North Dakota Agriculture Education

Content Standards

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North Dakota Department of Career and Technical Education

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North Dakota Technical Education Standards Process

**This set of standards was reviewed by North Dakota state Agriculture Education teachers, with special thanks to:
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It is the policy of the North Dakota State Board for Career and Technical Education not to discriminate in its educational programs, activities, or employment policies as required by Final Regulation implementing Title IX of the 1972 Education Amendments, Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973.

The Board policy does not advocate, permit, nor practice discrimination on the basis of sex, race, color, national origin, religion, age, or disability as required by various state and federal laws. Equal education opportunity is a priority of the North Dakota State Board for Career and Technical Education.

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Career and Technical Education Standards Introduction

Mission
The mission of the State Board for Career and Technical Education (CTE) is to work with others to provide all North Dakota citizens with the technical skills, knowledge, and attitudes necessary for successful performance in a globally competitive workplace.

Vision
The State Board for Career and Technical Education (CTE) is committed to providing career awareness, work readiness skills, occupational preparation, and retraining of workers throughout the state. Career and technical education will span all educational levels, providing youth with exploration opportunities and the foundation skills needed to enter the world of work while providing adults with skills needed to enter, re-enter, or advance in the workforce.

Goal
North Dakota Career and Technical Education's goal is to create a competitive and knowledgeable work force. This is accomplished through a variety of educational program areas that are organized to prepare students for careers in their chosen fields, to take leadership roles, and balance their multiple roles in life. CTE programs prepare students with the knowledge and skills to make informed career choices, to integrate and apply academic concepts, to prepare for successful participation in a global society, and to engage in lifelong learning.

Standards Development Process
Standards development is a multi-phase process. Existing and/or industry standards are the basis for the North Dakota Program Standards. A team of expert secondary and postsecondary teachers, business and industry representatives, and the state program supervisor draft the standards document. Once the document is finalized, the State Board for Career and Technical Education approves and adopts the standards.

Course Frameworks are also developed by the writing team. A framework includes a brief overview of the course content, topical units of study, and identifies the standards recommended for inclusion within the course. The frameworks are tailored to prepare young people for the opportunities in North Dakota. School Districts will use the frameworks as a guide for developing curriculum that reflects local needs.

Key Principles of Career and Technical Education

We believe that Career Technical Education:

1. **Draws its curricula, standards, and organizing principles from the workplace.**
   The workplace provides the context, objectives, and organizing constructs for instruction and assessment. The workplace also defines the standards of performance necessary, including those required for academic, technical, and employability skills.

2. **Is a critical and integral component of the total educational system, offering career-oriented benefits for all students.**
   CTE classes offer educational benefits to students pursuing careers requiring specific technical skills as well as providing a strong foundation for those pursuing a traditional four-year (or more) degree.

3. **Is a critical and integral component of the workforce development system, providing the essential foundation for a thriving economy.**
   Preparation of a well-prepared, qualified workforce requires solid academics, good work ethics, and specific technical skills as well as the ability to communicate, work with others, solve problems, and use information. CTE contributes directly to this preparation by providing a curriculum tied to specific workplace requirements.

4. **Maintains high levels of excellence supported through identification of academic and workplace standards, measurement of performance (accountability), and high expectations for participant success.**
   Career Technical Education is committed to continuous improvement, attention to industry certification, and the development of highly qualified teachers.

5. **Is robust and flexible enough to respond to the needs of the multiple educational environments, customers, and levels of specialization.**
   CTE involves a large and complex delivery system that (1) integrates career exploration, (2) provides effective tools for organizing all curricula, (3) facilitates the teaching and use of technology, (4) is integrated into the total learning experience, (5) enhances the learning of academic subjects, (6) teaches broad occupational skills, (7) includes all aspects of the industry, (8) teaches how to balance family and work responsibilities, (9) provides job-specific training, (10) is offered at multiple levels of the educational continuum, and (11) is delivered through a variety of educational environments.

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Standard 1	AGRICULTURE, FOOD, & NATURAL RESOURCES (AFNR) FOUNDATIONAL PATHWAY SKILLS

Analyze how issues, trends, technologies, and public policies impact systems in the Agriculture, Food, & Natural Resources Career Cluster.

Topic 1.1	**Research, examine, and discuss issues and trends that impact AFNR systems on local, state, national, and global levels.**
	Student Competencies
1.1.1	Identify issues impacting AFNR systems using historical and current data.
1.1.2	Summarize trends impacting AFNR systems.
1.1.3	Analyze AFNR issues and their impact on local, state, national, and global levels.
1.1.4	Predict the impact of current trends in AFNR systems on local, state, national, and global levels.
1.1.5	Interpret AFNR issues and their impacts to audiences with limited AFNR knowledge.
1.1.6	Determine the opportunities emerging trends create within the AFNR systems.

Topic 1.2	**Examine technologies and analyze their impact on AFNR systems.**
	Student Competencies
1.2.1	Research technologies used in AFNR systems.
1.2.2	Compare and contrast AFNR systems before and after the integration of technology.
1.2.3	Demonstrate appropriate use of technologies in AFNR workplace scenarios.
1.2.4	Analyze how technology is used in AFNR systems to maximize productivity.
1.2.5	Develop solutions in AFNR workplaces or scenarios using technology.
1.2.6	Evaluate the importance of technology use and how it impacts AFNR systems.

Topic 1.3	**Identify public policies and examine their impact on AFNR systems.**
	Student Competencies
1.3.1	Summarize public policies affecting AFNR systems.
1.3.2	Identify an AFNR problem that could be solved by public policy.
1.3.3	Analyze at least two public policies that impact AFNR system.
1.3.4	Propose a policy that will solve an AFNR problem.
1.3.5	Defend or challenge an AFNR public policy.
1.3.6	Create a plan for implementing a new public policy that will positively impact AFNR systems.

Evaluate the nature and scope of the Agriculture, Food, & Natural Resources Career Cluster and the role of agriculture, food, and natural resources (AFNR) in society and the economy.

Topic 1.4	**Research and use geographic and economic data to solve problems in AFNR systems.**
	Student Competencies

	1.4.1	Describe different types of geographic data used in AFNR systems.
	1.4.2	Identify economic data related to AFNR systems (e.g., commodity markets, food marketing, food, and nutritional assistance programs, etc.).
	1.4.3	Interpret AFNR related geographic data using a variety of systems and technologies (e.g., GIS, GPS, etc.).
	1.4.4	Evaluate a set of economic data and explain how it impacts an AFNR system.
	1.4.5	Defend the use of a set of geographical data used to solve a problem within AFNR systems.
	1.4.6	Create a strategy to solve a problem in an AFNR system using a set of economic data.
Topic 1.5		**Examine the impact of AFNR on the local, state, national, and global society and economy.**
		Student Competencies
	1.5.1	Identify the components within AFNR systems (e.g., Animal Systems: health, nutrition, genetics, etc.; Natural Resources Systems: soil, water, etc.).
	1.5.2	Describe how cultures on local, state, national, and global levels relate to AFNR systems.
	1.5.3	List the economic elements of the agricultural economy (e.g., environmental, crops, livestock, etc.).
	1.5.4	Examine the impact AFNR systems have on local, state, national, and global society and economy.
	1.5.5	Assess how people on local, state, national, and global levels interact with AFNR systems on a daily, monthly, or yearly basis.
	1.5.6	Assess the economic impact of an AFNR system on a local, state, national, and global level.
	1.5.7	Develop a strategy for explaining the breadth of AFNR systems to audiences with limited AFNR knowledge.
	1.5.8	Evaluate how cultural traditions, customs or policies have resulted from practices with AFNR systems.
	1.5.9	Evaluate how positive or negative changes in the local, state, national or global economy impacts AFNR systems.
Examine and summarize the importance of health, safety, and environmental management systems in AFNR workplaces.		
Topic 1.6		**Identify and explain the implications of required regulations to maintain and improve safety, health, and environmental management systems.**
		Student Competencies
	1.6.1	Identify implications of regulatory, safety, and health standards on AFNR systems (e.g., SDS, bio-terrorism, etc.)
	1.6.2	Summarize the importance of safety, health, and environmental management in the workplace.
	1.6.3	Explain a health, safety, and environmental procedures to comply with regulatory and safety standards.
	1.6.4	Analyze existing required regulations within an AFNR workplace.
	1.6.5	Evaluate how AFNR organizations and businesses promote improved health, safety, and environmental management.
	1.6.6	Develop methods to evaluate compliance with required safety, health, and environmental management regulations.
Topic 1.7		**Develop and implement a plan to maintain and improve health, safety, and environmental compliance and performance.**
		Student Competencies
	1.7.1	Identify components required in health and safety performance plans.
	1.7.2	Identify examples of environmental compliance plans from AFNR workplace.
	1.7.3	Analyze the effectiveness of health and safety performance plans of an AFNR workplace.
	1.7.4	Prepare plans to improve environmental compliance and performance within an AFNR system.

	1.7.5	Create and implement a plan to improve safety, health, and environmental management regulations in an AFNR workplace.
	1.7.6	Develop a strategy to educate employees on environmental compliance and performance in an AFNR workplace.
Topic 1.8	**Apply health and safety practices to AFNR workplaces.**	
	Student Competencies	
	1.8.1	Identify emergency response procedures for health and safety issues at AFNR workplaces.
	1.8.2	Identify examples of how to avoid health or safety risks in AFNR workplaces.
	1.8.3	Describe the risk level of contamination or injury as associated with AFNR tasks in the workplace.
	1.8.4	Assess various emergency response plan requirements for an AFNR workplaces and/or facility.
	1.8.5	Discuss first aid knowledge and procedures relevant to AFNR workplaces.
	1.8.6	Select appropriate responses for different levels of contamination or injury at an AFNR workplace.
	1.8.7	Create a plan to communicate appropriate responses for health and safety situations within an AFNR workplace.
	1.8.8	Evaluate AFNR workplaces to identify structure of health and safety practices and number of employees certified in first aid training.
	1.8.9	Create a plan to mitigate the level of contamination or injury identified as a risk in the workplace.
Topic 1.9	**Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.**	
	Student Competencies	
	1.9.1	Identify and differentiate the appropriate protective equipment for the safe use and operation of specific tools and equipment (e.g. PPE, etc.).
	1.9.2	Identify standard tools, equipment, and safety procedures related to AFNR tasks.
	1.9.3	Outline operating instructions related to operation, storage, and maintenance of tools and equipment related AFNR tasks.
	1.9.4	Demonstrate adherence to protective equipment requirements when using various AFNR tools and equipment.
	1.9.5	Demonstrate the set up and adjustment for tools and equipment related to AFNR tasks.
	1.9.6	Demonstrate appropriate operation, storage, and maintenance techniques for AFNR tools and equipment.
	1.9.7	Design plans to ensure the use of appropriate protective equipment when using various AFNR tools and equipment.
	1.9.8	Choose appropriate tools and equipment to complete AFNR tasks.
	1.9.9	Design operation, storage, and maintenance plans or schedules for AFNR tools and equipment.
	Demonstrate stewardship of natural resources in AFNR activities.	
Topic 1.10	**Identify and implement practices to steward natural resources in different AFNR systems.**	
	Student Competencies	
	1.10.1	Illustrate stewardship of natural resources.
	1.10.2	Explain how sustainability relates to AFNR activities.
	1.10.3	Analyze practices to steward natural resources in AFNR systems (e.g., wildlife and land conservation, soil and water practices, ecosystem management, etc.).
	1.10.4	Categorize sustainability practices that can be applied in AFNR systems (e.g., energy efficiency, recycle/reuse/repurpose, green resources, etc.).

	1.10.5	Create strategies for stewarding natural resources at home and within community.
	1.10.6	Recommend sustainability policies and plans for potential improvements for AFNR businesses or organizations.
Topic 1.11		**Assess and explain the natural resource related trends, technologies, and policies that impact AFNR systems.**
		Student Competencies
	1.11.1	Discuss historical and current natural resources trends and technologies.
	1.11.2	Identify current local, state, and federal policies impacting AFNR systems.
	1.11.3	Dissect natural resources trends and technologies impacting AFNR systems (e.g., climate change, green technologies, water resources, etc.).
	1.11.4	Compare natural resources policies impacting current AFNR systems (e.g., for water resources, land use, air quality, etc.).
	1.11.5	Predict emerging natural resource trends and technologies within AFNR systems.
	1.11.6	Propose strategies for implementing a new natural resources policy to positively impact AFNR systems.

Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food, & Natural Resources career pathways.

Topic 1.12		**Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).**
		Student Competencies
	1.12.1	Identify steps to pursue a career in an AFNR pathway (e.g., self-assessment, set goals, etc.).
	1.12.2	Classify the educational, training, and experiential requirements to pursue a career in an AFNR pathway (e.g., degrees, certifications, training, internships, etc.).
	1.12.3	Describe specific tools (e.g., resumes, portfolios, cover letters, etc.) and processes (e.g., interviews, applications, etc.) needed to pursue a career in an AFNR pathway.
	1.12.4	Design a personal plan outlining goals and steps to obtain a career in an AFNR pathway.
	1.12.5	Analyze personal skills for attaining a career in an AFNR pathway.
	1.12.6	Communicate personal goals, experiences, education, and skills utilizing specific tools (e.g., resumes, portfolios, cover letters, etc.) and processes (e.g., interviews, applications, etc.) for an AFNR career.
	1.12.7	Assess personal AFNR career goal progress.
	1.12.8	Design a personal plan for attaining the required education, training, and experiences for a career in an AFNR pathway.
	1.12.9	Justify personal goals, experiences, education, and skills to pursue a career in an AFNR pathway.
Topic 1.13		**Examine and choose career opportunities that are matched to personal skills, talents, and career goals in an AFNR pathway of interest.**
		Student Competencies
	1.13.1	Describe careers in each of the AFNR pathways.
	1.13.2	Assess how personal skills and align them with potential career opportunities in AFNR pathways.
	1.13.3	Evaluate the results of a personal career assessment related to potential careers in AFNR pathways.

Analyze the interaction among AFNR systems in the production, processing, and management of food, fiber, and fuel and the sustainable use of natural resources.		
Topic 1.14	**Examine and explain foundational cycles and systems of AFNR.**	
	Student Competencies	
	1.14.1	Explain the life cycles in AFNR (e.g., water cycle, nutrient cycle, carbon cycle, reproductive, mechanical, etc.).
	1.14.2	Explain the interactions between various AFNR systems (e.g., sustainability, animal, plant, food, natural resource, agribusiness, power structure and technical, and biotechnology , etc.).
	1.14.3	Analyze how life cycles affect production, processing, and management of food, feed, fiber, and fuel.
	1.14.4	Analyze the impact of producing and processing food, feed, fiber, and fuel within AFNR systems.
	1.14.5	Interpret the impact of life cycles within AFNR systems.
	1.14.6	Predict how AFNR systems may change or adapt in the future of food, feed, fiber, and fuel production based on current trends and data.
Explore the Supervised Agricultural Experience (SAE), National FFA, and the importance of agricultural education.		
Topic 1.15	**Recognize the value of a Supervised Agricultural Experience (SAE) as Work-Based Learning.**	
	Student Competencies	
	1.15.1	Define Supervised Agricultural Experience (SAE).
	1.15.2	Describe the lifelong learning and career skills that SAEs provide.
	1.15.3	List the types of foundational and immersion SAEs.
	1.15.4	Analyze the value of SAEs.
	1.15.5	Analyze the lifelong learning and career skills that are developed from SAE involvement.
	1.15.6	Categorize projects based on foundational or immersion types of SAEs.
	1.15.7	Justify the value of SAEs to students and their future.
	1.15.8	Evaluate the types of lifelong learning and career skills that SAEs help to develop.
	1.15.9	Compare the components of foundational and immersion SAEs.
Topic 1.16	**Implement the components of a Foundational SAE.**	
	Student Competencies	
	1.16.1	Investigate career opportunities based on individual strengths and preferences.
	1.16.2	Identify employability skills that are important in a chosen career field.
	1.16.3	Define record keeping and its relationship to personal financial literacy.
	1.16.4	Define workplace safety and its importance with AFNR.
	1.16.5	Identify issues, trends, technologies, and public policies that impact AFNR systems.
	1.16.6	Create a career plan of study.
	1.16.7	Perform an employability skills self-assessment to determine areas for growth.
	1.16.8	Craft a personal financial plan that supports one's financial goals.
	1.16.9	Analyze situations for workplace safety hazards.
	1.16.10	Research and analyze how issues, trends, technologies, and public policies impact AFNR systems.
	1.16.11	Implement and adjust a career plan of study.

	1.16.12	Practice employability skills that are important in a chosen career field.
	1.16.13	Apply personal financial practices that lead to financial independence.
	1.16.14	Design a workplace safety plan for a foundational SAE.
	1.16.15	Apply knowledge of issues, trends, technologies, and public policies that impact AFNR systems to solve a problem.
Topic 1.17	**Recognize the options within and participate in immersive supervised agricultural experiences.**	
	Student Competencies	
	1.17.1	Describe the knowledge and skills required to be successful in a specific AFNR career field.
	1.17.2	Connect record-keeping skills to financial literacy.
	1.17.3	Create a personal immersion SAE plan to develop the knowledge and skills required to be successful in a specific AFNR career field.
	1.17.4	Choose a record-keeping system to demonstrate financial literacy.
	1.17.5	Practice the skills required to be successful in a specific AFNR career field through an immersion SAE experience.
	1.17.6	Implement record-keeping practice for a specific immersion SAE.
Topic 1.18	**Analyze the history of the National FFA Organization and how this timeline has allowed the organization to remain relevant.**	
	Student Competencies	
	1.18.1	Identify key historical moments within FFA's history.
	1.18.2	Analyze the impact of historical events on the National FFA Organization.
	1.18.3	Interpret how the historical events within FFA's history have transitioned the organization to where it is today and where it may go in the future.
Topic 1.19	**Evaluate the structure and value of agricultural education.**	
	Student Competencies	
	1.19.1	Define classroom instruction, FFA, and Supervised Agricultural Experiences in the context of the three-component model of agricultural education.
	1.19.2	Identify topics explored in an agricultural course.
	1.19.3	Identify important facts and programs of the FFA.
	1.19.4	Identify what is learned in an SAE.
	1.19.5	Analyze how the components support one another in the education of students.
	1.19.6	Explain the impact classroom instruction has on student learning.
	1.19.7	Explain the impact FFA has on student learning.
	1.19.8	Explain the impact SAE has on student learning.
	1.19.9	Develop a plan to teach someone else about the 3-circle Ag. Education model.
	1.19.10	Justify the need for classroom instruction within agricultural education.
	1.19.11	Justify the need for FFA within agricultural education.
	1.19.12	Justify the need for SAE within agricultural education.
Topic 1.20	**Examine the key components providing directional leadership to the National FFA Organization.**	
	Student Competencies	

	1.20.1	Explain the creed and its purpose in an organization.
	1.20.2	Define an emblem and explain its purpose in an organization.
	1.20.3	Define a mission statement and explain its purpose in an organization.
	1.20.4	Define a program of activities and explain its purpose in an organization.
	1.20.5	Interpret the FFA Creed in the context of when it was written and what it looks like today.
	1.20.6	Interpret the FFA Emblem and all of its parts in the context of when it was designed and today.
	1.20.7	Interpret the FFA Mission statement in the context of when it was designed and what it is today.
	1.20.8	Build an outline for the chapter Program of Activities.
	1.20.9	Evaluate the impact of the FFA Creed on the National FFA Organization and its members.
	1.20.10	Evaluate the impact of the FFA Emblem on the National FFA Organization and its members.
	1.20.11	Evaluate the impact of the FFA Mission statement on the National FFA Organization and its members.
	1.20.12	Create a chapter Program of Activities.
Topic 1.21	**Analyze the structures and procedures to effectively and professionally run and manage a meeting.**	
	Student Competencies	
	1.21.1	Define parliamentary procedure and terms used in parliamentary procedure (e.g., motion, amendment, adjourn).
	1.21.2	Identify the purpose and components of a debate.
	1.21.3	Identify the purpose of organization documents such as agendas, minutes, constitutions, etc.
	1.21.4	Analyze the uses of parliamentary procedure in given meeting situations
	1.21.5	Practice a debate on a given topic.
	1.21.6	Select the proper document that should provide needed information in a given scenario.
	1.21.7	Demonstrate the use of parliamentary procedure in solving an organizational problem/issue.
	1.21.8	Apply debate principles in a business meeting.
	1.21.9	Create organizational documents for a meeting.
Topic 1.22	**Evaluate opportunities to develop leadership, citizenship, and career skills.**	
	Student Competencies	
	1.22.1	Define leadership and identify leadership skills.
	1.22.2	Define citizenship and identify citizenship skills.
	1.22.3	Identify career skills necessary in today's workplace.
	1.22.4	Identify opportunities available to develop leadership skills.
	1.22.5	Compare and contrast leadership skills and styles.
	1.22.6	Explain how citizenship activities build skills.
	1.22.7	Demonstrate the importance of career skills in a workplace setting.
	1.22.8	Explain how FFA offices, community service, leadership conferences, career development events, leadership development events, and other opportunities build leadership and citizenship skills.
	1.22.9	Evaluate your personal leadership skills and areas of growth related to leadership.
	1.22.10	Evaluate your personal citizenship and areas of growth.
	1.22.11	Evaluate your personal career skills and areas of growth.

	1.22.12	Design a plan to develop your personal leadership skills, including citizenship and career skills.

Standard 2	**AGRIBUSINESS SYSTEMS**	
	Apply management planning principles in AFNR businesses.	
Topic 2.1	**Apply economic principles to plan and manage inputs and outputs in an AFNR business.**	
	Student Competencies	
	2.1.1	Identify examples of microeconomic principles related to decisions about AFNR business inputs and outputs (e.g., supply, demand and equilibrium, elasticity, diminishing returns, opportunity cost, etc.).
	2.1.2	Identify examples of macroeconomic principles related to AFNR businesses (e.g., Gross Domestic Product, inflation, capital accounts, unemployment rate, etc.).
	2.1.3	Describe different global economic systems (e.g., traditional economic system, command economic system, market economic system, mixed economic system, etc.).
	2.1.4	Apply microeconomic principles to calculate values associated with different inputs and outputs in AFNR businesses (e.g., price, point of equilibrium, opportunity costs, marginal costs, etc.).
	2.1.5	Analyze the relationship between AFNR business and industry outputs and domestic and global macroeconomic trends (e.g., Gross Domestic Product, national income, rate of growth, price levels, etc.).
	2.1.6	Compare and contrast global economic policy and trade impacting AFNR businesses.
	2.1.7	Evaluate strategies using case studies to maximize the efficiency and sustainability of AFNR business inputs and outputs using microeconomic principles.
	2.1.8	Evaluate the impact of the current macroeconomic environment on decisions related to AFNR businesses.
	2.1.9	Recommend how an agribusiness might adapt to changing global economic scenarios or trade regimes.
Topic 2.2	**Evaluate and create statements of purpose and business goals for AFNR businesses.**	
	Student Competencies	
	2.2.1	Explain the importance of statements of purpose (e.g., vision, mission statement, core values, charter, etc.).
	2.2.2	Identify the meaning and importance of S.M.A.R.T. goals and objectives in AFNR business enterprises.
	2.2.3	Assess approaches for creating statements of purpose for AFNR businesses.
	2.2.4	Prepare short-term, intermediate, and long-term S.M.A.R.T. goals and objectives that are consistent with the statements of purpose for an AFNR business.
	2.2.5	Create statements of purpose for AFNR businesses.
	2.2.6	Revise AFNR S.M.A.R.T. goals and objectives based on data and observations.
Topic 2.3	**Develop and apply skills to manage an AFNR business in an efficient, legal, and ethical manner.**	
	Student Competencies	
	2.3.1	Identify examples of management skills used to organize an AFNR business (e.g., management types, organizational structures, time management techniques, conducting business agreements, etc.).
	2.3.2	Identify local, state, federal, international, and industry regulations that impact the management and operation of AFNR businesses.

	2.3.3	Identify common ethical dilemmas faced by AFNR businesses.
	2.3.4	Apply management skills used to organize an AFNR business (e.g. management types, organizational strategies, time management techniques, etc.).
	2.3.5	Assess the positive and negative impact of local, state, federal, international, and industry regulations on the management and operation of AFNR businesses.
	2.3.6	Examine the importance of using ethical standards within AFNR businesses.
	2.3.7	Evaluate strategies to improve the operation of AFNR businesses using management skills.
	2.3.8	Develop management or operational strategies to address and adhere to local, state, federal, international, and industry regulations.
	2.3.9	Recommend ethical management practices in an AFNR business scenario.
Topic 2.4		**Evaluate, develop, and implement procedures used to recruit, train, and retain productive human resources for AFNR businesses.**
		Student Competencies
	2.4.1	Explain the meaning and functions of human resources in AFNR businesses (e.g., recruitment, evaluate employee performance, employee record management, compensation, etc.).
	2.4.2	Identify common strategies used in AFNR businesses to recruit, train, and retain employees (e.g., career development, training plans, recruitment plans, evaluation programs, etc.).
	2.4.3	Describe common benefit and compensation plans for AFNR businesses.
	2.4.4	Apply knowledge of AFNR human resource practices to write business documents impacting employees (e.g., job descriptions, business information sheet, pamphlet, etc.).
	2.4.5	Analyze strategies used to recruit, train, and retain employees based on their effectiveness
	2.4.6	Compare and contrast benefit and compensation plans for AFNR business employees.
	2.4.7	Create a plan to maintain appropriate records and reports on human resources in AFNR businesses (e.g., personal records, absenteeism record, payroll data, employee requests, etc.).
	2.4.8	Design programs to recruit, train, and retain employees in AFNR businesses.
	2.4.9	Create recommendations for AFNR employers to improve current benefit and compensation plans (e.g., how to motivate employees, recognize productivity, equitably compensate, etc.).
		Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.
Topic 2.5		**Apply fundamental accounting principles, systems, tools, and applicable laws and regulations to record, track, and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).**
		Student Competencies
	2.5.1	Describe accounting systems and procedures used for record keeping in AFNR businesses (e.g., cash vs. accrual systems, identification of appropriate accounts, double-entry accounting, entry of debits and credits, etc.).
	2.5.2	Identify the features of different tools and services for recording, tracking, and auditing AFNR business transactions (e.g., electronic tools, paper-based tools, consultative services, online services, banking services, etc.).
	2.5.3	Evaluate the implementation and appropriateness of accounting systems and procedures used for record keeping in AFNR businesses.

	2.5.4	Compare and contrast the benefits and limitations of different tools and services for recording, tracking, and auditing AFNR business transactions (e.g., convenience, costs, data security, etc.).
	2.5.5	Recommend appropriate accounting systems to maintain records for AFNR businesses.
	2.5.6	Recommend tools and services to track, record, and audit AFNR business transactions that meet business needs and priorities (e.g., electronic and paper-based systems, etc.).
Topic 2.6		**Assemble, interpret, and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).**
		Student Competencies
	2.6.1	Compare and contrast the different types of financial reports (e.g., income statements, cash flow statements, equity statements, etc.) and their frequency of use (e.g., daily, weekly, monthly, quarterly, annual) for monitoring AFNR business performance.
	2.6.2	Summarize strategies for tracking, reporting, and managing inventory in AFNR businesses (e.g., spreadsheets, databases, word processing, networked systems, and the Internet, etc.).
	2.6.3	Define and classify different types of taxes that may be paid by AFNR businesses (e.g., income, property, sales, employment, estate, etc.).
	2.6.4	Prepare financial reports to describe the performance of AFNR businesses (e.g., balance sheet, income statement, statement of cash flows, statement of equity, etc., etc.).
	2.6.5	Prepare financial reports associated with inventory in AFNR businesses (e.g., cost of goods sold, margins on goods, etc.).
	2.6.6	Analyze reporting requirements for different types of taxes paid by AFNR businesses (e.g., income, property, sales, employment, etc.).
	2.6.7	Interpret financial reports for AFNR businesses (e.g., evaluating efficiency, profitability, net worth, financial ratios, etc.).
	2.6.8	Create recommendations to improve management of inventory in AFNR businesses (e.g., maintaining optimal levels, calculating costs of carrying input and output inventory, supply chain management,
	2.6.9	Demonstrate proper preparation of financial information to prepare tax filings for AFNR businesses.
		Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.
Topic 2.7		**Manage cash budgets, assets, Employment Tax Incentive opportunities for credits, loans, etc. to achieve AFNR business goals.**
		Student Competencies
	2.7.1	Identify components of cash budgets (e.g., anticipated revenue, production costs, overhead costs, profit, etc.).
	2.7.2	Identify factors that impact management of cash budgets in AFNR businesses (e.g., changes in price of inputs/outputs, financial investment performance, capital purchases, human resources, etc.).
	2.7.3	Examine components of cash budgets (e.g., anticipated revenue, production costs, overhead costs, profit, etc.) to determine AFNR enterprise feasibility.
	2.7.4	Analyze how buying a major asset (e.g., a tractor) would affect a business.
	2.7.5	Develop cash budgets for AFNR businesses.

	2.7.6	Predict the impact of management decisions on cash budgets in AFNR businesses.
Topic 2.8		**Analyze credit needs and manage credit budgets to achieve AFNR business goals.**
		Student Competencies
	2.8.1	Summarize the characteristics of different types of credit instruments available to AFNR businesses (e.g., lines of credit, operating notes, alternative sources of capital, etc.).
	2.8.2	Define the terms and conditions associated with credit instruments used in AFNR businesses (e.g., repayment terms, APR, grace periods, personal liability, interest rates, etc.).
	2.8.3	Analyze AFNR business needs to determine the necessity of loans for business operation.
	2.8.4	Compare and contrast strategies to responsibly manage credit budgets in AFNR businesses.
	2.8.5	Determine the information needed to obtain credit for AFNR businesses.
	2.8.6	Recommend appropriate uses of available credit budgets to meet goals in AFNR businesses.
		Develop a business plan for an AFNR business.
Topic 2.9		**Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.**
		Student Competencies
	2.9.1	Describe what a successful entrepreneur does.
	2.9.2	Categorize the characteristics of the types of ownership structures used in AFNR businesses (e.g., sole proprietorships, cooperatives, partnerships, Limited Liability Companies, and corporations).
	2.9.3	Identify the information needed to complete an AFNR business plan (e.g., S.M.A.R.T. goals and objectives, needs assessment, cash flow projection, etc.).
	2.9.4	Analyze the characteristics of successful entrepreneurs in an AFNR business.
	2.9.5	Analyze business plans for different types of ownership structures used in AFNR businesses (e.g., sole proprietorships, cooperatives, partnerships, Limited Liability Companies, and corporations).
	2.9.6	Prepare a business plan for an AFNR business.
	2.9.7	Demonstrate the application of entrepreneurial skills to conceptualize an AFNR business (e.g., idea generation, opportunity analysis, risk assessment, etc.).
	2.9.8	Evaluate the successes and failures of AFNR businesses within the global economics system as related to the business ownership structure.
	2.9.9	Assess the commercial and sustainable effectiveness of an AFNR business plan.
Topic 2.10		**Develop production and operational plans for an AFNR business.**
		Student Competencies
	2.10.1	Define the components of operational plans in AFNR businesses (e.g., location, supply and inventory management, production and distribution, organization structure, etc.).
	2.10.2	Describe the production process of an AFNR business.
	2.10.3	Compare and contrast the strengths and weaknesses of operational plans from different AFNR businesses to determine best practices.
	2.10.4	Assess alternative production systems for a specific agricultural product.

	2.10.5	Make recommendations to improve operational plans for an AFNR business based on best practices.
	2.10.6	Create strategies to improve the production process of an agricultural product for an AFNR facility (e.g., SWOT-strengths, weaknesses, opportunities, and threats, supply chain management, etc.).
Topic 2.11		**Identify and apply strategies to manage or mitigate risk.**
		Student Competencies
	2.11.1	Describe sources of risk for an AFNR business (e.g., financial risk, public perception of company, etc.).
	2.11.2	Summarize examples that illustrate the importance of risk and uncertainty within AFNR
	2.11.3	Analyze risk management strategies for AFNR businesses (e.g., cash flow projection, analyze market trends, etc.).
	2.11.4	Analyze alternative approaches to reducing risk for AFNR businesses (e.g., insurance for product liability, property, production or income loss for personnel life and health, etc.).
	2.11.5	Determine methods to match risk management strategies to risk situations in an AFNR business.
	2.11.6	Prepare a comprehensive risk management and contingency plan for an AFNR business.
		Use sales and marketing principles to accomplish AFNR business objectives.
Topic 2.12		**Determine the role of markets, trade, competition, and price in relation to an AFNR business sales and marketing plans.**
		Student Competencies
	2.12.1	Explain markets related to AFNR businesses (e.g. commodity markets, energy markets, etc.).
	2.12.2	Summarize different forms of market competition found in AFNR businesses (e.g., direct competitors, indirect competitors, replacement competitors, etc.).
	2.12.3	Analyze the role of trade and price in the market structure as it relates to AFNR businesses.
	2.12.4	Compare and contrast different forms of market competition and how they can be applied to different AFNR businesses.
	2.12.5	Predict future trends for a specific AFNR product as related to markets, trade, and price (e.g., corn, oil, wheat, etc.).
	2.12.6	Conduct experiments to determine market competition effectiveness of different AFNR businesses.
Topic 2.13		**Assess and apply sales principles and skills to accomplish AFNR business objectives.**
		Student Competencies
	2.13.1	Describe the components of the sales process for AFNR businesses (e.g., understand needs, develop solutions, close sales, etc.).
	2.13.2	Summarize examples of different types of sales calls used in AFNR businesses (e.g., cold calls, face-to-face meetings, follow-up calls, etc.).
	2.13.3	Apply the sales process to accomplish the goals and objectives of an AFNR business.
	2.13.4	Prepare an appropriate response to customer reactions that could be encountered during different types of sales calls used in AFNR businesses (e.g., objections, competitor prices, competing products, post-sale service, complaints about product, etc.).
	2.13.5	Recommend methods to improve the sales process of AFNR businesses.
	2.13.6	Create strategies for developing plans for different types of sales calls used in AFNR businesses.
Topic 2.14		**Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.**

Student Competencies		
	2.14.1	Explain marketing principles used in AFNR businesses (e.g., 4 P's-product, place, price, promotion, attention, interest, desire, action, etc.).
	2.14.2	Define different strategies used in marketing programs for AFNR businesses (e.g., Internet, direct to customer, social media, etc.).
	2.14.3	Summarize the purpose, components, and process to develop marketing plans for AFNR businesses.
	2.14.4	Assess appropriate alternative marketing strategies (e.g. value-adding, branding, niche marketing, etc.) for AFNR businesses using established marketing principles.
	2.14.5	Compare and contrast the strategies of marketing for products and services used in AFNR businesses (e.g., direct marketing, commodities, etc.).
	2.14.6	Perform a market analysis to gather information for marketing plans for AFNR businesses (e.g., evaluation of competitors, customers, domestic and international policy, regulations and rules, standards, etc.).
	2.14.7	Evaluate current AFNR marketing plans to determine the effectiveness of implementation of marketing principles and alternative marketing strategies
	2.14.8	Develop criteria to evaluate marketing strategies for products and services used in AFNR businesses.
	2.14.9	Construct comprehensive marketing plans for AFNR businesses.

Standard 3	ANIMAL SYSTEMS		
	Analyze historic and current trends impacting the animal systems industry.		
Topic 3.1	**Evaluate the development and implications of animal origin, domestication, and distribution on production practices and the environment.**		
	Student Competencies		
	3.1.1	Summarize the origin, significance, distribution, and domestication of different animal species.	
	3.1.2	Summarize major components of animal industrial systems (e.g., livestock, small animal, research, etc.).	
	3.1.3	Examine characteristics of animals that developed in response to environmental and production related influences.	
	3.1.4	Analyze the development of a variety of animal industries, technological advancements, research, and engineering practices and how they influenced products, services, and careers.	
	3.1.5	Evaluate the implications of animal characteristics on production practices and the environment.	
	3.1.6	Evaluate trends (e.g., labor, economic, environmental, etc.) and implications of future developments within different animal industries on production practices and the environment.	
Topic 3.2	**Assess and select animal production, marketing, and management methods based upon effectiveness and potential social and environmental impacts.**		
	Student Competencies		
	3.2.1	Define terms and methods related to animal production, marketing, and management (e.g., sustainable, conventional, responsibly sourced, quality assurance, natural, organic, etc.).	
	3.2.2	Compare marketing methods Assess and select animal production, marketing, and management methods based upon effectiveness and potential social and environmental impacts for animal products and services (e.g., conventional, niche markets, locally grown, etc.).	
	3.2.3	Summarize the types, purposes, and characteristics of effective record keeping and documentation practices for animal enterprises (e.g., breeding and genetic improvement, medical treatment, financial, legal requirements, etc.).	
	3.2.4	Identify wildlife management methods (e.g., depredation, invasive issues, biosecurity, habitat improvement, etc.) as they relate to animal production.	
	3.2.5	Analyze the impact of animal production, marketing, and management methods on end product quality (e.g., price, sustainability, transportation, labeling, animal welfare, etc.).	
	3.2.6	Determine costs of marketing versus predicted increases in sales.	
	3.2.7	Execute effective record keeping and documentation practice for animal enterprises.	
	3.2.8	Analyze local wildlife populations, challenges, and ecological measures that are being utilized as they relate to animal production.	
	3.2.9	Evaluate the effectiveness of different production, marketing, and management methods using data and evidence.	
	3.2.10	Develop marketing plans for an animal agriculture product or service.	
	3.2.11	Appraise the use of a specific record management system based upon its effectiveness for a business related to animal systems.	

	3.2.12	Design plans to manage wildlife populations to achieve a balance of optimal ecological health and animal production.
Topic 3.3		**Analyze laws and sustainable practices that impact animal agriculture from a local, tribal, state, national, and global perspective.**
		Student Competencies
	3.3.1	Identify the types of laws pertaining to animal production, marketing, and management.
	3.3.2	Explain sustainability in animal production, marketing, and management.
	3.3.3	Analyze the roles of state and federal agencies and how they govern animal industries, international trade, and animal production policies.
	3.3.4	Analyze the local and global impact of sustainable animal agriculture practices on human and environmental systems.
	3.3.5	Evaluate the impact of laws pertaining to animal agriculture (e.g., pros, cons, effect on individuals, effect on businesses, etc.).
	3.3.6	Create a plan for sustainable practices in animal agriculture.
		Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.
Topic 3.4		**Explain management techniques that ensure animal welfare.**
		Student Competencies
	3.4.1	Explain the difference between animal welfare and animal rights.
	3.4.2	Identify the challenges involved in working with animals and the various resources available (e.g., variety of tools, technology, equipment, facilities, animal behavior signals, etc.).
	3.4.3	Analyze programs that ensure the welfare of animals (e.g., prevent abuse or mistreatment).
	3.4.4	Analyze animal welfare procedures used to ensure safety and minimize stress during management practices.
	3.4.5	Design quality-assurance programs and procedures for animal production.
	3.4.6	Design safety procedures and plans for working with different species of animals based on animal behaviors and economical impact.
Topic 3.5		**Analyze procedures to ensure that animal products are safe for consumption.**
		Student Competencies
	3.5.1	Identify technology and equipment used in animal systems that support a safe and abundant food supply.
	3.5.2	Explain animal production best practices that minimize health risks.
	3.5.3	Identify animal tracking systems used in production (e.g., livestock, companion animals, exotics, premise, etc.).
	3.5.4	Utilize technology and equipment to perform animal husbandry and welfare procedures and techniques.
	3.5.5	Analyze consumer concerns with animal production practices relative to human health.
	3.5.6	Analyze the impact of animal traceback capabilities on producers and consumers.
	3.5.7	Recommend the use of specific techniques used to perform animal husbandry and welfare procedures.
	3.5.8	Evaluate programs to ensure the safety of animal products for consumption.
	3.5.9	Evaluate the effectiveness of animal tracking systems for a given species.

Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.		
Topic 3.6	**Analyze the nutritional needs of animals.**	
	Student Competencies	
	3.6.1	Identify essential nutrients required for animal health and analyze each nutrient's role in growth and performance.
	3.6.2	Differentiate between nutritional needs of animals based on growth stages, anatomy, and/or production systems (e.g., maintenance, gestation, work, growth, etc.).
	3.6.3	Develop a nutritionally balanced ration for an animal based on its production stage.
Topic 3.7	**Analyze feed rations and assess if they meet the nutritional needs of animals.**	
	Student Competencies	
	3.7.1	Compare and contrast common types of feedstuffs and their general quality and condition.
	3.7.2	Summarize the purpose, impact, and mode of action of feed additives and growth promotants in animal production.
	3.7.3	Evaluate the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements, and performance.
	3.7.4	Compare and contrast methods that utilize feed additives and growth promotants with natural production practices.
	3.7.5	Select appropriate feedstuffs for animals based on a variety of factors (e.g., economics, digestive system, and nutritional needs, etc.).
	3.7.6	Recommend whether or not to use feed additives and growth promotants using scientific evidence, production system needs, goals, and industry standards.
Topic 3.8	**Utilize tools, equipment, techniques, and technology to make animal nutrition decisions.**	
	Student Competencies	
	3.8.1	Identify the tools, equipment, techniques, and technology used to meet animal nutrition needs and ensure an abundant, safe, and quality food supply.
	3.8.2	Summarize the meaning of various components of feed labels and feeding directions.
	3.8.3	Utilize tools, equipment, techniques, and technology to perform animal nutrition tasks.
	3.8.4	Apply information from a feed label and feeding directions to feed animals.
	3.8.5	Evaluate the use of specific tools, equipment, techniques, and technology used to perform animal nutrition tasks.
	3.8.6	Evaluate the potential impacts, positive and negative, of compliance and/or noncompliance with a feed label and feeding directions.
Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.		
Topic 3.9	**Evaluate animals for breeding readiness and soundness.**	
	Student Competencies	
	3.9.1	Identify the male and female reproductive organs of the major animal species.
	3.9.2	Identify how age, size, life cycle, maturity level, and health status affect the reproductive efficiency of male and female animals.
	3.9.3	Summarize the importance of efficient and economic reproduction in animals.
	3.9.4	Analyze the functions of major organs in the male and female reproductive systems.

	3.9.5	Describe factors that lead to reproductive maturity.
	3.9.6	Evaluate reproductive disorders that occur in animals.
	3.9.7	Select breeding animals based on the health of the reproductive organs (e.g., reproductive soundness exams, etc.).
	3.9.8	Evaluate animals for reproductive readiness.
	3.9.9	Defend decisions to treat or cull animals with reproductive problems with both welfare and economic factors.
Topic 3.10	**Apply scientific principles to select and care for breeding animals.**	
	Student Competencies	
	3.10.1	Summarize genetic inheritance in animals.
	3.10.2	Define inheritance and terms related to inheritance in animal breeding (e.g., dominate, codominant, recessive, homozygous, heterozygous, etc.).
	3.10.3	Identify genetic defects that affect animal performance.
	3.10.4	Summarize different needs of breeding animals based on reproductive stage (e.g., newborn, parturition, gestation, gestation lengths, etc.).
	3.10.5	Analyze how genetics can optimize economic, ecological, health, and welfare outcomes.
	3.10.6	Demonstrate how to determine the probability of one or more traits
	3.10.7	Perform a DNA analysis.
	3.10.8	Analyze the care needs for breeding stock in each stage of reproduction.
	3.10.9	Evaluate breeding systems based on the principles of genetics.
	3.10.10	Justify the selection of breeding pairs to achieve a desired outcome.
	3.10.11	Recommend breeding decisions using DNA analysis data.
	3.10.12	Create a plan to differentiate care of a species of breeding animals throughout their reproductive stages.
Topic 3.11	**Apply scientific principles to animal breeding.**	
	Student Competencies	
	3.11.1	Identify natural and artificial breeding methods (e.g., natural breeding, artificial insemination, estrous synchronization, flushing, cloning, etc.).
	3.11.2	Describe the process and materials used in artificial insemination.
	3.11.3	Summarize the advantages and disadvantages of major reproductive management practices, including estrous synchronization, superovulation, flushing, and embryo transfer (e.g., cost, labor, equipment, etc.).
	3.11.4	Describe the use of quantitative breeding values (e.g., EPDs, Performance records, pedigrees) in the selection of genetically superior breeding stock.
	3.11.5	Calculate the potential economic benefits of natural versus artificial breeding methods.
	3.11.6	Demonstrate artificial insemination techniques.
	3.11.7	Analyze the processes of major reproductive management practices, including estrous synchronization, superovulation, flushing, and embryo transfer.
	3.11.8	Compare and contrast quantitative breeding value differences between genetically superior animals and animals of average genetic value.
	3.11.9	Select animal breeding methods based on reproductive and economic efficiency.

	3.11.10	Evaluate the implementation and effectiveness of artificial insemination techniques.
	3.11.11	Create a breeding plan that outlines procedures for estrous synchronization, superovulation, flushing, embryo transfer, and other reproductive management practices given a scenario.
	3.11.12	Evaluate animals for theoretical purchase based on Expected Progeny Difference, performance records, pedigrees, and specified production scenarios.

Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.		
Topic 3.12	**Design and evaluate animal housing, equipment, and handling facilities for the major systems of animal production.**	
Student Competencies		
	3.12.1	Describe the types of facilities needed to house and produce animal species in a safe, efficient, and humane manner.
	3.12.2	Identify equipment, technology, and handling facility procedures used in modern animal production (e.g., climate control devices, sensors, automation, etc.).
	3.12.3	Critique designs for an animal facility and prescribe alternative layouts and adjustments for the safe, sustainable, and efficient use of the facility.
	3.12.4	Analyze the use of modern equipment, technology, and handling facility procedures to determine if they enhance the safe, economic, and sustainable production of animals.
	3.12.5	Design an animal facility focusing on animal requirements, economic efficiency, sustainability, safety, and ease of handling.
	3.12.6	Recommend enhancements to equipment, technology, and handling procedures to improve sustainability and production efficiency.
Topic 3.13	**Comply with government regulations and safety standards for facilities used in animal production.**	
Student Competencies		
	3.13.1	Summarize the general standards that must be met in facilities for animal production (e.g., environmental, local zoning considerations, construction, etc.).
	3.13.2	Categorize laws and regulations pertaining to animal systems (e.g., environmental, consumer protection, entertainment, etc.).
	3.13.3	Analyze animal facilities to determine if industry standards have been met.
	3.13.4	Analyze laws pertaining to animal systems.
	3.13.5	Create facility designs to ensure they meet standards for the legal, safe, ethical, economical, and efficient production of animals.
	3.13.6	Evaluate the impact of laws pertaining to animal systems.
Classify, evaluate, and select animals based on anatomical and physiological characteristics.		
Topic 3.14	**Classify animals according to taxonomic classification systems and use (e.g., agricultural, companion, etc.).**	
Student Competencies		
	3.14.1	Explain the importance of the binomial nomenclature system for classifying animals.
	3.14.2	Compare and contrast major uses of different animal species (e.g., agricultural, companion, etc.).

	3.14.3	Summarize common classification terms utilized in animal systems (e.g., external and internal body parts, maturity, mature male, immature female, animal products, breeds, etc.).
	3.14.4	Classify animals using a taxonomic classification system.
	3.14.5	Analyze the economic value of animals for various applications in the agriculture industry.
	3.14.6	Analyze the visual characteristics of an animal or animal product to select correct classification terminology when referring to companion and production animals.
	3.14.7	Evaluate taxonomic characteristics to arrange animals according to the taxonomic classification system.
	3.14.8	Recommend different uses for an animal species based upon an analysis of local market needs, economic circumstances, and environmental circumstances.
	3.14.9	Communicate knowledge of animal systems with proper classification terms to others in an effective and accurate manner.

Topic 3.15	**Apply principles of comparative anatomy and physiology to uses within various animal systems.**
	Student Competencies

	3.15.1	Compare characteristics of a typical animal cell and identify the organelles.
	3.15.2	Describe the basic functions of animal cells in animal growth, reproduction, maintenance, and performance.
	3.15.3	Identify the properties, locations, functions, and types of animal cells, tissues, organs and body systems.
	3.15.4	Analyze the functions of each animal cell structure.
	3.15.5	Analyze the processes of meiosis and mitosis in animal growth, development, health, and reproduction.
	3.15.6	Compare and contrast animal cells, tissues, organs, body system types, and functions among animal species.
	3.15.7	Correlate the functions of animal cell structures to animal growth, development, health, and reproduction.
	3.15.8	Investigate how the processes of meiosis and mitosis can solve animal growth, development, health, and reproductive problems.
	3.15.9	Apply knowledge of anatomical and physiological characteristics of animals to make production and management decisions.

Topic 3.16	**Select animals for specific purposes and maximum performance based on anatomy and physiology.**
	Student Competencies

	3.16.1	Identify optimal anatomical and physiological characteristics according to established breed standards.
	3.16.2	Summarize the use of products and by-products derived from animals.
	3.16.3	Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.
	3.16.4	Select products from animals based on industry standards.
	3.16.5	Select animals to maximize performance based on anatomical and physiological characteristics. that affect health, growth, and reproduction.
	3.16.6	Evaluate animals to produce superior animal products based on industry standards.

Apply principles of effective animal health care.
Topic 3.17   **Design programs to prevent animal diseases, parasites, and other disorders and ensure animal welfare.**
Student Competencies

	3.17.1	Identify specific tools, techniques, and technology used in animal health management.
	3.17.2	Explain methods of determining animal health and disorders.
	3.17.3	Summarize the characteristics of wounds, common diseases, parasites, and physiological disorders that affect animals.
	3.17.4	Identify characteristics of causal agents and vectors of diseases and disorders in animals.
	3.17.5	Explain the clinical significance of common veterinary methods and treatment (e.g., aseptic techniques, antibiotic use, wound management, etc.).
	3.17.6	Demonstrate the proper use and function of specific tools, techniques, and technology related to animal health management.
	3.17.7	Perform simple health-check evaluations on animals.
	3.17.8	Analyze illnesses and disorders of animals based on symptoms and problems caused by wounds, diseases, parasites, and physiological disorders.
	3.17.9	Analyze data to evaluate preventive measures for controlling and limiting the spread of diseases, parasites, and disorders among animals.
	3.17.10	Assess the safety and effectiveness of facilities and equipment used for surgical and nonsurgical veterinary treatments and procedures.
	3.17.11	Select tools, techniques, and technology to meet specific animal health management goals.
	3.17.12	Determine when an animal health concern needs to be referred to an animal health professional.
	3.17.13	Treat common diseases, parasites, and physiological disorders of animals according to directions prescribed by an animal health professional.
	3.17.14	Design a health maintenance and a disease and disorder prevention plan for animals in their natural and/or confined environments.
	3.17.15	Recommend surgical and nonsurgical veterinary treatments and procedures to meet specific animal health care objectives.
Topic 3.18		**Analyze biosecurity measures utilized to protect the welfare of animals and health of humans on a local, state, national, and global level.**
		Student Competencies
	3.18.1	Summarize the importance of biosecurity to the animal industry at multiple levels (e.g., local, state, national, global).
	3.18.2	Identify zoonotic diseases including their historical significance and potential future implications.
	3.18.3	Analyze procedures at the local, state, and national levels to ensure biosecurity of the animal industry.
	3.18.4	Analyze the health risk of different zoonotic diseases to humans and identify prevention methods.
	3.18.5	Design a biosecurity plan for an animal operation.
	3.18.6	Evaluate the effectiveness of zoonotic disease prevention methods and procedures to identify those that are best suited to ensure public safety and animal welfare.
		Analyze environmental factors associated with animal production.
Topic 3.19		**Design management practices related to animal agriculture to enhance the environment.**
		Student Competencies

	3.19.1	Describe the effects of animal agriculture on the environment (e.g., waste disposal, carbon footprint, air quality, environmental efficiencies, grazing, improved soil, etc.).
	3.19.2	Assess the effectiveness of methods of reducing the negative effects and maximizing the positive effects of animal agriculture on the environment.
	3.19.3	Devise a plan that includes measures to reduce the negative impact and maximize the positive impact of animal agriculture on the environment.
Topic 3.20		**Evaluate the effects of environmental conditions on animals.**
		Student Competencies
	3.20.1	Summarize environmental conditions that impact animals (e.g., weather, sources of water, food resources, temperature, extreme weather, etc.).
	3.20.2	Identify best practices for ensuring optimal environmental conditions for animals.
	3.20.3	Critique the reliability and validity of evidence presented to support claims regarding the effects of environmental conditions on animal populations and performance (e.g., population changes, emerging species, extinction, climate change, etc.).
	3.20.4	Evaluate the effectiveness of methods to ensure optimal environmental conditions for animals.
	3.20.5	Apply valid and reliable research evidence to predict the potential effects of different environmental conditions for an animal population.
	3.20.6	Develop plans to establish favorable environmental conditions for animal growth, performance, welfare, and health based on a variety of factors (e.g., economic feasibility, environmental sustainability, impact on animals, etc.).

Standard 4	BIOTECHNOLOGY SYSTEMS	
Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., scientific technologies, historical events, societal trends, ethical and legal implications, etc.).
Topic 4.1		**Investigate and explain the relationships in the timeline of developing biotechnology applications and techniques in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).**
Student Competencies
	4.1.1	Diagram the progression of biotechnology and the evolution of scientific knowledge.
	4.1.2	Identify the benefits and risks of biotechnology compared with alternative approaches to improving agriculture.
	4.1.3	Identify careers, skills, and the educational preparation needed for entry level careers in biotechnology.
	4.1.4	Analyze emerging issues and applications associated with agricultural biotechnology.
	4.1.5	Compare and contrast the benefits and risks associated with using biotechnology to improve agriculture.
	4.1.6	Assess personal skill sets compared to the skills needed for entry level careers in biotechnology.
	4.1.7	Design a potential application of biotechnology to meet emerging agricultural and societal needs.
	4.1.8	Evaluate the short-term and long-term benefits and risks of applying biotechnology to agriculture.
	4.1.9	Create an individualized student experience that applies basic lab skills to lead to one of the identified jobs and careers.
Topic 4.2		**Evaluate the roles, scope, and implications of regulatory agencies on applications of biotechnology in agriculture and the protection of public interests (e.g., health, safety, environmental issues, etc.).**
Student Competencies
	4.2.1	Summarize the role and scope of biotechnology regulatory agencies (e.g., local, state, national, international).
	4.2.2	Identify regulatory issues related to biotechnology in agriculture.
	4.2.3	Explain the relationship between biotechnology regulatory agencies and the protection of public interests such as health, safety, and the environment.
	4.2.4	Compare and contrast biotechnology regulatory systems (e.g., local, state, national, international).
	4.2.5	Analyze the impact regulatory issues have on both the agricultural industry and on public acceptance of biotechnology in agriculture.
	4.2.6	Examine factors and data that regulatory agencies use to evaluate the potential risks a new application of biotechnology may pose to health, safety, and the environment.
	4.2.7	Evaluate how countries with different biotechnology regulatory systems impact trade and innovation.
	4.2.8	Propose a plan to address a regulatory issue pertaining to biotechnology in agriculture.
	4.2.9	Evaluate if new technologies present regulatory issues to health, safety or the environment.
Topic 4.3		**Analyze the relationship and implications of bioethics, laws, and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).**
Student Competencies
	4.3.1	Identify the emergence, evolution, and implications of bioethics associated with biotechnology in agriculture.

	4.3.2	Summarize legal issues related to biotechnology in agriculture (e.g., protection of intellectual property through patents, copyright, trademarks, etc.).
	4.3.3	Identify public perceptions of biotechnology in agriculture (e.g., social and cultural issues).
	4.3.4	Analyze the implications bioethics may have on future advancements in biotechnology and associated science fields.
	4.3.5	Determine the significance and impacts of legal issues related to biotechnology in agriculture.
	4.3.6	Analyze the impact of public perceptions on the application of biotechnology in different AFNR systems.
	4.3.7	Devise an argument for or against an ethical issue associated with biotechnology in agriculture.
	4.3.8	Propose a solution for a legal issue associated with biotechnology in agriculture.
	4.3.9	Design a survey to examine public perceptions of scientifically-based arguments regarding biotechnology in agriculture and reflect on the reasons why the public may support or resist significant breakthroughs using biotechnology.

Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).

Topic 4.4	**Read, document, evaluate, and secure accurate laboratory records of experimental protocols, observations, and results.**	
	Student Competencies	
	4.4.1	Compare and contrast common record-keeping methods used in a research and/or commercial laboratory (e.g., paper notebook, electronic notebook, etc.).
	4.4.2	Summarize best practices for data and information security in a research and/or commercial laboratory.
	4.4.3	Access a bioinformatics database to extract data.
	4.4.4	Maintain laboratory records documented in a laboratory to ensure data accuracy and integrity (e.g., avoid bias, record any conflicts of interest, avoid misinterpreted results, etc.).
	4.4.5	Determine when security procedures for data and information collected in a laboratory should be implemented.
	4.4.6	Analyze data extracted from a bioinformatics database.
	4.4.7	Propose improvements to documentation to ensure study replication, utility, and safety.
	4.4.8	Devise a strategy for ensuring the security of data and information collected in a laboratory.
	4.4.9	Create an application of bioinformatics to solve an agricultural issue.
Topic 4.5	**Identify and apply standard laboratory procedures and equipment maintenance to create and maintain reliable data.**	
	Student Competencies	
	4.5.1	Describe standard operating procedures for laboratory equipment.
	4.5.2	Categorize laboratory equipment according to its purpose in scientific research.
	4.5.3	Describe sterilization techniques for equipment in a laboratory (e.g., media bottles vs. laminar flow hood, etc.).
	4.5.4	Perform ongoing maintenance of laboratory equipment according to the standard operating procedures (e.g., calibration, testing, etc.).
	4.5.5	Operate laboratory equipment and measurement devices to get accurate and repeatable results.
	4.5.6	Perform sterilization techniques for equipment in a laboratory using standard operating procedures.
	4.5.7	Develop a maintenance program for laboratory equipment based upon the standard operating procedures.

	4.5.8	Develop a proposal for new laboratory equipment or measurement devices.
	4.5.9	Create a plan for sterilizing equipment in a laboratory according to standard operating procedures.
Topic 4.6	**Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.**	
	Student Competencies	
	4.6.1	Classify different types of personal protective equipment and demonstrate how to properly utilize the equipment.
	4.6.2	Describe aseptic techniques in the laboratory (e.g., sterile work area, sterile handling, personal hygiene, etc.).
	4.6.3	Categorize the types of solutions that are commonly prepared in a laboratory (e.g., buffers, reagents, media, etc.).
	4.6.4	Assess the need for personal protective equipment in a variety of situations and select the appropriate equipment to wear when working with biological and chemical materials.
	4.6.5	Demonstrate aseptic techniques in the laboratory.
	4.6.6	Formulate solutions using standard operating procedures (e.g. proper labeling, dilution, etc.).
	4.6.7	Evaluate the benefits and limitations of personal protective equipment.
	4.6.8	Create a standard operating procedure for working with biological materials based upon their classification.
	4.6.9	Create a plan for the storage of solutions (e.g., temperature, volatility, neighboring solutions, light sensitivity, etc.).
Topic 4.7	**Safely manage and dispose of biological materials, chemicals, and wastes according to standard operating procedures.**	
	Student Competencies	
	4.7.1	Describe hazards associated with biological and chemical materials.
	4.7.2	Perform waste disposal according to the standard operating procedures.
	4.7.3	Propose a management plan to reduce laboratory waste and prevent ecological or health problems related to waste disposal.
Topic 4.8	**Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.**	
	Student Competencies	
	4.8.1	Differentiate types of organisms by the physical and biological properties of those organisms. (e.g., plant and animal tissue, cell cultures, microbes, etc.).
	4.8.2	Identify the tools and techniques used to extract and purify DNA and RNA.
	4.8.3	Summarize the role and applications of protein purification in agricultural biotechnology.
	4.8.4	Compare and contrast proteins, enzymes, and antibodies and their relevant uses in agricultural microbiology.
	4.8.5	Apply appropriate aseptic techniques for isolating different organisms.
	4.8.6	Perform DNA or RNA extraction and purification techniques. (e.g., gel electrophoresis, southern blotting, etc.).
	4.8.7	Demonstrate protein separation techniques and interpret the results.
	4.8.8	Analyze how antibodies are formed and how they can be used in agricultural biotechnology.
	4.8.9	Create protocols to isolate, maintain, quantify, and store cell cultures according to standard operating procedures.
	4.8.10	Interpret data generated by extracting and purifying DNA or RNA (e.g., southern blotting, cloning, PCR, RT-PCR, etc.).
	4.8.11	Evaluate the biochemical properties of proteins to predict potential uses.
	4.8.12	Detect and quantify antigens by conducting an Enzyme-Linked Immunosorbent Assay (ELISA).

		Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).
Topic 4.9		**Apply biotechnology principles, techniques, and processes to modify a species.**
		Student Competencies
	4.9.1	Describe the techniques used to produce transgenic organisms (e.g., microbial synthetic biology, gene knockout therapy, traditional gene insertion, etc.).
	4.9.2	Summarize the process of transformation of cells with transgenic DNA.
	4.9.3	Analyze the processes and techniques used to produce transgenic eukaryotes (e.g., microbial synthetic biology, gene knockout therapy, traditional gene insertion, etc.).
	4.9.4	Transform plant or animal cells by performing a cellular transformation.
	4.9.5	Design experiments to evaluate an existing transgenic organism.
	4.9.6	Evaluate the results of a cellular transformation.
Topic 4.10		**Apply biotechnology principles, techniques, and processes to enhance the production of food through the use of microorganisms and enzymes.**
		Student Competencies
	4.10.1	Summarize reasons for detecting microbes.
	4.10.2	Describe enzymes, the changes they cause, and the physical and chemical parameters that affect enzymatic reactions (e.g., food, cellulosic bioenergy, etc.).
	4.10.3	Identify foods produced through the use of biotechnology (e.g., fermentation, etc.) to change the chemical properties of food for an intended purpose (e.g., create desirable nutritional profile, preservation, flavor, etc.).
	4.10.4	Assess the use of biotechnology to detect microbes.
	4.10.5	Analyze processes by which enzymes are produced through biotechnology.
	4.10.6	Compare and contrast the effectiveness, purpose, and outcomes associated with biotechnology as well as conventional processes used in food processing.
	4.10.7	Design an assay to detect a target microorganism in food, water, or the environment.
	4.10.8	Conduct studies using scientific techniques to improve or discover enzymes for use in biotechnology (e.g., microbial strain selection).
	4.10.9	Process food using biotechnology to achieve an intended purpose (e.g., preservation, flavor enhancement, etc.).
Topic 4.11		**Apply biotechnology principles, techniques, and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).**
		Student Competencies
	4.11.1	Describe the consequences of agricultural practices on natural populations.
	4.11.2	Summarize industrial biotechnology and the benefits and risks associated with its use in manufacturing (e.g., fabrics, plastics, etc.).
	4.11.3	List the potential applications of bioprospecting in biotechnology and agriculture.
	4.11.4	Analyze how biotechnology can be used to monitor the effects of agricultural practices on natural populations.
	4.11.5	Apply the processes used in the production of molecules for use in industrial applications.

	4.11.6	Assess the pros and cons of bioprospecting to achieve a research or product development objective.
	4.11.7	Evaluate the impact of modified organisms on the natural environment.
	4.11.8	Evaluate processes used in the synthesis of a molecule.
	4.11.9	Propose opportunities to use bioprospecting after weighing the short-term and long-term impacts on the environment.
Topic 4.12		**Apply biotechnology principles, techniques, and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).**
		Student Competencies
	4.12.1	Identify the aims and techniques involved in the selective plant-breeding process.
	4.12.2	Describe biotechnology processes applicable to animal health (e.g., genetic testing, etc.).
	4.12.3	Categorize the types of pharmaceuticals developed for animals and humans through biotechnology.
	4.12.4	Summarize the need for global biodiversity and applications of biotechnology to reduce threats to biodiversity.
	4.12.5	Select techniques and tools used to monitor and direct plant breeding.
	4.12.6	Assess the benefits, risks, and opportunities associated with using biotechnology to promote animal health.
	4.12.7	Distinguish between plant-based and animal-based pharmaceuticals.
	4.12.8	Utilize techniques to measure biodiversity in a population.
	4.12.9	Perform plant-breeding techniques (e.g., plant tissue culture, etc.).
	4.12.10	Design animal-care protocols to ethically monitor and promote animal systems associated with biotechnology.
	4.12.11	Evaluate the process used to produce pharmaceuticals from transgenic organisms (e.g., hormones for animals, etc.).
	4.12.12	Evaluate whether current threats to biodiversity will have an unsustainable impact on human populations.
Topic 4.13		**Apply biotechnology principles, techniques, and processes to produce bioproducts (e.g., fermentation, transesterification, methanogenesis, etc.).**
		Student Competencies
	4.13.1	Explain the need for bioproducts (e.g., cellulosic bioenergy, bioplastics, biofoams, biocomposites, biofuels, etc.).
	4.13.2	Differentiate between biomass and sources of biomass.
	4.13.3	Explain the process of fermentation and its potential applications.
	4.13.4	Summarize the process of transesterification and its potential applications.
	4.13.5	Describe the process of methanogenesis and its potential applications.
	4.13.6	Analyze the impact of the production and use of bioproducts on the environment.
	4.13.7	Assess the characteristics of biomass that make it useful for bioproduct production.
	4.13.8	Compare the relationship between fermentation and the process used to produce alcohol from biomass.
	4.13.9	Analyze the process used to produce biodiesel from biomass.
	4.13.10	Analyze the process used to produce methane from biomass.
	4.13.11	Defend how bioproducts could solve a global issue (e.g., environmental, agricultural, etc.).
	4.13.12	Evaluate the pros and cons of the technologies used to create bioproducts from biomass.
	4.13.13	Produce alcohol and co-products from biomass.
	4.13.14	Produce biodiesel and co-products from biomass.

	4.13.15	Produce methane and co-products from biomass.
Topic 4.14		**Apply biotechnology principles, techniques, and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).**
		Student Competencies
	4.14.1	Compare and contrast the use of natural organisms and genetically-engineered organisms in the treatment of wastes.
	4.14.2	Summarize the purpose of microorganisms in biological waste management.
	4.14.3	Describe the role of microorganisms in industrial chemical waste treatment.
	4.14.4	List examples of instances in which bioremediation can be applied to clean up environmental contaminants.
	4.14.5	Analyze the process by which organisms are genetically engineered for waste treatment.
	4.14.6	Assess the processes involved in biotreatment of biological wastes.
	4.14.7	Compare and contrast the processes involved in biotreatment of industrial chemical wastes.
	4.14.8	Analyze the risks and benefits of using biotechnology for bioremediation.
	4.14.9	Conduct studies to evaluate the treatment of a waste product using a genetically engineered organism.
	4.14.10	Evaluate the treatment of biological wastes with microorganisms.
	4.14.11	Monitor the treatment of industrial chemical wastes with microorganisms.
	4.14.12	Design a bioremediation project including plans to evaluate the effectiveness of the effort.

Standard 5	*EDUCATION, COMMUNICATION, AND LEADERSHIP*	
Develop a plan for an educational workshop or lesson - recognizing the breadth of opportunities in agricultural education that informs, educates and promotes a topic or concept relevant to AFNR.
Topic 5.1		**Explore the breadth of opportunities in agricultural education (e.g., using state or national resources, Teach Ag, university program information, professional associations, etc.).**
Student Competencies
	5.1.1	Identify various agricultural education careers within and beyond the scope of school-based agricultural education.
	5.1.2	Compare the educational requirements for entry to multiple agricultural education careers.
	5.1.3	Conduct a self-assessment to determine potential agricultural education career paths.
Topic 5.2		**Apply fundamental understanding of AFNR and agricultural education - including experiential learning - to the development of a workshop or lesson.**
Student Competencies
	5.2.1	Identify the components of an effective agricultural education, training, and development program.
	5.2.2	Describe the role of an agricultural education program and its contribution to the overall development of students and adults.
	5.2.3	Justify the need for an agricultural education program based on a specific demographic need (e.g., school or community issue or priority, etc.).
Apply curriculum development and effective instructional techniques to create, teach and evaluate an agricultural education lesson.
Topic 5.3		**Develop and deliver a workshop or lesson using a variety of methods and best practices in instruction and facilitation.**
Student Competencies
	5.3.1	Review an existing AFNR program to understand the essential components of educational programs (e.g. objectives, goals, assessments, planning, evaluation, outcomes).
	5.3.2	Select methods of instruction that best aligns with the objectives of a workshop, or lesson.
	5.3.3	Create formative and summative assessments for a program, workshop, or lesson.
Topic 5.4		**Evaluate facilitation or presentation strategies that encourage appropriate social interactions, embrace diversity, promote equity and build a positive learning environment that is welcoming to all individuals.**
Student Competencies
	5.4.1	Research effective and age-appropriate learning environment management techniques for all learners.
	5.4.2	Analyze strategies for ensuring an inclusive learning environment that prioritizes diversity, equity, and belonging
	5.4.3	Select methods of instruction and modalities that accommodate various learner styles and abilities, including personal and cultural assets.

Topic 5.5		Demonstrate impactful leadership as a credible resource for AFNR.
	Student Competencies	
	5.5.1	Understand personal leadership traits (such as organizational and personal management skills) that contribute to meeting the needs of learners, school, community, the AFNR industry, etc.
	5.5.2	Apply personal leadership traits to enhance professional education and leadership practice in the workplace (e.g., time management, planning, prioritizing, etc.).
	5.5.3	Create facilitation strategies to engage peers in reaching team and organizational goals in a variety of environments.

Evaluate the effectiveness of various communication strategies with related methods and platforms used by organizations across AFNR industries.

Topic 5.6		Identify the methods and characteristics of effective verbal, nonverbal, written, and visual communication.
	Student Competencies	
	5.6.1	Research the primary methods of communication including written, verbal, nonverbal, and visual (including digital and multimedia) communication.
	5.6.2	Compare and contrast communication platforms and how they influence attitudes, opinions or behaviors (e.g., social media, radio, television, print media, etc.).
	5.6.3	Compare and contrast the use of different methods of communication.
	5.6.4	Analyze questions, situations, and criticism within AFNR to determine if they are fact, inference, or opinion.
	5.6.5	Evaluate the benefits of using different communication methods in AFNR.
	5.6.6	Create a communication plan for addressing questions, situations, and criticism of issues within AFNR.

Topic 5.7		Analyze the use of verbal, nonverbal, written, and visual communication platforms in AFNR.
	Student Competencies	
	5.7.1	Describe examples of platforms used with verbal, nonverbal, written, and visual communication methods (e.g., newspaper, radio, photography, etc.).
	5.7.2	Describe examples of digital media platforms used with verbal, nonverbal, written, and visual communication methods (e.g., podcasting, social media, website design, etc.).
	5.7.3	Evaluate new ideas or innovations in communications
	5.7.4	Evaluate new ideas or innovations in digital communications (e.g., generative AI, social media, visual communication programs, etc.) used by AFNR professionals and organizations.
	5.7.5	Design different forms of written and visual communication to achieve a communication strategy.
	5.7.6	Investigate the misuse and potential impact of digital communication tools (e.g., misinformation, plagiarism, generative AI, misuse of photos, copyright, etc.).

Topic 5.8		Analyze similarities and differences between verbal, nonverbal, written, and visual communication methods.
	Student Competencies	
	5.8.1	Identify distinctions between written communications such as newsletters, news releases, advertisements, opinion pieces, etc.
	5.8.2	Identify distinctions between visual communications including video/digital media, graphic design, and the internet/social media.

	5.8.3	Identify distinctions between verbal communications including public speaking, presentations, debate, radio, etc.
	5.8.4	Examine the use and importance of written communication in AFNR.
	5.8.5	Examine the use and importance of visual communication in AFNR.
	5.8.6	Examine the use and importance of verbal communication in AFNR.
	5.8.7	Demonstrate elements of the writing process - including planning, organizing, writing, and editing/revising - to create a news release, or professional email, social media post, media plan, etc.
	5.8.8	Demonstrate the fundamentals of photography, editing, layout, graphic images, and/or design to create a visual message.
	5.8.9	Demonstrate verbal communication tactics such as active listening, interviewing, and/or public speaking to create a message.

Develop a written communication plan using various communication methods (e.g. news releases, social media, speaking opportunities, blogs, podcasts, etc.) to convey a message to an intended AFNR audience.

Topic 5.9	**Develop a communications plan that includes purpose, target audience, message, medium, and outcome evaluation.**

Student Competencies

	5.9.1	Identify the purpose of a communications plan (e.g., to influence, educate, inform, change behavior, etc.).
	5.9.2	Examine the primary and secondary target audience(s) for a communications plan.
	5.9.3	Propose communication method(s) for effectively reaching target audience(s) and methods for measuring desired outcomes (e.g. verbal/written feedback, survey, poll, etc.).

Topic 5.10	**Identify, apply and demonstrate communication skills and methods per the communications plan.**

Student Competencies

	5.10.1	Identify written communication methods (e.g., news release, blog, social media post, email communication, radio script, etc.) to effectively convey a message to AFNR.
	5.10.2	Identify visual communication methods (e.g., Facebook image, graphic, video, GIFS, photographs, interactive content, etc.) to effectively convey a message to ARNR.
	5.10.3	Identify verbal communication methods (e.g. radio script, speech/presentation, podcast, face-to-face conversation, etc.) to effectively convey a message to AFNR.
	5.10.4	Use written communication methods to develop a message(s) about AFNR.
	5.10.5	Use visual communication methods to develop a message(s) about AFNR.
	5.10.6	Use verbal communication methods to develop a message(s) about AFNR.
	5.10.7	Critique various written communication methods used in AFNR (e.g., news release, blog, social media post, email communication, etc.).
	5.10.8	Critique various visual communication methods used in AFNR.
	5.10.9	Critique various verbal communication methods used in AFNR.

Model characteristics of ethical, efficient, and effective leaders in the workplace and community (e.g. integrity, collaboration, self-awareness, self-regulation, etc.).

Topic 5.11	**Identify characteristics and behaviors that constitute ethical, efficient, and effective leadership.**

Student Competencies

	5.11.1	Identify the characteristics of ethical, efficient, and effective leaders (e.g., relates to others, is inclusive, exhibits integrity, etc.) in workplace and community settings.
	5.11.2	Analyze workplace and community leaders and identify what ethical, efficient, and effective leadership characteristics they demonstrate.
	5.11.3	Conduct a self-assessment of personal ethical and effective leadership characteristics and reflect upon the results to identify strengths and opportunities for growth improvement in the workplace (e.g., time management, planning, prioritizing, etc.).
Topic 5.12	**Demonstrate leadership through advocacy for AFNR-related issues.**
	Student Competencies
	5.12.1	Identify personal leadership scenarios that have traits that contributed to meeting the needs of students, school, community, and the AFNR industry.
	5.12.2	Conduct a self-assessment of personal, ethical, and effective leadership characteristics and reflect upon the results to identify opportunities for improvement.
	5.12.3	Create a personal leadership development plan to fully develop or improve one or more characteristics of an effective leader.

Standard 6	**ENVIRONMENTAL SYSTEMS**		
	Use analytical procedures and instruments to manage environmental service systems.		
Topic 6.1	**Analyze and interpret laboratory and field samples in environmental sustainability systems.**		
	Student Competencies		
	6.1.1	Identify sample types (e.g., air, water, soil, organism populations, etc.) and sampling techniques used to collect laboratory and field data.	
	6.1.2	Identify methods of statistical analysis commonly used in research (e.g., mean, standard deviation, standard error, error bars, etc.).	
	6.1.3	Determine the appropriate sampling techniques needed to generate data.	
	6.1.4	Summarize the purpose of statistical analysis methods commonly used in environmental service systems research and explain examples of their use in practice.	
	6.1.5	Prepare sample measurements using appropriate data collection techniques.	
	6.1.6	Utilize data analysis to identify trends in a data sample and assess the confidence that can be drawn from those conclusions.	
Topic 6.2	**Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).**		
	Student Competencies		
	6.2.1	Identify basic laboratory equipment and explain their uses.	
	6.2.2	Explain the uses of basic environmental monitoring instruments.	
	6.2.3	Demonstrate the proper use and maintenance of basic laboratory equipment.	
	6.2.4	Demonstrate the proper use and maintenance of environmental monitoring instruments.	
	6.2.5	Calibrate and use laboratory equipment according to standard operating procedures.	
	6.2.6	Calibrate and use environmental monitoring instruments according to standard operating procedures.	
	Evaluate the impact of public policies and regulations on environmental service system operations.		
Topic 6.3	**Interpret and evaluate the impact of laws, agencies, policies, practices, and consumer preferences affecting environmental service systems.**		
	Student Competencies		
	6.3.1	Identify Types of laws associated with environmental sustainability systems.	
	6.3.2	Identify different types of government agencies (e.g., county planning commission, soil and water conservation districts, relevant state agencies, US Forest Service, USDA, etc.)) associated with environmental sustainability systems.	
	6.3.3	Identify different types of Non Government Organizations (NGOs) (e.g., The Nature Conservancy, World Wildlife Fund, Ducks Unlimited, etc.) associated with environmental sustainability systems.	
	6.3.4	Research policies, practices and initiatives common in business and advocacy groups associated with environmental sustainability systems (e.g., zero-waste, LEED-certified, locally-grown, etc.).	

	6.3.5	Analyze how laws associated with environmental sustainability systems are developed for local (e.g., wellhead protection, littering, etc.), tribal, state (e.g., endangered species, etc.), and federal (e.g., Clean Air Clean Water, etc.) governments.
	6.3.6	Analyze the specific purpose of government agencies associated with environmental sustainability systems.
	6.3.7	Analyze the specific purpose of Non Government Organizations associated with environmental sustainability systems.
	6.3.8	Assess the intent, feasibility, and effectiveness of policies, practices, and initiatives common in business and advocacy groups associated with environmental sustainability systems.
	6.3.9	Evaluate the impact of laws associated with environmental sustainability systems (e.g., wildlife, people, environment, economy, etc.).
	6.3.10	Evaluate the impact of government agencies (e.g., local, state, and federal) associated with environmental sustainability systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.).
	6.3.11	Evaluate the impact of Non Government Organizations (e.g., local, state, and federal) associated with environmental sustainability systems.
	6.3.12	Evaluate the impact of policies, practices, and initiatives common in business and advocacy groups associated with environmental sustainability systems on wildlife, people, the environment, and the economy.
Topic 6.4		**Compare and contrast the impact of current trends on regulation of environmental sustainability systems.**
		Student Competencies
	6.4.1	Research the purpose, implementation, and impact of greenhouse gas emission policies (e.g., cap-and-trade, emission offsetting, zero-emissions, carbon-neutrality, carbon sequestration, etc.).
	6.4.2	Identify environmental sustainability systems regulations on international trade (e.g., Clean Air Act, EISA, Clean Water Act, Superfund, etc.).
	6.4.3	Summarize the impact that population growth has on environmental sustainability systems.
	6.4.4	Identify a current regional policy or topic related to environmental sustainability systems.
	6.4.5	Assess the impact of greenhouse gas emissions policies.
	6.4.6	Examine the impact of environmental sustainability systems regulations on international trade.
	6.4.7	Analyze the correlation between increased population size and the need for regulation of environmental sustainability systems.
	6.4.8	Assess the impact of a current policy or topic on the region's environmental sustainability systems.
	6.4.9	Devise a plan for educating others about greenhouse gas emissions and the impact on the supply chain.
	6.4.10	Evaluate the impact of specific environmental sustainability regulation policies (e.g., Clean Air Act, EISA, Clean Water Act, Superfund, etc.) on international trade.
	6.4.11	Predict the impact of future population growth on the regulation of environmental sustainability systems.
	6.4.12	Develop an action plan to address a current policy or topic to advance the region's environmental sustainability systems.
Topic 6.5		**Examine and summarize the impact of public perceptions and social movements on the regulation of environmental sustainability systems.**

		Student Competencies
	6.5.1	Summarize how the perception and regulation of environmental sustainability systems has changed over time.
	6.5.2	Examine how social changes (e.g., zero-waste philosophy, carbon footprints, recycling, etc.) have affected the implementation of new environmental sustainability systems.
	6.5.3	Analyze specific changes to perceptions and regulations of environmental sustainability systems and their impact on reducing the ecological, economical, and sociological impact.
	6.5.4	Assess the effectiveness of specific social changes related to regulation of environmental sustainability systems.
	6.5.5	Evaluate the impact of specific historical figures, or organizations, on the perception and regulation of environmental sustainability systems.
	6.5.6	Devise strategies for engaging the public to address a current AFNR issue brought on by social change.

Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

Topic 6.6	**Apply meteorology principles to environmental sustainability systems.**	
		Student Competencies
	6.6.1	Label the different components and structural layers of the earth's atmosphere.
	6.6.2	Explain how meteorological conditions influence air quality.
	6.6.3	Describe how climate change impacts regional environmental sustainability systems.
	6.6.4	Identify factors (e.g., water cycle, carbon cycle, life cycle, etc.) that affect the earth's balance of energy.
	6.6.5	Examine how components of the atmosphere (e.g., weather systems and patterns, structure of the atmosphere, etc.) affect environmental sustainability systems.
	6.6.6	Compare the relationships between meteorological conditions, air quality, and air pollutants.
	6.6.7	Assess the potential environmental, economic, and social consequences of climate change.
	6.6.8	Analyze how the greenhouse effect may alter the earth's balance of energy.
	6.6.9	Evaluate the impact of atmospheric conditions on environmental sustainability systems using meteorological data.
	6.6.10	Interpret data measuring air pollution, its threat on human populations, and ecological interactions.
	6.6.11	Evaluate the potential impacts of global climate change on environmental sustainability systems.
	6.6.12	Create an action plan to mitigate the impact of climate change on environmental sustainability systems.

Topic 6.7	**Apply soil science and hydrology principles to environmental sustainability systems.**	
		Student Competencies
	6.7.1	Define land uses, capability factors, and land capability classes.
	6.7.2	Describe the process of soil formation through weathering.
	6.7.3	Explain how the physical qualities of soil influence the infiltration and percolation of water.
	6.7.4	Define groundwater and its importance on environmental sustainability systems.
	6.7.5	Describe the hydrogeology process.
	6.7.6	Describe how groundwater and surface water interactions affect the existence of wetlands.
	6.7.7	Determine the land capability classes for a parcel of land using a soil survey.
	6.7.8	Analyze the chemical composition and mineral matter in the soil based on the rock type and parent material.

6.7.9	Assess the physical qualities of the soil that determine its potential for filtration of groundwater supplies and likelihood for flooding.
6.7.10	Assess the effectiveness of precautions taken to prevent or reduce contamination of groundwater.
6.7.11	Analyze how interactions between groundwater and surface water affect flow and availability of water.
6.7.12	Analyze the importance of the roles played by wetlands in regards to water availability, prevention of flooding, and other factors.
6.7.13	Design a master land-use management plan for a given area that utilizes land capability classes to minimize erosion and flooding, maximize development, and preserve topsoil.
6.7.14	Evaluate the soil composition to determine changes needed in the environmental sustainability system.
6.7.15	Evaluate different types of soil to determine their potential for filtration of groundwater supplies and likelihood for flooding.
6.7.16	Evaluate the methods used in a given example to protect groundwater.
6.7.17	Develop a plan to address water resources based on availability and human activity.
6.7.18	Recommend strategies for wetlands preservation and restoration that maximize services provided by wetlands while taking human concerns into consideration.

Topic 6.8	**Apply chemistry principles to environmental sustainability systems.**	
	Student Competencies	
6.8.1	Explain how chemistry affects soil structure and function (e.g., pH, cation-exchange capacity, filtration capability, flooding likelihood, etc.).
6.8.2	Explain how chemistry affects water quality and function (e.g., oxygen saturation, pH, biomagnification, etc.).
6.8.3	Explain how chemistry affects air quality and function (e.g., heat retention, formation of smog and acid rain, etc.).
6.8.4	Describe the relationship between water and soil chemistry and the formation of different kinds of wet-lands (e.g., fens, peat bogs, potholes, etc.).
6.8.5	Analyze the soil chemistry of a sample.
6.8.6	Analyze the water chemistry of a sample.
6.8.7	Analyze how components of atmospheric chemistry (e.g., air chemical components, heat, moisture, etc.) affect air quality.
6.8.8	Assess how different kinds of wetlands are formed based on the different types of soil and water chemistry present in each case.
6.8.9	Determine how a sample's soil chemistry may impact considerations in environmental sustainability systems.
6.8.10	Determine how a sample's water chemistry may impact considerations in environmental sustainability systems.
6.8.11	Assess the impact of atmospheric chemistry on operational decisions in environmental sustainability systems.
6.8.12	Evaluate the services provided by different types of wetlands.

Topic 6.9	**Apply microbiology principles to environmental sustainability systems.**	
	Student Competencies	
6.9.1	Summarize the contribution of microbial biodiversity to the physical and chemical characteristics of soil.
6.9.2	Describe how microbial populations in an ecosystem affect carbon cycling.

	6.9.3	Explain the role that microbes play in wastewater treatment.
	6.9.4	Describe potential applications of bioassay tests for environmental sustainability systems.
	6.9.5	Examine how the activities of microorganisms in soil affect environmental sustainability systems and ecosystem biodiversity.
	6.9.6	Analyze the microbial populations present in an area and their impact on carbon cycling.
	6.9.7	Examine the impact of wastewater treatment on environmental service systems.
	6.9.8	Conduct bioassay tests related to environmental sustainability systems.
	6.9.9	Evaluate how soil microorganisms in environmental sustainability systems can be used to minimize waste, maximize nutrient cycling, and increase ecosystem biodiversity.
	6.9.10	Develop strategies for negating air pollutants based on soil microbial populations (e.g., carbon sequestration and rates of decomposition).
	6.9.11	Recommend strategies to further reduce the environmental, economic, and social impact of wastewater treatment.
	6.9.12	Interpret the results of bioassay tests related to environmental sustainability systems.
Topic 6.10	**Apply ecology principles to environmental sustainability systems.**	
Student Competencies		
	6.10.1	Describe the role that biodiversity plays in environmental sustainability systems and how biodiversity can be measured.
	6.10.2	Explain the role played by habitats on environmental sustainability systems.
	6.10.3	Explain how carrying capacities relate to environmental sustainability systems (e.g., waste processing, rate or production of pollution, disease, etc.).
	6.10.4	Describe how ecological interactions can be used to assess environmental sustainability systems (e.g., macro invertebrates and/or amphibians as bioindicators).
	6.10.5	Calculate the amount of biodiversity in a given area using an appropriate method (e.g., quadrant assessment, transect measurements, etc.).
	6.10.6	Analyze the impact of the current rate of habitat loss on environmental sustainability systems
	6.10.7	Analyze the impact of a population exceeding its carrying capacity on environmental sustainability systems.
	6.10.8	Compare the benefits and drawbacks of using bioindicator species in environmental sustainability systems.
	6.10.9	Predict how changing the levels of biodiversity of an area will impact environmental sustainability systems.
	6.10.10	Devise strategies to minimize the future loss of habitats in environmental sustainability systems.
	6.10.11	Devise a strategy for monitoring and supporting environmental sustainability systems through management of a species' carrying capacity.
	6.10.12	Determine the pollutants in a given area using evidence from bioindicator species.
Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).		
Topic 6.11	**Develop systems of sustainability management for all categories of solid waste in environmental sustainability systems.**	
Student Competencies		
	6.11.1	Describe different types of pollution including point source and nonpoint source pollution.

	6.11.2	List ways in which pollution can be managed and prevented.
	6.11.3	Describe the conditions necessary for waste to be labeled as hazardous to the local environment
	6.11.4	Examine how industrial and nonindustrial pollution has damaged the environment.
	6.11.5	Conduct tests to determine the presence and extent of pollution.
	6.11.6	Classify examples of pollution as hazardous or nonhazardous to the local environment.
	6.11.7	Evaluate evidence for a given area for industrial and nonindustrial pollution.
	6.11.8	Create a plan for pollution remediation, management, or prevention for a given area.
	6.11.9	Construct a plan for handling hazardous waste in the local environment.
Topic 6.12	**Sustainably manage solid waste in environmental service systems.**	
	Student Competencies	
	6.12.1	Compare and contrast different types of solid waste and options for treating solid waste.
	6.12.2	Describe the components found entering sanitary landfills.
	6.12.3	Summarize the benefits and processes of composting.
	6.12.4	Describe the importance and potential impact of recycling.
	6.12.5	Analyze environmental hazards created by different types of solid waste, solid waste accumulation, and solid waste management.
	6.12.6	Analyze basic sanitary landfill operating procedures and design.
	6.12.7	Apply scientific principles to explain the benefits and processes of composting.
	6.12.8	Analyze different recycling methods.
	6.12.9	Develop a plan for solid waste management for a given situation that considers the environmental hazards, economic realities, and social concerns associated with this task.
	6.12.10	Evaluate sanitary landfill procedures for environmental, economic, and social sustainability.
	6.12.11	Evaluate the appropriateness of composting methods in different situations.
	6.12.12	Evaluate recycling programs and procedures.
Topic 6.13	**Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.**	
	Student Competencies	
	6.13.1	Classify the chemical and physical properties of drinking water.
	6.13.2	Describe methods commonly used to treat wastewater and septic waste.
	6.13.3	Analyze all steps in the public drinking water treatment process according to applicable standards.
	6.13.4	Examine the steps necessary to ensure wastewater and septic waste can be safely released into the environment.
	6.13.5	Evaluate samples of water and the processes necessary to verify that the samples are safe for consumption according to applicable standards.
	6.13.6	Evaluate examples of wastewater and/or septic waste for its potential to cause environmental, economic, and/or social problems.
Topic 6.14	**Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental sustainability systems.**	

		Student Competencies	
	6.14.1	List conventional energy sources and conservation measures to reduce the impact on environmental sustainability systems.	
	6.14.2	Describe alternative energy sources and the motivations for seeking alternatives to conventional energy sources as they relate to environmental monitoring.	
	6.14.3	Describe the factors that affect energy consumption are their relation to environmental monitoring.	
	6.14.4	Explain how energy consumption and the carbon cycle relate to environmental monitoring.	
	6.14.5	Describe the purpose and applications of life cycle assessments to environmental sustainability systems.	
	6.14.6	Compare the advantages and disadvantages of conventional energy sources in regard to environmental sustainability systems.	
	6.14.7	Analyze the advantages and disadvantages of alternative energy sources as they pertain to environmental sustainability systems.	
	6.14.8	Analyze the main categories of energy consumption.	
	6.14.9	Calculate the impact of the carbon cycle imbalance (due to energy consumption).	
	6.14.10	Conduct a life cycle assessment for a given source of energy.	
	6.14.11	Evaluate the impact burning fossil fuels has on environmental sustainability systems.	
	6.14.12	Evaluate the impact alternative energy sources have on environmental conditions.	
	6.14.13	Determine the most effective course of action to reduce energy consumption based on the needs of environmental sustainability systems.	
	6.14.14	Recommend a method to reduce the imbalance in the carbon cycle through changes to energy consumption using data from environmental monitoring.	
	6.14.15	Determine the best option for energy in regard to environmental sustainability systems using data from a life cycle assessment.	

Use tools, equipment, machinery and technology common to tasks in environmental service systems.

Topic 6.15	**Use technological and mathematical tools to map land, facilities, and infrastructure for environmental sustainability systems.**

		Student Competencies
	6.15.1	Explain the importance and applications of surveying and mapping for environmental sustainability systems.
	6.15.2	Describe the methods in which GIS can be used in environmental sustainability systems (e.g., tracing of point pollution, control of the spread of invasive species, etc.).
	6.15.3	Apply surveying and cartographic skills to make site measurements for a situation involving environmental sustainability systems.
	6.15.4	Apply GIS skills to a situation specific to environmental sustainability systems.
	6.15.5	Make a recommendation to address concerns and needs within an environmental sustainability systems situation using site measurements.
	6.15.6	Interpret GIS data to come to a conclusion about a scenario specific to environmental sustainability systems.

Topic 6.16	**Perform assessments of environmental conditions using equipment, machinery, and technology.**

		Student Competencies
	6.16.1	Summarize methods used to determine water quality (e.g., dissolved oxygen, chemical tests, macroinvertebrates, etc.) and to determine if a source of water has been contaminated.
	6.16.2	Summarize methods and tools used to measure soil health when determining if an area of land has been contaminated (e.g., soil probes, core monolith, soil fertility tests, etc.).
	6.16.3	Summarize methods and tools used to determine air quality and to determine if pollution is present (e.g., CO_2 probe, particulate matter sampler, etc.).
	6.16.4	Summarize methods used to determine ecological health and to determine if an ecosystem is threatened (e.g., quadrat analysis, bioindicators, mark-re-capture, etc.).
	6.16.5	Analyze different measurements of water quality to determine their effectiveness and limitations.
	6.16.6	Compare different measurements of soil quality (e.g., soil horizons, soil texture, organic matter, soil respiration, etc.) to determine their effectiveness and limitations.
	6.16.7	Compare different measurements of air quality (e.g., ozone, carbon monoxide, particulate matter, etc.) to determine their effectiveness and limitations.
	6.16.8	Compare different measurements of assessing ecological health (e.g., quadrat biodiversity assessments, transect surveys, population counts, detection of disease and invasive species, etc.) to determine their effectiveness and limitations.
	6.16.9	Evaluate a sample of water to determine its quality and if it has been contaminated.
	6.16.10	Evaluate a sample of soil to determine its quality and if it has been contaminated.
	6.16.11	Perform an evaluation of air quality to determine and assess its impact on human and ecological populations.
	6.16.12	Evaluate a habitat to determine its ecological quality and if it is threatened.

Standard 7	**FOOD PRODUCTS AND PROCESSING SYSTEMS**
	Develop and implement procedures to ensure safety, sanitation, and quality in food product and processing facilities.

Topic 7.1	**Distinguish between various food safety programs and management systems in food products and processing facilities.**

Student Competencies

	7.1.1	Summarize the purposes and objectives of safety programs in food products and processing facilities (e.g., Sanitation Standard Operating Procedures (SSOP); Good Manufacturing Practices (GMP); worker safety, etc.).
	7.1.2	Identify common equipment used in food products and processing systems (e.g., packaging, mixing, cooling, heating, preservation, etc.) and describe their function.
	7.1.3	Compare and contrast the different aspects of safety programs (e.g., Sanitation Standard Operating Procedures (SSOP); Good Manufacturing Practices (GMP); worker safety, etc.).
	7.1.4	Operate equipment used in food products and processing systems (e.g., dehydrator, food processor, mixer, grinder, etc.).
	7.1.5	Construct plans that ensure implementation of safety programs for food products and processing facilities.
	7.1.6	Construct food product protocols and parameters (Standard Operating Procedures) based upon equipment used in food products and processing.

Topic 7.2	**Apply food safety and quality assurance procedures in the harvesting, handling, and processing of food products.**

Student Competencies

	7.2.1	Identify hazards associated with food products and processing (e.g., physical, chemical, and biological).
	7.2.2	Identify cross-contamination hazards associated with food products and processing (e.g., waterborne, airborne, and personnel, etc.).
	7.2.3	Describe systematic approaches to control food safety (e.g., Hazard Analysis and Critical Control Points Plan (HACCP); Critical Control Point procedures (CCP); Good Agricultural Practices Plan (GAP), etc.).
	7.2.4	Summarize the purposes and objectives of quality assurance and food safety tests on food products (e.g., produce safety regulation, safe food transport, food contaminants, etc.).
	7.2.5	Describe the effects food-borne pathogens have on food products and humans.
	7.2.6	Outline procedures to control possible hazards associated with food products and processing.
	7.2.7	Outline procedures to control possible cross-contamination hazards associated with food products and processing.
	7.2.8	Develop plans that ensure implementation of safe handling procedures on food products.
	7.2.9	Conduct quality assurance tests on food products.
	7.2.10	Execute the procedures of microbiological tests used to detect food-borne pathogens.
	7.2.11	Evaluate the effectiveness of a control method implemented.
	7.2.12	Evaluate the effectiveness of a cross-contamination control method implemented (e.g., allergen swabbing).
	7.2.13	Interpret outcomes from safe handling procedures and results from quality assurance tests.
	7.2.14	Evaluate results of quality assurance tests on food products and examine steps to implement corrective procedures.

	7.2.15	Interpret microbiological tests for food-borne pathogens.
Topic 7.3		**Apply food safety procedures during storage and distribution to ensure food quality.**
		Student Competencies
	7.3.1	Summarize purposes of food storage procedures (e.g., first in/first out, temperature regulation, monitoring, etc.).
	7.3.2	Describe different electronic and paper-based documentation methods used to meet food safety and quality goals in food products and processing systems.
	7.3.3	Analyze characteristics of food products and determine appropriate storage procedures.
	7.3.4	Demonstrate methods of documentation procedures within food products and processing systems.
	7.3.5	Prepare plans that ensure implementation of proper food storage procedures.
	7.3.6	Recommend improvements to a documentation procedure used within a food products and processing facility.
		Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.
Topic 7.4		**Apply principles of nutrition and biology to develop food products that provide a safe, wholesome, and nutritious food supply for local and global food systems.**
		Student Competencies
	7.4.1	Summarize properties of common food constituents (e.g., proteins, carbohydrates, fats, vitamins, minerals).
	7.4.2	Describe methods of nutritional planning to meet essential needs for the human diet.
	7.4.3	Compare and contrast the relative value of food constituents relative to food product qualities (e.g., taste, appearance, etc.).
	7.4.4	Compare and contrast the nutritional needs of different human diets.
	7.4.5	Analyze the properties of food products to identify food constituents and evaluate nutritional value.
	7.4.6	Construct methods to design a healthy daily food guide for a variety of nutritional needs.
Topic 7.5		**Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome, and nutritious food supply for local and global food systems.**
		Student Competencies
	7.5.1	Describe the basic chemical makeup of different types of food.
	7.5.2	Identify common food additives and their properties (e.g., preservatives, antioxidants, buffers, stabilizers, colors, flavors, etc.).
	7.5.3	Summarize the application of biochemistry in the development of new food products (e.g., value added food products, genetically engineered food products, etc.).
	7.5.4	Explain how the chemical and physical properties of foods influence nutritional value and eating quality.
	7.5.5	Analyze the purpose of common food additives and how they influence the chemistry of food.
	7.5.6	Analyze how food products and processing facilities use biochemistry concepts to develop new food products.
	7.5.7	Design experiments to determine the chemical and physical properties of food products.
	7.5.8	Devise strategies to determine what additives are utilized and why they are included in a variety of food products.
	7.5.9	Develop plans to engineer new food items using bio-chemistry concepts.
Topic 7.6		**Apply principles of human behavior to develop food products to provide a safe, wholesome, and nutritious food supply for local and global food systems.**

		Student Competencies
	7.6.1	Explain the importance of food labeling to the consumer.
	7.6.2	Summarize relevant factors in planning and developing a new food product (e.g., regulation, creativity, economics, etc.).
	7.6.3	Analyze the required components on a food label.
	7.6.4	Determine consumer preference and market potential for a new food product using a variety of methods (e.g., double-blind testing, sensory evaluation testing, etc.).
	7.6.5	Determine a strategy to prepare and label foods according to the established standards of regulatory agencies.
	7.6.6	Design new food products that meet a variety of objectives (e.g., consumer preferences, market, nutritional needs, regulatory requirements, etc.).
		Select and process food products for storage, distribution and consumption.
Topic 7.7		**Implement selection, evaluation, and inspection techniques to ensure safe and quality food products.**
		Student Competencies
	7.7.1	Summarize characteristics of quality and yield grades of food products.
	7.7.2	Summarize procedures to select raw food products based on yield grades and quality grades.
	7.7.3	Describe protocols for inspection and harvesting techniques for animal food products (e.g., pre-mortem and post-mortem inspections, Food Safety Inspection Service guidelines (FSIS), etc.).
	7.7.4	Describe foods and byproducts derived from different classifications of food products (e.g., meat, egg, poultry, fish, dairy, fruits, vegetables, grains, legumes, oilseeds, etc.).
	7.7.5	Analyze factors that affect quality and yield grades of food products.
	7.7.6	Assemble procedures to perform quality-control inspections of raw food products for processing.
	7.7.7	Analyze inspection and harvesting of animals using regulatory agency approved or industry-approved techniques.
	7.7.8	Examine desirable qualities of food products derived from different classifications of food products.
	7.7.9	Outline procedures to assign quality and yield grades to food products according to industry standards.
	7.7.10	Evaluate care and handling procedures to maintain original food quality and yield.
	7.7.11	Respond to consumer concerns about the inspection and harvesting techniques of animals using accurate information based on regulatory agency approved or industry-approved techniques.
	7.7.12	Evaluate food products from different classifications of food products.
Topic 7.8		**Design and apply techniques of food processing, preservation, packaging, and presentation for distribution and consumption of food products.**
		Student Competencies
	7.8.1	Explain English and metric measurements used in the food products and processing industry.
	7.8.2	Describe methods and materials used for processing food for different markets (e.g., fresh food products, ready to eat food products, etc.).
	7.8.3	Identify methods of food preservation.
	7.8.4	Summarize types of materials and methods used in food packaging and presentation.
	7.8.5	Perform conversions between units of measure.

	7.8.6	Prepare foods for sale and distribution for different markets.
	7.8.7	Apply strategies to preserve different foods using various methods and techniques.
	7.8.8	Analyze the degree of desirable food qualities of food stored in various packaging.
	7.8.9	Design plans to formulate and package food products using a variety of weights and measures.
	7.8.10	Evaluate food quality factors on foods prepared for different markets (e.g., shelf life, shrinkage, appearance, weight, etc.).
	7.8.11	Recommend strategies to preserve different foods using various methods and techniques.
	7.8.12	Implement methods of selecting packaging materials to store a variety of food products.
Topic 7.9	**Create food distribution plans and procedures to ensure safe delivery of food products.**	
	Student Competencies	
	7.9.1	Describe the environmental impact of distributing food locally and globally.
	7.9.2	Describe the various paths food products take to get from food processing centers to consumers.
	7.9.3	Summarize different types of market demands for food products (e.g., local food, organic, non-GMO, etc.).
	7.9.4	Compare ways to reduce environmental impact from food distribution activities.
	7.9.5	Examine safety procedures used in food distribution to ensure a safe product is being delivered to consumers.
	7.9.6	Assess how market demand for food products influences the distribution of food products.
	7.9.7	Defend a strategy to determine ways for food distribution to reduce environmental impacts.
	7.9.8	Make recommendations to improve safety procedures used in food distribution scenarios to ensure a safe product is being delivered to consumers.
	7.9.9	Propose distribution plans for food products that meet specific market demands.
Explain the scope of the food industry and the historical and current developments of food product and processing.		
Topic 7.10	**Examine the scope of the food industry by evaluating local and global policies, trends, and customs for food production.**	
	Student Competencies	
	7.10.1	Summarize examples of policy and legislation that affect food products and processing systems in the United States and internationally (e.g., labeling, GMOs, biosecurity, food system policy, dietary guidelines, etc.).
	7.10.2	Describe the impact of consumer trends on food products and processing organic practices (e.g., health and nutrition, organic, information about food products, local food movements, farm-to-fork supply chains, food system transparency, etc.).
	7.10.3	Summarize cultural differences regarding food products and processing practices.
	7.10.4	Analyze the similarities and differences amongst policies and legislation that affect the food products and processing system in the U.S. or internationally.
	7.10.5	Implement methods to obtain data on food consumer trends in a specific market.
	7.10.6	Analyze food production and distribution outcomes based on cultural customs.
	7.10.7	Defend a personal point of view on policies and legislation that affect the food products and processing system in the U.S. or internationally
	7.10.8	Create food products that meet a specific consumer trend in a specific market.
	7.10.9	Design culturally sensitive food processing and distribution practices.

Topic 7.11	Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.	
	Student Competencies	
	7.11.1	Describe the components of the food products and processing industry (e.g., processing, distribution, byproducts, etc.).
	7.11.2	Explain environmental and safety concerns about the food supply.
	7.11.3	Describe current and emerging technologies related to food products and processing (e.g., high pressure processing of foods, automation, biotechnology, etc.).
	7.11.4	Analyze significant changes and trends in the food products and processing industry.
	7.11.5	Summarize current issues related to the safety and environmental concerns about foods and food processing (e.g., GMOs, irradiation, micro-organisms, contamination, etc.).
	7.11.6	Analyze desirable and undesirable outcomes of emerging technologies used in the food products and processing systems.
	7.11.7	Predict upcoming changes and trends in the food products and processing industry.
	7.11.8	Respond to consumer concerns about the environment and safety of the food supply using accurate information regarding food products and processing systems and practices.
	7.11.9	Evaluate the feasibility of implementing a current or emerging technology to improve a current food product or process used in a facility.
Topic 7.12	Identify the purpose of industry organizations, groups, and regulatory agencies that influence the local and global food systems.	
	Student Competencies	
	7.12.1	Summarize the purposes of organizations that influence or regulate the food products and processing industry.
	7.12.2	Describe the importance and usage of regulatory oversight of food safety and security in food products and processing (e.g., internationally, nationally, state, and local).
	7.12.3	Analyze the changes in the food products and processing industry brought about by industry organizations or regulatory agencies.
	7.12.4	Assess the application of industry standards in the food products and processing industry.
	7.12.5	Create methods to obtain data about organizations, groups, and regulatory agencies that affect the food products and processing industry.
	7.12.6	Create plans that ensure adherence to industry standards for food products and processing facilities.
Topic 7.13	Evaluate the effectiveness of current sustainability practices in their role to food products and processing	
	Student Competencies	
	7.13.1	Describe what sustainability is within the food industry.
	7.13.2	Identify various practices for sustainable food production, distribution, and waste (e.g., rooftop farming, composting, regenerative agriculture, vertical farming, short supply chains).
	7.13.3	Summarize why sustainability plays a key role in the food industry.
	7.13.4	Analyze the performance and efficiency of various practices for sustainable food production, distribution, and waste.

	7.13.5	Create a plan to educate on what food sustainability is.
	7.13.6	Design a program for a facility to promote sustainable food production, distribution, and waste.

Standard 8	*NATURAL RESOURCES SYSTEMS*	
Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
Topic 8.1		**Examine natural resource availability and ecosystem function in a particular region.**
Student Competencies
	8.1.1	Describe the process for classifying the different kinds of natural resources using common classification schemes (e.g., abiotic/biotic, renewable versus nonrenewable, native versus introduced, etc.).
	8.1.2	Summarize the components that comprise types of ecosystems (e.g., marine systems, desert systems, forest systems, etc.).
	8.1.3	Explain the importance of biodiversity to ecosystem function and availability of natural resources.
	8.1.4	Use dichotomous key to classify organisms.
	8.1.5	Analyze the interdependence of organisms within an ecosystem (e.g., food webs, niches, impact of keystone species, etc.).
	8.1.6	Analyze how species evolve, are naturally selected, and adapt.
	8.1.7	Devise strategies for the management (e.g., preservation, conservation, exploitation, etc.) of natural resources.
	8.1.8	Evaluate the interdependence of biotic and abiotic components (climate, geography, energy flow, nutrient cycling, etc.) in an ecosystem.
	8.1.9	Evaluate biodiversity in ecosystems and devise strategies to enhance the function of an ecosystem and the availability of natural resources by increasing the level of biodiversity.
Topic 8.2		**Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.**
Student Competencies
	8.2.1	Define the characteristics used to identify trees and woody plants.
	8.2.2	Define the characteristics used to identify herbaceous plants.
	8.2.3	Define the characteristics used to identify wildlife and insects.
	8.2.4	Define the characteristics used to identify aquatic species.
	8.2.5	Define the characteristics used to identify abiotic resources (e.g., soil types, climate, geography, etc.).
	8.2.6	Identify the purpose and value of resource inventories and population studies.
	8.2.7	Apply identification techniques to determine the species of a tree or woody plant.
	8.2.8	Apply identification techniques to determine the species of an herbaceous plant.
	8.2.9	Apply identification techniques to determine the species of wildlife or insect.
	8.2.10	Apply identification techniques to determine the species of an aquatic organism.
	8.2.11	Apply identification techniques to determine the types of abiotic resources in an area.
	8.2.12	Apply procedures for conducting resource inventories and population studies.
	8.2.13	Evaluate the species of trees present to assess the status of an ecosystem (e.g., presence of native versus invasive species, biodiversity, etc.).

	8.2.14	Evaluate the species of herbaceous plants present to assess the status of an ecosystem (e.g., presence of native versus invasive plants, biodiversity, etc.).
	8.2.15	Evaluate the species of wildlife and insects present to assess the status of an ecosystem.
	8.2.16	Evaluate the aquatic species present to assess the status of an ecosystem.
	8.2.17	Evaluate the abiotic resources present in an area to determine the best practices for improving, enhancing, and protecting an ecosystem.
	8.2.18	Interpret resource inventories and population studies in a given area over time.
Topic 8.3		**Apply ecological concepts and principles (e.g., weather, air quality, UV protection, atmospheric pressure, etc.) to the interaction of atmospheric and natural resource systems.**
		Student Competencies
	8.3.1	Classify different kinds of biogeochemical cycles (e.g., carbon, nitrogen, water cycles, etc.) and the role they play in natural resources systems.
	8.3.2	Explain how climate factors influence natural resource systems.
	8.3.3	Assess the role that the atmosphere plays in the regulation of biogeochemical cycles.
	8.3.4	Analyze the impact that climate has on natural resources and how this impact has changed due to human activity.
	8.3.5	Make recommendations to lessen the impact of human activity on the ability of the atmosphere to regulate biogeochemical cycles.
	8.3.6	Design strategies to address the primary causes of climate change and their impact on natural resource systems.
Topic 8.4		**Apply ecological concepts and principles to aquatic natural resource systems.**
		Student Competencies
	8.4.1	Summarize the roles and properties of watersheds.
	8.4.2	Describe the importance of groundwater and surface water to natural resources.
	8.4.3	Explain the role of riparian zones and riparian buffers in enhancing water quality.
	8.4.4	Explain methods and structures to control or reduce stream bank erosion.
	8.4.5	Assess the function of watersheds and their effect on natural resources.
	8.4.6	Analyze how different classifications of ground and surface water affect ecosystem function.
	8.4.7	Compare and contrast techniques used in the creation, enhancement, and management of riparian zones and riparian buffers.
	8.4.8	Model techniques used in the creation, enhancement, and management of structures used to control or reduce stream bank erosion.
	8.4.9	Evaluate the importance of watersheds to ecosystem function.
	8.4.10	Evaluate strategies to manage, protect, enhance, or improve sources of groundwater or surface water based on its properties.
	8.4.11	Evaluate strategies for the creation, enhancement, and management of riparian zones and riparian buffers.
	8.4.12	Evaluate strategies for the creation, enhancement, and management of stream bank erosion.
Topic 8.5		**Apply ecological concepts and principles to terrestrial natural resource systems.**
		Student Competencies

	8.5.1	Describe the stages of ecological succession.
	8.5.2	Compare and contrast the impact of habitat disturbances and habitat resilience.
	8.5.3	Compare and contrast techniques associated with sustainable forestry (e.g., timber stand improvement, diversity improvement, reforestation, etc.).
	8.5.4	Compare and contrast techniques associated with soil management (e.g., soil survey and interpretation, erosion control, etc.).
	8.5.5	Analyze examples of stages of succession.
	8.5.6	Analyze examples of habitat disturbances and habitat resilience.
	8.5.7	Analyze a forest in order to determine which forestry techniques would improve that habitat.
	8.5.8	Analyze a plot of land in order to determine which soil management techniques would be most applicable.
	8.5.9	Predict which species will become more prevalent through future stages of succession in an ecosystem.
	8.5.10	Interpret signs of habitat disturbances and resilience in an ecosystem to assess the health of an ecosystem.
	8.5.11	Devise a forest management plan that improves the habitat while optimizing the amount or quality of timber that can be harvested.
	8.5.12	Devise a soil management plan to minimize erosion and maximize biodiversity, plant productivity, and the formation of topsoil.
Topic 8.6		**Apply ecological concepts and principles to biotic organisms in natural resource systems.**
		Student Competencies
	8.6.1	Describe the importance of population ecology, population density, and population dispersion to natural resource systems.
	8.6.2	Identify examples of invasive species.
	8.6.3	Analyze the factors that influence population density and population dispersion in natural resource systems.
	8.6.4	Analyze factors that influence the establishment and spread of invasive species.
	8.6.5	Create a management plan for a population of a species in an ecosystem given its population ecology, population density, and population dispersion in natural resource systems.
	8.6.6	Devise a plan to manage, prevent, control, or eliminate invasive species in a given area.
		Analyze the interrelationships between natural resources and humans.
Topic 8.7		**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.).**
		Student Competencies
	8.7.1	List the types of laws associated with natural resource systems.
	8.7.2	Describe the types of agencies and organizations associated with natural resources systems.
	8.7.3	Analyze laws associated with natural resources systems.
	8.7.4	Analyze the relationships between public and private agencies and organizations associated with natural resources systems.

	8.7.5	Evaluate the impact of laws and treaties associated with natural resources systems (e.g., mitigation, water regulations, carbon emissions, game limits, invasive species, etc.).
	8.7.6	Evaluate the impact and effectiveness of agencies and organizations associated with natural resources systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions, etc.).
Topic 8.8		**Assess the impact of human activities on the availability of natural resources.**
		Student Competencies
	8.8.1	Summarize the relationship between natural resources, ecosystems, and human activity.
	8.8.2	Categorize the primary causes of extinction of living species due to human activity (e.g., overharvesting, habitat loss, invasive species, pollution, etc.).
	8.8.3	Describe the manner in which consumer decisions are related to the depletion of natural resources.
	8.8.4	Assess how different kinds of human activity (e.g., agriculture, infrastructure development, transportation, etc.) affect the use and availability of natural resources.
	8.8.5	Assess causes of extinction and how those causes related to loss of biodiversity.
	8.8.6	Analyze possible solutions to reduce the depletion of natural resources.
	8.8.7	Evaluate how the availability of natural resources can be improved through changes to human activity.
	8.8.8	Devise a strategy for preventing the loss of species and biodiversity that takes into account the primary causes of species extinction from human activity.
	8.8.9	Design a solution to reduce the depletion of natural resources affected by consumer decisions.
Topic 8.9		**Analyze how social perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.**
		Student Competencies
	8.9.1	Summarize the different social perceptions of natural resources (e.g., public versus private land ownership, laws and regulations, economics, green technology, traditional ecological knowledge, etc.).
	8.9.2	Illustrate how historical figures and social movements played a prominent role in shaping how natural resources are viewed and used today (e.g., Tribal and traditional ecological knowledge, Aldo Leopold, Teddy Roosevelt, John Muir, Rachel Carson, Gaylord Nelson, etc.).
	8.9.3	Describe how technology has affected the use and views of natural resources.
	8.9.4	Analyze how social perceptions can affect the use and sustainability of natural resources.
	8.9.5	Examine the relationship between current trends in natural resource systems and historical figures and movements that played a prominent role in shaping how natural resources are viewed and used today.
	8.9.6	Analyze how some technological advancements changed how natural resources were used and viewed (e.g., Industrial Revolution, fossil fuels, green technology, etc.).
	8.9.7	Develop predictions for how the management, protection, enhancement, and improvement of natural resources will evolve through social perceptions (e.g., establishment of national parks, public opinion, reduction of waste and energy consumption, partnership with tribal communities, etc.).
	8.9.8	Predict how society's views and use of natural resources will continue to change as a result of historical figures and trends in modern society.

	8.9.9	Predict how future technological advancements may affect the use and views of natural resources.
Topic 8.10		**Examine and explain how economics affects the use of natural resources.**
		Student Competencies
	8.10.1	Compare and contrast how the economic value of a natural resource affects its availability.
	8.10.2	Describe the impact of the use of natural resources on local, tribal, state, and national economies (e.g., outdoor recreation, energy production, preservation, etc.).
	8.10.3	Compare and contrast the economic impact of green technology and alternative energy.
	8.10.4	Assess whether economic value increases or decreases the conservation, protection, improvement, and enhancement of natural resources.
	8.10.5	Assess the importance of the use of natural resources on local, tribal, state, and national economies.
	8.10.6	Analyze how the adoption of green technology and/or alternative energy affected a local, tribal, state, or national economy.
	8.10.7	Devise a plan to improve the conservation, protection, improvement, and enhancement of natural resources based on economic value and practices.
	8.10.8	Predict how changes to the availability of natural resources because of human activity may impact a local, tribal, state, and national economy.
	8.10.9	Predict the economic impact of green technology and alternative energy.
Topic 8.11		**Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.**
		Student Competencies
	8.11.1	Describe ways in which a message regarding natural resources may be communicated to the public through standard media sources (e.g., press, radio/podcasts, TV, public appearances, social media etc.).
	8.11.2	Summarize how social media and the internet have changed how people perceive and utilize natural resources (e.g., greater awareness of conservation issues, calls to action, etc.).
	8.11.3	Describe how communication can be used to influence behavior, call people to action, and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.
	8.11.4	Assess the effectiveness of different methods for communicating natural resource messages.
	8.11.5	Assess how to most effectively communicate a message about the conservation, management, enhancement, and improvement of natural resources via social media and the Internet.
	8.11.6	Analyze examples of how communication can be used to influence behavior, call people to action, and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.
	8.11.7	Devise a strategy for communicating a natural resources message through media.
	8.11.8	Predict how messages about the conservation, management, enhancement, and improvement of natural resources will change because of social media and the Internet.
	8.11.9	Create a communication plan to influence the behavior of people, call people to action, and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.
		Develop plans to ensure sustainable production and processing of natural resources.

Topic 8.12	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.).
	Student Competencies
	8.12.1	Compare and contrast forest harvesting methods.

	8.12.1	Compare and contrast forest harvesting methods.
	8.12.2	Describe methods by which wildlife can be sustainably harvested (e.g., controlled harvests, hunting licenses, regulations, etc.).
	8.12.3	Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife, etc.) of mineral extraction to a local, tribal, state, and/or national economy.
	8.12.4	Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife, etc.) of fossil fuels to a local, tribal, state, and/or national economy.
	8.12.5	Compare and contrast the costs and benefits (e.g., environmental impacts, etc.) of shale oil from fracking to a local, tribal, state, and/or national economy.
	8.12.6	Compare and contrast the costs and benefits (e.g., environmental impacts, etc.) of alternative sources of energy (e.g., hydroelectric, solar, wind, biofuels, geothermal, etc.).
	8.12.7	Summarize how recreational uses of natural resources can be changed to improve sustainability.
	8.12.8	Categorize aquatic species used for commercial and recreational purposes.
	8.12.9	Assess harvesting methods in regards to their economic value, environmental impact, and other factors.
	8.12.10	Assess techniques used to harvest wildlife in regards to sustainability, practicality, and other factors.
	8.12.11	Assess the economic impact of mineral extraction in regards to the costs and benefits to a local, tribal, state, and/or national economy.
	8.12.12	Assess the economic impact of fossil fuel extraction in regards to the costs and benefits to a local, tribal, state, and/or national economy.
	8.12.13	Assess the economic impact of shale oil extraction (i.e., fracking) in regards to the costs and benefits to a local, tribal, state, and/or national economy.
	8.12.14	Assess factors that affect the economic, environmental, and social sustainability in regards to the use of alternative sources of energy.
	8.12.15	Assess different options for improving the sustainability of outdoor recreation based on its impact on natural resources and likelihood of acceptance.
	8.12.16	Analyze techniques used to acquire aquatic species for their environmental, economic, and social sustainability.
	8.12.17	Develop a forest harvesting plan that ensures economic, environmental, and social sustainability.
	8.12.18	Develop a method for the sustainable harvest of wildlife species.
	8.12.19	Evaluate methods used to extract and process minerals for economic, environmental, and social sustainability.
	8.12.20	Evaluate methods used to extract and process fossil fuels for economic, environmental, and social sustainability.
	8.12.21	Evaluate methods used to extract and process shale oil for economic, environmental, and social sustainability.
	8.12.22	Predict how the impact of alternative energy will change in the future based on trends in energy production and consumption.
	8.12.23	Recommend how an outdoor recreation activity can be made more sustainable in a manner that is accessible and equitable to those who take part in that activity.

	8.12.24	Develop recommendations for the sustainable harvest of aquatic species.
Topic 8.13		**Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing and evaluating natural resource management plans.**
	Student Competencies	
	8.13.1	Summarize how to use maps and technologies to identify directions and land features, calculate actual distance, and determine the elevations of points.
	8.13.2	Summarize how GIS (e.g., GPS receivers, UAVs, etc.) can be used to manage, conserve, improve and enhance the natural resources of an area.
	8.13.3	Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems, etc.) to locate natural resources.
	8.13.4	Analyze an area's resources using GIS technologies.
	8.13.5	Evaluate the availability of and threats to natural resources using cartographic skills, tools, and technologies (e.g., spread of invasive species, movement of wildlife populations, changes to biodiversity of edge of habitat versus interior, etc.).
	8.13.6	Use GIS data for a given area to devise a management plan for the management, conservation, improvement, and enhancement of its natural resources.
Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.		
Topic 8.14		**Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.**
	Student Competencies	
	8.14.1	Identify different kinds of streams.
	8.14.2	Identify characteristics of a healthy forest.
	8.14.3	Identify characteristics of a healthy wildlife habitat.
	8.14.4	Describe the characteristics of a rangeland and the global importance of the biome to providing multiple ecosystem services to humanity.
	8.14.5	Identify characteristics of natural resources that make them desirable for recreational purposes.
	8.14.6	Identify characteristics of healthy marine and coastal natural resources.
	8.14.7	Assess indicators of the biological health of a stream.
	8.14.8	Assess the methods used to improve a forest stand.
	8.14.9	Assess methods of wildlife habitat management.
	8.14.10	Apply methods for rangeland management for multiple ecosystem services.
	8.14.11	Assess management techniques for improving outdoor recreation opportunities.
	8.14.12	Assess methods to improve marine and coastal natural resources.
	8.14.13	Create an enhancement plan for a stream.
	8.14.14	Create a timber stand improvement plan for a forest.
	8.14.15	Devise a comprehensive improvement plan for a wildlife habitat.
	8.14.16	Revise a rangeland management plan to support the provisioning of multiple ecosystem services.
	8.14.17	Evaluate the impact of recreational activities on natural resources.

	8.14.18	Create an improvement plan for marine or coastal natural resources.
Topic 8.15	**Diagnose plant and wildlife diseases and follow protocols to prevent their spread.**	
	Student Competencies	
	8.15.1	Classify causes of diseases in plants and the correct authorities to whom some diseases should be reported.
	8.15.2	Classify causes of diseases in wildlife and aquatic species.
	8.15.3	Analyze a plant disease based on its symptoms.
	8.15.4	Analyze a wildlife or aquatic species disease based on its symptoms.
	8.15.5	Create a management plan to reduce infection and the spread of plant diseases in natural resource systems.
	8.15.6	Create a management plan to reduce infection and spread of wildlife or aquatic species diseases in natural resource systems.
Topic 8.16	**Prevent or manage introduction of ecologically harmful species in a particular region.**	
	Student Competencies	
	8.16.1	Identify ecologically harmful species common to a particular region.
	8.16.2	Summarize strategies and benefits of preventing the introduction of ecologically harmful species to a particular region.
	8.16.3	Analyze signs of the spread of ecologically harmful species.
	8.16.4	Implement a plan for preventing the spread of ecologically harmful species for its effectiveness.
	8.16.5	Create a management plan to reduce the spread of ecologically harmful species in natural resource systems.
	8.16.6	Devise strategies to prevent ecological damage that would result from the introduction of an ecologically harmful species.
Topic 8.17	**Manage fires in natural resource systems.**	
	Student Competencies	
	8.17.1	Describe the difference between desirable and undesirable fires and the role fire plays in a healthy ecosystem.
	8.17.2	Explain how fire management techniques have evolved.
	8.17.3	Assess techniques used to fight wildfires, manage prescribed fires and ensure human safety.
	8.17.4	Assess the effectiveness of techniques previously and currently used to prevent harmful fires.
	8.17.5	Develop a prevention plan for harmful fires for a particular region.
	8.17.6	Predict how fire management techniques will change in the future.

Standard 9	**PLANT SYSTEMS**		
Develop and implement a crop management plan for a given production goal that accounts for environmental factors.			
Topic 9.1	**Determine the influence of environmental factors on plant growth.**		
	Student Competencies		
	9.1.1	Describe the three measurements of light – color, intensity, and duration – that affect plant growth.	
	9.1.2	Identify the effects of environmental conditions (e.g., air movement, temperature, humidity, etc.) on plant growth.	
	9.1.3	Describe the effects of water quality on plant growth, (e.g., pH, dissolved solids, etc.).	
	9.1.4	Analyze plant responses to light color, intensity, and duration.	
	9.1.5	Determine the optimal environmental conditions for plant growth.	
	9.1.6	Analyze plant responses to water quality and quantity.	
	9.1.7	Recommend modifications to light for desired plant growth.	
	9.1.8	Evaluate a plan to maintain optimal environmental conditions for plant growth (e.g., day length, light, humidity, moisture, temperature, etc.).	
	9.1.9	Recommend modifications to water for desired plant growth.	
Topic 9.2	**Prepare and adjust growing media for use in plant systems.**		
	Student Competencies		
	9.2.1	Describe the major forms of growing media (e.g., hydroponics, soil, greenhouse potting mix, rockwool, etc.).	
	9.2.2	Identify the physical characteristics of soil water (e.g., water holding capacity, plant available water, permanent wilting point, gravitational water, etc.) and soil texture (e.g., sand, silt, clay, etc.).	
	9.2.3	Describe the physical and chemical characteristics of growing media and explain the influence they have on plant growth.	
	9.2.4	Discuss how differences in growing media can affect drainage (e.g., drain tile, surface drainage, tillage, porosity, irrigation, etc.).	
	9.2.5	Recommend a plan for managing crop growth in different growing media.	
	9.2.6	Determine the electroconductivity and pH for soil and how the results influence practices (e.g., irrigation, etc.).	
Topic 9.3	**Demonstrate planting techniques and create the conditions needed for seed germination.**		
	Student Competencies		
	9.3.1	Describe the steps to growing crops including crop selection, land preparation, seed selection, seed sowing, irrigation, fertilizing, and harvesting.	
	9.3.2	Plant a crop using the appropriate steps.	
	9.3.3	Recommend a crop to plant given a geographic region.	
Topic 9.4	**Develop and implement a nutrient management and/or fertilizer plan for specific plants or crops.**		
	Student Competencies		
	9.4.1	Explain the role of macronutrients and micronutrients for plant growth and development and their major functions (e.g., nitrogen, phosphorus, potassium, iron, sulfur, etc.).	

	9.4.2	Explain the influence of electric conductivity (EC, soluble salts), pH, and cation exchange capacity on the availability of plant nutrients and crop growth.
	9.4.3	Collect soil and plant tissue samples using industry accepted procedures and explain how incorrect sample collection will affect the results of a laboratory analysis.
	9.4.4	Explain the formulations of both organic and inorganic fertilizers.
	9.4.5	Summarize production methods focused on sustainable soil management (e.g., crop rotation, companion planting, cover crops, etc.).
	9.4.6	Identify nutrient deficiencies in plants.
	9.4.7	Contrast pH and cation exchange capacity between mineral soil and soilless growing media.
	9.4.8	Interpret laboratory analyses of soil and tissue samples
	9.4.9	Calculate the amount of fertilizer to be applied based on nutrient recommendation and fertilizer analysis.
	9.4.10	Assess the short-and long-term effects of production methods focused on sustainable soil management.
	9.4.11	Prepare a scouting report to correct elements negatively affecting plant growth in a field or greenhouse.
	9.4.12	Recommend a plan of action to adjust the electric conductivity (EC, soluble salts) and pH of growing media given soil tests for specific plants or crops.
	9.4.13	Prescribe fertilizer applications based on the results of a laboratory analysis of soil and plant tissue samples.
	9.4.14	Recommend a fertilizer application method (e.g., liquid, dry, variable rate, manure, etc.).
	9.4.15	Devise a plan for sustainable soil management for a selected cropping system.

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

Topic 9.5 **Classify plants according to taxonomic systems.**

Student Competencies

	9.5.1	Identify plants based on visual characteristics (e.g., seedling stages, fully grown, etc.).
	9.5.2	Classify the morphological characteristics and systems used to identify agricultural and herbaceous plants (e.g., life cycles, growth habit, plant use and as monocotyledons, or dicotyledons, woody, herbaceous, etc.) by common and scientific names.
	9.5.3	Assess the importance of plants to agricultural and ornamental plant systems by scientific names.

Topic 9.6 **Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.**

Student Competencies

	9.6.1	Identify structures in a typical plant cell and explain the function of plant cell organelles.
	9.6.2	Identify the components, the types, and the functions of plant roots.
	9.6.3	Identify the components and the functions of plant stems.
	9.6.4	Identify morphological features found in leaves, how they contribute to plant identification, and how they relate to overall plant growth.
	9.6.5	Describe the components of a flower, the functions of a flower, and the functions of flower components.
	9.6.6	Identify the functions and components of seeds and fruits.
	9.6.7	Apply the knowledge of cell differentiation and the functions of the major types of cells to plant systems.
	9.6.8	Analyze root tissues and explain the pathway of water and nutrients into and through root tissues.

	9.6.9	Contrast the difference in arrangement of vascular tissue between monocot and dicot plant stems.
	9.6.10	Analyze how leaves capture light energy and exchange gasses.
	9.6.11	Differentiate between the types of flowers and flower inflorescence (e.g., complete, incomplete, perfect, imperfect).
	9.6.12	Categorize the major types of seeds and fruits.
	9.6.13	Compare and contrast mitosis and meiosis.
	9.6.14	Evaluate the active and passive transport of minerals into and through the root system to plant nutrition.
	9.6.15	Evaluate the function of the xylem, phloem, and cambium tissues and their impact on plant systems.
	9.6.16	Devise a plan for agronomic management practices that takes into account leaf structure, function, and environmental factors (e.g., drought vs. humid conditions, adding adjuvants to spray solutions for successful pesticide applications, etc.).
	9.6.17	Evaluate the impact of plant and flower structure on plant breeding, production, and use.
	9.6.18	Evaluate the impact of different seed and fruit structures to plant culture and use.
Topic 9.7		**Apply knowledge of plant physiology and energy conversion to plant systems.**
		Student Competencies
	9.7.1	Describe the photosynthesis pathway and its reactants and products.
	9.7.2	Explain the stages of cellular respiration including their products and reactants.
	9.7.3	Explain primary growth and the role of the apical meristem.
	9.7.4	Categorize the five groups of naturally occurring plant hormones and synthetic plant growth regulators.
	9.7.5	Compare and contrast the effects of transpiration, translocation, and assimilation on plants.
	9.7.6	Differentiate between the types of photosynthesis (e.g., c3, c4, Cam) and its stages (e.g., light dependent and light independent reactions).
	9.7.7	Analyze factors that affect the rate of cellular respiration in a given crop production setting.
	9.7.8	Analyze plant growth and the process of secondary plant growth.
	9.7.9	Analyze the plant responses to plant growth regulators and different forms of tropism.
	9.7.10	Analyze the factors affecting the rate and products of transpiration, translocation, and assimilation.
	9.7.11	Evaluate the factors that affect photosynthesis and the impact those factors have on plant management and production problems.
	9.7.12	Evaluate the impact of plant respiration on plant growth, crop management, and post-harvest handling decisions.
	9.7.13	Relate the principles of primary and secondary growth to plant systems.
	9.7.14	Recommend the use of specific plant growth regulators to produce desired responses from plants (e.g., adding PGRs to a spray solution, etc.).
	9.7.15	Recommend plant management strategies that apply knowledge of transpiration, translocation, and assimilation on plant growth.
		Propagate, culture, and harvest plants and plant products based on current industry standards.
Topic 9.8		**Demonstrate plant propagation techniques in plant system activities.**
		Student Competencies
	9.8.1	Describe pollination, cross-pollination, and self-pollination of flowering plants.

	9.8.2	Identify sowing techniques used to create favorable conditions for seed germination.
	9.8.3	Summarize optimal conditions for asexual propagation.
	9.8.4	Explain the main stages of micropropagation.
	9.8.5	Explain the principles of recombinant DNA technology and the basic steps in the process.
	9.8.6	Apply the process of plant pollination and/or fertilization.
	9.8.7	Examine factors that affect seed viability, vigor, and germination rates.
	9.8.8	Demonstrate plant propagation techniques (e.g., cuttings, division, separation, layering, budding and grafting, etc.).
	9.8.9	Examine aseptic micropropagation techniques.
	9.8.10	Compare and contrast the potential risks and advantages associated with genetically modified agricultural and ornamental plants.
	9.8.11	Justify the use of pollination methods and practices used to maximize crop pollination (e.g., honey bee, leaf cutter bee, wind, ratio of males to females planted, etc.).
	9.8.12	Conduct tests associated with seed germination rates, viability, and vigor.
	9.8.13	Evaluate asexual propagation practices comparing productivity, efficiency, and cost.
	9.8.14	Recommend micropropagation techniques in a given scenario.
	9.8.15	Evaluate the impact of using genetically modified agricultural and ornamental crops on other production practices.
Topic 9.9		**Develop and implement a management plan for plant production.**
		Student Competencies
	9.9.1	Explain the importance of starting with pest- and disease-free propagation material.
	9.9.2	Explain the reasons for preparing growing media before planting.
	9.9.3	Determine seeding rate needed for specified plant populations or desired quantity of finished plants.
	9.9.4	Describe environmental conditions during the germination, growth, and development of a crop.
	9.9.5	Explain the stages of plant growth and the methods and reasons for controlling plant growth.
	9.9.6	Describe structures and technologies used for controlled atmosphere production of plants.
	9.9.7	Describe the use of hydroponic and aquaponic systems for plant production.
	9.9.8	Inspect propagation material for evidence of pests or disease.
	9.9.9	Prepare soil and growing media for planting with the addition of amendments.
	9.9.10	Assess how pre-plant treatments are used on seeds and plants.
	9.9.11	Adjust environmental conditions based on the progress of plantings.
	9.9.12	Demonstrate proper techniques to control and manage plant growth through mechanical, cultural, or chemical means.
	9.9.13	Compare and contrast the types of technologies used for controlled atmosphere production.
	9.9.14	Compare and contrast the types of systems used in hydroponic and aquaponic plant production.
	9.9.15	Demonstrate ways to produce pest- and disease-free propagation material.
	9.9.16	Assess how mechanical planting equipment performs soil preparation and seed placement.
	9.9.17	Recommend the calibration for mechanized seeding and/or planting equipment for a desired seed application rate.

	9.9.18	Prepare a plant production schedule based on predicted environmental conditions and desired market target (e.g., having plants ready to market on a specific day such as Mother's Day, organic production, low maintenance landscape plants, etc.).
	9.9.19	Prepare plant production schedules utilizing plant growth knowledge to get plants to their optimal growth stage at a given time.
	9.9.20	Recommend technology for use in controlled atmosphere production.
	9.9.21	Recommend the use of a hydroponic or aquaponic plant system.
Topic 9.10		**Develop and implement a plan for integrated pest management for plant production.**
		Student Competencies
	9.10.1	Identify plant pests, diseases, and disorders.
	9.10.2	Diagram the life cycles of major plant pests and diseases.
	9.10.3	Describe pest control strategies associated with integrated pest management and the importance of determining economic threshold.
	9.10.4	Summarize risks and benefits associated with the materials and methods used in plant pest management.
	9.10.5	Categorize common local weeds, insect pests, fungal, viral, bacterial, and infectious and noninfectious plant diseases.
	9.10.6	Predict pest and disease problems based on environmental conditions and life cycles.
	9.10.7	Calculate pesticide formulations including organic and synthetic active ingredients and selection of pesticides to control specific pests.
	9.10.8	Apply procedures for the safe handling, use, and storage of pesticides including personal protective equipment and Restricted Entry Interval.
	9.10.9	Devise solutions for plant pests, diseases, and disorders.
	9.10.10	Design a crop scouting program.
	9.10.11	Employ pest management strategies to manage pest populations, assess the effectiveness of the plan, and adjust the plan as needed.
	9.10.12	Evaluate environmental and consumer concerns regarding pest management strategies.
Topic 9.11		**Apply principles and practices of sustainable agriculture to plant production.**
		Student Competencies
	9.11.1	Compare and contrast different production systems (conventional and organic).
	9.11.2	Describe national/international and local/regional food production systems.
	9.11.3	Explain the impacts of environmental conditions on plant production.
	9.11.4	Analyze the alignment of modern technologies used in production systems (e.g., precision agriculture, GE crops, etc.) with USDA sustainable practices criteria.
	9.11.5	Examine the environmental impacts (e.g., carbon footprint, greenhouse gas, sustainability, food security, etc.) of the national/international production system on local/regional production system markets.
	9.11.6	Examine differing research conclusions related to environmental factors and their effect on plant production.
	9.11.7	Design plans for a plant systems enterprise that aligns with USDA sustainable practices criteria.

	9.11.8	Recommend the use of nationally/internationally grown or locally/regionally grown for a production operation system.
	9.11.9	Evaluate evidence supporting claims on how environmental conditions affect plant production.
Topic 9.12	**Harvest crops according to industry standards.**	
	Student Competencies	
	9.12.1	Identify harvesting methods and equipment.
	9.12.2	Explain the reasons for calculating crop loss and or damage.
	9.12.3	Assess the stage of growth to determine crop maturity or marketability.
	9.12.4	Analyze crop yield and loss data.
	9.12.5	Demonstrate mechanical harvesting practices used to process plant crops.
	9.12.6	Recommend strategies to reduce crop loss given specific crop yield and loss data.
Topic 9.13	**Haul and store crops according to industry standards.**	
	Student Competencies	
	9.13.1	Describe how safety is ensured at each stage of harvesting, hauling, and storing.
	9.13.2	Identify plant preparation methods for storing and shipping plants and plant products.
	9.13.3	Describe the techniques used to prepare plants and plant products for distribution.
	9.13.4	Analyze practices used to maintain a safe product through harvest, processing, storage, and shipment (e.g., Food Safety Modernization Act, Good Agricultural Practices, etc.).
	9.13.5	Analyze the proper conditions required to maintain the quality of plants and plant products held in storage and during shipping.
	9.13.6	Demonstrate techniques for grading, handling, and packaging plants and plant products for distribution.
	9.13.7	Demonstrate practices that govern safe plant production, distribution, and use/consumption.
	9.13.8	Evaluate environmental conditions in storage facilities for plants and plant products.
	9.13.9	Evaluate techniques for grading, handling, and packaging plants and plant products.
Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).		
Topic 9.14	**Evaluate, identify, and prepare plants to enhance an environment.**	
	Student Competencies	
	9.14.1	Identify plants by their purpose (e.g., floral plants, landscape plants, house plants, etc.).
	9.14.2	Demonstrate proper use of plants in their environment (e.g., focal and filler plants in floriculture, heat tolerant and shade plants in a landscape design, etc.).
	9.14.3	Create a design plan by selecting plants based on design elements and environmental conditions.
Topic 9.15	**Create designs using plants.**	
	Student Competencies	
	9.15.1	Explain the applications of design in agriculture and ornamental plant systems.
	9.15.2	Classify tools used for design (e.g., computer landscape software, drawing tools, florist tools, turf management, etc.).

	9.15.3	Explain the concept of landscape ecology and summarize factors that shape the ecology of a landscape (e.g., composition, structure, function, etc.).
	9.15.4	Create an aesthetically pleasing design utilizing plants in their proper environments.
	9.15.5	Demonstrate the use of tools used for creating designs.
	9.15.6	Provide examples of ecological factors incorporated into landscape designs or turfgrass management.
	9.15.7	Propose suggestions for improvement of a design (e.g., a floral arrangement, a landscape or a landscape plan, turfgrass management, etc.).
	9.15.8	Recommend appropriate tools to create a desired design.
	9.15.9	Utilize green technologies and sustainable practices that prevent or limit negative environmental impacts.

Standard 10	*POWER, STRUCTURAL, AND TECHNICAL SYSTEMS*

Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

Topic 10.1	Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural, and technical systems.

Student Competencies

	10.1.1	Identify renewable and nonrenewable energy sources used in AFNR.
	10.1.2	Compare and contrast the distribution methods for renewable and nonrenewable energy sources in an AFNR enterprise or business.
	10.1.3	Summarize methods used to benchmark energy use of AFNR structures (e.g., EUIs, Btus, etc.).
	10.1.4	Assess the environmental impacts of renewable and nonrenewable energy sources used in AFNR.
	10.1.5	Calculate the costs of using renewable and nonrenewable energy sources in an AFNR enterprise or business.
	10.1.6	Convert energy utilized in an AFNR structure to an energy utilization index (e.g., convert cubic feet CF, Kilowatt Hours kWh, etc. to British Thermal Units Btu consumption per square foot, etc.).
	10.1.7	Evaluate the efficiency of renewable and nonrenewable energy sources used in AFNR.
	10.1.8	Devise a plan to incorporate the use of selected energy sources in an ANFR enterprise or business.
	10.1.9	Evaluate data to select methods to conserve energy in AFNR structures.

Topic 10.2	Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

Student Competencies

	10.2.1	Compare and contrast applications of simple machines in AFNR related mechanical systems.
	10.2.2	Identify the tools, machines, and equipment needed to construct, fabricate, and/or repair projects in AFNR.
	10.2.3	Identify the types of safety hazards associated with different mechanical systems used in AFNR using appropriate sources (e.g., owner's manuals, Safety Data Sheet (SDS), chemical labels, pesticide labels, safety color codes, etc.).
	10.2.4	Perform mathematical calculations to determine the mechanical advantage of simple machines in AFNR related mechanical systems.
	10.2.5	Calculate the maintenance and purchase cost of tools, machines, and equipment used in AFNR.
	10.2.6	Demonstrate the proper selection, maintenance, and use of tools (including measuring tape), machines, and equipment.
	10.2.7	Design a plan to improve the efficiency of operation of AFNR related mechanical systems.
	10.2.8	Design a process to implement the safe use of AFNR related tools, machinery, and equipment.
	10.2.9	Develop a safety plan for different AFNR related mechanical systems ensuring compliance with industry standards.

Topic 10.3	Apply physical science and engineering principles to metal fabrication using a variety of welding and cutting processes and equipment (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.).

		Student Competencies
	10.3.1	Compare and contrast the principles and procedures of different welding and cutting processes and equipment (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.).
	10.3.2	Compare and contrast the properties of different metals used in AFNR power, structural, and technical systems (e.g., malleability, conductivity, visual properties, chemical composition, etc.).
	10.3.3	Identify standard welding symbols, specifications, joint configurations, and dimensional callouts used in welding blueprints.
	10.3.4	Determine the best welding and/or cutting process to be used in metal fabrication.
	10.3.5	Select the correct consumables (e.g., electrode, welding wire, gas, etc.) and settings (e.g., amperage, wire feed speed, flow rate, etc.) for use in various welding processes.
	10.3.6	Evaluate and identify weld defects and discontinuities.
	10.3.7	Evaluate the quality of metal fabrication procedures (e.g., SMAW, GMAW, GTAW, Oxy-fuel, CNC, and plasma arc torch, etc.).
	10.3.8	Construct and/or repair structures and/or equipment safely using metal fabrication procedures.
	10.3.9	Recommend solutions to minimize and/or eliminate defects and discontinuities.
	Operate and maintain AFNR mechanical equipment and power systems.	
Topic 10.4	**Perform preventative maintenance and scheduled service to maintain equipment, machinery, and power units used in AFNR settings.**	
		Student Competencies
	10.4.1	Identify the importance of cleanliness and appearance of equipment, machinery, and power units used in AFNR power, structural and technical systems to ensure proper functionality.
	10.4.2	Identify procedures for servicing mechanical systems and maintaining fluid levels on equipment, machinery, and power units.
	10.4.3	Perform preventative maintenance for equipment, machinery, and power units used in AFNR power, structural and technical systems.
	10.4.4	Perform service procedures for mechanical systems on equipment, machinery, and power units in accordance with manufacturer's manuals.
	10.4.5	Design a plan to communicate processes and procedures (e.g., lockout/tagout (LOTO), safety harnesses, etc.) for preventative maintenance and service schedule for equipment, machinery, and power units used in AFNR power, structural and technical systems.
	10.4.6	Assess equipment according to service specifications. (e.g., belts and drives, chains, sprockets, hoses, lines, nozzles, etc.).
Topic 10.5	**Operate machinery and equipment while observing all safety precautions in AFNR settings.**	
		Student Competencies
	10.5.1	Summarize the safe use of equipment, machinery, and power units.
	10.5.2	Identify safety hazards associated with equipment, machinery and power units used in AFNR power, structural, and technical systems (e.g., caution, warning, danger, etc.).

	10.5.3	Perform pre-operation inspections, start-up, and shut-down procedures on equipment, machinery and power units as specified in manufacturer's manuals.
	10.5.4	Operate equipment, machinery, and power units using safety principles and practices.
	10.5.5	Analyze the efficiency of equipment, machinery, and power units (e.g., theoretical field capacity, actual field capacity, return on investment, etc.).
	10.5.6	Adjust equipment, machinery, and power units for safe and efficient operation.
Service and repair AFNR mechanical equipment and power systems.	
Topic 10.6	**Troubleshoot, service, and repair components of internal combustion engines using manufacturers' guidelines.**	
	Student Competencies	
	10.6.1	Identify components of internal combustion engines.
	10.6.2	Describe the characteristics of internal combustion engines.
	10.6.3	Demonstrate how the components of internal combustion engines work together during operation.
	10.6.4	Determine service and repair needs of internal combustion engines using technical manuals and diagnostic tools.
	10.6.5	Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).
	10.6.6	Repair internal combustion engines.
Topic 10.7	**Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.**	
	Student Competencies	
	10.7.1	Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm's Law, Power Law, etc.).
	10.7.2	Contrast the characteristics of electronic components (e.g., battery, resistor, diode, transistor, capacitor, etc.).
	10.7.3	Classify the uses of electrical sensors and controls.
	10.7.4	Perform the measurements of the basic units of electrical circuits (e.g., motors, controls, lighting, etc.) with the appropriate tools.
	10.7.5	Utilize electrical systems, symbols, and diagrams.
	10.7.6	Select materials and tools used in electrical control circuit installation.
	10.7.7	Design electrical circuits using knowledge of the basic units of electricity and code.
	10.7.8	Evaluate malfunctioning electrical components and systems using testing procedures and equipment service/technical manuals.
	10.7.9	Build electrical control circuits to ensure proper operation.
Topic 10.8	**Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems (e.g., hydraulic, pneumatic, transmission, steering, powertrain, suspension, etc.).**	
	Student Competencies	
	10.8.1	Summarize the applications of common types of hydraulic and pneumatic systems.
	10.8.2	Compare and contrast operation principles and features of mechanical transmission systems (e.g., belts, chains, gears, bearings, seals, universals, drive shafts, etc.).

	10.8.3	Identify the components of suspension, braking, and steering systems.
	10.8.4	Distinguish between different hydraulic and pneumatic system symbols and diagrams.
	10.8.5	Calculate efficiency in power transmission systems using speed, torque, and power measurements.
	10.8.6	Analyze vehicle and machinery performance related to suspension, braking, and steering systems.
	10.8.7	Recommend repairs to hydraulic and pneumatic system components.
	10.8.8	Recommend repairs to the components of power transmission systems.
	10.8.9	Recommend repairs to vehicle suspension, braking, and steering systems.
Plan, build and maintain AFNR structures.	
Topic 10.9	**Create plans for AFNR structures.**	
Student Competencies	
	10.9.1	Explain the meaning of symbols used in plans and designs of agricultural structures.
	10.9.2	Interpret the parts and/or views of plans for agricultural structures.
	10.9.3	Apply scale measurement and dimension to develop plans of agricultural structures.
	10.9.4	Construct plans for agricultural structures using current technology (e.g., drafting software, computer-aided design, etc.).
	10.9.5	Create designs, plans, and related bill of materials for an agricultural structure using the design process.
	10.9.6	Design functional and efficient facilities.
Topic 10.10	**Determine structural requirements, specifications, customer needs, and estimate costs for AFNR structures.**	
Student Competencies	
	10.10.1	Summarize the information needed to complete a bill of materials for an AFNR structure.
	10.10.2	Identify sources of construction and materials standards and their importance (e.g., American National Standards Institute, ANSI, Underwriters' Laboratories, UL, etc.).
	10.10.3	Analyze a project plan to prepare a bill of materials.
	10.10.4	Examine and use building code requirements for agriculture structures and those tasked with enforcing them.
	10.10.5	Create a project cost estimate, including materials and labor for an AFNR structure.
	10.10.6	Conduct a building functionality and safety assessment on an agricultural structure using knowledge of industry standards and local code.
Topic 10.11	**Apply best practices and safety guidelines for use of hand and power tools associated with constructing and maintaining AFNR structures.**	
Student Competencies	
	10.11.1	Identify tools and equipment necessary for site preparation, surveying, and site layout.
	10.11.2	Identify tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs.
	10.11.3	Select appropriate tools and equipment necessary for site preparation, surveying, and site layout.
	10.11.4	Select appropriate tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs.

	10.11.5	Utilize tools and equipment necessary for site preparation, surveying, and site layout.
	10.11.6	Utilize tools and equipment necessary for wood, metal, plumbing, concrete, electrical, fencing, insulation, and additional construction needs.
Topic 10.12		**Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, surveying, electrical, plumbing, concrete/masonry, etc.).**
		Student Competencies
	10.12.1	Examine the criteria in selecting materials for constructing, maintaining, and/or repairing AFNR structures.
	10.12.2	Summarize the characteristics needed for an appropriate building site.
	10.12.3	Contrast the characteristics of wood, masonry, and/or metal products used in AFNR structures.
	10.12.4	Compare and contrast the characteristics of materials used in plumbing and water systems (e.g., copper, PVC, PEX, etc.).
	10.12.5	Contrast the characteristics of fencing materials, including government regulations and applicable installation codes for AFNR structures.
	10.12.6	Summarize the characteristics of the components found in concrete.
	10.12.7	Contrast types of insulation materials used in AFNR structures.
	10.12.8	Analyze samples of materials and/or products for quality and efficiency of workmanship.
	10.12.9	Complete a building site analysis checklist to select an appropriate building site.
	10.12.10	Calculate costs associated with the repair and replacement of wood, masonry, and/or metal components of an AFNR structure.
	10.12.11	Calculate the cost of a water system in an AFNR structure (e.g., copper, PEX, PVC, transportation of materials to jobsite, etc.).
	10.12.12	Calculate the cost of fencing materials for AFNR structures.
	10.12.13	Calculate volume for concrete projects.
	10.12.14	Calculate heat loss (e.g., Btu) in an AFNR structure.
	10.12.15	Select materials for a project based upon an analysis of the project and the quality of the materials.
	10.12.16	Demonstrate procedures for assessing site characteristics, identifying adjustments, and preparing a building site.
	10.12.17	Construct AFNR structures using wood, masonry, and/or metal materials.
	10.12.18	Install and/or repair pipes and plumbing equipment and fixtures in AFNR structures.
	10.12.19	Construct and/or repair fencing, including wood, static wire, electrical wire, and other fencing materials for AFNR structures.
	10.12.20	Construct and/or repair AFNR structures with concrete, brick, stone, or masonry.
	10.12.21	Install properly selected insulation materials to achieve a given thermal efficiency.
Topic 10.13		**Apply electrical wiring principles in AFNR structures.**
		Student Competencies
	10.13.1	Compare and contrast direct and alternating current.
	10.13.2	Contrast electrical circuits and the components of each.

	10.13.3	Analyze the electrical requirements of an AFNR structure.
	10.13.4	Calculate the cost of operating an electrical component or load (e.g., heater, motor, etc.).
	10.13.5	Install and/or repair loads and control devices following appropriate codes and standards.
	10.13.6	Install and/or repair electrical circuits (e.g., single pole switch, three-way switch, duplex outlet, etc.).
Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.	
Topic 10.14	**Apply current and/or identify emerging technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.**	
	Student Competencies	
	10.14.1	List current and emerging technologies used to solve problems and increase efficiency in AFNR systems.
	10.14.2	Summarize the specific application of technologies used to solve problems and increase the efficiency of AFNR systems (e.g., robotics, UAS, microcontrollers, CNC, etc.).
	10.14.3	Analyze data using current and emerging technologies.
	10.14.4	Examine the change in output after using technologies in AFNR systems.
	10.14.5	Solve problems using current and emerging technologies for AFNR systems.
	10.14.6	Create recommendations for the use of technology in AFNR systems.
Topic 10.15	**Prepare and/or use electrical drawings to design, install, and troubleshoot electronic control systems in AFNR settings.**	
	Student Competencies	
	10.15.1	Identify electrical control system components used in AFNR systems (e.g., transistors, relays, HVAC, logic controllers, etc.).
	10.15.2	Contrast the purpose of electrical sensors.
	10.15.3	Summarize the importance of programmable logic controllers (PLC), microcontrollers, and/or other computer-based systems.
	10.15.4	Analyze schematic drawings for electrical control systems.
	10.15.5	Select the correct electrical sensor for a given application.
	10.15.6	Assess the functions of programmable logic controllers (PLC), microcontrollers, and other computer-based systems.
	10.15.7	Design schematic drawings for electrical control systems.
	10.15.8	Troubleshoot and install electrical sensors.
	10.15.9	Develop a plan for using programmable logic controllers (PLC), microcontrollers, and/or other computer-based systems.
Topic 10.16	**Apply geospatial principles and technologies to solve problems and increase the efficiency of AFNR systems.**	
	Student Competencies	
	10.16.1	Identify the various geospatial technologies (i.e., GPS, GIS, remote sensing, telematics, etc.) used in AFNR systems.
	10.16.2	Describe the components of precision technologies used in AFNR systems.

	10.16.3	Assess geospatial technology (i.e., GPS, GIS, remote sensing, telematics, etc.) use and applications in AFNR systems.
	10.16.4	Analyze the economic impact of utilizing precision technologies (e.g., GPS/GIS, remote sensing, etc.) in AFNR systems.
	10.16.5	Analyze and interpret data from maps utilizing geospatial technologies.
	10.16.6	Install new and troubleshoot faulty instrumentation and equipment used for precision technologies (i.e., GPS receivers, yield monitors, remote sensors, etc.).

Career Ready Practices

1.   Lead as a Contributing & Professional Employee
Career-ready individuals understand the role and responsibilities of their position and demonstrate this understanding by regularly contributing to the success of their organization. They are reliable and lead by example through work ethic and professionalism, as defined by the standards set by their workplace. This Career Ready Practice includes understanding and exhibiting the core values of their organization and modeling strong morals, motivation, excellence, and consistency.

2.   Communicate Clearly, Effectively, & with Reason
Career-ready individuals are able to communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. This Career Ready Practice includes actively listening to peers and colleagues regardless of level and ensuring that diverse perspectives are heard, considered, and fostered. Regardless of communication method, individuals understand the needs of a specific audience and are able to tailor their message or style to meet these needs. Proficiency in communication helps build strong relationships, facilitates collaboration, and ensures that information is accurately exchanged.

3.   Think Critically to Make Sense of Problems & Persevere in Solving Them
Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and effectively plan to solve the problem in an efficient way. Individuals can analyze information and evaluate various courses of action for future success. This Career Ready Practice prepares individuals to tackle complex challenges, innovate solutions, and contribute to strategic planning and operational efficiency. Individuals should also use lessons learned from previous projects to improve future projects, systems, or processes through continuous improvement.

4.   Collaborate Productively while Using Cultural & Global Competencies
Career-ready individuals are able to work effectively in diverse teams to successfully accomplish a goal in both in-person and virtual environments. This Career Ready Practice includes understanding team dynamics, respecting diverse perspectives, demonstrating empathy, and contributing positively to team outcomes. Effective collaboration leverages the strengths of team members, enhances problem-solving, and leads to innovative solutions by recognizing that each team member has something unique to contribute. Preparing to work in diverse teams ensures readiness for the collaborative nature of modern workplaces and requires recognizing biases and advocating for inclusive practices. Cultivating an inclusive environment not only enhances team dynamics but also drives innovation and reflects positively on organizational culture.

5.   Use digital Skills & Technologies to Enhance Productivity & Make Data-informed Decisions

Career-ready individuals are digitally literate—proficient with the digital skills and technology that are regularly used in their evolving workplace. This Career Ready Practice involves using digital tools to enhance productivity, understanding the impact of technology on one's work, and staying updated with technological advancements that may have future impacts for a given industry area. Individuals can use technology and digital tools to analyze and report data, helping to make decisions that are data informed and data driven. Digitally literate individuals are also able to understand digital security and privacy and are able to use social media professionally and responsibly.

6.   Remain Resilient in a Changing Workplace & World of Work

Career-ready individuals have the ability to adjust to change and remain resilient in the face of challenges, both within a workplace and throughout their careers. This Career Ready Practice involves maintaining a positive attitude despite challenges and being open to new ideas and feedback. Individuals seek to act in ways that contribute to the betterment of themselves and their teams, families, community, and workplace. Developing adaptability, flexibility, and resilience helps individuals navigate career transitions, embrace new opportunities, and maintain productivity and well-being under pressure. This Career Ready Practice also includes attending to one's own mental well-being and developing an appropriate work-life balance to sustain productivity, reduce stress, and enhance overall quality of life, which directly affects professional performance and satisfaction.

7.   Manage Time & Space Effectively

Career-ready individuals are able to effectively manage their time and use organizational skills to prioritize tasks and meet deadlines. This Career Ready Practice includes planning, delegating tasks effectively, and maintaining a well-organized workspace in both physical and virtual environments. Developing these skills leads to increased efficiency, better project outcomes, and a balanced workload.

8.   Demonstrate a Creative & Innovative Mindset

Career-ready individuals are able to use innovation and creativity to think outside the box and develop new ideas and solutions. This Career Ready Practice encourages a mindset of continuous improvement and adaptability and fosters a spirit of curiosity, experimentation, and calculated risk-taking. It prepares individuals to improve systems, drive change, create value, and stay competitive in a rapidly evolving workplace.

9.   Act as a Good Steward of Organizational & Personal Finances & Resources

Career-ready individuals are financially literate and can demonstrate their ability to make cost effective decisions on behalf of themselves and their workplace. This Career Ready Practice includes managing personal finances, understanding financial documents, and making informed financial decisions. Financial literacy empowers individuals to make sound investments, budget effectively, and contribute to the financial health of their organization.

10.   Navigate an Education & Career Path Aligned to Strengths, Work Style, Interests, & Goals
Career-ready individuals are self-aware about their strengths and working style and can understand how to leverage these traits effectively to maximize their careers. They are also aware of their areas for improvement, seeking opportunities for growth and acting on feedback to continuously improve. This Career Ready Practice is essential for setting realistic career goals, pursuing professional development opportunities, reskilling and upskilling to keep skills and knowledge relevant, and achieving personal and professional fulfillment.

11.   Consider the Environmental & Social Impacts of Decisions
Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively affect and/or mitigate negative impact on other people, their communities, and the environment. They make decisions with integrity by considering the moral and ethical consequences of their decisions and actively planning for the long-term success of projects, systems, and processes. Developing sustainability and environmental literacy skills prepares individuals to also contribute to a greener future and address global challenges.

12.   Apply appropriate academic & technical skills
Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be effective and productive employees. They have the technical proficiency to use the language, tools, technologies, and methodologies that are relevant to their specific industry sector. They make connections between abstract concepts and real-world applications, and they make correct determinations about when applying an academic skill is appropriate in a workplace situation. This Career Ready Practice includes staying updated about industry advancements and continuously improving technical skills aligned with the changing needs of their sector.