

AFNR Content Standards Alignment – Principles of Agricultural Science – Plant

The **AFNR Content Standards Alignment** aligns CASE 4 Learning (CASE) Concepts and Performance Objectives to the National AFNR Content standards and performance indicators developed by the National Council for Agricultural Education (The Council). In the CASE learning model, Concepts are key elements of understanding that students are expected to learn. Concepts are developed by a curriculum committee of content experts comprised of industry representatives, post-secondary educators, and secondary teachers. Performance Objectives are how students will demonstrate their understanding of the concept. All Concepts and Performance Objectives measure student competency of the AFNR Content Standards within each Pathway.

The AFNR Content Standards provide state agricultural education leaders and educators with a high-quality, rigorous set of standards to guide what students should know and be able to do after completing a program of study in each of the following AFNR Career Pathways:

- Career Ready Practices
- Foundational
- Agribusiness Systems
- Animal Systems
- Biotechnology Systems
- Education, Communication, and Leadership
- Environmental Sustainability Systems
- Food Products and Processing Systems
- Natural Resource Systems
- Plant Systems
- Power, Structural, and Technical Systems

DEFINITIONS: Within each pathway, the standards are organized and aligned to CASE curriculum as follows:

- **Standards** – These are the standards owned by Advance CTE and used here with permission. The standards defined the scope and guided the development of the updated indicators and CASE measurements.
- **Performance Indicators** – These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.
- **CASE Measurements** – These are CASE Concepts with bulleted Performance Objectives. Students carry out the Performance Objectives to show understanding of the Concept, which indicates attainment of each performance indicator. The beginning CASE measurements require students to remember, understand, identify, explain, and summarize information. The intermediate CASE measurements require students to apply, analyze, compare, distinguish, and examine information and scenarios. The advanced CASE measurements require students to assess, evaluate, justify, improve, and create.

The **Principles of Agricultural Science – Plant** curriculum measures student competencies in the AFNR Pathways included in this blueprint. For more information about the National AFNR Content Standards, visit The National Council for Agricultural Education’s website at <https://www.thencae.org/afnr-standards>.

CAREER READY PRACTICES STANDARD

CRP.04. Communicate clearly, effectively and with reason.

Career-ready individuals communicate thoughts, ideas and action plans with clarity, whether using written, verbal and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
CRP.04.02. Produce clear, reasoned, and coherent written and visual communication in formal and informal settings.			ASA 1.1 Concept 2 Organization and record-keeping are important to the success of a plant business..
			• Develop and keep an Agriscience Notebook to record and store information presented in classroom discussions and activities throughout the course.

CAREER READY PRACTICES STANDARD

CRP.10. Plan education and career path aligned to personal goals.

Career-ready individuals take personal ownership of their own educational and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the educational and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors and other experts to assist in the planning and execution of career and personal goals.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
CRP.10.01. Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.	ASP 1.1 Concept 1 People work in a variety of agricultural enterprises to produce food, fiber, and fuel, which are essential to daily life.	ASP 1.1 Concept 4 Plant industries provide production and management career opportunities.	
	• Research plant industries and related careers.	• Research physical attributes and growth requirements for several species of plants.	

AGRIBUSINESS SYSTEMS STANDARD

ABS.05. Use sales and marketing principles to accomplish AFNR business objectives.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
ABS.05.03. Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.		ASP 9.2 Concept 2 Product, placement, price, and promotion are the four keys to marketing products.	
		Develop a presentation illustrating the four P's of marketing for each of the plant-based industries.	
		ASP 9.2 Concept 3 There are many products produced within plant-based industries and all require careful planning to ensure the marketability of the product.	
		Select crop(s) for a specific situation based on land analysis, local markets, and budget potential.	

PLANT SYSTEMS STANDARD

PS.01. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.01.01. Determine the influence of environmental factors on plant growth.		ASP 6.3 Concept 2 Light intensity and poor light exposure can alter the growth of plants by creating undesirable physical characteristics.	ASP 6.3 Concept 5 Plants respond to the length of daily dark periods to trigger physiological processes, such as flowering.
		Conduct an investigation to determine 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.
		ASP 6.4 Concept 1 Plant maturity is affected by the accumulation of thermal units during a growing season.	ASP 6.4 Concept 2 Temperature affects the metabolism rate of plants, including transpiration, respiration, and photosynthesis.
		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 with three different maturity target dates.
			ASP 6.4 Concept 3 Temperature is a principle determinant for plant dormancy of some seeds, bulbs, specialized roots, and species of perennial plants.
			Plant bulbs and schedule flowering for those bulbs to meet a holiday delivery date.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.01.02. Prepare and adjust growing media for use in plant systems.	ASP 2.1 Concept 1 Soil texture is a proportion of sand, silt, and clay, and influence how producers use soil.	ASP 2.1 Concept 2 Texture and structure of soil horizons affect soil permeability.	ASP 2.2 Concept 1 Soil pH determines the availability of nutrients required for plant growth and health.
	Conduct tests to determine soil texture by feel.	- Illustrate soil structure and determine how structure influences soil permeability. - Test soil permeability to understand the relationship between soil particle size and rate of water filtration.	Conduct a soil sample test to determine pH.
	ASP 2.1 Concept 3 Organisms found in soils improve soil quality.	ASP 2.1 Concept 4 Soil structure and texture influence the water-holding capacity and drainage of soil.	ASP 2.2 Concept 2 The optimal pH and salinity levels required for plant growth vary among plant species, and producers adjust the levels by using chemical treatments.
	Collect and identify macroscopic and microscopic organisms found in a soil sample.	Measure the water holding capacity of various test substances and compare data.	Correct for acidic soil conditions using lime.
	ASP 2.1 Concept 6 Internal drainage, evidenced by color, mottling, and permeability, affects soil management decisions.	ASP 2.1 Concept 5 Organic matter affects the porosity and water holding capacity of soils.	ASP 2.1 Concept 7 The structure and color of the soil profile determine the effective depth of a soil.
	Describe soil hue, value, and chroma and assess soils for drainage-related characteristics based on color.	Conduct an experiment to explore the relationship between organic matter and water holding capacity of soil.	Conduct an inquiry lab making predictions of soil characteristics using knowledge of the properties of the soil profile.
			ASP 2.2 Concept 3 Soil salinity concentration determines how well plants uptake water, and as a result, the ability of plants to absorb nutrients. - Determine the salinity of soil by measuring the electrical conductivity. ASP 2.2 Concept 4 Testing of soil samples detect imbalances of soil chemistry. - Measure soil salinity to determine the effects of chemical fertilizers on soil salinity levels.
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.01.03. Demonstrate planting techniques and create the conditions needed for seed germination.	ASP 7.3 Concept 1 Germinating seeds from embryo to seedling have visible anatomical parts and growth stages used to identify the plant as either a monocotyledon or a dicotyledon.	ASP 7.3 Concept 2 Plant seeds convert starch into glucose by the use of enzymes during the germination process.	ASP 7.3 Concept 4 Not all seeds are viable and, therefore, do not have the potential to germinate.

	- 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.	Conduct an experiment to test for seed viability.
		ASP 7.3 Concept 3 Environmental conditions, such as temperature, oxygen, and water, determine a seed's germination rate.	ASP 7.3 Concept 5 Dormancy is a strategy plants utilize to ensure some offspring will germinate at optimal times and plants rely on special treatments, such as light, cold temperatures, and scarification to break seed dormancy.
		- Design and conduct an experiment to show evidence of the effects of different variations of treatments required for seed germination. - Make a presentation to the class regarding research procedures and findings.	Perform scarification to treat seeds for seed coat dormancy.
		ASP 7.2 Concept 2 Plants use seeds to multiply species exponentially over time.	
		Calculate the reproductive biotic potential of plants.	
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.01.04. Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.	ASP 6.1 Concept 2 Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical tissue tests	ASP 3.2 Concept 3 Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health.	ASP 6.1 Concept 3 Nutrients can be added to the soil in various forms, such as chemical fertilizers, animal wastes, and organic matter.
	Identify the effects of nutrient deficiencies in plants by observing anatomical differences.	Compare the use of fertilizers, water, and media in hydroponic and traditional plant production systems.	Use mathematical formulas to solve problems regarding fertilizer analyses, rates, and cost comparisons.
		ASP 6.1 Concept 1 Plants obtain required nutrients from the soil provided the soil has the available nutrients.	ASP 6.1 Concept 4 Plants require sixteen nutrients for optimal growth and development.
		Use testing equipment to detect the levels of nitrogen, phosphorus, and potassium in soil samples.	- Define soil nutrient relationships using Mulder's Chart. - Read a sample soil analysis and compare it to crop nutrient removal rates.
		ASP 6.1 Concept 2 Nutrient deficiencies are detected in plants by the examination of anatomical features and chemical tissue tests Conduct plant tissue testing to determine the potential nutrients that are lacking in growing plants	

PLANT SYSTEMS STANDARD

PS.02. Apply principles of classification, plant anatomy, and plant physiology to plant production and management.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.02.01. Classify plants according to taxonomic systems.	ASP 4.5 Concept 3 Flowers are classified as either complete or incomplete based on the inclusion of either male or female parts, or both.	ASP 5.1 Concept 2 Plants and animals are categorized using a hierarchical system to group organisms by anatomical or physiological similarities.	ASP 5.1 Concept 4 All plants are named using a binomial system, which is a two-word system for naming plants with the first word being the generic name and the second word being the specific name.
	Classify flowers using a dichotomous key and predict the type of pollination for each flower.	Research the taxonomic classification for a plant species.	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.
	ASP 5.1 Concept 1 Plants are organized and identified and using physical characteristics.	ASP 5.1 Concept 3 The scientific names for plants consist of Latin words representing descriptive features associated with the plant.	ASP 5.1 Concept 5 Plant species are often subdivided into varieties and cultivars that will include additional names after the genus and species.
	Develop a flowchart to classify 20 different species of plants.	Research the meaning of scientific names for ten species of trees.	Create a cultivar name for a fictitious plant.
	ASP 6.4 Concept 4 Plants are classified as cool-season or warm-season plants based on their temperature requirements.		
	Explore hardiness zones and assign plants to appropriate zones according to temperature requirements.		
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.	ASP 4.1 Concept 1 There are different classifications of cells based on their utility.	ASP 4.2 Concept 2 The root has specific anatomical features responsible for anchoring the plant in the soil.	ASP 4.4 Concept 1 Agricultural scientists use leaf characteristics to identify species or varieties of plants.
	Develop a pictorial representation of cell function.	Examine a root structure and sketch representations of the structural form of a root.	Create a journal that includes sketches and identification information for 20 different species of local plants.
	ASP 4.1 Concept 2 Plant cells are comprised of many parts dependent upon each other that have essential functions for the survival of plant tissue.	ASP 4.2 Concept 3 Plant roots use differentiated cells that perform specific functions in the root, such as the absorption of water and dissolved nutrients.	ASP 4.3 Concept 3 Environmental conditions, such as temperature and precipitation, are reflected in the growth rates of plants and evidence of those conditions can be found in woody stems.
	- Identify and label plant cell organelles. - Represent relationships between organelles using a graphic organizer	Examine cell differentiation as it relates to root cells.	Create a poster depicting the lifespan of a tree referencing environmental conditions, historical events, and stages of growth.

	ASP 4.1 Concept 3 Plant cells contain microscopic organelles specific to plant functions.	ASP 4.1 Concept 4 Cells use water, oxygen, and glucose to produce energy and metabolic by-products of carbon dioxide and water.	ASP 4.5 Concept 4 Flowering structures are precursors for seeds, seed pods, and fruit.
	• Correctly prepare slides of plant cells for viewing under a microscope.	• Collect and analyze data to provide evidence of cell metabolism.	• Use knowledge of flower structure to predict the type of seed structure based on a flowering structure.
	ASP 4.2 Concept 1 A plant's root, stem, leaves, and flower are vital for plant health and growth.	ASP 4.2 Concept 4 Plants use the process of osmosis, influenced by the turgidity of plant tissues, for the uptake of water and dissolved nutrients required for plant growth.	
	• Describe the function of the major plant parts.	• Conduct an experiment to simulate the osmosis process of plant root hairs.	
	ASP 4.3 Concept 1 Stems of plants provide physical support, storage of nutrients, and necessary pathways for the translocation of materials throughout the plant.	ASP 4.3 Concept 2 The majority of plant growth takes place in meristematic tissue.	
	• Identify differences between internal structures of monocotyledon and dicotyledon features.	• Compare plant survival and recovery from damage to meristematic tissue.	
	ASP 4.4 Concept 2 Leaves have several parts with differences in physical characteristics, such as shape and venation patterns.	ASP 4.4 Concept 3 Leaf cells contain a specialized pigment known as chlorophyll that is used by the plant to harvest radiant energy from the sun.	
	• Identify the characteristics of simple and compound leaves.	• Investigate the pigments and food storage systems found in plant leaves.	
	ASP 4.5 Concept 1 The parts of the flower are the mechanisms for pollination and fertilization and are used by a plant to complete sexual reproduction.	ASP 4.4 Concept 4 Leaves produce and store food.	
	• Identify the parts of a flower and explain the function for each part.	• Compare stored sugar content of leaves.	
	ASP 7.1 Concept 1 Mitosis has five distinct phases necessary for cell division.	ASP 4.5 Concept 2 Concept maps assist in structuring ideas or concepts and illustrating the various connections between those ideas.	
	• Identify the different stages of mitosis in plant root cells.	• Develop a concept map to illustrate the understanding of related ideas and nomenclature necessary to discuss the parts and functions of a flower.	
		ASP 7.1 Concept 2 Plant egg cells require meiosis and mitosis for development.	
		• Describe the steps of gamete cell production.	
		ASP 7.1 Concept 3 Fertilization, a necessary step for seed development,	

		occurs when pollen unites with an egg cell. • Illustrate the processes of meiosis and fertilization of an egg.	
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.		ASP 6.2 Concept 1 The composition of plant containers will affect the rate of water loss by evaporation in potted plants. • Conduct an experiment to determine the rate of transpiration and evaporation for different plant growing containers.	ASP 6.2 Concept 4 Water requirements and tolerances vary among plant species. • Compare wilting points among various species.
		ASP 6.2 Concept 2 Water is used by plants for the translocation of materials within the vascular systems of plants and used to complete the photosynthesis process. • Collect evidence of water movement through a stem detecting transpiration pull.	ASP 6.2 Concept 5 The wilting point is a critical physiological stage that, if exceeded, can cause permanent damage to the health and physical appearance of plants. • Monitor soil moisture to determine the wilting point of different plant species.
		ASP 6.2 Concept 3 Water is used to help cool the plant during periods of above optimal temperature conditions through the process of transpiration. • Examine how environmental conditions affect the water loss of a plant.	ASP 6.3 Concept 3 Photosynthetic rate is affected by environmental factors, such as light exposure, availability of carbon dioxide, and temperature. • Manipulate environmental factors to test their effects on plants.
		ASP 6.3 Concept 1 Light is absorbed by chlorophyll and used by plants to convert carbon dioxide and water into glucose and oxygen through the process of photosynthesis. • Collect evidence of the dependence of photosynthesis with light.	
		ASP 6.3 Concept 4 The level of red and blue-violet light emitted in a spectrum determines the quality of a light source intended for plant use. • Examine the relationship between the rate of photosynthesis and light spectrum quality.	

PLANT SYSTEMS STANDARD

PS.03. Propagate, culture and harvest plants and plant products based on current industry standards.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.03.01. Demonstrate plant propagation techniques in plant system activities.	ASP 7.4 Concept 3. Safe tool and equipment use is required to perform asexual propagation on plants to avoid personal injury.	ASP 7.1 Concept 4 Dominant and recessive alleles determine the phenotypic characteristics of plants.	ASP 7.1 Concept 5 Hybrid plants are an important source of agronomic commodities.
	Identify hazards and safe practices for the plant laboratory.	Perform computer simulations related to genetic inheritance to learn about the role genetics play in plant production.	Perform a simulation predicting offspring from a hybrid cross.
		ASP 7.2 Concept 1 Flower pollination often requires natural agents, such as wind, water, insects, and vertebrates.	ASP 7.2 Concept 4 Plants require methods of seed dispersal to ensure their survival in nature.
		Use clues given to identify the type of pollination agent in a variety of scenarios.	- Analyze articles related to issues involving seed dispersal to develop prescriptive plans to resolve the issue of seed dispersal. - Illustrate the steps involved with seed dispersal and the relationship between plants and animals in this process.
		ASP 7.4 Concept 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.	ASP 7.4 Concept 1 Some plant hybrids will produce seeds with genetic characteristics that are inconsistent with the parent plant genotype; therefore, producers use asexual propagation methods for reproducing the desired traits.
		Compare and contrast different asexual propagation methods.	Demonstrate how to perform common asexual propagation methods, such as grafting, budding, layering, division, and cuttings properly.
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.03.02. Develop and implement a management plan for plant production.	ASP 3.1 Concept 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.	ASP 3.1 Concept 2 There are a variety of ingredients used in potting soil that provide permeability, porosity, and fertility needed for container crops.	ASP 3.1 Concept 3 Greenhouse and nursery plant producers calculate and purchase media in cubic feet or cubic yard increments.
	Identify components commonly used in potting media.	Test different potting media ingredients to determine the permeability and porosity qualities of the media.	Calculate the volume of various containers using mathematics.

		Determine the percentage of ingredients found in a potting soil mixture.	
	ASP 3.2 Concept 1 Hydroponic crop production has advantages over traditional cropping systems, such as efficient use of space and resources.	ASP 3.2 Concept 2 Careful management and monitoring of water quality in a hydroponic system are necessary to ensure plant health.	ASP 3.2 Concept 4 Hydroponic systems provide essential growth requirements for plants in a variety of ways.
	List the advantages and disadvantages of hydroponics and traditional crop production systems.	Compare the use of fertilizers, water, and media in hydroponic and traditional plant production systems.	Design a hydroponic system incorporating the design principles of a specific type of system, such as nutrient flow, aggregate, water culture, or aeroponics.
PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.03.03. Develop and implement a plan for integrated pest management for plant production.	ASP 8.1 Concept 1 Pests have negative effects on plant growth, such as yield and quality.	ASP 8.1 Concept 3 Proper detection of symptoms can determine plant pest threats.	ASP 8.1 Concept 5 An Integrated Pest Management plan assures that the management of pests is economically and environmentally sound.
	Research and share symptoms and damage caused by pests.	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.
	ASP 8.1 Concept 2 Plant pests include several organisms, including insects, mollusks, nematodes, vertebrates, and weeds.	ASP 8.1 Concept 4 Biological, chemical, and mechanical methods, as well as cultural practices, are options for eradication or deterring pests.	ASP 8.1 Concept 6 Plant producers consider life cycles of plant pests before employing proper control measures.
	Identify anatomical features of pests that help determine what types of pests are responsible for crop predation.	Compare and contrast pest eradication and pest control methods.	Create a pictorial model of the life cycle of pests.
	ASP 8.2 Concept 1 Plant disease-causing agents, such as bacteria, fungi, and viruses, affect the health of plants.	ASP 8.2 Concept 2 Plant diseases cause visible symptoms in plant growth, such as defoliation, abscesses, growths, and decaying of plant tissue.	ASP 8.2 Concept 3 Knowledge of disease prevention and treatment is important to protect plants from infection.
	Read articles related to common plant diseases and summarize the similarities and the differences among disease-causing agents.	Develop an understanding of plant disease, causes, and means of prevention and control.	Develop a plant disease management plan.
		ASP 8.2 Concept 4 Plant disease-causing agents are microscopic. - Compare the size of bacteria and viruses with other common objects to gain perspective of scale. - Investigate bacteria cells under a microscope.	

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	Intermediate	Advanced
PS.03.04. Apply principles and practices of sustainable agriculture to plant production.	ASP 9.1 Concept 1 Specialized equipment is required for soil tillage and the planting, harvesting, and transporting of agronomic crops.	ASP 9.1 Concept 2 The growing environment for plants may be altered by structures, such as greenhouses, to provide optimal temperature requirements.	ASP 9.2 Concept 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.
	• Research machinery and equipment used to produce plants and create a study guide. • Categorize machinery used to produce plants according to use.	• Conduct an experiment to determine the effects of greenhouse coverings on temperature.	• Develop a business proposal to utilize 20 acres to raise plants.
	ASP 9.2 Concept 1 Agronomy, floriculture, forestry, and nursery and landscape are the four major classifications of plant-based industries.	ASP 9.1 Concept 3 Methods of irrigation vary, and each method has advantages and disadvantages related to the impact on the environment.	
	• Create a slide show of different plant industries.	• Research irrigation methods and compare each method to understand function and purpose.	
	ASP 1.1 Concept 3 Plants are used to sustain human existence by providing many essential products, such as food, fiber, fuel, and medicine.		
	• Survey their dependence upon plants.		