AGRISCIENCE TECHNOLOGY I

#01021

Description

Agriscience Technology courses integrate biological and technological concepts with principles of agriculture. Courses are designed in sequences to provide experiences in the subject matter. Units are selected to develop knowledge and skills pertaining to nutrition, reproduction, diseases, breeding, genetics, anatomy, and physiology in animals and plants. Genetic engineering, biotechnology, plant propagation techniques, agricultural production technologies, marketing technologies, aquaculture, animal health, and small animal care are examples of units that may be taught.

These courses integrate leadership and supervised agricultural experience programs. Career opportunities and educational preparation are examined. Learning activities are varied with classroom, laboratory and field experiences.

Note: These courses can be taught for Agricultural Education credit only.

½ to 1 credit
Max credit=1
Grades 9-12

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

Standard 3	*ANIMAL SYSTEMS*	
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.).
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.
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.
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.).
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.).
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.

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.
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.
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.
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.).
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.
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.).

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.).
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.).
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.
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.
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.).
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.
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.).
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.

Standard 4	*BIOTECHNOLOGY SYSTEMS*	
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.
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.
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).
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.
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.).
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.).
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.
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.
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.
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.).
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.
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.
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.
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.

Standard 5	***EDUCATION, COMMUNICATION, AND LEADERSHIP***	
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.
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.
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).
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.
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.
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.).
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.).
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.
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.).
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.
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.
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.

Standard 6	ENVIRONMENTAL 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.).
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.
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.).
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.
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.
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.
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.
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.).
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.
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).
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
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.
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.
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.
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.).
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., CO2 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.).

Standard 7		***FOOD PRODUCTS AND PROCESSING SYSTEMS***
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.
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.
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.
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.
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.).
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.).
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.).
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.
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.).
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.

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.).
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).
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).

Standard 8	*NATURAL RESOURCES SYSTEMS*	
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.
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.
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.
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.
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.).
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.
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.
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.
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.
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.
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.
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.
	8.12.2	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.
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.
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.
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.
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.
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.

Standard 9	*PLANT SYSTEMS*	
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.).
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.).
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.
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.).
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.).
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.
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.
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.
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.
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.
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.
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.
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.

Standard 10	***POWER, STRUCTURAL, AND TECHNICAL SYSTEMS***	
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.).
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.
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.).
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.
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.).

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.
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.