

## ASP Expanded Lesson Review

The following is a compiled listing of the concepts, performance objectives, standard alignment, and essential questions by lesson.

### Lesson 1.1 – The World of Agricultural Education

#### Concepts

1. Many people work in a variety of agricultural enterprises to produce food, fiber, and fuel, which are essential to daily life.
2. Agricultural education includes learning about agriculture systems, natural resource management, science, business, communication, and leadership.
3. The National FFA Organization provides opportunities to build necessary life skills, such as leadership and personal character.
4. Supervised Agricultural Experience programs provide opportunities to explore potential career choices and develop professional career goals.

#### Performance Objectives

*It is expected that students will*

- Develop and keep an Agriscience Notebook to record and store information presented in classroom discussions and activities throughout the course.
- Interpret types of activities associated with agriculture from a case study about an agricultural entrepreneur.
- Set personal goals for premier leadership, personal growth, and career success.
- Develop a Supervised Agricultural Experience (SAE) implementation plan.

#### Standards and Benchmarks Addressed

##### ***AFNR Career Cluster – Agribusiness Systems Career Pathway Content Standards***

**Lesson 1.1 will address parts of the following performance elements:**

**ABS.03. Performance Element:** Utilize record keeping to accomplish AFNR business objectives while complying with laws and regulations.

##### ***AFNR Career Cluster – CSN – LifeKnowledge and Foundation Skills***

**CSN.02. Performance Element:** Personal Growth: Develop a skill set to enhance the positive evolution of the whole person.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**

## ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What is agriculture?
2. What is agricultural education?
3. What are the components of agricultural education?
4. What are the different areas of study in agricultural education?
5. How is agriculture more than farming?
6. What is the definition of agribusiness?
7. What is the FFA?
8. What does the acronym FFA stand for?
9. How do I join and become involved in FFA?
10. Why are setting long-term and short-term goals important?
11. What is meant by premier leadership, personal growth, and career success?
12. How can I start a Supervised Agricultural Experience (SAE) program?
13. What are the benefits of participating in FFA and developing a SAE?
14. What are the benefits of keeping an Agriscience Notebook?

## **Lesson 1.2 – A World without Enough Plants**

### **Concepts**

1. The many different types of plant industries provide career opportunities in plant production and management.
2. Plants are used to sustain human existence by providing many essential products, such as food, fiber, fuel, and medicine.
3. Plants have aesthetic value to humans.

4. Environmental factors, such as temperature and rainfall influence crop production and the types of crops grown in different regions of the country.

## Performance Objectives

*It is expected that students will*

- Present relevant plant industry vocabulary and definitions to the class.
- Survey their personal dependency upon plants.
- Map regions of crop production.
- Investigate environmental influences on crop production.
- Record notes and reflections related to information presented in class regarding the importance of plants.
- Begin an ongoing course project researching physical attributes and growth requirements for several species of plants.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 1.2 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification to the production and management of plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Interdependence of organisms**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Natural resources**
- **Science and technology in local, national, and global challenges**

### ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## Essential Questions

1. What is meant by the phrase “crop production?”
2. What represents or makes up a plant business?
3. What career opportunities are available in a plant business?
4. How do botany and horticulture differ?
5. How common are plants in everyday life?
6. What uses do plants have for human survival?
7. What is biofuel?
8. Why are certain crops grown in specific regions in the country?
9. Why could there be a shortage of plant related products to meet global demands?
10. What are the issues facing crop production?
11. What different growth factors must be considered when raising healthy productive plants?

## Lesson 2.1 – Starting from the Ground Up

### Concepts

1. Mineral matter, air, water, and organic matter are found in different proportions within a soil and define soil quality.
2. Mineral soils consist of three different particle sizes, specifically sand, silt, and clay.
3. Organisms, found in soils, help to form soils and improve soil quality.
4. Geographical features and environmental factors influence the formation process of soils and impact soil quality.
5. Soils form in layers that have distinguishing characteristics from other layers in a soil profile.
6. Soil color can vary due to the parent material it was derived from and environmental forces that formed it.
7. Soil erosion results in the loss of quality top soil and is a concern in the study of mineral soils.

### Performance Objectives

*It is expected that students will*

- Conduct a sediment test to determine the particle sizes of the mineral matter and the presence of organic matter in a sample of soil.
- Investigate the effects organic matter has on soil porosity and soil air holding capacity.
- Examine a soil sample to determine what kinds of microorganisms are present.
- Conduct an investigation of soil deposition caused by water.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 2.1 will address parts of the following performance elements:

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Constancy, change, and measurement**
- **Form and function**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Structure and properties of matter**
- **Motions and forces**

**Earth and Space Science – Content Standard D:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Origin and evolution of the earth system**
- **Natural and human-induced hazards**

### ***Principles and Standards for School Mathematics***

**Measurement** Instructional programs from pre-kindergarten through grade 12 should enable all students to apply appropriate techniques, tools, and formulas to determine measurements.

### ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## Essential Questions

1. How are soils formed?
2. What is in soil?
3. How are different colors of soil created?
4. What is parent material?

5. How old are soils?
6. What is a mineral soil?
7. How do sand, silt, and clay differ?
8. What type of organisms live in soil and what purpose do they serve?
9. What influences the formation of soil?
10. What is a soil profile?
11. What is important to know about soil layers?
12. What is soil erosion and why is it important to understand?

## Lesson 2.2 – Understanding Soil Properties

### Concepts

1. Sand, silt, and clay are three sizes of mineral particles that comprise soil texture.
2. Soil structure and soil texture are elements that affect soil function.
3. The structure and color of the soil profile determines the effective depth of a soil.
4. Mottling, soil horizon color, and permeability of the soil provide clues for determining internal drainage characteristics of soil.
5. Organic matter influences the porosity and water holding capacity of soils.
6. Soil permeability is influenced by the texture and structure of soil horizons.

### Performance Objectives

*It is expected that students will*

- Conduct tests to determine soil texture by feel.
- Test soil permeability to understand the relationship between soil particle size and rate of water filtration.
- Demonstrate the principles of water holding capacity and represent differences between test substances with data.
- Conduct an experiment providing evidence for the role of organic matter related to water holding capacity of the soil.
- Conduct an inquiry lab making predictions of soil characteristics using knowledge of the properties of the whole system.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 2.2 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Structure and properties of matter**

**Earth and Space Science – Content Standard D:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Origin and evolution of the earth system**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Natural resources**

## ***Principles and Standards for School Mathematics***

### **Measurement**

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- understand measurable attributes of objects and the units, systems, and processes of measurement
- apply appropriate techniques, tools, and formulas to determine measurements

## ***Standards for the English Language Arts***

### **Standard 5**

Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences and for a variety of purposes.

### **Standard 7**

Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people)

- to communicate their discoveries in ways that suit their purpose and audience.
- Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## 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. What constitutes a loam soil?
5. What is permeability as it pertains to soils and why is it important?
6. What soil substances influence the water-holding capacity of soil?
7. How is porosity critical for plant production?
8. What effects does soil texture have on porosity, permeability, and water holding capacity?
9. Why do certain types of soil structure formations indicate soil quality?
10. What is the role of organic matter in soil?

## Lesson 2.3 – Soil Chemistry

### Concepts

1. Soil pH determines the availability of nutrients required for plant growth and health.
2. Soil salinity concentration determines how well plants uptake water, and as a result the ability of plants to absorb the available necessary nutrients.
3. Testing of soil samples detect imbalances related to soil chemistry factors.
4. The optimal pH and salinity level required for plant growth varies among plant species and the levels are adjusted with the use of chemical treatments.

### Performance Objectives

*It is expected that students will*

- Test the pH of solutions using LabQuest® devices.
- Classify substances according to their pH level using a pH scale.
- Conduct a soil sample test to determine pH.
- Correct for acidic soil conditions using lime.
- Determine the salinity of soil by measuring the electrical conductivity.
- Determine the effects that chemical fertilizers have on soil salinity levels.

### Standards and Benchmarks Addressed

## ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 2.3 will address parts of the following performance elements:

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Constancy, change, and measurement**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Chemical reactions**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• understand numbers, ways of representing numbers, relationships among numbers, and number systems</li><li>• compute fluently and make reasonable estimates</li></ul>
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• understand measurable attributes of objects and the units, systems, and processes of measurement</li><li>• apply appropriate techniques, tools, and formulas to determine measurements</li></ul>
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
<b>Problem Solving</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to solve problems that arise in mathematics and in other contexts.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

### ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## 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. What is salinity and why does it affect plant growth?
6. How can a soil with a low pH be corrected for optimal plant growing conditions?
7. How can high salinity levels be prevented by soil management?
8. What will happen if you over fertilize with chemical-based fertilizers?
9. How does the testing of soil aid in understanding soil chemistry?
10. What is fertilization of the soil and why is it necessary?
11. How is soil chemistry related to plant nutrients?

## Lesson 3.1 – Mixing Media

### Concepts

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.
2. Media is sold in cubic feet or cubic yard increments and calculation of usage is an important skill for greenhouse and nursery production.
3. There are many different types of ingredients used in potting soil that provide permeability and porosity needed for container crops.

### Performance Objectives

*It is expected that students will*

- Identify components commonly used in potting media.
- Test different potting media ingredients to determine the permeability and porosity qualities of the media.
- Determine the percentage of ingredients found in a potting soil mixture.
- Calculate the volume of various containers using mathematics.

### Standards and Benchmarks Addressed

***AFNR Career Cluster – Plant Systems Career Pathway  
Content Standards***

**Lesson 3.1 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Structure and properties of matter**

## ***Principles and Standards for School Mathematics***

### **Number and Operations**

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- understand numbers, ways of representing numbers, relationships among numbers, and number systems
- understand meanings of operations and how they relate to one another
- compute fluently and make reasonable estimates

### **Algebra**

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- represent and analyze mathematical situations and structures using algebraic symbols
- analyze change in various contexts

### **Geometry**

Instructional programs from pre-kindergarten through grade 12 should enable all students to use visualization, spatial reasoning, and geometric modeling to solve problems.

### **Measurement**

Instructional programs from pre-kindergarten through grade 12 should enable all students to understand measurable attributes of objects and the units, systems, and processes of measurement.

### **Problem Solving**

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- solve problems that arise in mathematics and in other contexts
- monitor and reflect on the process of

mathematical problem solving

**Connections** Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

### **Essential Questions**

1. What is potting media?
2. What is the difference between potting media and mineral soil?
3. What materials are used in potting media?
4. What is the function of potting media ingredients, such as perlite and vermiculite?
5. Where do perlite and vermiculite originate?
6. Why is garden soil not a good choice for container-grown plants?
7. How are potting media quantities calculated?
8. What choices exist for purchasing potting media?
9. How many cubic inches and cubic feet are in a cubic yard?
10. How are cubic inches calculated for a round pot?

## **Lesson 3.2 – Hydroponics**

### **Concepts**

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.
2. Hydroponic crop production has advantages over traditional cropping systems, such as efficient use of space and resources.
3. There are many considerations to examine when choosing between hydroponic production and traditional crop production, such as the spread of disease and increased equipment costs.
4. Hydroponic crop production in a greenhouse provides the potential for yearlong crop production regardless of environmental conditions.
5. Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health.

### **Performance Objectives**

*It is expected that students will*

- Compare the use of fertilizers, water, and media in hydroponic and traditional plant production systems.
- Recognize the different types of hydroponic systems available.
- Design a hydroponic system incorporating the design principles of a specific type of system, such as nutrient flow, aggregate, water culture, or aeroponics.
- Monitor hydroponic system water quality for electrical conductivity, pH, dissolved oxygen, and nutrient levels.
- Determine the impact water quality has on plant growth in a hydroponic system.

## **Standards and Benchmarks Addressed**

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 3.2 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

**PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Constancy, change, and measurement**

**Science and Technology – Content Standard E:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities of technological design**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Science and technology in local, national, and global challenges**

### ***Principles and Standards for School Mathematics***

#### **Number and Operations**

Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.

#### **Algebra**

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- understand patterns, relations, and functions
- use mathematical models to represent and understand quantitative relationships

	<ul style="list-style-type: none"> <li>analyze change in various contexts</li> </ul>
<b>Measurement</b>	<p>Instructional programs from pre-kindergarten through grade 12 should enable all students to:</p> <ul style="list-style-type: none"> <li>understand measurable attributes of objects and the units, systems, and processes of measurement</li> <li>apply appropriate techniques, tools, and formulas to determine measurements</li> </ul>
<b>Data Analysis and Probability</b>	<p>Instructional programs from pre-kindergarten through grade 12 should enable all students to formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.</p>
<b>Connections</b>	<p>Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.</p>

## ***Standards for the English Language Arts***

<b>Standard 1</b>	<p>Students read a wide range of print and non-print texts to build an understanding of texts of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classical and contemporary works.</p>
<b>Standard 7</b>	<p>Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.</p>
<b>Standard 12</b>	<p>Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).</p>

## **Essential Questions**

1. What is hydroponics?
2. What advantages and disadvantages do hydroponic systems have compared to traditional cropping practices?
3. What equipment is needed to raise plants using hydroponic methods?
4. What are the management issues with the production of plants using hydroponics?
5. What are the different types of hydroponic systems available?
6. How do hydroponic systems lessen the impact on the environment and natural resources?

7. What role will hydroponics play in the future of sustainable crop production?
8. Why is water pH important for plant growth in hydroponic systems?
9. What requirements are needed to grow plants in a hydroponic system?
10. How are nutrient and dissolved oxygen levels monitored in a hydroponic system?

## Lesson 4.1 – Cells: Life's Smallest Units

### Concepts

1. Plant cells share similarities and differences with animal cells.
2. Plant cells are comprised of many parts that have essential functions for the survival of plant tissue, such as respiration.
3. Cell organelles can only be seen using a microscope.
4. There are different classifications of cells based on their utility.
5. New plant growth is not possible without meristematic tissues.
6. Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water.

### Performance Objectives

*It is expected that students will*

- Identify and label plant and animal cell organelles.
- Distinguish structural differences between plant and animal cells.
- Develop a pictorial representation of cell function.
- Correctly prepare slides of plant cells for viewing under a microscope.
- Collect and analyze data to provide evidence of cell metabolism.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standard***

**Lesson 4.1 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

#### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **The cell**
- **Matter, energy, and organization in living systems**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to <ul style="list-style-type: none"><li>• understand numbers, ways of representing numbers, relationships among numbers, and number systems</li><li>• compute fluently and make reasonable estimates</li></ul>
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to <ul style="list-style-type: none"><li>• represent and analyze mathematical situations and structures using algebraic symbols</li><li>• use mathematical models to represent and understand quantitative relationships</li></ul>
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to <ul style="list-style-type: none"><li>• understand measurable attributes of objects and the units, systems, and processes of measurement</li><li>• apply appropriate techniques, tools, and formulas to determine measurements</li></ul>
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to select and use appropriate statistical methods to analyze data.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 8</b>	Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

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

## Lesson 4.2 – The Radicle Root

### Concepts

1. The four major parts of a plant are the root, stem, leaves, and flower; and their functions are vital for plant health and growth.
2. The root has specific anatomical features responsible for anchoring the plant in the soil.
3. Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients.
4. Specialized plant cells have unique anatomical features, such as a root hair that serve very specific functions.
5. Plants use the process of osmosis for the uptake of water and dissolved nutrients required for plant growth.
6. Water uptake through plant roots is influenced by the turgidity of plant tissues.

### Performance Objectives

*It is expected that students will*

- Identify the four major parts of plant structure.
- Describe the function of the major plant parts.
- Examine a root structure and sketch representations of the structural form for a root.
- Examine cell differentiation as it relates to root cells.
- Conduct an experiment to simulate the osmosis process of plant root hairs.

### Standards and Benchmarks Addressed

***AFNR Career Cluster – Plant Systems Career Pathway  
Content Standard***

Lesson 4.2 will address parts of the following performance elements:

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **The cell**

## ***Standards for the English Language Arts***

Standard 12                  Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What are the four major parts of a plant?
2. What are three functions for each of the major plant parts?
3. What is a root system?
4. What is a root hair?
5. How do roots grow?
6. What are the three kinds of root systems?
7. How does a root absorb water and nutrients from the soil?
8. What part of the root absorbs water from the soil?
9. What are differentiated cells?
10. What are turgid cells and why are they important to plant life?
11. How is knowledge about root anatomy and physiology important in the management of plants?

## **Lesson 4.3 – Stems, Stalks, and Trunks**

### **Concepts**

1. Stems of plants provide physical support, storage of nutrients, and necessary pathways for translocation of materials throughout the plant.

2. 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.

## Performance Objectives

*It is expected that students will*

- Examine internal structures of stems.
- Identify differences between monocotyledon and dicotyledon features.
- Research and examine the life span of a tree including environmental conditions that coincided with the growth of a tree.
- Create a poster depicting the lifespan of a tree referencing stages of growth with historical events.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 4.3 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors on plant growth.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Behavior of organisms**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to analyze change in various contexts
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to develop and

	evaluate inferences and predictions that are based on data
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 7</b>	Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What is a stem?
2. What provides the rigid structure for plant stems to support the weight of leaves, flowers, and fruit?
3. How do nutrients flow within a stem structure?
4. What is the xylem and phloem?
5. How do monocotyledon and dicotyledon plants differ in terms of stem structure?
6. Are tree trunks similar in composition as flower stems? Why or why not?
7. How can stem growth be altered to produce desired characteristics for end use of plant material?
8. How does a severe climate change affect plant growth?

## **Lesson 4.4 – Leave It to Leaves**

### **Concepts**

1. Leaves are comprised of several parts that have differences in physical characteristics, such as shape and venation patterns.
2. The understanding of leaf characteristics assists agricultural scientists in identifying species or varieties of plants.
3. Leaf cells contain a specialized pigment known as chlorophyll that is used by the plant to harvest radiant energy from the sun.
4. Leaves produce food in the form of sugars that fuel the metabolic functions of a plant.
5. Leaves produce and store food.

## Performance Objectives

*It is expected that students will*

- Create a journal that includes sketches and identification information for 20 different species of local plants.
- Identify the characteristics of simple and compound leaves.
- Investigate the pigments and food storage systems found in plant leaves.
- Explain the process plants use to produce and store food.
- Explain why leaves are important to plants.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 4.4 will address parts of the following performance elements:

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**

### ***Principles and Standards for School Mathematics***

**Measurement** Instructional programs from pre-kindergarten through grade 12 should enable all students to apply appropriate techniques, tools, and formulas to determine measurements.

### ***Standards for the English Language Arts***

**Standard 8** Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## Essential Questions

1. What is a leaf?
2. What are the basic parts of a leaf?
3. How are the parts of the leaf used to distinguish among different plant species?
4. What is chlorophyll?
5. Why is chlorophyll important to a leaf?
6. What is meant by the phrase “radiant energy from the sun”?
7. How do simple leaves and compound leaves differ?
8. What is photosynthesis and why is it important to plant function?
9. What is transpiration?
10. What is the fuel that plants use to thrive?
11. Where does a plant store food reserves?

## Lesson 4.5 – Flower Power

### Concepts

1. Flowers are classified as either complete or incomplete based on the inclusion of either male or female parts, or both.
2. The parts of the flower are the mechanisms for pollination and fertilization and are used by a plant to complete sexual reproduction.
3. Concept maps assist in structuring ideas or concepts and illustrating the various connections between those ideas.

### Performance Objectives

*It is expected that students will*

- Identify the parts of a flower and explain the function for each part.
- Construct a model representing the parts of a flower.
- Develop a concept map to illustrate understanding of related ideas and nomenclature necessary to discuss the parts and functions of a flower.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 4.5 will address part of the following performance element:

**PS.01. Performance Element:** Examine plant anatomy and plant physiology.

#### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**

## ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

### **Essential Questions**

1. What are the parts of a flower?
2. Why are the parts of a flower important?
3. How does knowing the parts of the flower affect you in learning about plants?
4. What are the mechanisms required for pollination?
5. What are the mechanisms required for fertilization?
6. What constitutes a perfect flower?
7. What is the difference between a complete or incomplete flower?
8. What is the true purpose of showy petals of a flower?

## **Lesson 5.1 – Sorting Out Plants**

### **Concepts**

1. Classification of people, places, and things are a basic skill used in daily life, scientific research, and the agricultural industry.
2. Plants and animals are categorized using a hierarchical system to group organisms by anatomical or physiological similarities.
3. Plant parts are used as visual clues for differentiating between plant species often referred to as plant identification.
4. Classification is based on morphology that uses plant forms, such as parts, size, color, and usefulness to sort and group into classes with similar features.

### **Performance Objectives**

*It is expected that students will*

- Determine different ways to group objects.
- Develop a flowchart to classify 20 different species of plants.

- Research the taxonomic classification for a plant species.
- Prepare for the plant identification portions of the Agronomy, Floriculture, Forestry, or Nursery/Landscape Career Development Events.

## **Standards and Benchmarks Addressed**

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 5.1 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Biological evolution**

**History and Nature of Science – Content Standard G:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Nature of scientific knowledge**

### ***Standards for the English Language Arts***

- |                    |   |
|--------------------|---|
| <b>Standard 5</b>  | Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences and for a variety of purposes.                |
| <b>Standard 8</b>  | Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge. |
| <b>Standard 12</b> | Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).  |

## **Essential Questions**

1. What is plant identification?
2. What is morphology?
3. How do you classify plants?
4. How can the same plant be in multiple classification categories?

5. Why use Latin terminology for the scientific classification of plants?
6. What are the hierarchical levels for taxonomic classification?
7. What is the difference between a genus and a species designation?
8. What is taxonomy?

## Lesson 5.2 – Plant Names

### Concepts

1. Plants are classified and named based upon distinguishing characteristics, such as their physical features.
2. 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.
3. The scientific names for plants consist of Latin words representing descriptive features associated with the plant.
4. Plant species are often subdivided into varieties and cultivars that will include additional names after the genus and species.

### Performance Objectives

*It is expected that students will*

- Categorize plants by using leaf characteristics.
- Identify plants by using physical features.
- Research the meaning of scientific names for 10 species of trees.
- 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.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 5.2 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

#### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**

**History and Nature of Science – Content Standard G:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Nature of scientific knowledge**

## ***Standards for the English Language Arts***

- Standard 3** Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and other texts, their word identification strategies, and their understanding of textual features (e.g. sound-letter correspondence, sentence structure, context, graphics).
- Standard 8** Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Standard 9** Students develop an understanding of and respect for diversity in language use, patterns, and dialects across cultures, ethnic groups, geographic regions, and social roles.
- Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What is meant by the phrase “distinguishing characteristics”?
2. What is taxonomy?
3. How was binomial nomenclature developed?
4. What is the process for naming plants using binomial nomenclature?
5. What is the process for naming new cultivated plants?
6. What is the origin for the words representing a genus name?
7. What is described by the species name of a plant?
8. How does a variety and cultivar differ?
9. Why is Latin used as the language for naming plants?
10. Why is the genus a capitalized word?
11. How can you determine if the scientific name of a plant includes a variety name?
12. What is the problem with using the common name of a plant?

## **Lesson 6.1 – Plant Food**

### **Concepts**

1. Plants require sixteen nutrients for optimal growth and development.
2. Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical test of tissues.
3. Plants obtain required nutrients from the soil provided the soil has the available nutrients.
4. Nutrients can be added to the soil in various ways, such as chemical fertilizers, animal wastes, and organic matter.

## Performance Objectives

*It is expected that students will*

- Use testing equipment to detect the levels of nitrogen, phosphorus, and potassium in soil samples.
- Identify the effects of nutrient deficiencies in plants by observing anatomical differences.
- Conduct plant tissue testing to determine the potential nutrients that are lacking in growing plants.
- Use mathematical formulas to solve problems regarding fertilizer analyses, rates, and cost comparisons.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 6.1 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**
- **Behavior of organisms**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Environmental quality**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to represent and analyze mathematical situations and structures using algebraic symbols.
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"> <li>• understand measurable attributes of objects and the units, systems, and processes of measurement</li> <li>• apply appropriate techniques, tools, and formulas to determine measurements</li> </ul>
<b>Problem Solving</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to solve problems that arise in mathematics and in other contexts.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 8</b>	Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What is a nutrient?
2. What do specific plant nutrients do for plant growth and health?
3. How do plants get nutrients?
4. How can soil be modified to provide more nutrients for the plant?
5. What is N-P-K in terms of symbols for fertilizer?

6. What nutrients are needed for plant growth?
7. What would happen to a plant if it was exposed to too much of a certain type of nutrient?
8. How do you know when a plant does not have enough of a certain type of nutrient?
9. How do you know how much fertilizer to apply to the soil for a certain crop?
10. What are the differences among fertilizer sources?
11. How are mathematics used in fertilizer analysis, rates of application, and cost benefit analysis?

## Lesson 6.2 – All Wet

### Concepts

1. Water is used by plants for the translocation of materials within the vascular systems of plants and used to complete the photosynthesis process.
2. Water is used to help cool the plant during periods of above optimal temperature conditions through the process of transpiration.
3. Different substances that plant containers are made from will affect the rate of water loss by evaporation in potted plants.
4. Water requirements and tolerances vary among plant species.
5. The wilting point is a critical physiological stage that if exceeded can cause permanent damage to the health and physical appearance of plants.

### Performance Objectives

*It is expected that students will*

- Conduct an experiment to determine the rate of transpiration and evaporation for different plant growing containers.
- Examine how the rate of water loss is altered by environmental conditions.
- Collect evidence of water movement through a stem detecting transpiration pull.
- Monitor soil moisture to determine the wilting point of different plant species.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 6.2 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**
- **Behavior of organisms**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• represent and analyze mathematical situations and structures using algebraic symbols</li><li>• use mathematical models to represent and understand quantitative relationships</li><li>• analyze change in various contexts</li></ul>
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to apply appropriate techniques, tools, and formulas to determine measurements.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).
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## **Essential Questions**

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

## Lesson 6.3 – Lighting it Up

### Concepts

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.
2. Photosynthetic rate is affected by environmental factors, such as light exposure, availability of carbon dioxide, and temperature.
3. The level of red and blue-violet light emitted in a spectrum determines the quality of a light source intended for plant use.
4. Growth of plants is altered by light intensity and poor light exposure can create undesirable physical characteristics.
5. Plants respond to the length of daily dark periods to trigger physiological processes, such as flowering.
6. Plants and animals are codependent in ecosystems.

### Performance Objectives

*It is expected that students will*

- Investigate the interactions between animals and plants to understand the role of photosynthesis in biological systems.
- Collect evidence of the dependence of photosynthesis with light.
- Examine the relationship between the rate of photosynthesis and light spectrum quality.
- Conduct an investigation determining the effects of light intensity on plant growth.
- Calculate target dates for marketing flowering plants based on the length of time that plants are exposed to light.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 6.3 will address parts of the following performance elements:

- PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.
- PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.
- PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Evolution and equilibrium**
- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Interdependence of organisms**
- **Matter, energy, and organization in living systems**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to represent and analyze mathematical situations and structures using algebraic symbols.
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• understand measurable attributes of objects and the units, systems, and processes of measurement</li><li>• apply appropriate techniques, tools, and formulas to determine measurements</li></ul>

<b>Problem Solving</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to solve problems that arise in mathematics and in other contexts.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).
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### **Essential Questions**

1. What is photosynthesis?
2. What is chlorophyll?
3. What undesirable physical characteristics result in plants from altering light intensity?
4. What happens if plant leaves are not exposed to light?
5. What is the relationship between plants and animals?
6. How does light exposure affect the rate of photosynthesis?
7. How can photosynthesis be measured?
8. Which artificial light sources are adequate for plant growth?
9. What is a light spectrum and how can knowledge of the spectrum be used for plant production?
10. What color of the light spectrum do plants use for photosynthesis?
11. Why do plant leaves appear green?
12. What is phototropism and why is it important to understand when raising plants?
13. How can plants be programmed to flower for seasonal markets?
14. Why is day length important for the physiology of plants?
15. How do plants react to the length of light or dark periods?

## **Lesson 6.4 – Chilly Lilies**

### **Concepts**

1. Plants are classified as cool season or warm season plants based on their temperature requirements.
2. Temperature affects the metabolism rate of plants including transpiration, respiration, and photosynthesis.
3. Plant maturity is determined by the accumulation of thermal units during a growing season.

4. Temperature is a principle determinant for plant dormancy of some seeds, bulbs, specialized roots, and species of perennial plants.

## Performance Objectives

*It is expected that students will*

- Calculate estimated plant maturity dates using growing degree-days to compare two geographical locations.
- Calculate a growing schedule for a crop started on the same date, but have three different maturity target dates.
- Plant bulbs and schedule flowering for those bulbs to meet a holiday delivery date.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 6.4 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

**PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Constancy, change, and measurement**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**
- **Behavior of organisms**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to develop and

	evaluate inferences and predictions that are based on data.
<b>Problem Solving</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to solve problems that arise in mathematics and in other contexts.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 7</b>	Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **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 optimal temperature for plant growth?

## **Lesson 7.1 – Kernels of Life**

### **Concepts**

1. Germination rate in seeds is largely determined by the proper balance of environmental conditions, such as temperature, oxygen, and water.
2. Not all seeds are viable and therefore do not have the potential to germinate.
3. 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.

4. The germinating seed has visible anatomical parts and structures from embryo to seedling stages that are used to identify the plant as either a monocotyledon or a dicotyledon.
5. Plant seeds convert starch into glucose by the use of enzymes during the germination process.

## Performance Objectives

*It is expected that students will*

- Conduct an experiment to test for seed viability.
- Perform scarification to treat seeds for seed coat dormancy.
- Sketch and label the stages of germination.
- Design and conduct an experiment to show evidence of the effects for different variations of treatments required for seed germination.
- Write a research report for an experiment showing evidence to support conclusions.
- Make a presentation to the class regarding their research procedures and findings.
- Identify the structures of seeds and plant embryos.
- Distinguish between monocotyledon and dicotyledon seedlings using anatomical features.
- Provide evidence in the form of data related to starch conversion to sugar during a seed germination experiment.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 7.1 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

**PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Form and function**

**Science as Inquiry – Content Standard A:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Chemical reactions**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Interdependence of organisms**
- **Matter, energy, and organization in living systems**
- **Behavior of organisms**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to analyze change in various contexts.
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to apply appropriate techniques, tools, and formulas to determine measurements.
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 4</b>	Students adjust their use of spoken, written, and visual language (e.g. conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
<b>Standard 7</b>	Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **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. What happens if a seed is exposed to too much water?
6. What happens if a seed does not have enough water present during germination?
7. Why is the optimal temperature important for seed germination?
8. Why do plant seeds require oxygen?
9. What specific anatomical features are used to distinguish a monocotyledon from a dicotyledon in plant seedlings?
10. What are the stages of seedling development?
11. How do plant seedlings have enough energy to go from seed to seedling without generating food by photosynthesis?
12. What physiological factors cause a seed not to be viable?
13. How are enzymes used by a plant during the germination process?
14. What purpose does dormancy serve for plant seeds?
15. How is dormancy of plant seeds broken?

## Lesson 7.2 – Pollination and Fertilization

### Concepts

1. Flower pollination can happen with the assistance of several different pollination agents, such as wind, water, insects, and animals.
2. Fertilization is a necessary step for seed development.
3. The majority of plant growth happens in meristematic tissues of plants.
4. Plant egg cells require meiosis and mitosis for development.
5. Mitosis has five distinct phases necessary for cell division.
6. Genetic variation in plants is achieved by cross-pollination.
7. Dominant and recessive genes determine the phenotypic characteristics of plants.

### Performance Objectives

*It is expected that students will*

- Dissect a complete flower and identify the individual parts.
- Prepare a slide to be viewed under a microscope for examining cellular material of plant tissue.
- Identify the different stages of mitosis in plant root cells.
- Perform computer simulations related to genetic inheritance in order to learn about the role genetics plays in plant production.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 7.2 will address parts of the following performance elements:

- PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.
- PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Molecular basis of heredity**
- **Biological evolution**
- **Behavior of organisms**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them</li><li>• develop and evaluate inferences and predictions that are based on data</li><li>• understand and apply basic concepts of probability.</li></ul>

### ***Standards for the English Language Arts***

<b>Standard 4</b>	Students adjust their use of spoken, written, and visual language (e.g. conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
<b>Standard 12</b>	Students use spoken, written and visual language to

accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## Essential Questions

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

## Lesson 7.3 – Fruits, Nuts, and Monkeys

### Concepts

1. Plants use seeds to multiply species exponentially over time.
2. Seeds are protected or supported by specialized anatomical structures called fruit.
3. There are different types of fruit structures that can be used to identify or classify plant species.
4. Plants require methods of seed dispersal to ensure their survival in nature.
5. The existence of some plant species may be threatened if they depend on a specific animal for seed dispersal.

### Performance Objectives

*It is expected that students will*

- Calculate the reproductive biotic potential of plants.
- Read articles related to issues involving seed dispersal.
- Summarize and develop prescriptive plans to resolve the issue of seed dispersal.
- Create a cycle diagram to illustrate the steps involved with seed dispersal and the relationship between plants and animals in this process.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standard***

Lesson 7.3 will address parts of the following performance elements:

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

### ***National Science Education Standards - Life Science***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Biological evolution**
- **Interdependence of organisms**
- **Behavior of organisms**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Natural resources**

### ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• understand numbers, ways of representing numbers, relationships among numbers, and number systems</li><li>• compute fluently and make reasonable estimates</li></ul>
<b>Algebra</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to represent and analyze mathematical situations and structures using algebraic symbols.
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to develop and evaluate inferences and predictions that are based on data.
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## **Standards for the English Language Arts**

Standard 1 Students read a wide range of print and non-print texts to build an understanding of texts of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classical and contemporary works.

### **Essential Questions**

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

## **Lesson 8.1 – Plant Multiplication**

### **Concepts**

1. Some plant hybrids will produce seeds with genetic characteristics that are inconsistent with the parent plant genotype; therefore, asexual propagation methods are required for reproducing the desired traits.
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.
3. The tools and equipment required to perform asexual propagation on plants may create safety hazards for producers if not properly used.

### **Performance Objectives**

*It is expected that students will*

- Demonstrate how to perform common asexual propagation methods, such as grafting, budding, layering, division, and cuttings properly.
- Compare and contrast different asexual propagation methods.
- Decide the most appropriate method of asexual reproduction for different types of plant material.

### **Standards and Benchmarks Addressed**

## ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

Lesson 8.1 will address parts of the following performance elements:

**PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Behavior of organisms**

### ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

### **Essential Questions**

1. What is asexual propagation?
2. What is the difference between grafting, budding, layering, division, and cuttings?
3. What are the advantages of one method of asexual propagation versus another?
4. Which attributes in plants determine the most suitable method of asexual propagation?
5. Why does asexual propagation work?
6. What safety precautions must be observed when using tools and equipment during asexual propagation work?
7. How do plant growth hormones and nutrient interactions affect asexual propagation?
8. How is asexual propagation used on the commercial scale for plant production?

## **Lesson 9.1 – Pesky Bugs and Plants**

### **Concepts**

1. Pests have negative effects on plant growth, such as yield and quality.
2. Plant pests include several organisms including insects, mollusks, nematodes, vertebrates, and weeds.
3. Proper detection of symptoms can determine plant pest threats.

4. Biological, chemical, and mechanical methods as well as cultural practices are options for eradication or deterring pests.
5. An Integrated Pest Management plan assures that the management of pests is economically and environmentally sound.
6. Life cycles of plant pests must be considered prior to employing proper control measures.

## Performance Objectives

*It is expected that students will*

- Identify how pests affect crop quality.
- Identify anatomical features of pests that help determine what type of pests are responsible for crop predation.
- Identify specific symptoms of damage caused by pests.
- Create an Integrated Pest Management plan and discuss ways to implement such a plan.
- Determine pest populations based upon using a statistical estimation method.
- Identify harmful insects and list the crops the insects prefer.
- Create a pictorial model of the life cycle of pests.
- Compare and contrast pest eradication and pest control methods.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 9.1 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evolution and equilibrium**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Biological evolution**
- **Interdependence of organisms**
- **Behavior of organisms**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Measurement</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• understand measurable attributes of objects and the units, systems, and processes of measurement</li><li>• apply appropriate techniques, tools, and formulas to determine measurements</li></ul>
<b>Data Analysis and Probability</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• develop and evaluate inferences and predictions that are based on data</li><li>• understand and apply basic concepts of probability</li></ul>
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 7</b>	Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.
<b>Standard 8</b>	Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What constitutes a pest?
2. What types of pests exist?
3. How are plant pests controlled?
4. What is Integrated Pest Management?
5. Why is observation critical to detection of pests?
6. How can pest management have negative effects on the environment?

7. What are the important decisions a producer must consider when deciding upon the method or methods of pest control that are best to use?
8. What can knowledge about the lifecycle of a pest contribute to the control of a pest?
9. How does the type of pest determine the type of plant damage?
10. What is the trade-offs for chemical pest control versus biological control and cultural practices?
11. How does gathering a sample of a population determine a population of a larger area?
12. Why is the use of sampling crucial in controlling plant pests?

## Lesson 9.2 – Diving into Diseases

### Concepts

1. Plant disease-causing agents, such as bacteria, fungi, and viruses cause detrimental health effects on plants.
2. Plant disease-causing agents are microscopic and damage plants in various ways.
3. Plant diseases cause visible symptoms in plant growth, such as defoliation, abscesses, growths, and decaying of plant tissue.
4. Knowledge of disease prevention and treatment is important to protect plants from infection.

### Performance Objectives

*It is expected that students will*

- Read articles related to common plant diseases and summarize the similarities and the differences among disease-causing agents.
- Develop a plant disease management plan.
- Compare the size of bacteria and viruses with other common objects to gain perspective of scale.
- Investigate bacteria cells under a microscope.
- Develop an understanding of plant disease, its causes, and means of prevention and control.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 9.2 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Evidence, models, and explanation**
- **Form and function**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**
- **Behavior of organisms**

## ***Standards for the English Language Arts***

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What are the sources of plant diseases?
2. What types of damage occurs as the result of plant diseases?
3. What is the difference between disease prevention and disease treatment?
4. How can plant diseases be treated?
5. How can plant disease be prevented?
6. Why are plant diseases a formidable foe to agricultural producers?
7. What are the methods of disease reproduction and infection of plant tissue?
8. How do weather and climate affect plant diseases?
9. How can plant diseases be identified?
10. What is disease?
11. What are the two types of disease control?
12. How do bacteria, fungi, and viruses differ?
13. What is defoliation?
14. What is meant by the phrase “infected plant”?
15. What determines an infection versus an outbreak?
16. What are the three main disease-causing agents?

# Lesson 10.1 – Tools of Plant Production

## Concepts

1. Specialized equipment is required for soil tillage and the planting, harvesting, and transporting of agronomic crops.
2. The growing environment for plants may be altered by structures, such as greenhouses to provide optimal temperature requirements.
3. Irrigation is critical for many commercial plant species.
4. Methods of irrigation vary and each method has advantages and disadvantages related to the impact on the environment.

## Performance Objectives

*It is expected that students will*

- Research information about machinery and equipment used to produce plants and create a study guide for the National FFA Agronomy CDE.
- Categorize machinery used to produce plants according to use.
- Conduct an experiment to determine the effects of greenhouse coverings on temperature.
- Research irrigation methods and compare each method to understand function and purpose.

## Standards and Benchmarks Addressed

### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 10.1 will address parts of the following performance elements:**

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

**PS.03. Performance Element:** Propagate, culture, and harvest plants.

### ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Form and function**

**Physical Science – Content Standard B:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Conservation of energy and increase in disorder**

**Life Science – Content Standard C:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Matter, energy, and organization in living systems**

**Science and Technology – Content Standard E:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Abilities of technological design**
- **Understandings about science and technology**

**Science in Personal and Social Perspectives – Content Standard F:** As a result of their activities in grades 9-12, all students should develop understanding of

- **Environmental quality**
- **Science and technology in local, national, and global challenges**

## ***Principles and Standards for School Mathematics***

**Number and Operations** Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.

**Measurement** Instructional programs from pre-kindergarten through grade 12 should enable all students to apply appropriate techniques, tools, and formulas to determine measurements.

## ***Standards for the English Language Arts***

**Standard 7** Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.

**Standard 8** Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**Standard 12** Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What kinds of equipment and machinery are needed for raising plants?
2. What is tillage?
3. How are field crops harvested?
4. How do greenhouses maintain warmer temperatures than outside air?
5. What are greenhouses made of?
6. What equipment does a greenhouse need to maintain optimal plant growth?
7. What is irrigation?

8. What methods of irrigation are available to supply water to plants?
9. What method of irrigation is best for water conservation?

## Lesson 10.2 – Planting Seeds of Fortune

### Concepts

1. Product, placement, price, and promotion are the four keys to marketing products.
2. Agronomy, floriculture, forestry, and nursery and landscape are the four major classifications of plant-based industries.
3. There are many products produced within plant-based industries and all require careful planning to ensure the marketability of the product.
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.

### Performance Objectives

*It is expected that students will*

- Develop a presentation as a team illustrating the four P's of marketing for each of the plant-based industries.
- Research and develop a business plan proposal utilizing 20 acres of school district property to raise plants.

### Standards and Benchmarks Addressed

#### ***AFNR Career Cluster – Agribusiness Systems Career Pathway Content Standards***

**Lesson 10.2 will address parts of the following performance elements:**

**ABS.01. Performance Element:** Utilize economic principles to establish and manage an AFNR enterprise.

**ABS.02. Performance Element:** Utilize appropriate management planning principles in AFNR business enterprises.

**ABS.07. Performance Element:** Create a production system plan.

#### ***AFNR Career Cluster – Plant Systems Career Pathway Content Standards***

**Lesson 10.2 will address parts of the following performance elements:**

**PS.01. Performance Element:** Apply knowledge of plant classification, plant anatomy and plant physiology to the production and management of plants.

**PS.02. Performance Element:** Prepare a plant management plan that addresses the influence of environmental factors, nutrients, and soil on plant growth.

**PS.04. Performance Element:** Employ elements of design to enhance an environment.

## ***National Science Education Standards***

**Unifying Concepts and Processes:** As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- **Systems, order, and organization**
- **Evidence, models, and explanation**

## ***Principles and Standards for School Mathematics***

<b>Number and Operations</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to compute fluently and make reasonable estimates.
<b>Problem Solving</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to: <ul style="list-style-type: none"><li>• solve problems that arise in mathematics and in other contexts</li><li>• apply and adapt a variety of appropriate strategies to solve problems</li></ul>
<b>Connections</b>	Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and apply mathematics in contexts outside of mathematics.

## ***Standards for the English Language Arts***

<b>Standard 4</b>	Students adjust their use of spoken, written, and visual language (e.g. conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
<b>Standard 5</b>	Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences and for a variety of purposes.
<b>Standard 7</b>	Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, and people) to communicate their discoveries in ways that suit their purpose and audience.
<b>Standard 8</b>	Students use a variety of technological and informational resources (e.g. libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
<b>Standard 12</b>	Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information).

## **Essential Questions**

1. What are the four plant-based industries?
2. What are examples for uses of plants in the four plant industries?
3. What are the four aspects of marketing?
4. What are the steps in developing a business management plan?