# NATURAL/ENVIRONMENTAL RESOURCES

## #01063

## Description

**This course allows students to increase awareness of the close ties among living organisms. Natural and environmental concerns with the interrelationships of living organisms and the world around us. Leadership development and supervised agricultural experience programs are also integral to this course.**

***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. |
| | 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. |
| **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. |
| **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. |
| **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. |
| **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.). |
| **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. |
| **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. |
| **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. |
| **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. |
| **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. |

| 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. |
| | 3.1.3 | Examine characteristics of animals that developed in response to environmental and production related influences. |
| | 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** | |
| | 3.2.4 | Identify wildlife management methods (e.g., depredation, invasive issues, biosecurity, habitat improvement, etc.) as they relate to animal production. |
| | 3.2.12 | Design plans to manage wildlife populations to achieve a balance of optimal ecological health and animal production. |
| **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. |
| **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*** |
|---|---|---|
| **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 4.9** | **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 4.11** | **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** | |
| | 4.12.4 | Summarize the need for global biodiversity and applications of biotechnology to reduce threats to biodiversity. |
| | 4.12.8 | Utilize techniques to measure biodiversity in a population. |
| | 4.12.12 | Evaluate whether current threats to biodiversity will have an unsustainable impact on human populations. |
| **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*** | |
|---|---|---|
| **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 5.5** | **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** | |
| | 5.6.2 | 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. |
| **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.). |

| 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.). |
| | 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. |
| **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. |
| **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. |
| **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. |
| **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., 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.). |
| | 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 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. |
| | 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. |
| **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. |
| **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. |
| | 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. |
| **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*** | |
|---|---|---|
| **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 9.5** | **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. |
| **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. |
| | 9.10.11 | 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** | |
| | 9.11.5 | 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. |
| | 9.11.9 | Evaluate evidence supporting claims on how environmental conditions affect plant production. |