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Statewide Framework Document for: 011101

Plant Science

Standards may be added to this document prior to submission but may not be removed from the framework to meet state credit equivalency requirements. Performance assessments and leadership alignment may be developed at the local level. In order to earn state approval, performance assessments must be submitted within this framework. **This course is eligible for one credit biology or lab science.** The Washington State Science Standards performance expectations for high school blend core ideas (Disciplinary Core Ideas, or DCIs) with scientific and engineering practices (SEPs) and crosscutting concepts (CCCs) to support students in developing usable knowledge that can be applied across the science disciplines. These courses are to be taught in a three-dimensional manner. The details about each performance expectation can be found at Next Generation Science Standards.

School District Name	
Course Title: Plant Science	**Total Framework Hours:** 180
CIP Code: 011101 ☒ Exploratory ☐ Preparatory	**Date Last Modified:** December 30, 2020
Career Cluster: Agriculture, Food and Natural Resources	**Cluster Pathway:** Plant Systems
Course Summary: Plant Science is a general course that focuses on the scientific principles that underlie the breeding, cultivation, and production of agricultural plants. Students will also learn about the production, processing, and distribution of agricultural plant products. Instruction in the plant sciences includes crop cultivation, agricultural production, and the processing of agricultural and food products. As with all agriculture courses, instruction and assessment in the Supervised Agriculture Experience (SAE) is a requirement. The Supervised Agriculture Experience includes placing a student in a position where he or she will learn the practices of entrepreneurship and the fundamentals of research and experimentation in the agricultural field. Participants in the SAE will conduct exploratory projects with the purpose of learning about and improving practices in their surroundings. SAE.01. This course will include instruction in and Student involvement in Supervised Agriculture Experience Projects (SAE).	
Eligible for Equivalent Credit in: Science	**Total Number of Units:** 11

Unit 1: Career Exploration and Opportunities	**Total Learning Hours for Unit:** 10

Unit Summary:

Competencies include:

1.1.1 Many people work in a variety of agricultural enterprises to produce food, fiber, and fuel, which are essential to daily life.

1.1.4 Agricultural education includes learning about agriculture systems, natural resource management, science, business, communication, and leadership.

1.1.5 The National FFA Organization provides opportunities to build necessary life skills, such as leadership and personal character.

1.1.6 Supervised Agricultural Experience programs provide opportunities to explore potential career choices and develop professional career goals.

1.2.1 The many different types of plant industries provide career opportunities in plant production and management.

1.2.2 Plants are used to sustain human existence by providing many essential products, such as food, fiber, fuel, and medicine.

1.2.3 Plants have aesthetic value to humans.

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

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- Develop a Supervised Agricultural Experience (SAE) implementation plan.
- Use the Agriculture Experience Tracker (AET) online record keeping system to maintain accurate records on the SAE project.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students think creatively, manage goals and time, and be self-directed learners while planning and implementing their SAE project.
- Students access and evaluate information through the use of the animal science notebook to store information accessed in this course.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.04.01. Performance Indicator: Create designs using plants.

Level I: PS.04.01.02.a. Discuss the applications of art in agriculture/horticulture.

Aligned Washington State Academic Standards	
Science	**Washington Science Standards (Next Generation Science Standards):** HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 2: Mineral Soils	**Total Learning Hours for Unit:** 20

Unit Summary:

Competencies include:

- 2.1.1 Mineral matter, air, water, and organic matter are found in different proportions within a soil and define soil quality.
- 2.1.2 Mineral soils consist of three different particle sizes, specifically sand, silt, and clay.
- 2.1.3 Organisms, found in soils, help to form soils and improve soil quality.
- 2.1.4 Geographical features and environmental factors influence the formation process of soils and affect soil quality.
- 2.1.5 Soils form in layers that have distinguishing characteristics from other layers in a soil profile.
- 2.1.6 Soil color can vary due to the parent material it was derived from and environmental forces that formed it.
- 2.1.7 Soil erosion results in the loss of quality topsoil and is a concern in the study of mineral soils.
- 2.2.1 Sand, silt, and clay are three sizes of mineral particles that are comprised in soil texture.
- 2.2.2 Soil structure and soil texture are elements that affect soil function.
- 2.2.3 The structure and color of the soil profile determines the effective depth of a soil.
- 2.2.4 Mottling, soil horizon color, and permeability of the soil provide clues for determining internal drainage characteristics of soil.
- 2.2.5 Organic matter influences the porosity and water holding capacity of soils.
- 2.2.6 Soil permeability is influenced by the texture and structure of soil horizons.
- 2.3.1 Soil pH determines the availability of nutrients required for plant growth and health.
- 2.3.2 Soil salinity concentration determines how well plants uptake water, and, as a result, the ability of plants to absorb the available necessary nutrients.
- 2.3.3 Testing of soil samples detects imbalances related to soil chemistry factors.
- 2.3.4 The optimal pH and salinity level required for plant growth varies among plant species and is adjusted with the use of chemical treatments.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students think creatively, access and evaluate information, and interact effectively with others to conduct soil tests including PH, permeability, and porosity.
- Students reason effectively and be self-directed learners as they test different potting media ingredients.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.02.02. Performance Indicator: Prepare growing media for use in plant systems.

Level I: PS.02.02.01.a. Identify the major components of growing media and describe how growing media support plant growth.
Level II: PS.02.02.01.b. Describe the physical characteristics of growing media and explain the influence they have on plant growth.
Level III: PS.02.02.01.c. Formulate and prepare growing media for specific plants or crops.
Level I: PS.02.02.02.a. Identify the categories of soil water.
Level II: PS.02.02.02.b. Discuss how soil drainage and water holding capacity can be improved.

PS.02.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.

Level I: PS.02.03.01.a. Identify the essential nutrients for plant growth and development and their major functions.
Level I: PS.02.03.02.a. Discuss the influence of pH and cation exchange capacity on the availability of nutrients.
Level III: PS.02.03.02.c. Adjust the pH of growing media.
Level I: PS.02.03.03.a. Collect soil and plant tissue samples for testing and interpret the test results.
Level II: PS.02.03.03.b. Determine the nutrient content of soil using appropriate laboratory procedures and prescribe fertilization based on results.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level I: PS.03.02.02.a. Explain the reasons for preparing growing media before planting.
Level II: PS.03.02.02.b. Prepare soil for planting with the addition of amendments.

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

	HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 3: Soilless Systems	**Total Learning Hours for Unit:** 15

Unit Summary:

Competencies include:

- 3.1.1 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.
- 3.1.2 Media is sold in cubic feet or cubic yard increments and calculation of usage is an important skill for greenhouse and nursery production.
- 3.1.3 There are many different types of ingredients used in potting soil that provide permeability and porosity needed for container crops.
- 3.2.1 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.
- 3.2.2 Hydroponic crop production has advantages over traditional cropping systems, such as efficient use of space and resources.
- 3.3.3 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.
- 3.3.4 Hydroponic crop production in a greenhouse provides the potential for yearlong crop production regardless of environmental conditions.
- 3.3.5 Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students think creatively to develop a pictorial representation of cell function.
- Students reason effectively and work independently to prepare slides of plant cells. They will access and evaluate information by collecting and analyzing evidence of cell metabolism.
- Students manage goals and time, work creatively with others, and work effectively in diverse teams to design a hydroponic system.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.02.02. Performance Indicator: Prepare growing media for use in plant systems.

Level I: PS.02.02.01.a. Identify the major components of growing media and describe how growing media support plant growth.

Level II: PS.02.02.01.b. Describe the physical characteristics of growing media and explain the influence they have on plant growth.

Level III: PS.02.02.01.c. Formulate and prepare growing media for specific plants or crops.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level I: PS.03.02.02.a. Explain the reasons for preparing growing media before planting.

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins that carry out the essential functions of life through systems of specialized cells. HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net

	transfer of energy. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 4: Anatomy and Physiology	**Total Learning Hours for Unit:** 30

Unit Summary:

Competencies include:

- 4.1.1 Plant cells share similarities and differences with animal cells.
- 4.1.2 Plant cells are composed of many parts that have essential functions for the survival of plant tissue, such as respiration.
- 4.1.3 Cell organelles can only be seen using a microscope.
- 4.1.4 There are many different classifications of cells based on their utility.
- 4.1.5 New plant growth is not possible without meristematic tissues comprised of actively dividing cells.
- 4.1.6 Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water.
- 4.2.1 The four major parts of a plant are the root, stem, leaves, and flower; and their functions are vital for plant health and growth.
- 4.2.2 The root has specific anatomical features responsible for anchoring the plant in the soil.
- 4.2.3 Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients.
- 4.2.4 Specialized plant cells have unique anatomical features, such as a root hair, that serve very specific functions.
- 4.2.5 Plants use the process of osmosis for the uptake of water and dissolved nutrients required for plant growth.
- 4.2.6 Water uptake through plant roots is influenced by the turgidity of plant tissues.
- 4.3.1 Stems of plants provide physical support, storage of nutrients, and necessary pathways for translocation of materials throughout the plant.
- 4.3.2 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.
- 4.4.1 Leaves are comprised of several parts that have differences in physical characteristics, such as shape and venation patterns.
- 4.4.2 The understanding of leaf characteristics assists agricultural scientists in identifying species or varieties of plants.

4.4.3 Leaf cells contain a specialized pigment known as chlorophyll that is used by the plant to harvest radiant energy from the sun.
4.4.4 Leaves produce food in the form of sugars that fuel the metabolic functions of a plant.
4.4.5 Leaves produce and store food.
4.5.1 Flowers are classified as either complete or incomplete based on the inclusion of either male or female parts, or both.
4.5.2 The parts of the flower are the mechanisms for pollination and fertilization and are used by a plant to complete sexual reproduction.
4.5.3 Concept maps assist in structuring ideas or concepts and illustrating the various connections between those ideas.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- 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.
- 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.
- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students work creatively with others and use systems thinking to determine a way to group objects and create a flowchart to classify 20 different species of plants.
- Students work independently and think creatively to create a journal including sketches and identification for 20 different species of local plants.

- Students think creatively and reason effectively to create a model that represents the parts of a flower.
- Students access and analyze information and use technology to research taxonomic classifications.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.01.01. Performance Indicator: Classify agricultural plants according to taxonomy systems.

Level I: PS.01.01.02.a. Describe the morphological characteristics used to identify agricultural plants.

PS.01.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

Level I: PS.01.02.01.a. Diagram a typical plant cell and identify plant cell organelles and their functions.

Level III: PS.01.02.01.c. Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems.

Level I: PS.01.02.02.a. Identify the components, the types and the functions of plant roots.

Level II: PS.01.02.02.b. Identify root tissues and explain the pathway of water and nutrients into and through the root tissues.

Level III: PS.01.02.02.c. Relate the active and passive transport of minerals into and through the root system to plant nutrition.

Level I: PS.01.02.03.a. Identify the components and the functions of plant stems.

Level II: PS.01.02.03.b. Describe the processes of translocation.

Level I: PS.01.02.04.a. Discuss leaf morphology and the functions of leaves.

Level II: PS.01.02.04.b. Explain how leaves capture light energy and allow for the exchange of gases.

Level III: PS.01.02.04.c. Explain the relationships between leaf structure and functions and plant management practices.

Level I: PS.01.02.05.a. Identify the components of a flower, the functions of a flower and the functions of flower components.

Level II: PS.01.02.05.b. Identify the different types of flowers and flower forms.

Level III: PS.01.02.05.c. Apply the knowledge of flower structures to plant breeding, production and use.

PS.01.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.

Level I: PS.01.03.01.a. Explain the basic process of photosynthesis and its importance to life on Earth.

Level II: PS.01.03.01.b. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.

Level III: PS.01.03.01.c. Explain the light-dependent and light-independent reactions that occur during photosynthesis and apply the knowledge to plant management.

Level I: PS.01.03.02.a. Explain cellular respiration and its importance to plant life.

Level II; PS.01.03.02.b. Explain factors that affect cellular respiration and identify the products and byproducts of cellular respiration.

Level III: PS.01.03.02.c. Explain the four stages of aerobic respiration and relate cellular respiration to plant growth, crop management and post-harvest handling.

Level I: PS.01.03.03.a. Define primary growth and the role of the apical meristem.

Level II: PS.01.03.03.b. Explain the process of secondary plant growth.

Level III: PS.01.03.03.c. Relate the principles of primary and secondary growth to plant systems.

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

	HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 5: Taxonomy	**Total Learning Hours for Unit:** 8

Unit Summary:

Competencies include:

- 5.1.1 Classification of people, places, and things are a basic skill used in daily life, scientific research, and the agricultural industry.
- 5.1.2 Plants and animals are categorized using a hierarchical system to group organisms by anatomical or physiological similarities.
- 5.1.3 Plant parts are used as visual clues for differentiating between plant species, often referred to as plant identification.
- 5.1.4 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.
- 5.2.1 Plants are classified and named based upon distinguishing characteristics, such as their physical features.
- 5.2.2 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.
- 5.2.3 The scientific names for plants consist of Latin words representing descriptive features associated with the plant.
- 5.2.4 Plant species are often subdivided into varieties and cultivars that will include additional names after the genus and species.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.

- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students think creatively and collaborate with others to create a fictitious plant describing the physical features and applying the principles of binomial nomenclature.
- Students reason effectively and use systems thinking to use testing equipment to detect the levels of nitrogen, phosphorus, and potassium in soil samples.
- Students use and manage information and solve problems by using mathematical formulas regarding fertilizer analysis.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.01.01. Performance Indicator: Classify agricultural plants according to taxonomy systems.

Level I: PS.01.01.01.a. Explain systems used to classify plants.
Level II: PS.01.01.01.b. Compare and contrast the hierarchical classification of agricultural plants.
Level III: PS.01.01.01.c. Classify agricultural plants according to the hierarchical classification system, life cycles, plant use and as monocotyledons or dicotyledons.
Level I: PS.01.01.02.a. Describe the morphological characteristics used to identify agricultural plants. Level II: PS.01.01.02.b. Identify agriculturally important plants by common names.
Level III: PS.01.01.02.c. Identify agriculturally important plants by scientific names

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

	HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ETS1-2. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 6: The Growing Experiment	**Total Learning Hours for Unit:** 26

Unit Summary:

Competencies include:

- 6.1.1 Plants require sixteen nutrients for optimal growth and development.
- 6.1.2 Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical test of tissues.
- 6.1.3 Plants obtain required nutrients from the soil provided the soil has the available nutrients.
- 6.1.4 Nutrients can be added to the soil in various ways, such as chemical fertilizers, animal wastes, and organic matter.
- 6.2.1 Water is used by plants for the translocation of materials within the vascular systems of plants and used to complete the photosynthesis process.
- 6.2.2 Water is used to help cool the plant during periods of above-optimal temperature conditions through the process of transpiration.
- 6.2.3 Different substances that plant containers are made from will affect the rate of water loss by evaporation in potted plants.
- 6.2.4 Water requirements and tolerances vary among plant species.
- 6.2.5 The wilting point is a critical physiological stage that if exceeded can cause permanent damage to the health and physical appearance of plants.
- 6.3.1 Light is absorbed by chlorophyll and used by plants to convert carbon dioxide and water into glucose and oxygen through the process of photosynthesis.
- 6.3.2 Photosynthetic rate is affected by environmental factors, such as light exposure, availability of carbon dioxide, and temperature.
- 6.3.3 The level of red and blue-violet light emitted in a spectrum determines the quality of a light source intended for plant use.
- 6.3.4 Growth of plants is altered by light intensity and can create undesirable physical characteristics.
- 6.3.5 Plants respond to the length of daily dark periods to trigger physiological processes, such as flowering.
- 6.3.6 Plants and animals are codependent in ecosystems.

6.4.1 Plants are classified as cool season or warm season plants based on their temperature requirements.
6.4.2 Temperature affects the metabolism rate of plants including transpiration, respiration, and photosynthesis.
6.4.3 Plant maturity is determined by the accumulation of thermal units during a growing season.
6.4.4 Temperature is a principle determinant for plant dormancy of some seeds, bulbs, specialized roots, and species of perennial plants

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- 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.
- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students manage projects and be responsible to others by conducting an experiment to determine the rate of transpiration and evaporation for different plant growing containers.
- Students use problem solving to determine the effects of light intensity on plant growth.
- Students access and evaluate information and work independently while investigating the interactions between animals and plants to understand the role of photosynthesis in biological systems.

- Students think creatively, use and manage information, and communicate clearly by designing and conducting an experiment, writing a research report, and making a class presentation.

Industry Standards and/or Competencies:
Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.02.01. Performance Indicator: Determine the influence of environmental factors on plant growth.

Level I: PS.02.01.01.a. Describe the qualities of light that affect plant growth.
Level II: PS.02.01.01.b. Describe plant responses to light color, intensity and duration.
Level III: PS.02.01.01.c. Evaluate plant responses to varied light color, intensity and duration.
Level I: PS.02.01.02.a. Describe the effects air, temperature and water have on plant metabolism and growth. Level II: PS.02.01.02.b. Determine the optimal air, temperature and water conditions for plant growth.
Level III: PS.02.01.02.c. Design, implement and evaluate a plan to maintain optimal conditions for plant growth.

PS.02.02. Performance Indicator: Prepare growing media for use in plant systems.

Level II: PS.02.02.02.b. Discuss how soil drainage and water holding capacity can be improved. PS.02.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.

Level I: PS.02.03.01.a. Identify the essential nutrients for plant growth and development and their major functions.
Level II: PS.02.03.01.b. Describe nutrient deficiency symptoms and recognize environmental causes of nutrient deficiencies. Level III: PS.02.03.01.c. Monitor plants for signs of nutrient deficiencies and prepare a scouting report.
Level III: PS.02.03.03.c. Determine the nutrient content of plant tissue samples using appropriate laboratory procedures and prescribe fertilization based on results.
Level I: PS.02.03.04.a. Identify fertilizer sources of essential plant nutrients, explain fertilizer formulations and describe different methods of fertilizer application.
Level II: PS.02.03.04.b. Calculate the amount of fertilizer to be applied and calibrate equipment to apply the prescribed amount of fertilizer. Level III: PS.02.03.04.c. Use variable-rate technology to apply fertilizers to meet crop nutrient needs.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level I: PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop. Level II: PS.03.02.04.b. Monitor the progress of plantings and determine the need to adjust environmental conditions.

Level III: PS.03.02.04.c. Prepare and implement a plant production schedule based on predicted environmental conditions. Level I: PS.03.02.05.a. Explain the reasons for controlling plant growth.

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

	HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 7: Sexual Reproduction	**Total Learning Hours for Unit:** 26

Unit Summary:

Competencies include:

- 7.1.1 Germination rate in seeds is largely determined by the proper balance of environmental conditions, such as heat, oxygen, and water.
- 7.1.2 Not all seeds are viable and therefore do not have the potential to germinate.
- 7.1.3 Dormancy is a strategy plants use 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.
- 7.1.4 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.
- 7.1.5 Plant seeds convert starch into glucose by the use of enzymes during the germination process.
- 7.2.1 Flower pollination can happen with the assistance of several different pollination agents, such as wind, water, insects, and animals.
- 7.2.2 Fertilization is a necessary step for seed development.
- 7.2.3 The majority of plant growth happens in meristematic tissues of plants.
- 7.2.4 Eggs require meiosis and mitosis for development.
- 7.2.5 Mitosis has five distinct phases necessary for cell division. Genetic variation in plants is achieved by cross-pollination.
- 7.2.6 Dominant and recessive genes determine the phenotypic characteristics of plants.
- 7.3.1 Plants use seeds to multiply species exponentially over time.
- 7.3.2 Seeds are protected or supported by specialized anatomical structures called fruit.
- 7.3.3 There are different types of fruit structures that can be used to identify or classify plant species.
- 7.3.4 Plants require methods of seed dispersal to ensure their survival in nature.
- 7.3.5 The existence of some plant species may be threatened if they depend on a specific animal for seed dispersal.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.
- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students access and evaluate information and apply technology effectively to perform computer simulations related to genetic inheritance.
- Students solve problems and produce results by demonstrating how to perform common asexual propagation methods.
- Students work effectively in diverse teams and interact effectively with others to dissect a complete flower and identify the parts.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.01.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

Level II: PS.01.02.01.b. Compare and contrast mitosis and meiosis.
Level I: PS.01.02.05.a. Identify the components of a flower, the functions of a flower and the functions of flower components.
Level III: PS.01.02.05.c. Apply the knowledge of flower structures to plant breeding, production and use.
Level I: PS.01.02.06.a. Explain the functions and components of seeds and fruit.
Level II: PS.01.02.06.b. Identify the major types of fruit.
Level III: PS.01.02.06.c. Apply the knowledge of seed and fruit structures to plant culture and use.

PS.03.01. Performance Indicator: Demonstrate plant propagation techniques.

Level I: PS.03.01.01.a. Explain pollination, cross-pollination and self-pollination of flowering plants.
Level II: PS.03.01.01.b. Diagram the process of plant fertilization.
Level I: PS.03.01.02.a. Demonstrate sowing techniques and provide favorable conditions for seed germination.
Level II: PS.03.01.02.b. Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor.
Level III: PS.03.01.02.c. Conduct tests associated with seed germination rates, viability and vigor.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level II: PS.03.02.03.b. Apply preplant treatments required of seeds and plants and evaluate the results.
Level III: PS.03.02.03.c. Operate mechanized planting equipment.
Level I: PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop.

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):**

	HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 8: Asexual Reproduction	**Total Learning Hours for Unit:** 8

Unit Summary:

Competencies include:

8.1.1 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.

8.1.2 Using asexual propagation methods, such as grafting, division, budding, layering, or cuttings, is an efficient way to produce new plants exhibiting desired characteristics of a parent plant.

8.1.3 The tools and equipment required to perform asexual propagation on plants may create safety hazards for producers if not properly used.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.
Example:

- Students think creatively and use systems thinking to create an Integrated Pest Management plan.
- Students use and manage information and communicate clearly while interacting effectively with others to create a pictorial model of the life cycle of pests.
- Students work independently and solve problems by determining pest populations based upon a statistical estimation method.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.01.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.

Level I: PS.01.03.03.a. Define primary growth and the role of the apical meristem.
Level II: PS.01.03.04.b. Identify the plant responses to plant growth regulators and different forms of tropism.
Level III: PS.01.03.04.c. Select plant growth regulators to produce desired responses from plants.

PS.03.01. Performance Indicator: Demonstrate plant propagation techniques.

Level I: PS.03.01.03.a. Describe optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by cuttings, division, separation and layering.
Level II: PS.03.01.03.b. Demonstrate proper procedures in budding or grafting selected materials.
Level III: PS.03.01.03.c. Evaluate asexual propagation practices based on productivity and efficiency.
Level I: PS.03.01.04.a. Define micropropagation, discuss advantages associated with the practice and outline the four main stages of the process.
Level II: PS.03.01.04.b. Demonstrate aseptic micropropagation techniques.
Level III: PS.03.01.04.c. Propagate plants by micropropagation.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level I: PS.03.02.03.a. Demonstrate proper planting procedures and post-planting care.
Level II: PS.03.02.03.b. Apply preplant treatments required of seeds and plants and evaluate the results

Aligned Washington State Academic Standards

Science	HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain

	relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 9: Surviving a Harsh Environment	**Total Learning Hours for Unit:** 7

Unit Summary:

Competencies include:

9.1.1 Pests have negative effects on plant growth, such as yield and quality losses.
9.1.2 Plant pests include several organisms including insects, mollusks, nematodes, vertebrates, and weeds.
9.1.3 Proper detection of symptoms can determine plant pest threats.
9.1.4 Biological, chemical, and mechanical methods as well as cultural practices are options for eradication or deterring pests.
9.1.5 An Integrated Pest Management plan ensures that the management of pests is economically and environmentally sound.
9.1.6 Life cycles of plant pests must be considered prior to employing proper control measures.
9.2.1 Plant disease-causing agents, such as bacteria, fungi, and viruses, cause detrimental health effects on plants.
9.2.2 Plant disease-causing agents are microscopic and damage plants in various ways.
9.2.3 Plant diseases cause visible symptoms in plant growth, such as defoliation, abscesses, growths, and decaying of plant tissue.
9.2.4 Knowledge of disease prevention and treatment is important to protect plants from infection.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Identify how pests affect crop quality.
- Identify anatomical features of pests that help determine the type of pests that 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.
- 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.
- 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.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students reason effectively and use and manage information to research irrigation methods and compare for function and purpose.
- Students are responsible to others and work effectively in diverse teams while communicating clearly through the development of a plant disease management plan.
- Students work independently to investigate bacteria cells under a microscope.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level I: PS.03.02.01.a. Explain the importance of starting with pest- and disease-free propagation material.

PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management.

Level I: PS.03.03.01.a. Identify types of plant pests and disorders.

Level II: PS.03.03.01.b. Identify major local weeds, insect pests and infectious and noninfectious plant diseases.

Level III: PS.03.03.01.c. Design and implement a crop-scouting program.

Level I: PS.03.03.02.a. Describe damage caused by plant pests and diseases.

Level II: PS.03.03.02.b. Diagram the life cycles of major plant pests and diseases.

Level III: PS.03.03.02.c. Predict pest and disease problems based on environmental conditions and life cycles.

Level I: PS.03.03.03.a. Describe pest control strategies associated with integrated pest management.

Level II: PS.03.03.03.b. Describe types of pesticide controls and formulations.

Level III: PS.03.03.03.c. Employ pest management strategies to manage pest populations, assess the effectiveness of the plan, and adjust the plan as needed.

Level I: PS.03.03.04.a. Explain risks and benefits associated with the materials and methods used in plant pest management.

Level II: PS.03.03.04.b. Explain procedures for the safe handling, use and storage of pesticides.

Level III: PS.03.03.04.c. Evaluate environmental and consumer concerns regarding pest management strategies

Aligned Washington State Academic Standards

Science	**Washington Science Standards (Next Generation Science Standards):** HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain

	relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 10: Crop Production and Marketing	**Total Learning Hours for Unit:** 20

Unit Summary:

Competencies include:

- 10.1.1 Specialized equipment is required for soil tillage and the planting, harvesting, and transporting of agronomic crops.
- 10.1.2 The growing environment for plants may be altered by structures, such as greenhouses, to provide optimal temperature requirements.
- 10.1.3 Irrigation is critical for many commercial plant species.
- 10.1.4 Methods of irrigation vary and each method has advantages and disadvantages related to the impact on the environment.
- 10.2.1 Product, placement, price, and promotion are the four keys to marketing products.
- 10.2.2 Agronomy, floriculture, forestry, and nursery and landscape are the four major classifications of plant-based industries.
- 10.2.3 There are many products produced within plant-based industries and all require careful planning to ensure the marketability of the product.
- 10.2.4 Basic steps, such as analyzing the situation, deciding on an objective, developing a plan, and measuring the results, are key components of a business plan.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

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

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students work effectively in diverse teams, be responsible to others, and produce results to develop a team presentation for each of the plant-based industries.
- Students are self-directed learners and collaborate with others to research and develop a business plan.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Plant Science Pathway:

PS.01.01. Performance Indicator: Classify agricultural plants according to taxonomy systems.

Level II: PS.01.01.02.b. Identify agriculturally important plants by common names.

Level III: PS.01.01.02.c. Identify agriculturally important plants by scientific names.

PS.01.02. Performance Indicator: Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.

Level III: PS.01.02.05.c. Apply the knowledge of flower structures to plant breeding, production and use.

Level III: PS.01.02.06.c. Apply the knowledge of seed and fruit structures to plant culture and use.

PS.01.03. Performance Indicator: Apply knowledge of plant physiology and energy conversion to plant systems.

Level III: PS.01.03.04.c. Select plant growth regulators to produce desired responses from plants.

PS.02.01. Performance Indicator: Determine the influence of environmental factors on plant growth.

Level II: PS.02.01.02.b. Determine the optimal air, temperature and water conditions for plant growth.

Level III: PS.02.01.02.c. Design, implement and evaluate a plan to maintain optimal conditions for plant growth.

PS.02.02. Performance Indicator: Prepare growing media for use in plant systems.

Level III: PS.02.02.01.c. Formulate and prepare growing media for specific plants or crops.

PS.02.03. Performance Indicator: Develop and implement a fertilization plan for specific plants or crops.

Level III: PS.02.03.01.c. Monitor plants for signs of nutrient deficiencies and prepare a scouting report.

Level II: PS.02.03.04.b. Calculate the amount of fertilizer to be applied and calibrate equipment to apply the prescribed amount of fertilizer.

Level III: PS.02.03.04.c. Use variable-rate technology to apply fertilizers to meet crop nutrient needs.

PS.03.01. Performance Indicator: Demonstrate plant propagation techniques.

Level I: PS.03.01.02.a. Demonstrate sowing techniques and provide favorable conditions for seed germination.

Level II: PS.03.01.02.b. Handle seed to overcome seed dormancy mechanisms and to maintain seed viability and vigor.

Level III: PS.03.01.05.b. Give examples of the risks and advantages associated with genetically modified plants.

Level III: PS.03.01.05.c. Evaluate the performance of genetically modified crops.

PS.03.02. Performance Indicator: Develop and implement a plant management plan for crop production.

Level II: PS.03.02.01.b. Inspect propagation material for evidence of pests or disease.

Level II: PS.03.02.02.b. Prepare soil for planting with the addition of amendments.
Level III: PS.03.02.02.c. Prepare growing media for planting.
Level I: PS.03.02.03.a. Demonstrate proper planting procedures and post-planting care.
Level II: PS.03.02.03.b. Apply preplant treatments required of seeds and plants and evaluate the results.
Level III: PS.03.02.03.c. Operate mechanized planting equipment.
Level I: PS.03.02.04.a. Observe and record environmental conditions during the germination, growth and development of a crop.
Level II: PS.03.02.04.b. Monitor the progress of plantings and determine the need to adjust environmental conditions.
Level III: PS.03.02.04.c. Prepare and implement a plant production schedule based on predicted environmental conditions.
Level I: PS.03.02.05.a. Explain the reasons for controlling plant growth.
Level II: PS.03.02.05.b. Demonstrate proper techniques to control and manage plant growth through mechanical, cultural or chemical means.
Level III: PS.03.02.05.c. Create and implement a plan to control and manage plant growth.

PS.03.03. Performance Indicator: Develop and implement a plan for integrated pest management.
Level I: PS.03.03.01.a. Identify types of plant pests and disorders.
Level III: PS.03.03.01.c. Design and implement a crop-scouting program.
Level III: PS.03.03.03.c. Employ pest management strategies to manage pest populations, assess the effectiveness of the plan and adjust the plan as needed.

PS.03.04. Performance Indicator: Apply principles and practices of sustainable agriculture to plant production.
Level II: PS.03.04.01.b. Describe sustainable agriculture practices and compare the ecological effects of traditional agricultural practices with those of sustainable agriculture.
Level III: PS.03.04.01.c. Prepare and implement a plan for an agricultural enterprise that involves practices in support of sustainable agriculture.

PS.03.05. Performance Indicator: Harvest, handle and store crops.
Level II: PS.03.05.01.b. Assess the stage of growth to determine crop maturity or salability and demonstrate proper harvesting techniques.
Level I: PS.03.05.02.a. Explain reasons for calculating crop yield and loss.
Level II: PS.03.05.02.b. Evaluate crop yield and loss data.
Level III: PS.03.05.02.c. Implement plans to reduce crop loss.
Level I: PS.03.05.03.a. Identify storage methods for plants and plant products.
Level II: PS.03.05.03.b. Explain the proper conditions to maintain the quality of plants and plant products held in storage.
Level III: PS.03.05.03.c. Monitor environmental conditions in storage facilities for plants and plant products.
Level I: PS.03.05.04.a. Explain the reasons for preparing plants and plant products for distribution.
Level II: PS.03.05.04.b. Demonstrate techniques for grading, handling and packaging plants and plant products for distribution.
Level III: PS.03.05.04.c. Evaluate techniques for grading, handling and packaging plants and plant products

Aligned Washington State Academic Standards	
Science	**Washington Science Standards (Next Generation Science Standards):** HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more

	manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept

Unit 11: Career Leadership, Communication, and Documents	**Total Learning Hours for Unit:** 10

Unit Summary:

Competencies include:

- Participate in a job interview.
- Produce a well-written cover letter, job application, and follow-up letter.
- Follow oral and written directions with understanding; form questions that clarify directions as needed.
- Communicate effectively in oral, written, visual and nonverbal modes.
- Recognize and demonstrate reflective listening skills and assertive communications skills in the workplace.
- Identify acceptable work habits and personal characteristics.
- Demonstrate knowledge of the opportunities for leadership development available through an appropriate student organization.

Performance Assessments: (Districts to complete for each unit)

Example assessments for this unit include:

- Students explore the role of leadership in agricultural careers through research and discussions. Identify what is good communication in both written and verbal form within agricultural careers and develop documentation that allows them to most effectively reach specific audiences for particular purposes.

Leadership Alignment: (Districts to complete for each unit)

Leadership alignment must include a unit specific project/activity that aligns with the 21st Century Leadership Skills.

Example:

- Students are self-directed learners, work independently, and communicate clearly by participating in a job interview.
- Students make judgments and decisions to recognize and demonstrate reflective listening skills and assertive communications skills, and will be responsible to others and reason effectively to identify work habits.
- Students create media products and communicate clearly by producing a well-written cover letter, job application, and follow-up letter.

Industry Standards and/or Competencies:

Agriculture, Food, and Natural Resources (AFNR) Standards - Life Knowledge and Career Cluster Skills:

CS.01.03. Performance Indicator: Vision: Establish a clear image of what the future should look like.

CS.01.05. Performance Indicator: Awareness: Desire purposeful understanding related to professional and personal activities.

CS.02.03. Performance Indicator: Professional Growth: Develop awareness and apply skills necessary for achieving career success.

CS.03.01. Performance Indicator: Communication: Demonstrate oral, written and verbal skills.

Level II: CS.03.01.01.b. Select the appropriate form of technical and business writing or communication for a specific situation. Level II: CS.03.01.02.b. Prepare a resume. Level II: CS.03.01.03.b. Deliver a business presentation for a peer group (e.g., class presentation).			
Aligned Washington State Academic Standards			
Science	HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.		
Science and Engineering Practice		**Disciplinary Core Idea**	**Crosscutting Concept**