AFNR Content Standards Alignment – Natural Resources and Ecology

The ***AFNR Content Standards Blueprint*** 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 (Integrated)
- Foundation Skills (Integrated)
- 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 ***Natural Resources and Ecology*** 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.	NRE 1.1 Concept 2 Organized record keeping is an important skill for people working in the fields of natural resources and ecology. • Develop and keep an NRE Notebook to record and store information that is used throughout the course and for future agricultural science projects.	NRE 1.2 Concept 2 The result of regular observations of the natural world, accurate and useful field notes are a tool in the scientific study of the natural world. • Record observations of natural artifacts using scientific in a field journal-style entry.	

FOUNDATIONAL PATHWAY SKILLS STANDARD			
FPS.05. Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
FPS.05.02. Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.	NRE 1.1 Concept 4 Career opportunities exist in natural resources and ecology for all levels of education in areas of study including conservation, education, management, and recreation. • Research studies and careers within natural resources and ecology and share with the class. • Document and record natural resources and ecology areas of study and career opportunities shared during student presentations.		

ENVIRONMENTAL SUSTAINABILITY SYSTEMS STANDARD			
ESS.02. Evaluate the impact of public policies and regulations on environmental service system operations.			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
ESS.02.01. Interpret and evaluate the impact of laws, agencies, policies, practices, and consumer preferences affecting environmental service systems.		NRE 9.1 Concept 3 Many organizations influence the protection of species and the environment.	
		• Research federal natural resource agencies and identify primary purposes and responsibilities each agency has regarding water contamination. • Argue the role of federal natural resource agencies in a water contamination scenario.	

ENVIRONMENTAL SUSTAINABILITY SYSTEMS STANDARD			
ESS.03. Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
ESS.03.01. Apply meteorology principles to environmental sustainability systems.	NRE 4.1 Concept 1 The atmosphere consists of various levels defined by distinct characteristics, such as density, temperature, and chemical composition.	NRE 4.1 Concept 2 Gases found in the atmosphere, such as oxygen and nitrogen, take different forms as they move through a biogeochemical cycle.	NRE 4.1 Concept 3 An essential function of the atmosphere is the natural warming of the surface of the Earth.
	• Develop a graph and diagram depicting the levels of the atmosphere and their defining characteristics.	• Compare the movement of oxygen and nitrogen to the water cycle.	• Investigate the air temperature at different levels over 24 hours.
	NRE 4.2 Concept 1 The measurement of the gases and particulates present at various levels determines air quality.	NRE 4.2 Concept 2 Natural occurring processes and human activity influence air quality.	NRE 4.2 Concept 3 The greenhouse effect theory explains the potential reasons and causes of global warming.
	• Measure the particulate matter level in the air, the amount and percentage of light blocked by the particulate matter. • Compare air quality levels for different locations, demonstrating an understanding of the Air Quality Index.	• Monitor carbon dioxide concentrations in a classroom with different levels of ventilation.	• Simulate the greenhouse effect in a small scale model. • Investigate air quality for the Ecosystem Study.
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
ESS.03.02. Apply soil science and hydrology principles to	NRE 2.1 Concept 1 Soil formation factors, including climate and parent material, influence soil types and uses.	NRE 2.1 Concept 3 Soil is a natural filter and can collect nutrients and other materials from water.	NRE 2.1 Concept 4 The development, use, and management of soil as a natural resource are related to soil properties.

environmental sustainability systems.	• Depict the process of soil formation by drawing a comic strip.	• Compare the permeability and filtration capacity of different soil types.	• Calculate the slope of an area of land. • Classify land according to appropriate use based on slope, erosion factors, and drainage.
	NRE 2.1 Concept 2 Soil texture and structure influence soil properties and usability.	NRE 2.2 Concept 3 A soil survey is a land-use planning tool.	
	• Determine soil texture by feel and ribbon testing. • Describe and sketch the differences in soil structure types.	• Use the *Web Soil Survey* to gather information for land use planning.	

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	**Intermediate**	**Advanced**
ESS.03.03. Apply chemistry principles to environmental sustainability systems.	NRE 3.2 Concept 1 The Water Quality Index uses a series of tests, such as temperature, dissolved oxygen, pH, turbidity, and nitrates, to indicate the overall quality of a body of water.	NRE 3.2 Concept 2 Water quality determines potential water uses, such as for drinking, irrigation for agriculture, industrial use, and recreational use.	
	• Review water quality tests that determine the temperature, pH, turbidity, dissolved oxygen, total solids, biochemical oxygen demand, phosphates, nitrates, and fecal coliform.	• Calculate the quality of local water by completing the Water Quality Index.	
		NRE 3.2 Concept 3 Environmental conditions and human activities influence water quality.	
		• Determine the ability of different soils to filter acid rain.	

ENVIRONMENTAL SUSTAINABILITY SYSTEMS STANDARD			
ESS.04. Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
ESS.04.01. Develop systems of sustainability management for all categories of solid waste in environmental sustainability systems.	NRE 8.1 Concept 3 Managing waste impacts society and has environmental costs and benefits.		
	• Conduct a school recycling inventory and calculate the reduction in carbon dioxide emissions that result.		

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	**Intermediate**	**Advanced**
ESS.04.02. Sustainably manage solid waste in environmental service systems.		NRE 8.1 Concept 4 Proper waste management is essential for healthy ecosystems. • Investigate the positive and negative impacts of waste on the environment and improve the environmental costs of waste management. • Develop an integrated municipal waste management process to reduce waste for a community.	

NATURAL RESOURCE SYSTEMS STANDARD
NRS.01. Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	**Intermediate**	**Advanced**
NRS.01.01. Examine natural resource availability and ecosystem function in a particular region.	NRE 1.1 Concept 3 The perception of conservation, preservation, and exploitation regarding the use of natural resources influence natural resource management decisions.	NRE 6.2 Concept 2 Organisms use natural processes to adapt to their environments and increase their chances of survival.	
	• Record notes and reflections related to the information presented in class regarding conservation, preservation, and exploitation.	• Investigate an animal's adaptive nature, such as the beak of a bird to its environment to acquire food for survival.	
		NRE 6.2 Concept 3 Human pressures of populations cause artificial selection within a population.	
		• Predict the probability of the occurrence of qualitative traits within an animal species using Punnett Squares.	
	NRE 1.2 Concept 1 A biome, classified by the predominant vegetation, is primarily determined by climate, altitude, and latitude.	NRE 1.2 Concept 3 The diversity of an ecosystem includes both the living and non-living components.	
	• Research a biome and determine the defining characteristics of that biome. • Use multimedia presentation tools to share biome information as a team.	• Observe a local ecosystem and record field notes based on their observations. • Identify and initiate research of a chosen ecosystem to be studied for the remainder of the course.	

	NRE 5.1 Concept 1 Energy and nutrients flow through trophic levels within an ecosystem.	NRE 5.1 Concept 2 The geographic area of an ecosystem influences the complexity and type of organisms present.	
	• Determine the sequence of energy flow of a group of organisms and sketch the food web. • Calculate the percent of energy transfer through the trophic levels of a food chain.	• Use a graphic organizer to depict an energy pyramid and the relationships within that pyramid. • Research their ecosystem of choice and determine a food chain present in that ecosystem.	
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.	NRE 6.1 Concept 1 Biodiversity refers to the variety of living components in an ecosystem.	NRE 6.1 Concept 2 Plants are scientifically identified using taxonomy and various classification systems.	
	• Determine the biodiversity of plants in a given area using a common sampling technique.	• Conduct a survey of the vegetation present in a given plot of land and classify the plants according to their features.	
	NRE 6.1 Concept 3 Vegetation type present in an ecosystem is influenced by the environment and the activity of animals and humans.		
	• Simulate the process of vegetative succession by role playing in a game.		
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.01.03. Apply ecological concepts and principles (e.g., weather, air quality, UV protection, atmospheric pressure, etc.) to the interaction of atmospheric and natural resource systems.	NRE 3.1 Concept 1 Solar energy drives the hydrologic cycle, resulting in water evaporating into the atmosphere and returning to the surface of the Earth in different forms.	NRE 3.1 Concept 2 Water is converted into a series of forms as it moves through the environment over time.	
	• Diagram the hydrologic cycle and define terms used in describing the movement of water through the cycle.	• Simulate the movement of water through the hydrologic cycle using a model system.	
		NRE 3.1 Concept 3 Lakes, rivers, and oceans are three significant types of bodies of water that have characteristics influenced by climate, topography, and organisms.	
		• Compare aquatic ecosystems and note differences and similarities. • Identify lakes, rivers, and oceans found in North America and research the characteristics of geography, climate,	

		and elevation that influence those bodies of water. • Investigate an aquatic ecosystem and research the defining characteristics of that ecosystem.	
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.			NRE 3.2 Concept 4 The movement of water through watersheds and soil can alter the quality of water. • Compare Q-Values and Water Quality Indexes at two river locations and analyze the causes of the changes. • Evaluate the water resources and quality of a chosen ecosystem.
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.	NRE 6.1 Concept 4 Plant populations shift in response to changes in the environment. • Simulate the process of vegetative succession by role playing in a game.	NRE 2.2 Concept 2 Erosion influences land use and may cause environmental changes in ecosystems. • Design and conduct an experiment to determine the effects of slope and vegetation on erosion.	
		NRE 7.2 Concept 1 Effective forest management requires identifying goals and proposed uses of the forest, such as aesthetics, recreation, urban values, water, wilderness, wildlife, and wood products. • Determine the value of local trees using the National Tree Benefit calculator. • Calculate board feet of lumber and estimate the economic value of local trees	NRE 7.2 Concept 2 Forest management techniques include timber extraction, planting, and replanting of various species, cutting roads and pathways through forests, and fire management. • Develop a forest management plan summary based on the research of an assigned national forest.
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.01.06. Apply ecological concepts and principles to biotic organisms in natural resource systems.		NRE 5.1 Concept 3 The availability of natural resources determines the carrying capacity of a given species in an ecosystem. • Simulate the carrying capacity of a deer population with access to food, water, and shelter.	NRE 6.2 Concept 4 Various objectives influence the management of wildlife species. • Conduct hypothetical wildlife management decisions and identify at least four factors that can affect the size of a wildlife population.

		• Determine the habitat area requirements for a group of animals in an ecosystem and the overall area needed to sustain the ecosystem.	

NATURAL RESOURCE SYSTEMS STANDARD			
NRS.02.01. Analyze the interrelationships between natural resources and humans.			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.02.01. Examine and interpret the purpose, enforcement, impact, and effectiveness of laws, agencies, and private and public organizations related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, environmental policy, local, state, and national conservation organizations, agricultural extension service, etc.).		NRE 9.1 Concept 1 Environmental policies and regulations, such as the Endangered Species Act and wilderness protection designations, have been established to protect the environment for future generations of wildlife, vegetation, and human use. • Research species classified as endangered, threatened, sensitive, or extinct and develop an informative flyer.	
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.02.02. Assess the impact of human activities on the availability of natural resources.	NRE 8.1 Concept 1 Human populations and their food, fiber, and fuel needs impact the natural environment. • Determine their carbon footprint and their family's carbon footprint and consider how to reduce their carbon emission impact on the natural environment.		
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.02.03. Analyze how social perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.	NRE 1.1 Concept 1 Individuals have different perceptions about natural resources and ecology. • Survey and determine current thoughts regarding the use and management of natural resources. NRE 8.2 Concept 2 Protected natural spaces, such as National Parks and		

	Scenic areas, have been designated to preserve landmarks as well as native flora and fauna. • Research a national park or forest to identify and summarize its history, unique features, and available recreational activities to develop a guide.		
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.02.04. Examine and explain how economics affects the use of natural resources.		NRE 8.1 Concept 2 Energy is available from diverse renewable and nonrenewable sources. • Simulate the buying and selling of energy units from a diverse group of energy producers and discuss how energy prices affect the average consumer.	NRE 9.2 Concept 1 Balancing the human population's needs and demands for food, fiber, fuel, with maintaining environmental quality is a complex social issue. • Review their beliefs and opinions on how natural resources should be utilized and write a brief statement summarizing their views.
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.02.05. Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.	NRE 9.1 Concept 2 National conservation practices have shifted over time due to changes in environmental perceptions. • Explore the impact of natural resource and conservation practices and policies related to sustainability.		

NATURAL RESOURCE SYSTEMS STANDARD			
NRS.03. Develop plans to ensure sustainable production and processing of natural resources.			
PERFORMANCE INDICATOR	**CASE MEASUREMENTS**		
	Beginning	**Intermediate**	**Advanced**
NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest and rangeland products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).	NRE 7.3 Concept 1 Essential mineral resources are available due to many different practices and methods. • Synthesize and connect to the different mining practices and methods used to mine significant mineral resources through a mining simulation. • Investigate the process of enhanced oil recovery while considering the resources used to recover the oil.	NRE 7.3 Concept 2 Natural resource mining has positive and negative impacts on the environment and human populations. • Consider the impact mining has on the environment and natural resources and determine mining practices to protect the environment. • Characterize the effects of oil spills on ecosystems and humans.	

	• Investigate methods for cleaning up oil spills. • Design and test an oil-water separator.	• Evaluate the human uses of land and resources for a chosen ecosystem.	
		NRE 8.2 Concept 1 Human recreational activities impact the natural environment and native species.	NRE 8.2 Concept 3 Recreational use of natural resource areas requires the development of skills to ensure the individual's safety while protecting the integrity of the natural resource.
		• Identify current uses and historical states of outdoor recreational areas in their ecosystem and determine how human use has affected the native species in both beneficial and harmful ways.	• Investigate and plan an outdoor experience that incorporates personal interests yet leaving the smallest footprint to protect natural resources.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	**Intermediate**	**Advanced**
NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing and evaluating natural resource management plans.	NRE 2.2 Concept 1 Topographic maps provide information on the configuration of the surface of the Earth.		NRE 9.2 Concept 2 Ecosystems change based upon management decisions over time.
	• Read a topographic map and understand the steepness of the slope portrayed on the map.		• Develop a multiple-use management plan for the ecosystem they have studied throughout the course. • Plan reuse of a superfund site balancing environmental, community, and commercial needs

NATURAL RESOURCE SYSTEMS STANDARD

NRS.04. Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

PERFORMANCE INDICATOR	CASE MEASUREMENTS		
	Beginning	**Intermediate**	**Advanced**
NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.		NRE 6.2 Concept 1 Wildlife requires habitat, including food, water, shelter, and space, suited to their needs to thrive in a community.	NRE 6.2 Concept 5 Wildlife management includes improving habitat for a focal species.
		• Research the habitat requirements of an animal and write a description of those needs to match an animal with its proper habitat.	• Select a focal species in the ecosystem study and make a habitat management plan for that animal.

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.01.04. Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.	NRE 7.1 Concept 1 Sustainable agriculture practices include the efficient use of non-renewable and on-farm resources and, where appropriate, integrate natural biological cycles. • Read a story about non-sustainable use and apply the lessons learned to agricultural land management. • Examine the unstainable practices that led to the Dust Bowl and sustainable practices still conducted today. • Use the “4R” nutrient stewardship approach to make fertilizer recommendations.		

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.03.04. Apply principles and practices of sustainable agriculture to plant production.			NRE 7.1 Concept 2 Agricultural stewardship balances agriculture productivity and profitability while conserving natural resources. • Apply skills and knowledge learned regarding stewardship and sustainable agriculture management decisions related to a fictitious property, determine a commodity to raise, apply for a stewardship program, and choose the best stewardship practices to implement.