

Introduction to Natural Resources and Ecology Systems

8040 36 weeks

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Acknowledgments

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Course Description

Suggested Grade Level: 9 or 10

This course serves as the introductory-level course for the Natural Resources Career Pathway. Students will explore the study of natural resources and begin to develop skills and knowledge required for employment in occupations related to forestry, wildlife and natural resources management, and conservation.

As noted in [Superintendent's Memo #058-17 \(2-28-2017\)](#), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.

Task Essentials Table

8040	Tasks/Competencies
<input checked="" type="checkbox"/>	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.
<input checked="" type="checkbox"/>	Participate in an SAE.
<input checked="" type="checkbox"/>	Identify the benefits and responsibilities of FFA membership.
<input checked="" type="checkbox"/>	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
<input type="checkbox"/>	Apply for an FFA degree and/or an agricultural proficiency award.
<input checked="" type="checkbox"/>	Define terms and key concepts related to natural resources, ecology, and environmental sciences.
<input checked="" type="checkbox"/>	Analyze influences on the agricultural industry and surrounding ecosystems.
<input type="checkbox"/>	Explain principles and processes of ecological succession.
<input type="checkbox"/>	Explain the concept of tragedy of the commons.
<input checked="" type="checkbox"/>	Describe the principles, threats, and benefits of biodiversity.
<input type="checkbox"/>	Analyze a local ecosystem.
<input checked="" type="checkbox"/>	Analyze programs of supporting organizations and partners that play a role in natural resource management.
<input checked="" type="checkbox"/>	Explain common life cycles as they relate to the environment.
<input checked="" type="checkbox"/>	Explain the safety procedures and programs associated with the outdoors.
<input checked="" type="checkbox"/>	Describe the composition of the atmosphere.
<input checked="" type="checkbox"/>	Identify air pollutants, their sources, and their impacts on the environment.
<input type="checkbox"/>	Describe current methods utilized to reduce air pollutants and improve air quality.
<input checked="" type="checkbox"/>	Describe the soil formation process and components of soil.
<input checked="" type="checkbox"/>	Evaluate soil texture and soil properties.
<input checked="" type="checkbox"/>	Demonstrate procedures for collecting soil samples and conducting soil tests.
<input checked="" type="checkbox"/>	Create soil amendment recommendations for a given crop or land use based on soil analysis results.
<input checked="" type="checkbox"/>	Examine best management practices for improving soil health.
<input checked="" type="checkbox"/>	Describe erosion, its effects on the environment, and prevention methods.

<input checked="" type="radio"/>	Conduct a water percolation test.
<input checked="" type="radio"/>	Demonstrate how to use a soil survey.
<input type="radio"/>	Describe the characteristics of water and the processes of the hydrologic cycle.
<input checked="" type="radio"/>	Explain the components of a watershed.
<input checked="" type="radio"/>	Delineate a watershed.
<input checked="" type="radio"/>	Explain the importance of wetlands to an ecosystem.
<input checked="" type="radio"/>	Explain the function and benefits of flood-control structures.
<input checked="" type="radio"/>	Explain the various methods of water treatment to meet national drinking water standards.
<input checked="" type="radio"/>	Conduct a water quality analysis on a given body of water or water sample.
<input checked="" type="radio"/>	Explain how total maximum daily load (TMDL) is calculated and its effects on watersheds.
<input checked="" type="radio"/>	Examine methods of residential and municipal waste water treatment systems.
<input checked="" type="radio"/>	Compare the major types of forests in Virginia, the U.S., and the world.
<input type="radio"/>	Analyze basic tree structure and growth.
<input checked="" type="radio"/>	Identify common trees native to Virginia.
<input checked="" type="radio"/>	Examine the major threats to forests, including biotic, abiotic, and human-induced threats and their impact on the forest.
<input checked="" type="radio"/>	Describe forest products, including those made from wood and other products from trees.
<input checked="" type="radio"/>	Demonstrate various methods of measuring standing timber.
<input checked="" type="radio"/>	Determine the value and volume of a given tract.
<input checked="" type="radio"/>	Analyze various silvicultural practices.
<input checked="" type="radio"/>	Explain safety practices used in the forest industry.
<input checked="" type="radio"/>	Analyze the benefits and risks associated with forest fires.
<input checked="" type="radio"/>	Examine classification levels within the science of taxonomy.
<input checked="" type="radio"/>	Analyze the status of wildlife populations.
<input checked="" type="radio"/>	Compare native wildlife species and their requirements.
<input checked="" type="radio"/>	Inventory wildlife species in a given area.

<input type="radio"/>	Describe the steps in establishing and managing wildlife habitats.
<input checked="" type="radio"/>	Describe fisheries in Virginia (e.g., commercial and sport fishing, farm raised fish, hatcheries).
<input checked="" type="radio"/>	Describe aquatic habitats.
<input checked="" type="radio"/>	Describe common fish and aquatic species in a given area.
<input checked="" type="radio"/>	Describe aquatic inventory/sampling methodologies.
<input checked="" type="radio"/>	Compare different forms of renewable and non-renewable energy sources.
<input checked="" type="radio"/>	Research alternative energy sources.
<input checked="" type="radio"/>	Explain the global economic impact of energy use or depletion.
<input checked="" type="radio"/>	Explain the impact of major land development on the environment and ecosystems.
<input checked="" type="radio"/>	Explain zoning classifications and the effects of zoning.
<input checked="" type="radio"/>	Design a community in which impact on the environment is kept to a minimum.
<input checked="" type="radio"/>	Interpret land-use maps.
<input checked="" type="radio"/>	Analyze a comprehensive plan for a community.
<input checked="" type="radio"/>	Describe current environmental policies/regulations.
<input checked="" type="radio"/>	Identify local, state, and federal conservation, natural resource, and environmental regulatory agencies and programs.
<input checked="" type="radio"/>	Describe water-use planning and water rights policies.

Legend: Essential Non-essential Omitted

Note: Competencies 39-43 have been added to ensure compliance with federal legislation: National FFA Organization's Federal Charter Amendments Act (Public Law 116-7, <https://www.congress.gov/116/plaws/publ7/PLAW-116publ7.pdf>). All inquiries may be sent to cte@doe.virginia.gov. Students are provided opportunities for leadership, personal growth, and career success. Instruction is delivered through three major components: classroom and laboratory instruction, supervised agricultural experience (SAE) program, and student leadership (FFA).

Curriculum Framework

Task Number 39

Identify the role of supervised agricultural experiences (SAEs) in agricultural education.

Definition

Identification should include

- defining an SAE program as *an opportunity for students to consider multiple careers and occupations in the agriculture, food, and natural resources (AFNR) industries, learn expected workplace behavior, develop specific skills within an industry, and apply academic and occupational skills in the workplace or a simulated workplace environment*
- researching the Foundational SAE
 - career exploration and planning
 - personal financial planning and management
 - workplace safety
 - employability skills for college and career readiness
 - agricultural literacy
- researching the Immersion SAE
 - entrepreneurship/ownership
 - placement/internships
 - research (experimental, analytical, invention)
 - school business enterprises
 - service learning
- developing a plan to participate in an SAE, based on personal and career goals
- researching available awards and degrees, based on SAE participation.

Teacher resource: [SAE Resources](#), National Council for Agricultural Education

Process/Skill Questions

- What are examples of SAEs related to this course and in the AFNR industries?
- Where can a copy of the Virginia SAE Record Book be found?
- What is an Immersion SAE?
- How does a placement/internship SAE differ from an ownership/entrepreneurship SAE?
- How does an SAE provide relevant work experience and contribute to the development of critical thinking skills?
- How is the SAE an extended individualized instructional component of a student's Career Plan of Study?
- How can an SAE be used to provide evidence of student growth and participation in authentic, work-related tasks?
- What are the four types of SAEs?
- What are the advantages of participating in work-based learning experiences and projects?
- How does one choose an appropriate SAE in which to participate?

Task Number 40

Participate in an SAE.

Definition

Participation should include

- developing, completing, or continuing a plan to participate in an SAE as a work-based learning experience, based on personal and career goals
- documenting experience, connections, positions held, and competencies attained, using the *Virginia SAE Record Book*
- researching available awards and degrees, based on SAE participation.

Teacher resources:

[FFA SAE](#)

[The Agricultural Experience Tracker](#)

Process/Skill Questions

- What are the advantages of participating in work-based learning experiences and projects?
- How do SAEs help prepare students for the workforce?
- What are some examples of SAEs in AFNR?

Exploring Leadership Opportunities through FFA

Task Number 41

Identify the benefits and responsibilities of FFA membership.

Definition

Identification should include

- benefits
 - listing opportunities to participate in community improvement projects and career development events (CDEs) and leadership development events (LDEs)
 - exploring leadership development opportunities
- responsibilities
 - researching the responsibilities of FFA officers, committees, and members
 - locating resources that guide participation in FFA activities
 - explaining the FFA Creed, Motto, Salute, and mission statement
 - explaining the meaning of the FFA emblem, colors, and symbols
 - explaining significant events and the history of the organization.

Process/Skill Questions

- How does one become an FFA member?
- What is the FFA's mission and how does it accomplish its mission?
- What are the benefits and responsibilities of FFA membership?
- What five FFA activities are available through the local chapter?
- What are some significant events in FFA history? How have these events shaped membership over time?
- What is the FFA program of activities (POA), and how is it used?

Task Number 42

Describe leadership characteristics and opportunities as they relate to agriculture and FFA.

Definition

Description should include

- examples of successful leaders
- types of leadership
 - autocratic
 - participative
 - laissez-faire
 - servant
 - followership
- positive leadership qualities and traits of successful leaders
- opportunities for participating in leadership activities in FFA
- demonstrating methods for conducting an effective meeting.

Process/Skill Questions

- Who are some successful leaders in the agriculture industry?
- What qualities make a successful leader?
- What are leadership traits?
- What is the difference between positive and negative leadership?

Task Number 43

Apply for an FFA degree and/or an agricultural proficiency award.

Definition

Application should include

- identifying types of FFA degrees
 - Greenhand

- Chapter
- State
- American
- identifying proficiency award areas
 - entrepreneurship
 - placement
 - combined
 - agriscience research
- exploring CDEs and LDEs related to this course
- identifying all SAE criteria to be eligible for the award
- identifying the type of award
- applying for an FFA award.

Teacher resource: [FFA Agricultural Proficiency Awards](#)

Process/Skill Questions

- Where are the awards and their application criteria located?
- What are the benefits of winning an FFA award?
- What are the benefits and requirements of an FFA degree?
- What FFA awards are available?
- How does the FFA degree program reward FFA members in all phases of leadership, skills, and occupational development?
- What is the highest degree that can be conferred upon an FFA member at the national level?
- What are the requirements for a Greenhand FFA degree?

Understanding Basic Environmental Management

Task Number 44

Define terms and key concepts related to natural resources, ecology, and environmental sciences.

Definition

Definitions may include, but are not limited to,

- abiotic and biotic factors
- adaptation
- atmosphere
- biodiversity
- biome
- carnivore
- carrying capacity

- climate
- communities
- competition
- conservation
- consumptive and non-consumptive uses
- distribution
- domestication
- dominant species
- ecology
- ecosystem
- emigration
- environment
- food web
- habitat
- herbivore
- homeostasis
- immigration
- invasive species
- minerals
- mortality
- natality
- natural resources
- niche
- non-renewable natural resources
- omnivore
- pollution
- population and population density
- predation
- preservation
- recycling
- renewable natural resources
- reusing
- selection
- species diversity
- succession
- sustainability
- terrestrial communities
- water cycle
- weather
- wildlife

Process/Skill Questions

- What is the difference between renewable and non-renewable natural resources? Give examples of each.
- What factors affect the water cycle?
- What is the difference between sustainability and viability?
- Why is biodiversity important?
- What role do recycling, reusing, and reducing play in our daily lives, and what is the effect of these life choices?

- What are the major differences between preservation and conservation, and what influence do they have on our lives today and in the future?
- What role does carrying capacity play in the environment? In agriculture production?
- What impact does an invasive species have on a native species? Immediately? Long term?
- What are the components of a food web?
- How does population density play a role in an ecosystem?
- What is the implication of natality and mortality on an ecosystem?
- What is the difference between abiotic and biotic?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

Task Number 45

Analyze influences on the agricultural industry and surrounding ecosystems.

Definition

Analysis could include local and global environmental issues such as

- public land and water use
- water, soil, and air quality
- loss of habitat (i.e., deforestation, urbanization) population growth
- watersheds (i.e., restrictions, agricultural, commercial)
- wildlife populations
- invasive species
- natural events
- energy production (include coal mining, hydraulic fracturing, and renewable energies).

Process/Skill Questions

- How is our demand for fossil fuels impacting the environment today?
- How does habitat fragmentation impact ecosystems?
- What regulations impact the use of natural resources?
- What behaviors contribute to water pollution?
- What are the major local environmental issues?
- How does hydraulic fracturing affect water quality?
- How does overpopulation affect ecosystems?
- What management responsibilities should be considered regarding these issues (e.g., loss of habitat, overpopulation, pollution, wildfires, exotic and invasive species, extreme weather conditions, recreational use of natural resources)?
- How does habitat loss affect wildlife population?

- What impact do environmental regulations have on the agricultural industry on your life today and in the future?
- What impact does water quality have on life?
- Why is protecting the watershed important?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.03. Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06. Apply ecological concepts and principles to living organisms in natural resource systems.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 46

Explain principles and processes of ecological succession.

Definition

Explanation should include

- climax stage
- disturbance
- dominant species
- pioneer species
- competitive advantage
- primary and secondary succession.

Process/Skill Questions

- What are some examples of pioneer species?
- What is a dominant species?
- Why is competition so important to the stability of an ecosystem?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.05. Apply ecology principles to environmental service systems.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 47

Explain the concept of tragedy of the commons.

Definition

Explanation should include

- definition of *tragedy of the commons*
- description of how an individual's use of natural resources impacts others and the ways that use of natural resources can be regulated
- overuse of a common resource and the impact it has on everyone else
- overgrazing
- soil erosion
- fossil fuels
- renewable and non-renewable resource usage.

Process/Skill Questions

- What are some examples of tragedy of the commons?
- How can use be regulated?
- How does the tragedy of the commons explain current challenges in the economy?
- What is the current legislation regarding conservation of the tragedy of the commons?
- What is your responsibility when using natural resources?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 48

Describe the principles, threats, and benefits of biodiversity.

Definition

Analysis should include

- definition of biodiversity
- effects of geographic location
- methods to promote and preserve biodiversity
- commercial, social, and economic benefits

- threats to biodiversity.

Process/Skill Questions

- What is biodiversity?
- How does biodiversity change as we move north or south of the equator?
- How does global latitude affect species diversity? In what ways can you manage an ecosystem to increase biodiversity?
- What creates a stable ecosystem?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.04. Apply microbiology principles to environmental service systems.

ESS.03.05. Apply ecology principles to environmental service systems.

NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

Task Number 49

Analyze a local ecosystem.

Definition

Analysis should include

- the influences of abiotic and biotic factors
- components of food web and relationships between organisms (predator, prey, commensalism, mutualism, parasitism, consumer, producer, decomposer).

Process/Skill Questions

- What is the difference between abiotic and biotic?
- What is the difference between mutualism, commensalism, predation, and parasitism?
- What impact does mutualism, commensalism, predation, and parasitism have on an ecosystem?
- How do abiotic factors impact an environment? Ecosystem?
- How do biotic factors impact an environment? Ecosystem?
- What is a keystone species?
- How do prey and predator interact?
- How does this influence the food web? How does the predator-prey relationship have an impact at the ecosystem level when all of the prey have been eliminated?
- How does the Lotka-Volterra model illustrate the impacts of the predator-prey relationship?
- How does the carrying capacity of an environment impact the predator-prey relationship?
- How do migrant species play a role in the ecosystem?

- What management choices can be made to improve the ecosystem?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.06. Apply ecological concepts and principles to living organisms in natural resource systems.

Task Number 50

Analyze programs of supporting organizations and partners that play a role in natural resource management.

Definition

Analysis should include the difference between public, private, and professional organizations (i.e., Ducks Unlimited, Society of American Foresters, The Wildlife Society, American Fisheries Society, National Audubon Society, Trout Unlimited).

Process/Skill Questions

- What is the difference between public, private, and professional organizations?
- What role do the various organizations play in managing natural resources?
- What are the impacts of the various organizations (identify positive and negative aspects)?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.02.01. Examine and interpret the purpose, enforcement, impact, and effectiveness of laws and agencies related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Task Number 51

Explain common life cycles as they relate to the environment.

Definition

Explanation should include

- nitrogen cycle
- carbon cycle
- water cycle.

Process/Skill Questions

- How does the level of carbon dioxide on the atmosphere contribute to global climate change?
- How does agriculture sequester carbon?
- How does agriculture release carbon?
- How does the nitrogen cycle impact our lives?
- How does the carbon cycle impact our lives?
- Explain the implications of the water cycle and how the cycle is impacted by our daily lives?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

NRS.01.03. Apply ecological concepts and principles to atmospheric natural resource systems.

Task Number 52

Explain the safety procedures and programs associated with the outdoors.

Definition

Explanation should include

- wild animals
- poisonous plants
- pathway obstructions and hazards
- equipment (e.g., mowers, chainsaws, trimmer/pruners, power tools)
- chemical
- waterways and boating (see [Virginia Boater Education](#)).
- hunting ([Virginia Hunter Education](#)).

Process/Skill Questions

- What are the safety procedures you should follow regarding the operation of a chainsaw? Lawn mower? Trimmer/pruner?
- Where do you find the chemical safety procedures on a container?
- What are safety data sheets (SDS)?
- How can you educate the public about wild animals that might be encountered?

- What poisonous plants and animals are commonly found in Virginia's outdoor recreation areas?
- How should pathway hazards be marked or improved?
- What chemical safety issues might arise in an outdoor recreation area?
- How can you limit your exposure to unsafe conditions in the outdoors?
- Who must complete Virginia's boater education course? Hunter education course?

Protecting the Environment

Task Number 53

Describe the composition of the atmosphere.

Definition

Description should include

- layers of the atmosphere
- gases and components that make up the atmosphere.

Process/Skill Questions

- What are the most common gases in the atmosphere?
- What are the four layers of the atmosphere?
- What is water vapor responsible for?
- Where is the concentration of gases the densest? What is ozone?
- How do chlorofluorocarbons affect the ozone layer of the Earth?
- How can you protect yourself from ultraviolet rays?
- What human activities cause ozone depletion?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.01. Apply meteorology principles to environmental service systems.

NRS.01.03. Apply ecological concepts and principles to atmospheric natural resource systems.

Task Number 54

Identify air pollutants, their sources, and their impacts on the environment.

Definition

Identification should include

- a description of the six major pollutants (e.g., ozone, SO₂, NO₂, CO, Pb, particulate matter)
- a description of the pollutants that result from combustion emissions
- methane and ruminant agriculture.

Process/Skill Questions

- What is smog?
- What is particulate matter and how does it get into the atmosphere?
- How does agriculture contribute to the amount of methane on the atmosphere?
- Which pollutants are considered to be “greenhouse gases”?
- Which pollutants result from agricultural practices?
- What are examples of natural air pollutants?
- What are other sources of air pollution?
- What is the impact of air pollution on human health?
- What can be done to reduce the amount of air pollution produced?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.03.03. Apply chemistry principles to environmental service systems.

Task Number 55

Describe current methods utilized to reduce air pollutants and improve air quality.

Definition

Description should include

- catalytic converter
- control emissions
- reusing and recycling
- building inspection
- proper maintenance of equipment
- reduction in the use of pesticides

- discontinuation of the use of aerosols
- adherence to codes and laws regarding outdoor burning.

Process/Skill Questions

- What purpose does a catalytic converter serve?
- Who enforces outdoor burning laws?
- What are alternatives to pesticide use?
- How do recycling and reusing products reduce pollution?
- What is the impact of outdoor burning?
- How can we educate the population regarding air pollution and its impact?
- How can you reduce your contribution to air pollution?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.03. Apply chemistry principles to environmental service systems.

NRS.01.03. Apply ecological concepts and principles to atmospheric natural resource systems.

Task Number 56

Describe the soil formation process and components of soil.

Definition

Description should include

- soil-forming factors (e.g., parent material, climate organisms, topography, time)
- soil origins (e.g., alluvial, marine, loess, glacial, organic deposits)
- related key terms and concepts (e.g., micronutrients, macronutrients, minerals, pore space, bedrock, humus, topsoil, weathering).

Process/Skill Questions

- How is the material content of soil determined?
- What natural processes create soil?
- How does glacial activity impact soil?
- How does the composition of soil impact the agriculture industry?
- What role do living organisms play in the soil?
- What impact does topsoil have on the production of plants?
- What is the difference between the types of deposits?
- What role does humus play in soil?
- How does the type of soil determine how it can be used?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Apply chemistry principles to environmental service systems.

ESS.03.04. Apply microbiology principles to environmental service systems.

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 57

Evaluate soil texture and soil properties.

Definition

Evaluation should include the use of the textural triangle and the field test methods.

Process/Skill Questions

- What are the soil particles/separates from smallest to largest?
- How do you use a soil texture triangle?
- How do you use the ribbon method?
- What soil separate does the ribbon method measure?
- What is the purpose of determining soil texture and soil properties?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.05.02. Perform assessments of environmental conditions using equipment, machinery and technology.

Task Number 58

Demonstrate procedures for collecting soil samples and conducting soil tests.

Definition

Demonstration should include

- ensuring equipment is free from contaminants
- choosing a random pattern of testing area
- removing soil from root depth
- ensuring the sample is free from organic debris
- mixing the sample well.

Process/Skill Questions

- Why is it important to conduct a soil test prior to planting?
- How can soil pH be changed?
- What effect does pH have on soil nutrients and plants?
- What plant species typically grow in acidic or alkaline conditions?
- Why is it important to use clean equipment?
- At what depth do you take soil samples?
- Why should organic matter be removed from soil sample?
- How do you determine the sample area?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

Task Number 59

Create soil amendment recommendations for a given crop or land use based on soil analysis results.

Definition

Recommendations should consider the chemical, physical, and biological quality of the soil tested.

Process/Skill Questions

- What results/information are given in a soil analysis?
- What is the difference between chemical, physical, and biological aspects of the soil?
- Why is lime applied to land? Sulfur?
- Why is prior knowledge of plant species important for nutrient recommendations?
- How often should you take a soil sample of your land if you want to grow vegetable crops or grazing crops?
- How does one best support biological health and diversity in soil?

- What is the impact of soil pH on plant growth?
- Why is soil biology important to soil quality?
- What are the major nutrients for plant growth?
- How can you use the information in the sample to properly manage the soil/land?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Apply chemistry principles to environmental service systems.

ESS.03.04. Apply microbiology principles to environmental service systems.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 60

Examine best management practices for improving soil health.

Definition

Examination should include

- the current state of the soil (e.g., organic matter, macronutrient and micronutrient availability)
- the planned use of the soil
- soil management practices (e.g., no-till farming, cover crops, addition of organic matter).

Process/Skill Questions

- What is organic matter?
- What positive effects does organic matter have on soil?
- What soil conservation methods are available?
- What is the estimated cost for implementing the practice in a given location?
- What are the environmental costs to not using best management practices for a given area?
- What caused the soil to be depleted?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 61

Describe erosion, its effects on the environment, and prevention methods.

Definition

Description should include

- process of erosion by water, wind, ice, or human activity
- types of water erosion (e.g., rill, sheet, gully)
- effects of erosion on agricultural production
- effects of erosion on water quality physical
- properties of soil that allow for wind erosion
- conditions that are favorable to wind erosion
- effects of wind erosion on soil
- methods to protect soil from eroding (e.g., the use of vegetation, geotextiles, mulch, retaining walls, windbreaks, cover crops, buffer strips).

Process/Skill Questions

- What effect does erosion have on production capability?
- What are the best management practices for reducing and controlling water and wind erosion?
- What is sedimentation?
- How does water erosion affect the environment?
- How does wind erosion affect the environment?
- What is accelerated erosion?
- What are the more significant anthropogenic causes of erosion?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 62

Conduct a water percolation test.

Definition

Test should include

- definition of *water percolation*

- use of a procedure to determine a quality percolation rate
- analysis of the results of a percolation test.

Process/Skill Questions

- What does water percolation determine?
- What time span indicates adequate water percolation?
- What types of soils typically indicate good water percolation?
- What impact does water percolation have on agriculture production and ecosystems?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

Task Number 63

Demonstrate how to use a soil survey.

Definition

Demonstration should include use of maps, tables, and information included in a local soil survey.

Process/Skill Questions

- What information is included in a soil survey?
- What are soil surveys commonly used to determine?
- Where can one find soil surveys?
- What are the limits to a soil survey?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 64

Describe the characteristics of water and the processes of the hydrologic cycle.

Definition

Description should include

- major properties and characteristics of water
- groundwater and surface water interactions
- major characteristics of the hydrologic cycle
- how the properties of water affect the hydrologic cycle.

Process/Skill Questions

- What elements make up water?
- What characteristics of water are made possible by hydrogen bonding?
- What are the sources of water? How do we use these sources?
- What is the relationship of water and land?
- What are several ways water gets into the atmosphere?
- How is the hydrologic cycle affected by the physical properties of water?
- How do the properties of water affect the hydrologic cycle?
- What role does groundwater play in our daily lives?
- How does surface water interact?
- How is the hydrological cycle related to water storage?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

Task Number 65

Explain the components of a watershed.

Definition

Explanation should include

- definition of a watershed
- identification of local watershed/watersheds in Virginia
- identification of the components of a watershed (e.g., physiography, climate, hydrology, ecological resources, land alterations, sources).

Process/Skill Questions

- What happens to precipitation when it falls on land?
- What are some characteristics of a healthy watershed?
- What are some factors that affect water infiltration?
- What role does agriculture play in a watershed?

- What is your impact on a watershed?
- What is the effect of watershed characteristics on the environment?
- What implications can a watershed have on human health?
- How can we improve a watershed?
- How can others be educated about improving a watershed?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Task Number 66

Delineate a watershed.

Definition

Delineation should include

- interpreting a topographic map to identify features of a watershed
- identifying the outlet or downstream point of a watershed, headwaters, or watercourse
- determining a watershed boundary.

Process/Skill Questions

- What are the implications from runoff on a watershed?
- What is a contour interval?
- How do contours relate to water flow?
- How do humans and human-built ecosystems impact or influence a watershed?
- Why is it important to delineate a watershed?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Task Number 67

Explain the importance of wetlands to an ecosystem.

Definition

Explanation should include

- definition of a *wetland*
- types of wetlands (e.g., marshes, swamps, bogs, fens)
- characteristics of a wetland (e.g., vegetation, soils, hydrology)
- benefits of wetlands (e.g., water control and quality, habitat, recreation).

Process/Skill Questions

- What is the difference between man-made wetlands and wetlands that occur naturally?
- What is the role in the ecosystem of the area?
- What management strategies are used to preserve wetlands?
- What is the role of a wetland in regard to wildlife and agriculture?
- Identify major concerns/hazards/issues regarding wetlands?
- How could you defend the preservation of wetlands?
- What are the differences between the various types of wetlands?
- What are three benefits of wetlands?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Task Number 68

Explain the function and benefits of flood-control structures.

Definition

Explanation should include

- the need for flood controls
- the ways that floods can be controlled (e.g., dam, levee, floodplain)
- how flood-control structures function using the physical properties of water.

Process/Skill Questions

- What are the benefits and consequences of flooding to an ecosystem?
- What have been some advantages and disadvantages of flood-control structures?
- How can the properties of water be manipulated to control an area from flooding?
- What strategies need to be employed to protect areas that are prone to flooding?

Task Number 69

Explain the various methods of water treatment to meet national drinking water standards.

Definition

Explanation should include

- boiling
- chemical disinfection
- ultraviolet light
- carbon filtration
- reverse osmosis
- distillation.

Process/Skill Questions

- What are the benefits from water treatment?
- What contaminants can be removed from the use of each water-treatment method?
- What is the water quality standard for water treatment?
- What process(es) does your local water-treatment facility use?
- How can water be made potable in the field?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.04.03. Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.05.02. Perform assessments of environmental conditions using equipment, machinery and technology.

Task Number 70

Conduct a water quality analysis on a given body of water or water sample.

Definition

Analysis of water quality should include, but not limited to, testing water for

- chemical sampling (e.g., pH, nutrients, dissolved oxygen)
- physical sampling (e.g., temperature, clarity, biological indicators).

Process/Skill Questions

- What types of water pollutants are monitored?
- How are these pollutants identified?
- What are some ways to monitor water pollutants?
- How can macroinvertebrates help determine the health of a waterway?
- Why does “chemical” analysis of a water sample only provide a snapshot of water quality?
- What is the impact of poor water quality?
- What is the impact of good water quality?
- How does temperature affect dissolved oxygen levels?
- What equipment is needed to test water quality?
- How can excess nutrient harm a waterway?
- Why is it important to know the quality of water?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.05.02. Perform assessments of environmental conditions using equipment, machinery and technology.

Task Number 71

Explain how total maximum daily load (TMDL) is calculated and its effects on watersheds.

Definition

Explanation should include

- defining *TMDL*, *point*, and *non-point source pollution*
- identifying sources of point and non-point source pollution
- identifying the effects of pollutants (e.g., nutrients, sediment) on a body of water and aquatic life
- defining *eutrophication*.

Process/Skill Questions

- What is the difference between point source and non-point source pollution?
- What is TMDL, and what does it mean?
- How is TMDL calculated?
- How does eutrophication negatively impact the ecosystem?
- Why were TMDLs imposed?
- What impact do pollutants have on aquatic life? On the environment?
- What state agency oversees TMDLs?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.04.01. Use pollution control measures to maintain a safe facility and environment.

ESS.05.01. Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

Task Number 72

Examine methods of residential and municipal waste water treatment systems.

Definition

Examination should include

- septic systems
- drain fields
- municipal systems
- gray water disposal.

Process/Skill Questions

- What method is your town/city using?
- What is the purpose of waste water treatment?
- What is considered when selecting a water treatment system?
- What types of residential waste water treatments are there?
- What type of filtration methods are used?
- How is the location of the treatment system chosen?
- How would soil type affect the location?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.04. Apply microbiology principles to environmental service systems.

ESS.04.03. Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

Managing Forest Resources

Task Number 73

Compare the major types of forests in Virginia, the U.S., and the world.

Definition

Comparison should include the characteristics of tropical, temperate, and boreal forests.

Process/Skill Questions

- Where are the types of forests located in the world?
- How are the forests distinctly different in terms of vegetation? Growth? Use?
- What characteristics are used to determine the types of forests?
- What are the major differences between the types of forests?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

Task Number 74

Analyze basic tree structure and growth.

Definition

Analysis of structure and growth processes should include

- parts of the tree and their functions (e.g., trunk, branch, crown, leaves, bark, roots, seeds, flowers, cones).
- growth processes (e.g., photosynthesis, respiration, nutrient and water movement throughout the tree).

Process/Skill Questions

- How does a tree transport water and nutrients to all its parts?
- How does a tree grow in diameter? Height?
- What is heartwood, and what is its purpose?
- What are some influencing factors that affect tree growth?
- What are the products and reactants of photosynthesis? Respiration?
- What is the purpose of sapwood?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.

Task Number 75

Identify common trees native to Virginia.

Definition

Identification should include all tree species native to Virginia according to bark, leaf shape and formation, and fruit.

Process/Skill Questions

- What are the ways tree species can be identified?
- What are the three common branch arrangements?
- What is the difference between simple, compound, and bipinnately compound leaves?
- What are the different types of margins on leaves?
- What are three families of trees native to Virginia?
- What 15 native trees are around your school/area?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

PS.02.01. Classify plants according to taxonomic systems.

Task Number 76

Examine the major threats to forests, including biotic, abiotic, and human-induced threats and their impact on the forest.

Definition

Examination should include

- common forest diseases
- invasive species
- insects
- urbanization
- environmental pollutants.

Process/Skill Questions

- How do tree diseases (hardwoods and softwoods) affect forestry practices from forest, to factory, to sales?
- What is an invasive species?
- What invasive species pose a threat to Virginia forests?
- What impact do invasive species have on the forestry industry?
- What are some biological and chemical control methods for forest insects?
- How do pollutants impact tree growth? Give specific examples.
- How has urbanization affected forestry health?
- What factors make forests more susceptible to invasive species?
- How can invasive species change the makeup of a forest?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.04.03. Prevent or manage introduction of ecologically harmful species in a particular region.

Task Number 77

Describe forest products, including those made from wood and other products from trees.

Definition

Description should include the following products:

- Wood
- Bark
- Cellulose
- Sap (gums and resins)
- Fruit
- Leaves

- Seed

Process/Skill Questions

- What products are made from the various parts of the tree?
- How does the tree species determine the product produced? Give examples of specific products and the tree species used to make them.
- How is a log sawed into lumber?
- How many different products can you obtain from trees?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 78

Demonstrate various methods of measuring standing timber.

Definition

Demonstration may include the use of the following equipment:

- Biltmore stick
- Calipers
- Diameter tape
- Clinometers

Process/Skill Questions

- What is pacing and how is it used in measuring volume?
- What is diameter at breast height (DBH)? What is the standard height, and why is it important?
- What is the distance of a chain?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

Task Number 79

Determine the value and volume of a given tract.

Definition

Determination of the value and volume of a given tract may include, but is not limited to,

- knowing the area of the tract of forest
- identifying and finding the volume of each tree
- adding the volume of all the softwood and hardwood trees separately within a given tract
- measuring land area
- calculating the worth of a given land area based on given values.

Process/Skill Questions

- What are the tools used to measure the volume of standing timber?
- What are the species and the volume of each standing tree?
- What are some sampling and measuring practices that can influence the accuracy of a partial timber cruise?
- How can topography affect your measurements?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 80

Analyze various silvicultural practices.

Definition

Analysis should include, but not limited to, the following:

- Harvesting techniques
- Regeneration methods
- Site preparation
- Necessary equipment for forest operations
- Recommended Best Management Practices (BMPs)

Process/Skill Questions

- What is silviculture?
- What are some silviculture practices that improve forest production?
- What are some factors that determine which harvesting method is used?
- Where and why is each method used?

- What equipment is needed for each method of harvesting trees?
- How is artificial regeneration of a forest different from natural regeneration?
- What are a tree's stages of growth from planting to harvesting?
- How does the final use of a tree affect the method that is used to harvest it?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.05. Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Task Number 81

Explain safety practices used in the forest industry.

Definition

Explanation should include the importance of wearing proper personal protective equipment, using each piece of equipment as intended, following operating procedures, and following Occupational Safety and Health Administration (OSHA) guidelines.

Process/Skill Questions

- What personal protective equipment should be worn while working with and/or handling tree equipment?
- What are some examples of safety measures that should be taken when operating tree equipment?
- What is the main purpose of OSHA?
- What is the proper procedure for operating tree equipment?
- What continuing education or certification programs are available in Virginia?

Task Number 82

Analyze the benefits and risks associated with forest fires.

Definition

Analysis should include

- the benefits of a controlled burn
- forest fire prevention methods and programs

- forest fire suppression tools and techniques
- concepts associated with the fire triangle.

Process/Skill Questions

- When should a prescribed fire be used?
- What is the purpose of a prescribed fire? What is the difference between fire prevention and fire suppression?
- What are some examples of fire prevention techniques? Fire suppression techniques?
- What agencies oversee fire prevention/suppression?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.04.04. Manage fires in natural resource systems.

Managing Wildlife Resources

Task Number 83

Examine classification levels within the science of taxonomy.

Definition

Examination should include

- the purpose of classification
- an understanding of each division
- the ability to classify organisms.

Process/Skill Questions

- What is a hierarchical structure?
- What are the different classification levels in the science of taxonomy?
- Why does the classification of animals determine how different animals live in their environments?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.01. Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

Task Number 84

Analyze the status of wildlife populations.

Definition

Analysis should include determining whether wildlife species

- are endangered
- are extinct
- are threatened
- have been extirpated
- have reintroduction capability
- have been impacted by invasive species.

Process/Skill Questions

- What is the difference between extinct, endangered, and threatened species of wildlife?
- What is the impact of an animal going extinct?
- What species of animals in Virginia are on the endangered or threatened list?
- What animals have become extinct in Virginia?
- How is extirpated and extinct different?
- What are common invasive wildlife species in Virginia?
- How do invasive species affect wildlife populations and ecosystems?
- What are ways to control invasive species in an ecosystem?
- What is required to reintroduce a species?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing, and evaluating natural resource management plans.

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Task Number 85

Compare native wildlife species and their requirements.

Definition

Comparison should include differences in habitat, food, appearance, and lifestyle of amphibians, fish, reptiles, mammals, and birds.

Process/Skill Questions

- What are the habitat requirements of wildlife?
- What factors contribute to the reduction of animal populations?
- What are the physical characteristics of different species?
- How does that reflect where and how they live? What they eat?
- How do humans effect animal populations?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing, and evaluating natural resource management plans.

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Task Number 86

Inventory wildlife species in a given area.

Definition

Inventory should include a scientific observation based on the species' life history to obtain an accurate count.

Process/Skill Questions

- What is the species' life history (e.g., description, geographic distribution, habitat, reproduction and growth, patterns in activity, behavior, stressors)?
- What quantifiable method (e.g., observation, counting) of monitoring a species can be used?
- Why is a sampling design an important part of data collection?
- How do human factors affect wildlife populations?
- Why is monitoring wildlife populations important?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

Task Number 87

Describe the steps in establishing and managing wildlife habitats.

Definition

Description should include

- identifying the target population
- identifying survival requirements and sources (e.g., food, water, cover, and a place to rear young)
- management techniques for sustained survival and population growth.

Process/Skill Questions

- What is a target population?
- What are the survival requirements for the target population?
- What are the food and water requirements of the selected wildlife species?
- What type of cover/nesting area does the wildlife species require?
- How was the wildlife habitat established? What are the initial population numbers found in the wildlife habitat?
- What are the basic needs of wildlife?
- What are the different types of wildlife habitats?
- What benefits do wildlife habitats provide humans?
- How can understanding key influences/laws shape the management and harvesting of wildlife species?
- How can maximum sustained yield, optimum yield, and adaptive resource management be used to manage and harvest wildlife species? What are their advantages and disadvantages?
- What are key limitations and concerns with regard to reintroduction or relocation projects as a management tool?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

NRS.04.02. Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

Managing Fisheries Resources

Task Number 88

Describe fisheries in Virginia (e.g., commercial and sport fishing, farm raised fish, hatcheries).

Definition

Description should include

- aquaculture
- warm and cool water fisheries
- commercial fishing laws
- sport fishing regulations.

Process/Skill Questions

- What is aquaculture?
- How do fishing regulations protect the fish population?
- How do farm-raised fish vary from wild populations?
- How does a hatchery or a fish farm determine what fish to raise?
- How does location of a hatchery or fish farm determine the type of fish raised?
- What controversies exist in terms of commercial fishing?
- What role do fisheries play in Virginia's economy?
- What role does aquaculture play in the economy?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.01. Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

NRS.02.01. Examine and interpret the purpose, enforcement, impact, and effectiveness of laws and agencies related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 89

Describe aquatic habitats.

Definition

Description should include

- marshes
- wetlands
- tidal flats
- streams and rivers
- lakes and ponds
- oceans
- vernal pools.

Process/Skill Questions

- What is the difference between a marsh and wetland?
- What aquatic life will you find in each habitat?
- How do environmental issues affect aquatic habitats?
- What effect does acid rain have on aquatic habitats/species?
- What is the correlation between freshwater mussels and water quality?
- How are freshwater mussels dependent on fish?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Task Number 90

Describe common fish and aquatic species in a given area.

Definition

Description should include

- characteristics
- locations
- habitats
- feeding patterns
- spawning/mating patterns
- aquatic species (i.e., amphibians, bivalves, benthic macroinvertebrates, shellfish).

Process/Skill Questions

- How does temperature correlate to the species present?
- What effect does water quality have on the population?
- What man-made entities exist to benefit a species in a given area?
- How does pollution correlate to the presence/absence of a species?
- What role do macroinvertebrates play in the aquatic habitat? On the fish population? And other aquatic species?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Task Number 91

Describe aquatic inventory/sampling methodologies.

Definition

Description should include

- information about the length, weight, age, and sex/maturity of fish
- techniques for fish preservation
- the use of a seine net for aquatic sampling
- comparisons of various methods of aquatic sampling
- examination of the Virginia Save Our Streams methods (e.g., pollution tolerant, somewhat pollution tolerant, and pollution intolerant benthic macroinvertebrates)
- water quality measures (e.g., pH, dissolved oxygen, alkalinity, nitrates, nitrites).

Process/Skill Questions

- Why is inventory sampling important?
- What are the similarities and differences between passive and active methods of collection?
- How are unwanted fish removed from an area?
- How can fisheries be affected by forestry?
- Why are benthic macroinvertebrates an indicator of water quality? How do fish species correlate to benthic macroinvertebrates?
- How do turbidity and algae affect the fish population?
- Why is determining water quality important?
- Why should you use both chemical and benthic macroinvertebrates together to determine water quality?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

NRS.01.02. Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

NRS.01.04. Apply ecological concepts and principles to aquatic natural resource systems.

Exploring Energy Resources and Consumption

Task Number 92

Compare different forms of renewable and non-renewable energy sources.

Definition

Comparison of renewable and non-renewable sources should include

- fossil fuels (i.e., coal, oil, natural gas)
- nuclear power
- solar power
- hydroelectric power
- hydrokinetic power
- wind power
- geothermal.

Process/Skill Questions

- What are the advantages and disadvantages of using coal?
- Why are liquid fuels more advantageous than coal or wood?
- What are the potential environmental consequences of locating, extracting, transporting, and burning petroleum?
- What negative effects does natural gas have on the environment?
- What are the advantages and disadvantages of using nuclear power?
- Why may the use of solar power be limited in some areas?
- What are the positive and negative aspects of using hydroelectric power?
- What are the methods of obtaining hydrokinetic power?
- What are the negative effects that wind power can have on the environment?
- How can agriculture benefit from wind power?
- What are the positive and negative effects of geothermal power?

- What is the difference between renewable and non-renewable resources?
- What are examples of non-renewable resources? Renewable?
- How can the dependence on non-renewable resources be shifted to renewable energy sources?
- What are the reasons for reliance on non-renewable sources?
- What is the implication on our society when non-renewable resources are exhausted?
- What will replace the resources when they are exhausted?
- What role do renewable resources play in our energy future?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 93

Research alternative energy sources.

Definition

Research should include various energy sources such as the following:

- Biofuel (biodiesel, ethanol)
- Biopower
- Hydrogen
- Natural gas
- Nuclear power
- Methanol
- Wood
- Gasoline
- Geothermal energy
- Solar energy
- Atomic energy
- Wind energy

- Hydropower
- Methane

Process/Skill Questions

- What are the advantages of using alternative energy sources? Disadvantages?
- What are the concerns about using biofuels?
- What are the advantages of biofuels?
- What agricultural crops can be used for biofuels?
- How can waste from the animal industry be used for fuel?
- How can biomass be used as an energy source?
- How is ethanol produced?
- What effect does biofuel production have on food and feed supplies?
- What are some of the factors that should be considered when deciding which alternative fuel is the best?
- What are the advantages of using alternative energy sources rather than traditional sources such as fossil fuels?
- How can solar energy be used as an alternative energy source?
- How does a nuclear power plant operate?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Task Number 94

Explain the global economic impact of energy use or depletion.

Definition

Explanation should include

- the impacts of different forms of energy (e.g., wind, solar, fossil fuels, natural gas, geothermal) according to geographic regions
- the impact of carbon emissions on the environment
- the impact of energy conservation strategies.

Process/Skill Questions

- What will be the impacts on the global economy if non-renewable resources are depleted?
- What challenges exist in adopting new energy technologies? What is the current breakdown for energy consumption? Non-renewable fuels vs. renewable fuels?
- What are the largest consumers of energy?
- How can the agriculture industry reduce its demand for energy?
- How can individuals reduce energy consumption?
- How can we as a nation reduce our consumption of energy?
- What are the implications if an energy shortage occurs?
- How can we shift our energy consumption to renewable sources?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

ESS.05.01. Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.03.01. Sustainably produce, harvest, process, and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

Examining Land Use

Task Number 95

Explain the impact of major land development on the environment and ecosystems.

Definition

Explanation should include how land used for agriculture, industry, and commercial development impacts the environment and ecosystems in terms of sedimentation, nutrient load, air quality, plant life, wildlife, aquatic plant life, animal, macroinvertebrates, and fisheries.

Process/Skill Questions

- What is the impact of sedimentation?
- What steps are currently taken by land developers to limit impacts on the environment? How effective are these steps?
- How have agricultural practices evolved to lessen impact on the environment?
- What types of development are most detrimental to the environment and ecosystems?
- What ways can the impacts of development be mitigated effectively?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.01. Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.02.03. Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Analyze how modern perceptions of natural resource management, protection, enhancement, and improvement change and develop over time.

NRS.02.04. Examine and explain how economics affects the use of natural resources.

NRS.02.05. Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

Task Number 96

Explain zoning classifications and the effects of zoning.

Definition

Explanation should include the restrictions and allowances for the following classifications:

- Commercial
- Industrial
- Multi-family residential
- Residential commercial
- Single-family residential
- Agriculture
- Public land

Process/Skill Questions

- How do the zoning classifications differ?
- Why does each zoning classification have restrictions?
- What is the purpose of each zoning classification?
- What are the processes for zoning reclassifications?
- How does zoning impact your life?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.01. Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.02.03. Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

Task Number 97

Design a community in which impact on the environment is kept to a minimum.

Definition

Design should include clean, efficient, and sustainable uses of water, energy, buildings, roadways, waste disposal, and buffer and riparian zones to keep environmental impact to a minimum.

Process/Skill Questions

- What are the limitations of the land (e.g., water, topography, and distance from major cities)?
- What technologies can be used to aid in designing a community that will have a minimum impact on the environment?

- What are some examples of environmentally friendly development?
- How can urban best management practices (direct and indirect) be implemented to decrease storm water runoff and increase groundwater recharge?
- What techniques can be used to decrease the amount of energy used, and what alternative methods can be employed?
- What is the rationale of keeping environmental impacts to a minimum?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.03.01. Apply meteorology principles to environmental service systems.

ESS.04.01. Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Manage safe disposal of all categories of solid waste in environmental service systems.

ESS.04.03. Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.04.04. Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

Task Number 98

Interpret land-use maps.

Definition

Interpretation should include

- identifying the scale and measuring distances
- determining resolution
- recognizing topographic features
- identifying different types of soil
- identifying different types of land cover
- identifying other distinguishing features, such as bodies of water.

Process/Skill Questions

- Why are scale, resolution, and coordinate systems important? What do they tell the viewer?
- Why are topography, soil type, and land cover important on land-use maps? What do they tell the viewer?

- How can land-use maps aid farmers? Homeowners? Developers? Land-use planners? Government agencies?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

ESS.05.01. Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

NRS.03.02. Demonstrate cartographic skills, tools, and technologies to aid in developing, implementing, and evaluating natural resource management plans.

Task Number 99

Analyze a comprehensive plan for a community.

Definition

Analysis should include reading a plan to determine the goals for the community in regard to

- agricultural land
- town/city area
- open spaces
- water resources
- historical and conservation easements
- capital improvements
- transportation.

Process/Skill Questions

- What does the comprehensive plan outline?
- How will the plan affect the environment in terms of growth, regulations, and available resources?
- What could be done to improve the comprehensive plan?
- How often is the comprehensive plan updated? Does this correspond with the community's long-term planning goals?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.03.02. Apply soil science and hydrology principles to environmental service systems.

ESS.04.01. Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Manage safe disposal of all categories of solid waste in environmental service systems.

Exploring Government Policies, Agencies, and Regulations

Task Number 100

Describe current environmental policies/regulations.

Definition

Description should include the following laws

- Clean Water Act
- Safe Water Drinking Act
- Water Quality Act
- Chesapeake Bay TMDL
- Agricultural Stewardship Act
- National Environmental Policy Act
- Other local and state regulations that apply (will vary by area)

Process/Skill Questions

- What is the difference between a law and a regulation?
- What led to the creation of each law?
- How was the environment impacted prior to the creation of each law?
- What is the main purpose of each law (including any amendments)?
- How has each law improved water quality?
- How has each law affected (positively and negatively) land uses (e.g., agriculture, industry, residential)?
- What agency (or agencies) are responsible for administering and enforcing each law?
- What are the penalties for violating each law?
- What Virginia laws are enforced in your area?
- How do these laws impact agricultural production?
- Why is enforcing these laws important to agriculture?
- How has each law improved air quality?

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

NRS.02.01. Examine and interpret the purpose, enforcement, impact, and effectiveness of laws and agencies related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

Task Number 101

Identify local, state, and federal conservation, natural resource, and environmental regulatory agencies and programs.

Definition

Identification should include the main programs offered by the following local, state, and federal conservation agencies:

- Soil and Water Conservation Districts
- Virginia Department of Conservation and Recreation
- Virginia Department of Forestry
- Virginia Department of Game and Inland Fisheries
- Virginia Department of Environmental Quality
- Virginia Marine Resources Commission
- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency (EPA)
- U.S. Department of Agriculture (USDA)
- Natural Resources Conservation Services (NRCS)

Process/Skill Questions

- What is the primary purpose of the agencies mentioned?
- How does each division function?
- What role does each organization play?
- What major programs are offered by soil and water conservation districts, and how do these programs improve natural resources?
- How do local, state, and federal agencies manage wildlife and wildlife harvesting activities?
- What are the purposes of state and national parks and forests?
- How do local, state, and federal conservation agencies work together to improve the environment?
- How can private landowners contribute to conservation efforts?
- How can agricultural producers contribute to conservation efforts?
- What activities does the law address?
- Who enforces the Virginia Erosion and Sediment Control laws, regulations, and certification regulations?
- What are common practices outlined in the Virginia Erosion and Sediment Control law that will help prevent soil erosion problems? When are these practices implemented?

- What are the penalties for violating the Virginia Erosion and Sediment Control laws, regulations, and certification regulations?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.02.02. Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

NRS.02.02. Assess the impact of human activities on the availability of natural resources.

Task Number 102

Describe water-use planning and water rights policies.

Definition

Description should include a definition of *water-use planning*, examples of situations in which a water-use plan would be used, and guidelines for developing a water-use plan.

Process/Skill Questions

- What is the purpose of a water-use plan?
- How can a community become involved in a water-use plan?

The National Council for Agricultural Education: Agriculture, Food and Natural Resources Content Standards

ESS.04.01. Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Manage safe disposal of all categories of solid waste in environmental service systems.

NRS.04.01. Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

SOL Correlation by Task

39	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.	English: 9.3, 9.5, 10.3, 10.5
40	Participate in an SAE.	English: 9.5, 9.8, 10.5, 10.8
41	Identify the benefits and responsibilities of FFA membership.	English: 9.5, 9.6, 9.7, 9.8, 10.5, 10.6, 10.7, 10.8

42	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.	English: 9.5, 10.5 History and Social Science: VUS.8, VUS.9, VUS.10, VUS.11, WHII.8, WHII.10, WHII.11
43	Apply for an FFA degree and/or an agricultural proficiency award.	English: 9.5, 10.5
44	Define terms and key concepts related to natural resources, ecology, and environmental sciences.	English: 9.3, 10.3 History and Social Science: WG.2
45	Analyze influences on the agricultural industry and surrounding ecosystems.	English: 9.5, 10.5 Science: ES.6b
46	Explain principles and processes of ecological succession.	English: 9.3, 9.5, 10.3, 10.5 Science: BIO.8a, BIO.8c
47	Explain the concept of tragedy of the commons.	English: 9.3, 9.5, 10.3, 10.5 History and Social Science: WG.2, WG.4 Science: ES.6
48	Describe the principles, threats, and benefits of biodiversity.	English: 9.3, 9.5, 10.3, 10.5 Science: BIO.8
49	Analyze a local ecosystem.	English: 9.5, 10.5 Science: BIO.8
50	Analyze programs of supporting organizations and partners that play a role in natural resource management.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: GOVT.1, GOVT.15
51	Explain common life cycles as they relate to the environment.	English: 9.5, 9.8, 10.5, 10.8 Science: BIO.8b
52	Explain the safety procedures and programs associated with the outdoors.	English: 9.5, 9.8, 10.5, 10.8
53	Describe the composition of the atmosphere.	
54	Identify air pollutants, their sources, and their impacts on the environment.	Science: ES.6d, ES.11d
55	Describe current methods utilized to reduce air pollutants and improve air quality.	English: 9.5, 10.5
56	Describe the soil formation process and components of soil.	English: 9.5, 10.5 Science: ES.8a
57	Evaluate soil texture and soil properties.	
58	Demonstrate procedures for collecting soil samples and conducting soil tests.	
59	Create soil amendment recommendations for a given crop or land use based on soil analysis results.	

60	Examine best management practices for improving soil health.	
61	Describe erosion, its effects on the environment, and prevention methods.	English: 9.5, 10.5 Science: ES.8e
62	Conduct a water percolation test.	Science: ES.8e
63	Demonstrate how to use a soil survey.	
64	Describe the characteristics of water and the processes of the hydrologic cycle.	English: 9.5, 10.5 Science: ES.8d
65	Explain the components of a watershed.	English: 9.3, 9.5, 10.3, 10.5
66	Delineate a watershed.	
67	Explain the importance of wetlands to an ecosystem.	English: 9.3, 9.5, 10.3, 10.5
68	Explain the function and benefits of flood-control structures.	English: 9.5, 10.5
69	Explain the various methods of water treatment to meet national drinking water standards.	English: 9.5, 10.5
70	Conduct a water quality analysis on a given body of water or water sample.	Science: BIO.1h, BIO.1i, BIO.2a, CH.1e, CH.1h
71	Explain how total maximum daily load (TMDL) is calculated and its effects on watersheds.	English: 9.3, 9.5, 10.3, 10.5 Science: BIO.8d, ES.10d
72	Examine methods of residential and municipal waste water treatment systems.	English: 9.5, 10.5
73	Compare the major types of forests in Virginia, the U.S., and the world.	History and Social Science: WG.5 Science: BIO.8e
74	Analyze basic tree structure and growth.	Science: BIO.2d
75	Identify common trees native to Virginia.	English: 9.3, 9.5, 10.3, 10.5 Science: BIO.8e
76	Examine the major threats to forests, including biotic, abiotic, and human-induced threats and their impact on the forest.	Science: BIO.8d
77	Describe forest products, including those made from wood and other products from trees.	English: 9.5, 10.5
78	Demonstrate various methods of measuring standing timber.	
79	Determine the value and volume of a given tract.	
80	Analyze various silvicultural practices.	Science: BIO.8d
81	Explain safety practices used in the forest industry.	English: 9.5, 9.8, 10.5, 10.8
82	Analyze the benefits and risks associated with forest fires.	Science: BIO.8d
83	Examine classification levels within the science of taxonomy.	Science: BIO.6
84	Analyze the status of wildlife populations.	Science: BIO.8a, BIO.8d
85	Compare native wildlife species and their requirements.	
86	Inventory wildlife species in a given area.	
87	Describe the steps in establishing and managing wildlife habitats.	English: 9.5, 10.5

88	Describe fisheries in Virginia (e.g., commercial and sport fishing, farm raised fish, hatcheries).	English: 9.5, 10.5
89	Describe aquatic habitats.	English: 9.5, 10.5
90	Describe common fish and aquatic species in a given area.	English: 9.5, 10.5 Science: BIO.8e
91	Describe aquatic inventory/sampling methodologies.	English: 9.5, 10.5 Science: BIO.1a, BIO.1h, BIO.1i, BIO.1m, ES.6c
92	Compare different forms of renewable and non-renewable energy sources.	Science: ES.6
93	Research alternative energy sources.	English: 9.5, 9.8, 10.5, 10.8 Science: ES.6
94	Explain the global economic impact of energy use or depletion.	English: 9.5, 10.5 Science: ES.6d
95	Explain the impact of major land development on the environment and ecosystems.	English: 9.5, 10.5 History and Social Science: WG.2 Science: ES.6c, ES.6d, ES.7b
96	Explain zoning classifications and the effects of zoning.	English: 9.5, 10.5 History and Social Science: GOVT.16
97	Design a community in which impact on the environment is kept to a minimum.	Science: BIO.8d
98	Interpret land-use maps.	History and Social Science: WG.3 Science: ES.1d
99	Analyze a comprehensive plan for a community.	English: 9.5, 10.5 History and Social Science: GOVT.1
100	Describe current environmental policies/regulations.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: GOVT.9, GOVT.16
101	Identify local, state, and federal conservation, natural resource, and environmental regulatory agencies and programs.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: GOVT.8, GOVT.15
102	Describe water-use planning and water rights policies.	English: 9.5, 10.5 History and Social Science: GOVT.1, GOVT.9

FFA Information

The National FFA is an organization dedicated to preparing members for leadership and careers in the science, business, and technology of agriculture. Local, state, and national activities and award programs provide opportunities to apply knowledge and skills acquired through agriculture education.

For additional information about the student organization, see the [National FFA website](#) and the [Virginia FFA Association website](#).

The following leadership development events are available for this course:

- [Agricultural Issues](#)
- [Conduct of Chapter Meetings](#)
- [Creed Speaking](#)
- [Employment Skills](#)
- [Extemporaneous Public Speaking](#)
- [Parliamentary Procedure](#)
- [Prepared Public Speaking](#)

The following career development events are available for this course:

- [Environmental & Natural Resources](#)
- [Forestry](#)

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- Customer Service Specialist (CSS) Examination
- Ecology Conservation & Management Examination
- Forest Products and Processing Assessment
- National Career Readiness Certificate Assessment
- Natural Resources Systems Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Agricultural Business Fundamentals I (8022/36 weeks)
- Agricultural Business Management III (8026/36 weeks)
- Agricultural Business Operations II (8024/36 weeks)
- Agricultural Production Technology (8010/36 weeks)
- Applied Agricultural Concepts (8072/18 weeks)
- Applied Agricultural Concepts (8073/36 weeks)
- Biological Applications in Agriculture (8086/36 weeks)
- Biotechnology Applications in Agriculture (8087/36 weeks)
- Biotechnology Foundations in Agricultural and Environmental Science (8085/36 weeks)
- Community Forestry and Tree Management (8048/36 weeks)
- Ecology and Environmental Management (8045/18 weeks)
- Ecology and Environmental Management (8046/36 weeks)
- Fisheries and Wildlife Management (8041/36 weeks)
- Forestry Management (8042/36 weeks)
- Forestry Management, Advanced (8044/36 weeks)
- Foundations of Agriculture, Food, and Natural Resources (8006/36 weeks)
- Operating the Farm Business (8014/36 weeks)
- Outdoor Recreation, Parks, and Tourism Systems Management (8043/36 weeks)
- Sustainability and Renewable Technologies (8414/36 weeks)

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Environmental Service Systems	Agricultural Products Sales Representative Environmental Compliance Inspector Environmental Sampling and Analysis Technician Hazardous Materials Handler Recycling Coordinator Secondary School Teacher Toxicologist Turf Farmer Water Conservationist

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
Natural Resources Systems	Ecologist Fish and Game Officer Fisheries Technician Forest Manager, Forester Forest Technician Geological Technician Logging Equipment Operator Microbiologist Outdoor Recreation Guide Park Manager Park Technician Range Technician Wildlife Manager
Plant Systems	Agricultural Products Sales Representative Botanist Forest Geneticist Nursery and Greenhouse Manager Ornamental Horticulturist Plant Breeder/ Geneticist Secondary School Teacher Soil and Plant Scientist Tree Surgeon
Power, Structural, and Technical Systems	Agricultural Equipment Operator

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	Occupations
Engineering and Technology	Civil Engineer Civil Engineering Technician Environmental Engineer Human Factors Engineer
Science and Mathematics	Ecologist Environmental Scientist Geoscientist Hydrologist Microbiologists Oceanographer Plant Biologist Secondary School Teacher