvest grain crops.
2. Describe the factors that are used in federal grain grading.
3. Describe the factors that affect grain quality.
4. Describe the methods that are used to harvest grain crops.
5. Explain the factors that affect the quality of stored grains.
6. Describe how crop quality can be maintained during harvest and storage.
7. Identify the methods of drying grain.

**Grade Level Expectations**

SC/ME/1/G/09-11/a  SC/ST/1/C/09-11/a

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

**Resources**


**Supplies & Equipment**

- Glass jars
- Samples of commonly stored grain (e.g., corn, wheat, soybeans)

**Supplemental Information**

1. **Internet Sites**
**Interest Approach**

Collect several samples of commonly stored grain (e.g., corn, wheat, and soybeans). Divide each sample of grain into two small glass jars. Take one of the samples of each grain and add additional moisture to the jar to stimulate heat and mold damage. (This should be done in advance of the lesson to produce mold.) Use this for discussion.

**Communicate the Learning Objectives**

1. Identify the factors that determine the proper time to harvest grain crops.
2. Describe the factors that are used in federal grain grading.
3. Describe the factors that affect grain quality.
4. Describe the methods that are used to harvest grain crops.
5. Explain the factors that affect the quality of stored grains.
6. Describe how crop quality can be maintained during harvest and storage.
7. Identify the methods of drying grain.

<table>
<thead>
<tr>
<th>Instructor Directions</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td>Identify the factors that determine the proper time to harvest grain crops.</td>
</tr>
</tbody>
</table>
| It is important to harvest a crop at the optimum time in order to ensure the greatest yield and highest quality. | 1. Plant characteristics  
   a. Stage of maturity  
   b. Tendency to lodge  
   c. Tendency to shatter  
2. Climatic factors  
   a. Rainfall  
   b. Humidity  
   c. Temperature  
3. Harvesting methods |
| **Objective 2**       | Describe the factors that are used in federal grain grading. |
| Grain quality is important to both the producer and the purchaser. To the producer, a better quality grade for the crop can mean a higher return for the investment. For the purchaser, grain quality is important to ensure that the grain can be processed into consumer products. | 1. Class  
2. Test weight per bushel  
3. Percentage of damaged kernels  
4. Percentage of foreign material  
5. Percentage of other classes |
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 3</strong></td>
<td>Describe the factors that affect grain quality.</td>
</tr>
</tbody>
</table>
| *Grading agricultural products requires special skills. Grain quality is influenced by several factors.* | 1. Purity of crop and variety  
2. Percentage of weeds and other mixtures  
3. Percentage of diseased and damaged kernels |
| **Objective 4**       | Describe the methods that are used to harvest grain crops. |
| *Harvesting the grain crop is an important step in the process of grain production. The decision of which harvesting method to use is important.* | 1. Direct combine method  
2. Windrow-pickup combine method |
| **Objective 5**       | Explain the factors that affect the quality of stored grains. |
| *The potential for profit from high yielding crops can be decreased if the grain is improperly stored. When storing grain, consideration should be given to those factors that affect grain spoilage and deterioration.* | 1. High moisture content  
2. Heat damage  
3. Rotting  
4. Improper drying (too dry, too wet)  
5. Foreign material present  
6. Insect and rodent infestation |
| **Objective 6**       | Describe how crop quality can be maintained during harvest and storage. |
| *Steps to prevent stored grain deterioration should be taken in advance in order to prevent problems.* | 1. Harvest grain at proper moisture content  
2. Properly construct and maintain storage bins  
3. Protect against pests (insects, rodents, birds)  
4. Provide proper ventilation  
5. Secure from fire and wind damage  
6. Inspect grain frequently |
| **Objective 7**       | Identify the methods of drying grain. |
| *Ask students to give reasons for drying grain on the farm (reduce machine and field losses through early harvest, improved market price by more timely marketing, better market grade, reduced storage losses, etc.). Then, discuss the methods of drying stored grain.* | 1. Drying with forced, unheated air  
2. Drying with forced, heated air  
3. Field drying |
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Other activities</td>
</tr>
<tr>
<td></td>
<td>1. Take a field trip to a farm or local grain elevator and have students observe facilities used to dry and store grain crops.</td>
</tr>
<tr>
<td></td>
<td>2. Visit a grain harvesting operation and allow students to observe the process.</td>
</tr>
<tr>
<td>Closure/Summary</td>
<td>Harvesting and storing quality grain involves harvesting in a timely manner, using appropriate methods for harvesting and storage, and maintaining stored grain to prevent losses due to spoilage.</td>
</tr>
<tr>
<td>Evaluation: Quiz</td>
<td>Answers:</td>
</tr>
<tr>
<td></td>
<td>1. True</td>
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<tr>
<td></td>
<td>2. True</td>
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<td>3. False</td>
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<td>5. True</td>
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<td>6. a</td>
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<td>7. c</td>
</tr>
<tr>
<td></td>
<td>8. b</td>
</tr>
<tr>
<td></td>
<td>9. c</td>
</tr>
</tbody>
</table>
Evaluation

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

T 1. Premature harvesting usually results in smaller yields and reduction in quality.

T 2. The percentage of moisture in the grain varies with the stage of maturity.

F 3. Wheat is usually harvested by direct combining when the grain moisture is above 16%.

F 4. Direct combining works best when the crop ripens unevenly and the grain moisture is low.

T 5. Excessive moisture usually results in the deterioration of stored grain caused by mold growth and heat damage.

Circle the letter that corresponds to the best answer.

6. Drying grain with unheated air should be used when grain moisture content is no more than

   a. 15% moisture   
   b. 30% moisture   
   c. 45% moisture   
   d. 60% moisture

Correct answer is a.

7. For final drying, unheated air should contain less than

   a. 10% to 15% humidity  
   b. 20% to 25% humidity  
   c. 50% to 60% humidity  
   d. 80% to 90% humidity

Correct answer is c.
8. One benefit of drying with unheated air is
   a. Discounts on fuel costs
   b. Lower initial equipment costs
   c. Increased supervision
   d. Overdrying
   **Correct answer is b.**

9. What is one disadvantage of drying grain with heated air?
   a. Wetter grain can be dried
   b. Less time is required to dry grain
   c. More supervision is needed
   d. Weather conditions have little effect on drying time
   **Correct answer is c.**
The student will be able to describe factors related to harvesting and storing quality forages.

Learning Objectives

1. Describe the factors which determine the appropriate time to harvest forages.
2. Explain how forage quality is determined.
3. Identify when forages should be harvested.
4. Explain the methods which are used to harvest forages.
5. Explain what causes the quality of forages to deteriorate.
6. Describe how forage deterioration can be prevented.
7. Identify the basic storage requirements of forages.
8. Explain the ways to improve field drying.

Grade Level Expectations

SC/ME/1/G/09-11/a  SC/ST/1/C/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
   - Ppt 1 – Yield and Quality in Forages

Supplies & Equipment

- Forage samples

Supplemental Information

1. Internet Sites

## Instructor Directions

### Objective 1

As plants mature, yield increases but quality decreases. Selecting the appropriate time to harvest is an important factor influencing crop quality. In order to ensure high quality forages, harvesting must be completed at the appropriate time. Display Ppt 1.

- Ppt 1 – Yield and Quality in Forages

### Objective 2

The quality of hay or silage is directly related to the level of milk production in dairy cattle and rate of gain in livestock production. Producing and harvesting quality forages is important to enable farmers to provide quality feed to livestock.

## Content Outline

### Objective 1

Describe the factors which determine the appropriate time to harvest forages.

1. Balance between quality and yield (appropriate time)
2. Weather conditions – avoid rain, which leaches nutrients from cut forages

### Objective 2

Explain how forage quality is determined.

1. Physical appearance
   a. Visual appearance
      - Leafy
      - Fine texture
      - No foreign material
   b. Color (bright green)
   c. Odor (pleasant)
2. Chemical analysis
   a. Crude protein content
   b. Fiber content
   c. Digestibility
   d. Lignin content
### Objective 3

*In order to store and feed hay, silage, or haylage of high quality, the forage crop must be of quality. Harvesting must be done at the appropriate time to produce a quality feed product.*

Identify when forages should be harvested.

- Harvest when the crop is fully mature
- **1. Alfalfa** – first flower to 1/10 bloom
- **2. Alsike clover** – 1/2 to full bloom
- **3. Bird’s-foot trefoil** – 1/10 bloom
- **4. Cowpeas** – when first pods have started to ripen
- **5. Corn silage** – harvest when kernels are fully dented and glazed
- **6. Crimson clover** – 1/2 bloom
- **7. Fescue** – boot to early heading
- **8. Ladino clover** – full bloom
- **9. Lespedeza** – early bloom
- **10. Medium red clover** – 1/4 to 1/2 bloom
- **11. Small grains** – boot stage to early dough stage
- **12. Soybeans** – when beans in the pod are half developed
- **13. Sweet clover** – when first blooms appear
- **14. Brome grass** – early bloom (anthesis)
- **15. Orchard grass** – fully headed but before bloom
- **16. Reed canary grass** – when first heads appear
- **17. Timothy** – early bloom (anthesis)

### Objective 4

*Mechanization has improved forage harvesting and handling. Forage harvesting methods vary depending upon how the forage will be stored and used.*

Explain the methods which are used to harvest forages.

1. Grazing
2. Dry hay systems
   - a. Conventional bales
   - b. Large round bales
   - c. Large rectangular bales
   - d. Portable haystack
   - e. Field cubes
3. High moisture systems
   - a. Green chopped
   - b. Haylage (40-60%)
   - c. Silage (60-70%)
4. Special forage processing systems
   - a. Stationary cubers
   - b. Pelleting machines

### Objective 5

*Forage deterioration can be a costly problem. Deterioration of forages decreases quality and profit. Deterioration in some*  

Explain what causes the quality of forages to deteriorate.

1. Improper harvest time (early or late)
2. Improper baling time (wet or too dry)
3. Improper harvesting methods
4. Improper storage
<table>
<thead>
<tr>
<th>Instructor Directions</th>
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</tr>
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<tbody>
<tr>
<td>forage crops can be harmful to animal health.</td>
<td></td>
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</table>

**Objective 6**

Forages provide an excellent source of nutrients to livestock. If deterioration of forages is permitted, the feed value decreases. Measures to prevent forage deterioration should be taken in order to ensure quality.

Describe how forage deterioration can be prevented.

1. Harvest at proper time
2. Use proper harvest methods
3. Ensure proper moisture content at harvest
4. Maintain proper storage facilities

**Objective 7**

Proper storage techniques are just as important to forages as to grains. If storage is improper, deterioration of forages due to mold, heat damage, rotting, and spoilage will occur.

Identify the basic storage requirements of forages.

1. Dry hay
   a. Protection from weather
   b. Protection from insects, animals, and birds
   c. Adequate ventilation
2. Silage and haylage
   a. Protection from weather
   b. Protection from insects, animals, and birds
   c. Air tight facility
   d. Provisions for proper filling, emptying, monitoring, and cleaning

**Objective 8**

Most forage crop deterioration is caused by excessive moisture content, which leads to reduction in quality, heat damage, and molding. Methods of drying forages can reduce moisture levels, improve storage, and ensure quality.

Explain the ways to improve field drying.

1. Swath drying
2. Windrow drying
3. Crushing or conditioning
4. Chemical additives

**Application**

Other activities
1. Take a class field trip to a local farm to observe a forage harvesting operation (e.g., cutting, baling, or storing).
2. Display samples of several grades of forages that have been baled. Discuss the quality (e.g., color, odor, leafiness, and stems) of each.
3. Display a bale that was baled at too high a moisture content. Break open the bale and discuss the molding
and heat damage along with the possible hazard from fires caused by improperly stored hay.

**Closure/Summary**

Forage crops are vital feedstuffs for livestock and dairy operations in the U.S. Quality forages are an excellent source of essential nutrients that increase weight gain in livestock and milk production in dairy cattle. Harvest time, method of harvesting, and proper storage are all important factors in producing quality forages.

<table>
<thead>
<tr>
<th>Evaluation: Quiz</th>
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</tr>
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<tbody>
<tr>
<td>1. True</td>
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<td>9. b</td>
<td></td>
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<tr>
<td>10. d</td>
<td></td>
</tr>
</tbody>
</table>
Evaluation

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

T 1. Proper harvesting time is important to ensure the quality of a forage.

T 2. Soybeans can be considered a forage crop.

F 3. Nutrient value and palatability increase once the forage passes the optimum harvest point.

F 4. Weather conditions are not a consideration during harvest.

F 5. Chemical analysis is the most common method of determining forage quality.

Circle the letter that corresponds to the best answer.

6. Shattering is a result of
   a. Early harvest
   b. High moisture content
   c. Late harvest
   d. Improper storage

Correct answer is c.

7. Lodging is a result of
   a. High moisture content
   b. Improper storage
   c. Early harvest
   d. Delayed harvest

Correct answer is d.

8. What is the moisture content of silage?

   a. 25% to 30%
   b. 40% to 60%
   c. 60% to 75%
   d. 80% to 95%

Correct answer is c.
9. What is the moisture content of haylage?
   a. 25% to 30%
   b. 40% to 60%
   c. 60% to 75%
   d. 80% to 95%
   **Correct answer is b.**

10. Leaching of nutrients from forages is caused by
    a. Overdrying in the sun
    b. Improper storage
    c. Early cutting
    d. Rain damage
    **Correct answer is d.**
The student will be able to describe methods of plant pest control.

Learning Objectives

1. Identify the types of pests which affect plant growth.
2. Describe the methods which are used to control weeds.
3. Describe the methods which are used to control insects.
4. Describe the methods which are used to control plant diseases.
5. Explain how pesticides can be handled and applied safely.
6. Explain how “integrated pest management” is used in agriculture.

Grade Level Expectations


Resources, Supplies & Equipment, and Supplemental Information

Resources


Supplies & Equipment

- Flour infested with weevils

Supplemental Information

1. Internet Sites

### Interest Approach

Locate some flour that is infested with weevils. Have the class inspect the flour. Ask them if they would like to eat cake or bread made from this flour. Point out the weevils and describe the problem of crop insects in the U.S.

### Communicate the Learning Objectives

1. Identify the types of pests which affect plant growth.
2. Describe the methods which are used to control weeds.
3. Describe the methods which are used to control insects.
4. Describe the methods which are used to control plant diseases.
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<tbody>
<tr>
<td><strong>Objective 1</strong></td>
<td>Identify the types of pests which affect plant growth.</td>
</tr>
<tr>
<td>*Crop producers must continually work to control plant pests.</td>
<td>1. Weeds</td>
</tr>
<tr>
<td>*Damage to crops from pests is a major problem in the U.S. Many developing countries</td>
<td>2. Insects</td>
</tr>
<tr>
<td>have very low levels of production due to competition from plant pests.*</td>
<td>3. Plant diseases</td>
</tr>
<tr>
<td><strong>Objective 2</strong></td>
<td>Describe the methods which are used to control weeds.</td>
</tr>
<tr>
<td>*Weeds cause considerable damage and loss to crops annually. Crop growth can be</td>
<td>1. Hand</td>
</tr>
<tr>
<td>hindered because of weeds. Crop quality can also be reduced by weed seeds in the crop</td>
<td>2. Mechanical cultivation</td>
</tr>
<tr>
<td>at harvest.*</td>
<td>3. Chemical methods</td>
</tr>
<tr>
<td>4. Biological methods</td>
<td></td>
</tr>
<tr>
<td><strong>Objective 3</strong></td>
<td>Describe the methods which are used to control insects.</td>
</tr>
<tr>
<td>*Insects continue to challenge crop producers and scientists to find new ways to</td>
<td>1. Genetic</td>
</tr>
<tr>
<td>control them and the damage they cause.*</td>
<td>2. Cultural</td>
</tr>
<tr>
<td><strong>Objective 4</strong></td>
<td>Describe the methods which are used to control plant diseases.</td>
</tr>
<tr>
<td><em>Prevention of plant diseases is preferable to trying to cure it after it has begun.</em></td>
<td>1. Genetic (disease-resistant varieties)</td>
</tr>
<tr>
<td>2. Cultural (crop rotation, cultivation methods)</td>
<td>3. Chemical (fungicides, etc.)</td>
</tr>
<tr>
<td>4. Isolation (quarantine stations, etc.)</td>
<td></td>
</tr>
<tr>
<td>Instructor Directions</td>
<td>Content Outline</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td><strong>Objective 5</strong></td>
<td>Explain how pesticides can be handled and applied safely.</td>
</tr>
</tbody>
</table>
| **In 1988, over 820 million pounds of pesticides were used at a cost of over six billion dollars in the U.S. Pesticides are toxic to crop pests, but may also be hazardous to humans and other animals. Pesticides should be handled and applied safely.** | 1. Be properly trained in pesticide application  
2. Read and follow pesticide label directions  
3. Understand the toxicity ratings, signal words, and symbols  
4. Wear protective clothing and use protective equipment  
5. Provide proper storage |
| **Objective 6**       | Explain how “integrated pest management” is used in agriculture. |
| **Pest management is a concern of every crop producer. A great deal of research has gone into developing methods of pest control. Concern for the environment and the effects of chemicals on food products have prompted producers and researchers to work at developing different strategies to control crop pests. IPM (integrated pest management) is one of those strategies.** | Integrated pest management (IPM) uses multiple techniques of pest control once economic thresholds have been established. |
| **Application**       | Other activities  
1. Have students compile a list of pesticides they have at home and record the label information.  
2. Have a commercial pesticide applicator speak to the class on safety procedures.  
3. Have students select a crop pest from a teacher-generated list and research the pest’s life cycle, crops affected, control methods, etc.  
4. Collect and mount specimens of crop pests (e.g., weeds and insects), which can be used for future study and reference. |
<p>| <strong>Closure/Summary</strong>   | Preventing crop pests is more efficient than trying to get rid of them after they become a problem. Methods used to control crop pests include the safe use of pesticides, good cultural practices, and the incorporation of integrated pest management strategies. |</p>
<table>
<thead>
<tr>
<th>Instructor Directions</th>
<th>Content Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation: Quiz</td>
<td>Answers:</td>
</tr>
<tr>
<td></td>
<td>1. False</td>
</tr>
<tr>
<td></td>
<td>2. True</td>
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<tr>
<td></td>
<td>3. False</td>
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<td>8. c</td>
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<tr>
<td></td>
<td>9. a</td>
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<tr>
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<td>10. b</td>
</tr>
</tbody>
</table>
Evaluation

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

F 1. Crop pests include all species of insects.

T 2. Preventing crop pests is more efficient than controlling pests once they appear.

F 3. Mechanical methods can be used to control diseases in a growing crop.

F 4. Genetic pest control involves the use of chemicals.

T 5. Integrated Pest Management incorporates multiple control techniques.

T 6. Pesticides should never be transferred to glass food jars for storage.

Match the management practice with the type of control.

<table>
<thead>
<tr>
<th>Management Practice</th>
<th>Type of Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>d 7. Crop rotation</td>
<td>a. Genetic</td>
</tr>
<tr>
<td>c 8. Using predator insects</td>
<td>b. Chemical</td>
</tr>
<tr>
<td>a 9. Using pest-resistant cultivars</td>
<td>c. Biological</td>
</tr>
<tr>
<td>b 10. Aerial dusting of crops</td>
<td>d. Cultural</td>
</tr>
</tbody>
</table>
Agricultural Science II

Curriculum Guide: Crop Science

Unit Objective:
Students will demonstrate an understanding of crops and crop production by creating, organizing, and participating in a mini Agronomy Career Development Event.

Show-Me Standards: 1.8, CA6

References:


Instructional Strategies/Activities:
• Students will engage in study questions in lessons 1 through 9.
• Students will complete WS 3.1, Parts of a Bean Seed; WS 3.2, Parts of a Grass Plant and Leaf; WS 3.3, Characteristics of Selected Crop and Weed Plants; WS 3.4, Seed Identification Score Sheet; and WS 4.1, Seed Information and Germination Test.
• Additional activities that relate to the unit objective can be found under the heading “Other Activities” in the following locations: p. 20 (1, 2) and p. 83 (2).

Performance-Based Assessment:
Students will work in groups to create, organize, and participate in a mini Agronomy Career Development Event. Each group will be responsible for one class of seed or plant samples in the overall event and will also compete as a team in the whole event.

Assessment will be based on the overall content and presentation of the class in the event and on performance in the contest. At the instructor’s discretion, students will contribute to the assessment process by providing a brief evaluation of their teammates’ performance in designing and setting up their class in the event.
Crop Science
Instructor Guide

The instructor should assign the performance-based assessment activity at the beginning of the unit. Students will work toward completing the activity as they progress through the unit lessons. The assessment activity will be due at the completion of the unit.

1. Divide students into groups and assign each group a class of seed or plant samples to organize in a mini Agronomy Career Development Event.
   a. Each group will also compete in the whole event as a team.
   b. The event will follow, as closely as possible, the format and guidelines of a larger event but will be scaled to the size and time constraints available for the project.


3. Students will be responsible for the content of their display and its overall presentation.

4. Sample classes could include, but are not limited to, seed identification, wheat judging, soybean judging, and alfalfa hay judging.

5. Students may consult the instructor for assistance if they have difficulty locating materials, but they must be responsible for the overall content, design, and presentation of their class in the event.
   b. Classes to be judged should only include seeds or plants or use judging factors that have been discussed by the instructor with all the students as a group.
6. Scale down or divide classes as needed so that all groups do an equal amount of work.
   a. For example, for seed identification, students could present 10 crop or weed seeds discussed in class, or seed identification could be assigned to more than one group.
   b. If a class is assigned to more than one group, guide students as needed to ensure that each group presents different material.

7. Verify the students’ placement of their assigned class prior to the contest and suggest corrections as needed.

8. If desired, have students contribute to the assessment process by completing a short evaluation of their teammates’ performance in helping to design and set up their portion of the event. A peer evaluation form is included following the scoring guide.
   a. Have students complete the peer evaluation form by following the instructions listed at the top. Students should base their assessment on how much each person contributed to the project.
   b. If tasks are divided so that students do only one type of task to contribute to the project, have students adjust their peer evaluation form by disregarding the category that does not apply to a particular teammate. Instead of assessing teammates on two categories worth 0 to 3 points, students will assess teammates on one category worth 0 to 6 points.
   c. To determine the final peer evaluation score, add up the scores that a student receives from the other members of the group and divide the total by the number of scores received. The maximum number of points possible for each student is 6.

9. The final assessment score will be a combination of the student’s class display score, contestant score, and final peer evaluation score.

10. Present an appropriate award to the high-scoring team and individual, if desired.
Crop Science
Student Handout

1. You will work with a group to organize a class of seed or plant samples to be judged in a mini Agronomy Career Development Event.

2. Your group will also compete in the whole event as a team.

3. The contest will follow the format and guidelines of a full-scale Agronomy Career Development Event.

4. You will be responsible for the content and presentation of your class of seeds or samples.

5. The instructor will verify your placement of your class of samples prior to the contest.

6. If requested, you will contribute to the assessment process by completing a short evaluation of your teammates’ performance in helping to design and set up your class of seeds or samples in the event.
   a. Following the event, fill out the peer evaluation score sheet.
   b. Give the completed score sheet to your instructor.

7. Your final assessment score will be a combination of your class display score, your contestant score, and your final peer evaluation score.
## Agricultural Science II

### Scoring Guide

**Assessment Area** | **Criteria** | **0 Points** | **1 Point** | **2 Points** | **3 Points** | **4 Points** | **Weight** | **Total** |
--- | --- | --- | --- | --- | --- | --- | --- | --- |
Thoroughness and Accuracy of CDE Project | Project includes all required seeds or samples and placement is correct | Failed | Poor | Fair | Good | Excellent | X 10 |  |
Presentation of CDE Project | Project is well organized and eye-appealing | Failed | Poor | Fair | Good | Excellent | X 2.5 |  |
**TOTAL** |  |  |  |  |  |  |  | /50 pts. |

| Assessment Area | Seed Identification 0-11 Points | Wheat Judging 0-11 Points | Soybean Judging 0-11 Points | Alfalfa Hay Judging 0-11 Points | Total |
--- | --- | --- | --- | --- | --- |
Agronomy Career Development Event |  |  |  |  |  |
Peer Evaluation |  |  |  |  | 6 pts. maximum |
**TOTAL** |  |  |  |  | /50 pts. |

**Final Assessment Total ________/100 pts.**

**Comments:**
Crop Science
Peer Evaluation

Write your name on the line above. Fill in the names of your teammates in the spaces provided below. For each category listed below, give each teammate a score from 0 to 3 based on his or her contribution to the project. Use the following guide.
• 0—no contribution
• 1—minimal contribution
• 2—average contribution
• 3—excellent contribution

Add the person’s score in each category and place the total in the column at the right. Give the completed score sheet to your instructor.

Project development includes tasks such as planning and research. Project completion includes writing, assembling, or presenting the project. If tasks are divided so that you or your teammates do only one type of task to contribute to the project, consult the instructor about how to adjust your evaluation form.

<table>
<thead>
<tr>
<th>Name of Teammate</th>
<th>Project Development 0-3 Points</th>
<th>Project Completion 0-3 Points</th>
<th>Total (6 Points Max.)</th>
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