# Principles of Agricultural Science – Plant
# Expanded Lesson Review

## Lesson 1.1 A World Without Enough Plants

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. People work in a variety of agricultural enterprises to produce food, fiber, and fuel, which are essential to daily life. | • Research plant industries and related careers. (Activity 1.1.1) |
| 2. Organization and record-keeping are important to the success of a plant business. | • Develop and keep an *Agriscience Notebook* to record and store information presented in classroom discussions and activities throughout the course. (Activity 1.1.2) |
| 3. Plants are used to sustain human existence by providing many essential products, such as food, fiber, fuel, and medicine. | • Survey their dependence upon plants. (Activity 1.1.3) |
| 4. Plant industries provide production and management career opportunities. | • Begin an ongoing course project researching physical attributes and growth requirements for several species of plants. (Project 1.1.4) |

### Essential Questions

1. How common are plants in everyday life?
2. How are plants important for human survival?
3. Why are certain crops grown in specific regions in the country?
4. What are the benefits of keeping an *Agriscience Notebook*?
5. What is meant by the phrase “crop production”?
6. What represents or makes up a plant business?
7. What career opportunities are available in a plant business?
8. What are the issues facing crop production?
9. What factors should a producer consider when growing healthy plants?
10. How are priorities determined for a business?

# Lesson 2.1 Understanding Soil Properties

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Soil texture is a proportion of sand, silt, and clay, and influence how producers use soil. | • Conduct tests to determine soil texture by feel. (Activity 2.1.1) |
| 2. Texture and structure of soil horizons affect soil permeability. | • Illustrate soil structure and determine how structure influences soil permeability. (Activity 2.1.2)<br>• Test soil permeability to understand the relationship between soil particle size and rate of water filtration. (Activity 2.1.5) |
| 3. Organisms found in soils improve soil quality. | • Collect and identify macroscopic and microscopic organisms found in a soil sample. (Activity 2.1.3) |
| 4. Soil structure and texture influence the water-holding capacity and drainage of soil. | • Measure the water holding capacity of various test substances and compare data. (Activity 2.1.4) |
| 5. Organic matter affects the porosity and water holding capacity of soils. | • Conduct an experiment to explore the relationship between organic matter and water holding capacity of soil. (Activity 2.1.5) |
| 6. Internal drainage, evidenced by color, mottling, and permeability, affects soil management decisions. | • Describe soil hue, value, and chroma and assess soils for drainage-related characteristics based on color. (Activity 2.1.6) |
| 7. The structure and color of the soil profile determine the effective depth of a soil. | • Conduct an inquiry lab making predictions of soil characteristics using knowledge of the properties of the soil profile. (Project 2.1.7) |

## Essential Questions

1. What are the size comparisons among the three soil particles?
2. What do sand, silt, and clay each contribute to soil characteristics?
3. How are sand, silt, and clay detected in a soil sample?
4. How do soil microorganisms contribute to soil quality?
5. What constitutes a loam soil?
6. What is permeability as it pertains to soils, and why is it important?
7. What soil substances influence the water-holding capacity of soil?
8. How is porosity critical for plant production?
9. What effects does soil texture have on porosity, permeability, and water holding capacity?
10. How do soil color and mottles indicate the water-related properties of a soil?
11. Why are different horizons visible in a soil profile?
12. Why do certain types of soil structure formations indicate soil quality?
13. What is the role of organic matter in soil?

# Lesson 2.2 Soil Chemistry

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Soil pH determines the availability of nutrients required for plant growth and health. | • Conduct a soil sample test to determine pH. (Activity 2.2.1) |
| 2. The optimal pH and salinity levels required for plant growth vary among plant species, and producers adjust the levels by using chemical treatments. | • Correct for acidic soil conditions using lime. (Activity 2.2.2) |
| 3. Soil salinity concentration determines how well plants uptake water, and as a result, the ability of plants to absorb nutrients. | • Determine the salinity of soil by measuring the electrical conductivity. (Activity 2.2.3) |
| 4. Testing of soil samples detect imbalances of soil chemistry. | • Measure soil salinity to determine the effects of chemical fertilizers on soil salinity levels. (Activity 2.2.3) |

## Essential Questions

1. What does the pH scale represent?
2. How do plants grow in a basic soil versus a neutral soil?
3. How do different kinds of plants tolerate high levels of salinity?
4. How is plant nutrient availability affected by plant growth?
5. Why does salinity affect plant growth?
6. How can a soil with a low pH be corrected for optimal plant growing conditions?
7. How does fertilization affect soil?
8. How does the testing of soil aid in understanding soil chemistry?
9. Why is it necessary to fertilize soil?
10. How is soil chemistry related to plant nutrients?

# Lesson 3.1 Mixing Media

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Potting media has specific qualities suited for container crops, such as using lightweight and inexpensive materials that provide the essential components needed for drainage and porosity. | • Identify components commonly used in potting media. (Activity 3.1.1) |
| 2. There are a variety of ingredients used in potting soil that provide permeability, porosity, and fertility needed for container crops. | • Test different potting media ingredients to determine the permeability and porosity qualities of the media. (Activity 3.1.1)<br>• Determine the percentage of ingredients found in a potting soil mixture. (Activity 3.1.1) |

| | |
|---|---|
| 3. Greenhouse and nursery plant producers calculate and purchase media in cubic feet or cubic yard increments. | • Calculate the volume of various containers using mathematics. (Activity 3.1.2) |

## Essential Questions

1. Why is potting media critical for plants?
2. How is the density of an object measured?
3. What is the difference between potting media and mineral soil?
4. Why does potting media consist of a variety of components?
5. What is the function of potting media ingredients, such as perlite and vermiculite?
6. Why is garden soil not a good choice for container-grown plants?
7. How are potting media quantities handled and calculated?
8. What choices exist for purchasing potting media?
9. How is volume calculated for a round pot?

# Lesson 3.2 Hydroponics

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Growing crops with a hydroponic method relies on using water with or without potting media instead of mineral soil to provide the necessary growth requirements. | • Examine and discuss hydroponic system components. (Activity 3.2.1) |
| 2. Hydroponic crop production has advantages over traditional cropping systems, such as efficient use of space and resources. | • List the advantages and disadvantages of hydroponics and traditional crop production systems. (Activity 3.2.2) |
| 3. Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health. | • Compare the use of fertilizers, water, and media in hydroponic and traditional plant production systems. (Activity 3.2.2) |
| 4. Hydroponic systems provide essential growth requirements for plants in a variety of ways. | • Design a hydroponic system incorporating the design principles of a specific type of system, such as nutrient flow, aggregate, water culture, or aeroponics. (Project 3.2.3) |

## Essential Questions

1. How do hydroponic systems compare to traditional cropping practices?
2. What equipment is needed to raise plants using hydroponic methods?
3. What are the management issues with the production of plants using hydroponics?
4. How do the different types of hydroponic systems differ?
5. How do hydroponic systems lessen the impact on the environment and natural resources?
6. What role will hydroponics play in the future of sustainable crop production?
7. Why is water quality important for plant growth in hydroponic systems?

8. How is water quality monitored in a hydroponic system?

# Lesson 4.1 Cells: Life's Smallest Units

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. There are different classifications of cells based on their utility. | • Develop a pictorial representation of cell function. (Project 4.1.1) |
| 2. Plant cells are comprised of many parts dependent upon each other that have essential functions for the survival of plant tissue. | • Identify and label plant cell organelles. (Project 4.1.1)<br>• Represent relationships between organelles using a graphic organizer. (Activity 4.1.3) |
| 3. Plant cells contain microscopic organelles specific to plant functions. | • Correctly prepare slides of plant cells for viewing under a microscope. (Activity 4.1.2) |
| 4. Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water. | • Collect and analyze data to provide evidence of cell metabolism. (Activity 4.1.4) |

## Essential Questions

1. What is a cell?
2. How are cells classified?
3. What is the function of cell organelles, and how do they work together?
4. How do cells perform plant functions?
5. How do plant cells convert raw nutrients into energy?
6. How are cellular respiration and cellular metabolism related?
7. Why is understanding cells important to understanding plants and plant systems?

# Lesson 4.2 Radicle Root

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. A plant's root, stem, leaves, and flower are vital for plant health and growth. | • Describe the function of the major plant parts. (Activity 4.2.1) |
| 2. The root has specific anatomical features responsible for anchoring the plant in the soil. | • Examine a root structure and sketch representations of the structural form of a root. (Activity 4.2.2) |
| 3. Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients. | • Examine cell differentiation as it relates to root cells. (Activity 4.2.3) |
| 4. Plants use the process of osmosis, influenced by the turgidity of plant tissues, for the uptake of water and dissolved nutrients required for plant growth. | • Conduct an experiment to simulate the osmosis process of plant root hairs. (Activity 4.2.4) |

## Essential Questions

1. How do the four major parts of a plant function together?
2. How does the root system of a plant contribute to plant health?
3. How do roots grow?
4. What differences exist between the three kinds of root systems?
5. How does a root absorb water and nutrients from the soil?
6. What part of the root absorbs water from the soil?
7. What are differentiated cells?
8. What are turgid cells, and why are they important to plant life?
9. How is knowledge about root anatomy and physiology important in the management of plants?

# Lesson 4.3 Stems, Stalks, and Trunks

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Stems of plants provide physical support, storage of nutrients, and necessary pathways for the translocation of materials throughout the plant. | • Identify differences between internal structures of monocotyledon and dicotyledon features. (Activity 4.3.1) |
| 2. The majority of plant growth takes place in meristematic tissue. | • Compare plant survival and recovery from damage to meristematic tissue. (Activity 4.3.2) |
| 3. Environmental conditions, such as temperature and precipitation, are reflected in the growth rates of plants and evidence of those conditions can be found in woody stems. | • Create a poster depicting the lifespan of a tree referencing environmental conditions, historical events, and stages of growth. (Project 4.3.3) |

## Essential Questions

1. What provides the structure for plant stems needed to support the weight of leaves, flowers, and fruit?
2. How do nutrients flow within a stem?
3. Why are the xylem and phloem critical for a plant?
4. How do monocotyledon and dicotyledon plants differ in terms of stem structure?
5. How do tree trunks compare to herbaceous stems?
6. How can stem growth be altered to produce desired characteristics for the end-use of plant material?
7. How does a severe climate change affect plant growth?
8. How does damage to meristematic tissue affect plant growth?

# Lesson 4.4 Leave It to Leaves

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Agricultural scientists use leaf characteristics to identify species or varieties of plants. | • Create a journal that includes sketches and identification information for 20 different species of local plants. (Project 4.4.1) |
| 2. Leaves have several parts with differences in physical characteristics, such as shape and venation patterns. | • Identify the characteristics of simple and compound leaves. (Project 4.4.1) |
| 3. Leaf cells contain a specialized pigment known as chlorophyll that is used by the plant to harvest radiant energy from the sun. | • Investigate the pigments and food storage systems found in plant leaves. (Activity 4.4.2) |
| 4. Leaves produce and store food. | • Compare stored sugar content of leaves. (Activity 4.4.2) |

## Essential Questions

1. How do plant leaves contribute to plant processes?
2. How are the parts of the leaf used to distinguish among different plant species?
3. Why is chlorophyll important to a plant?
4. What type of energy do plants harvest from the sun?
5. How do simple leaves and compound leaves differ?
6. Why is photosynthesis important to plant function?
7. How do plants use transpiration to regulate their environment?
8. What is a plant's fuel source?
9. Where does a plant store food reserves?

# Lesson 4.5 Flower Power

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The parts of the flower are the mechanisms for pollination and fertilization and are used by a plant to complete sexual reproduction. | • Identify the parts of a flower and explain the function for each part. (Activity 4.5.1) |
| 2. Concept maps assist in structuring ideas or concepts and illustrating the various connections between those ideas. | • Develop a concept map to illustrate the understanding of related ideas and nomenclature necessary to discuss the parts and functions of a flower. (Activity 4.5.2) |
| 3. Flowers are classified as either complete or incomplete based on the inclusion of either male or female parts, or both. | • Classify flowers using a dichotomous key and predict the type of pollination for each flower. (Activity 4.5.3) |
| 4. Flowering structures are precursors for seeds, seed pods, and fruit. | • Use knowledge of flower structure to predict the type of seed structure based on a flowering structure. (Project 4.5.4) |

## Essential Questions

1. What role(s) do the parts of a flower serve in reproduction?
2. How do flowers differ in form and function?
3. What is the difference between a flower and inflorescence?
4. How are flowers organized?
5. How is monocot inflorescence different from dicot inflorescence?
6. What are the mechanisms required for pollination and fertilization?
7. What constitutes a perfect flower?
8. What is the difference between a complete or incomplete flower?
9. What is the true purpose of showy petals of a flower?
10. How does the type of flower determine the type of seed structure produced by the plant?
11. What value do flowers have for humans?
12. Why are flowers valuable in an ecosystem?

# Lesson 5.1 Sorting Out Plants

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Plants are organized and identified and using physical characteristics. | • Develop a flowchart to classify 20 different species of plants. (Activity 5.1.1) |
| 2. Plants and animals are categorized using a hierarchical system to group organisms by anatomical or physiological similarities. | • Research the taxonomic classification for a plant species. (Activity 5.1.2) |
| 3. The scientific names for plants consist of Latin words representing descriptive features associated with the plant. | • Research the meaning of scientific names for ten species of trees. (Activity 5.1.3) |
| 4. All plants are named using a binomial system, which is a two-word system for naming plants with the first word being the generic name and the second word being the specific name. | • Create a fictitious plant describing the physical features and apply the principles of binomial nomenclature to create a common and scientific name for the plant. (Project 5.1.4) |
| 5. Plant species are often subdivided into varieties and cultivars that will include additional names after the genus and species. | • Create a cultivar name for a fictitious plant. (Project 5.1.4) |

## Essential Questions

1. How do you identify plants?
2. What is morphology?
3. How do you classify plants?
4. How can the same plant be in multiple classification categories?
5. Why do scientists use Latin terminology for the scientific classification of plants?
6. What are the hierarchical levels of taxonomic classification?

7. What is the difference between a genus and a species designation?
8. What is taxonomy?
9. What is meant by the phrase “distinguishing characteristics”?
10. How does a scientist use taxonomy?
11. Why is binomial nomenclature used?
12. What is the process for naming plants using binomial nomenclature?
13. How do varieties and cultivars differ?
14. Why is Latin used as the language for naming plants?
15. How can you determine if the scientific name of a plant includes a variety name?
16. What is the problem with using the common names of plants?

# Lesson 6.1 Plant Food

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Plants obtain required nutrients from the soil provided the soil has the available nutrients. | • Use testing equipment to detect the levels of nitrogen, phosphorus, and potassium in soil samples. (Activity 6.1.1) |
| 2. Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical tissue tests. | • Identify the effects of nutrient deficiencies in plants by observing anatomical differences. (Activity 6.1.2)<br>• Conduct plant tissue testing to determine the potential nutrients that are lacking in growing plants. (Activity 6.1.2) |
| 3. Nutrients can be added to the soil in various forms, such as chemical fertilizers, animal wastes, and organic matter. | • Use mathematical formulas to solve problems regarding fertilizer analyses, rates, and cost comparisons. (Activity 6.1.3) |
| 4. Plants require sixteen nutrients for optimal growth and development. | • Define soil nutrient relationships using Mulder’s Chart. (Activity 6.1.4)<br>• Read a sample soil analysis and compare it to crop nutrient removal rates. (Activity 6.1.4) |

## Essential Questions

1. What do specific plant nutrients do for plant growth and health?
2. How do plants obtain nutrients?
3. How can soil be modified to provide more nutrients for the plant?
4. What nutrients do plants need for growth?
5. How do nutrients interact with one another in the soil?
6. What would happen to a plant exposed to too much of a certain type of nutrient?
7. How do you know when a plant does not have enough of a certain type of nutrient?
8. How do you know how much fertilizer to apply to the soil for a certain crop?
9. What are the differences among fertilizer sources?

10. How are mathematics used in fertilizer analysis, rates of application, and cost-benefit analysis?

# Lesson 6.2 All Wet

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. The composition of plant containers will affect the rate of water loss by evaporation in potted plants. | • Conduct an experiment to determine the rate of transpiration and evaporation for different plant growing containers. (Activity 6.2.1) |
| 2. Water is used by plants for the translocation of materials within the vascular systems of plants and used to complete the photosynthesis process. | • Collect evidence of water movement through a stem detecting transpiration pull. (Activity 6.2.2) |
| 3. Water is used to help cool the plant during periods of above optimal temperature conditions through the process of transpiration. | • Examine how environmental conditions affect the water loss of a plant. (Activity 6.2.2) |
| 4. Water requirements and tolerances vary among plant species. | • Compare wilting points among various species. (Activity 6.2.3) |
| 5. The wilting point is a critical physiological stage that, if exceeded, can cause permanent damage to the health and physical appearance of plants. | • Monitor soil moisture to determine the wilting point of different plant species. (Activity 6.2.3) |

## Essential Questions

1. How does the substance a pot is made from influence water loss?
2. How do stomata influence a plant? What is transpiration, and why do plants transpire?
3. How do transpiration, evaporation, and runoff differ?
4. What affects the rate of transpiration in plants?
5. How is transpiration related to temperature?
6. What is translocation?
7. How are the xylem and phloem involved in the process of translocation?
8. Why should the wilting of a plant be prevented?
9. How can too much water be harmful to the growing environment of a plant?
10. What determines the water requirements of plants?
11. How is soil moisture monitored to prevent plant wilting?

# Lesson 6.3 Lighting It Up

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Light is absorbed by chlorophyll and used by plants to convert carbon dioxide and water into glucose and oxygen through the process of photosynthesis. | • Collect evidence of the dependence of photosynthesis with light. (Activity 6.3.1) |

| | |
|---|---|
| 2. Light intensity and poor light exposure can alter the growth of plants by creating undesirable physical characteristics. | • Conduct an investigation to determine the effects of light intensity on plant growth. (Project 6.3.2) |
| 3. Photosynthetic rate is affected by environmental factors, such as light exposure, availability of carbon dioxide, and temperature. | • Manipulate environmental factors to test their effects on plants. (Project 6.3.2) |
| 4. The level of red and blue-violet light emitted in a spectrum determines the quality of a light source intended for plant use. | • Examine the relationship between the rate of photosynthesis and light spectrum quality. (Activity 6.3.3) |
| 5. Plants respond to the length of daily dark periods to trigger physiological processes, such as flowering. | • Calculate target dates for marketing flowering plants based on the length of time that plants are exposed to light. (Activity 6.3.4) |

## Essential Questions

1. How does altering light intensity affect plants?
2. What happens if plant leaves are not exposed to light?
3. How does light exposure affect the rate of photosynthesis?
4. How can photosynthesis be measured?
5. Which artificial light sources are adequate for plant growth?
6. What is a light spectrum, and how can knowledge of the spectrum be used for plant production?
7. How do the colors of the light spectrum influence photosynthesis in plants?
8. Why do plants appear green?
9. Why is phototropism important to understand when raising plants?
10. How can plants be programmed to flower for seasonal markets?
11. Why is day length important for the physiology of plants?
12. How do plants react to the length of light or dark periods?

# Lesson 6.4 Chilly Lilies

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Plant maturity is affected by the accumulation of thermal units during a growing season. | • Calculate estimated plant maturity dates using growing degree-days to compare two geographical locations. (Activity 6.4.1) |
| 2. Temperature affects the metabolism rate of plants, including transpiration, respiration, and photosynthesis. | • Calculate a growing schedule for a crop started on the same date with three different maturity target dates. (Problem 6.4.2) |
| 3. Temperature is a principle determinant for plant dormancy of some seeds, bulbs, specialized roots, and species of perennial plants. | • Plant bulbs and schedule flowering for those bulbs to meet a holiday delivery date. (Project 6.4.3) |

| | |
|---|---|
| 4. Plants are classified as cool-season or warm-season plants based on their temperature requirements. | • Explore hardiness zones and assign plants to appropriate zones according to temperature requirements. (Activity 6.4.4) |

## Essential Questions

1. What is a cool-season plant?
2. What constitutes a warm-season plant designation?
3. Why do plants transpire?
4. How does temperature affect transpiration, respiration, and photosynthetic rates?
5. What are growing degree days, and how are they calculated?
6. How are growing degree day units used to estimate plant maturity?
7. What is vernalization, and why is it important for plant production?
8. How does temperature influence plant dormancy?
9. How are plant environments altered to provide the optimal temperature for plant growth?

# Lesson 7.1 Plant Genetics

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Mitosis has five distinct phases necessary for cell division. | • Identify the different stages of mitosis in plant root cells. (Activity 7.1.1) |
| 2. Plant egg cells require meiosis and mitosis for development. | • Describe the steps of gamete cell production. (Activity 7.1.2) |
| 3. Fertilization, a necessary step for seed development, occurs when pollen unites with an egg cell. | • Illustrate the processes of meiosis and fertilization of an egg. (Activity 7.1.2) |
| 4. Dominant and recessive alleles determine the phenotypic characteristics of plants. | • Perform computer simulations related to genetic heritance to learn about the role genetics play in plant production. (Activity 7.1.3) |
| 5. Hybrid plants are an important source of agronomic commodities. | • Perform a simulation predicting offspring from a hybrid cross. (Activity 7.1.4) |

## Essential Questions

1. How does a plant transfer pollen from the anthers to the stigma?
2. What are the steps involved in the fertilization of plant embryos?
3. How is meiosis involved in plant reproduction?
4. How do meiosis and mitosis differ?
5. How can specific traits in plants be predicted in offspring?
6. What are dominant genetic traits, and why are they important to understanding genetic probability?
7. What is the Punnett Square, and how is it used in plant genetics?
8. What are the stages (phases) of mitosis?

9. What is crossbreeding or cross-pollination?
10. Why are hybrid plants valuable?

# Lesson 7.2 Pollination and Dispersion

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Flower pollination often requires natural agents, such as wind, water, insects, and vertebrates. | • Use clues given to identify the type of pollination agent in a variety of scenarios. (Activity 7.2.1) |
| 2. Plants use seeds to multiply species exponentially over time. | • Calculate the reproductive biotic potential of plants. (Activity 7.2.2) |
| 3. Identification and classification of plant species often rely on special structures that protect and support seeds. | • Develop a dichotomous key to classify seed-bearing structures. (Activity 7.2.3)<br>• Use the dichotomous key and observations of seed-bearing structures to determine the classification of structure. (Activity 7.2.3) |
| 4. Plants require methods of seed dispersal to ensure their survival in nature. | • Analyze articles related to issues involving seed dispersal to develop prescriptive plans to resolve the issue of seed dispersal. (Project 7.2.4)<br>• Illustrate the steps involved with seed dispersal and the relationship between plants and animals in this process. (Project 7.2.4) |

## Essential Questions

1. How does pollination occur in nature?
2. How is biotic potential determined?
3. How does the use of mathematics aid in understanding the biotic potential of plants?
4. What is the purpose of fruit on a plant?
1. How are fruits identified or classified based on anatomical features?
2. Why do some plants produce more seeds than other plants?
3. Why is it important for plants to have a method to disperse seeds?
4. How does seed dispersal affect plant and animal interactions?

# Lesson 7.3 Kernels of Life

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Germinating seeds from embryo to seedling have visible anatomical parts and growth stages used to identify the plant as either a monocotyledon or a dicotyledon. | • Identify the structures of seeds and plant embryos. (Activity 7.3.1)<br>• Distinguish between monocotyledon and dicotyledon seedlings using anatomical features. (Activity 7.3.1) |

| | |
|---|---|
| 2. Plant seeds convert starch into glucose by the use of enzymes during the germination process. | • Provide evidence in the form of data related to starch conversion to sugar during a seed germination experiment. (Activity 7.3.2) |
| 3. Environmental conditions, such as temperature, oxygen, and water, determine a seed's germination rate. | • Design and conduct an experiment to show evidence of the effects of different variations of treatments required for seed germination. (Project 7.3.3)<br>• Make a presentation to the class regarding research procedures and findings. (Project 7.3.3) |
| 4. Not all seeds are viable and, therefore, do not have the potential to germinate. | • Conduct an experiment to test for seed viability. (Activity 7.3.4) |
| 5. Dormancy is a strategy plants utilize to ensure some offspring will germinate at optimal times and plants rely on special treatments, such as light, cold temperatures, and scarification to break seed dormancy. | • Perform scarification to treat seeds for seed coat dormancy. (Activity 7.3.5) |

## Essential Questions

1. How does a seed germinate?
2. What environmental conditions are required for seeds to germinate?
3. How do we determine the germination rate for seeds?
4. What is the function of water in seed germination?
5. How does temperature influence seed germination?
6. Why do plant seeds require oxygen?
7. What are specific anatomical features used to distinguish a monocotyledon from a dicotyledon in plant seedlings?
8. What are the stages of seedling development?
9. How do plant seedlings have enough energy to go from seed to seedling without generating food by photosynthesis?
10. What physiological factors cause a seed not to be viable?
11. How does a plant use enzymes during the germination process?
12. What purpose does dormancy serve for plant seeds?

# Lesson 7.4 Plant Multiplication

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Some plant hybrids will produce seeds with genetic characteristics that are inconsistent with the parent plant genotype; therefore, producers use asexual propagation methods for reproducing the desired traits. | • Demonstrate how to perform common asexual propagation methods, such as grafting, budding, layering, division, and cuttings properly. (Activities 7.4.1, 7.4.2, 7.4.3, 7.4.4, and 7.4.5) |
| 2. Using asexual propagation methods, such as grafting, division, budding, layering, or cuttings, are efficient ways to produce new plants exhibiting desired characteristics of a parent plant. | • Compare and contrast different asexual propagation methods. (Activities 7.4.1, 7.4.2, 7.4.3, 7.4.4, and 7.4.5) |

| | |
|---|---|
| 3. Safe tool and equipment use is required to perform asexual propagation on plants to avoid personal injury. | • Identify hazards and safe practices for the plant laboratory. (Activities 7.4.1, 7.4.2, 7.4.3, 7.4.4, and 7.4.5) |

## Essential Questions

1. How does asexual propagation work?
2. Why do producers often prefer asexual propagation methods over sexual reproduction?
3. How does knowledge of plant growth help a person understand asexual propagation?
4. What are the advantages of one method of asexual propagation versus another?
5. How does a producer decide which method of asexual propagation to use for a specific plant?
6. Which attributes in plants determine the most suitable method of asexual propagation?
7. How does asexual propagation compare to sexual reproduction from a plant producer standpoint?
8. How can asexual propagation be more efficient than sexual reproduction?
9. What safety precautions do producers follow when using tools and equipment during asexual propagation work?
10. How do plant growth hormones and nutrient interactions affect asexual propagation?
11. How is asexual propagation used on the commercial scale for plant production?

# Lesson 8.1 Pesky Bugs and Plants

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Pests have negative effects on plant growth, such as yield and quality. | • Research and share symptoms and damage caused by pests. (Project 8.1.1) |
| 2. Plant pests include several organisms, including insects, mollusks, nematodes, vertebrates, and weeds. | • Identify anatomical features of pests that help determine what types of pests are responsible for crop predation. (Project 8.1.1) |
| 3. Proper detection of symptoms can determine plant pest threats. | • Identify specific symptoms of damage caused by pests. (Problem 8.1.2) |
| 4. Biological, chemical, and mechanical methods, as well as cultural practices, are options for eradication or deterring pests. | • Compare and contrast pest eradication and pest control methods. (Problem 8.1.2) |
| 5. An Integrated Pest Management plan assures that the management of pests is economically and environmentally sound. | • Create an Integrated Pest Management plan and discuss ways to implement such a plan. (Problem 8.1.2)<br>• Determine pest populations based upon using a statistical estimation method. (Activity 8.1.3) |
| 6. Plant producers consider life cycles of plant pests before employing proper control measures. | • Create a pictorial model of the life cycle of pests. (Activity 8.1.4) |

## Essential Questions

1. What is a pest?

2. What types of pests exist?
3. How are plant pests managed?
4. How does Integrated Pest Management impact the agriculture industry?
5. Why is observation critical to detecting pests?
6. How can pest management affect the natural environment?
7. What are the considerations for a producer when choosing the best method(s) of pest control?
8. Why is knowledge about the lifecycle of a pest helpful in controlling a pest?
9. How does the type of pest influence the type of plant damage?
10. How do various pest control methods and practices compare?
11. How is the pest population determined for a large area?
12. Why is the use of sampling crucial in controlling plant pests?

# Lesson 8.2 Diving into Diseases

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Plant disease-causing agents, such as bacteria, fungi, and viruses, affect the health of plants. | • Read articles related to common plant diseases and summarize the similarities and the differences among disease-causing agents. (Project 8.2.1) |
| 2. Plant diseases cause visible symptoms in plant growth, such as defoliation, abscesses, growths, and decaying of plant tissue. | • Develop an understanding of plant disease, causes, and means of prevention and control. (Project 8.2.1) |
| 3. Knowledge of disease prevention and treatment is important to protect plants from infection. | • Develop a plant disease management plan. (Project 8.2.1) |
| 4. Plant disease-causing agents are microscopic. | • Compare the size of bacteria and viruses with other common objects to gain perspective of scale. (Activity 8.2.2)<br>• Investigate bacteria cells under a microscope. (Activity 8.2.2) |

## Essential Questions

1. What types of damage are the results of plant diseases?
2. How does disease treatment differ from disease prevention?
3. Why are plant diseases a formidable foe to agricultural producers?
4. What are the methods of disease reproduction and infection of plant tissue?
5. How do weather and climate affect plant diseases?
6. How do you identify plant diseases?
7. How do diseases differ from other plant pests?
8. What are the two types of disease control?
9. What is the difference between an infection and an outbreak?

10. How do disease-causing agents differ?

# Lesson 9.1 Tools of Plant Production

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Specialized equipment is required for soil tillage and the planting, harvesting, and transporting of agronomic crops. | • Research machinery and equipment used to produce plants and create a study guide. (Activity 9.1.1)<br>• Categorize machinery used to produce plants according to use. (Activity 9.1.1) |
| 2. The growing environment for plants may be altered by structures, such as greenhouses, to provide optimal temperature requirements. | • Conduct an experiment to determine the effects of greenhouse coverings on temperature. (Activity 9.1.2) |
| 3. Methods of irrigation vary, and each method has advantages and disadvantages related to the impact on the environment. | • Research irrigation methods and compare each method to understand function and purpose. (Activity 9.1.3) |

## Essential Questions

1. What kinds of equipment and machinery do producers use for raising plants?
2. How does tillage impact plant growth?
3. How do harvest methods vary based upon the crop?
4. How do greenhouses maintain warmer temperatures than outside air?
5. What equipment does a greenhouse need to maintain optimal plant growth?
6. How do irrigation methods compare?
7. What role does irrigation play in producing more food?

# Lesson 9.2 Planting Seeds of Fortune

| Concepts | Performance Objectives |
|---|---|
| *Students will know and understand* | *Students will learn concepts by doing* |
| 1. Agronomy, floriculture, forestry, and nursery and landscape are the four major classifications of plant-based industries. | • Create a slide show of different plant industries. (Project 9.2.1) |
| 2. Product, placement, price, and promotion are the four keys to marketing products. | • Develop a presentation illustrating the four P's of marketing for each of the plant-based industries. (Project 9.2.1) |
| 3. There are many products produced within plant-based industries and all require careful planning to ensure the marketability of the product. | • Select crop(s) for a specific situation based on land analysis, local markets, and budget potential. (Problem 9.2.2) |
| 4. Basic steps, such as analyze the situation, decide on your objective, develop a plan, and measure the results are key components of a business plan. | • Develop a business proposal to utilize 20 acres to raise plants. (Problem 9.2.2) |

## Essential Questions

1. What are the four plant-based industries?
2. How are plants used differently by the four plant industries?
3. How are plants used in everyday life?
4. What are the four aspects of marketing?
5. What are the steps in developing a business management plan?
6. What are the components of a business proposal?
7. How are plant businesses organized?