

Fisheries and Wildlife Management

8041 36 weeks

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Course Description

Suggested Grade Level: 11 or 12

The Fisheries and Wildlife Management course offers instruction in identification and management of both terrestrial and aquatic wildlife and of their habitats. Content addressing the issues related to endangered species and organizations that protect fisheries and wildlife is also included.

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

8041	Tasks/Competencies
+	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.
+	Participate in an SAE.

+	Identify the benefits and responsibilities of FFA membership.
+	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.
○	Apply for an FFA degree and/or an agricultural proficiency award.
+	Explain how anatomy contributes to an animal's ability to survive in given habitats.
+	Examine classification levels within the science of taxonomy.
+	Examine cell structure and cell function in animals.
+	Describe the process of mitosis.
+	Define the phases in the process of meiosis.
+	Describe the history of wildlife management in the United States.
+	Define the <i>era of abundance</i> , <i>era of over-exploitation</i> , <i>era of protection</i> , <i>era of game management</i> , <i>era of environmental management</i> , and <i>era of conservation biology</i> .
+	Identify the private and nonprofit organizations focused on stewardship of fisheries and wildlife.
+	Describe the benefits brought about by outdoor enthusiasts and wildlife organizations.
+	Identify conservation agencies in Virginia.
+	Describe the roles of federal agencies in the protection of fisheries and wildlife.
+	Explain funding sources for wildlife management agencies.
+	Describe the relationship between an ecosystem and a biome.
+	Describe ecosystem overlap.
+	Describe the cleansing role of wetlands.
+	Compare the similarities and differences of the terrestrial biomes found in North America.
+	Explain the value of wildlife to society.
+	Identify the benefits of wildlife to humans.
+	Describe successful stewardship practices.
+	Examine the importance of protection and preservation of species.
+	Describe the United States Endangered Species Act (ESA).
+	Explain the effects of the Endangered Species Act requirements on agriculture.

+	Identify species protected by the Endangered Species Act.
+	Identify threatened and endangered (T&E) species in Virginia.
+	Describe environmental factors that lead to the extinction of certain species.
+	Explain how agricultural research can help protect vulnerable wildlife species.
+	Describe the different types of habitats.
+	Explain factors that cause a species to become threatened and/or endangered.
+	Describe the loss of habitat in Virginia.
+	Explain the importance of each element of habitat.
+	Describe the anthropogenic impact on habitat.
+	Explore the adaptation of various wildlife species to human development.
+	Identify specific activities in which humans harm or destroy wildlife habitat.
+	Evaluate habitat protection and improvement efforts.
+	Identify characteristics specific to mammals.
+	Describe the biology, ecology, and importance of mammals.
+	Identify species of rodents and lagomorphs in Virginia and North America.
+	Identify species of ungulates (hoofed mammals) in Virginia and North America.
+	Describe the ungulate ruminant digestive system.
+	Describe the positive and negative impacts of the white-tailed deer population on Virginia residents.
+	Evaluate hunting as a tool for managing wildlife populations.
+	Investigate the role of predatory mammals in Virginia and North America.
+	Identify unusual mammal species in Virginia and North America.
+	Describe the role that each group of mammals plays in its ecosystems.
+	Explain the extirpation of certain mammal species from Virginia and their possible reintroduction.
+	Describe management activities and practices used to control mammal populations.
+	Identify species of reptiles and amphibians in Virginia and North America.
+	Describe the biological and ecological importance of reptiles and amphibians.

+	Describe methods of managing reptile and amphibian species.
+	Explore avian physiology and biology.
+	Identify waterfowl species common to Virginia.
+	Explain modern waterfowl management practices.
+	Describe the benefits provided by groups like Ducks Unlimited and the Audubon Society.
+	Identify game bird species common to Virginia.
+	Describe game bird habitat and ecology.
+	Evaluate hunting regulations and their impact on game bird management.
+	Describe raptor species common to Virginia.
+	Describe characteristics of raptors.
+	Describe the role of raptors in urban, suburban, and rural habitats.
+	Describe the impact on "secondary consumers" (e.g., raptors) of chemicals used in agricultural, industrial, and domestic settings.
+	Investigate perching bird species in Virginia.
+	Explain habitat requirements of perching birds.
+	Evaluate the anthropogenic impact on songbird populations in Virginia.
+	Investigate the variety of shorebirds found in Virginia during different seasons.
+	Describe characteristics of shorebirds.
+	Describe skeletal structures found in aquatic species.
+	Describe muscle structures found in aquatic species.
+	Describe the external anatomy of aquatic species, including fins and scales.
+	Identify adaptations of aquatic species to habitat.
+	Describe digestive systems of aquatic species.
+	Describe respiratory systems of aquatic species.
+	Examine water characteristics.
+	Describe water quality indicators and standards.

+	Explain the importance of water quality management practices.
+	Describe methods for raising levels of dissolved oxygen in water.
+	Identify management practices that protect water systems from pollution.
+	Identify agencies that assist in protecting water systems.
+	Describe the anatomy and physiology of fish.
+	Describe the metabolic process of freshwater fish species.
+	Describe physical differences between saltwater and freshwater fish species.
+	Describe the spawning processes and reproduction of fish species.
+	Describe the importance of species diversity within a water system.
+	Explain the role of predator species and the benefits of predation.
+	Explain the difference between Virginia's warm-water and cold-water fish species.
+	Identify characteristics of diadromous, anadromous, and catadromous fish species.
+	Describe the life cycle and spawning process of anadromous, diadromous, and catadromous fish.
+	Describe the internal guidance systems of migratory fish.
+	Explain management techniques used to improve fish populations.
+	Describe the classification system of freshwater mollusks and crustaceans.
+	Describe biological and physiological characteristics of mollusks and crustaceans.
+	Explain freshwater mollusks' role as water quality indicators.
+	Describe the diversity of freshwater mollusks found in Virginia's streams.
+	Describe sound practices in fisheries management.
+	Describe parameters used in indices of fish populations, including the utility of these indices.
+	Describe fish structures and habitats.
+	Describe harvesting methods.
+	Describe population management tools used in fisheries.
+	Identify the uses of fisheries.
+	Research career opportunities within the fisheries and wildlife management field.

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?

Examining the Principles of Zoology

Task Number 44

Explain how anatomy contributes to an animal's ability to survive in given habitats.

Definition

Explanation should include

- warm-blooded vs. cold-blooded (endothermic [homeotherms] vs. ectothermic [poikilotherms])
- skeletal system (vertebrate and invertebrate)
- respiratory systems
- digestive systems
- reproductive systems
- muscular systems
- nervous systems
- size and body configuration (e.g., large body surface area to volume vs. small harsh environments such as the arctic).

Process/Skill Questions

- What is the definition of *habitat*?
- What are the similarities and differences between vertebrates and invertebrates?
- What is the difference between ectothermic and endothermic?
- What is the definition of *ruminant*?
- What advantages does a ruminant animal have over animals with other digestive systems?
- In what ways have species adapted to survive in different environments?
- How is reproductive success based upon habitat availability?
- How does an animal's role in the ecosystem influence its adaptations?
- What advantages do different locomotion systems give to select animals (e.g., birds vs. snakes, bipedal vs. quadrupedal)?

Task Number 45

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
- an historical context review of binomial nomenclature and the importance of it as a common language of science.

Process/Skill Questions

- What is a hierarchical structure?
- What are the different classification levels in the science of taxonomy?
- How can we use the Linnaeus classification system to help us understand the role of an animal in its environment?
- On what was Linnaeus' hierarchy originally based? What is it based on today?
- Why do we need a classification system that can be used by multiple countries and groups of people?
- What are the origins of classification?

Task Number 46

Examine cell structure and cell function in animals.

Definition

Examination should include

- parts of an animal cell
- function of the parts
- differentiation in cell function for different body processes.

Process/Skill Questions

- How do animal cells differ from plant cells?
- What are the parts of an animal cell?
- What is the function of each part of an animal cell?
- How do animal cells differ from human cells? How are they the same?
- What types of cells have general functions vs. specific functions within the body?
- What special cellular adaptations do some animals/organisms have to enhance survival?
- What are differences between prokaryotes and eukaryotes? What are examples of each?

Task Number 47

Describe the process of mitosis.

Definition

Description should include

- the following phases of mitosis:
 - Interphase
 - Prophase
 - Metaphase
 - Anaphase
 - Telophase
- the significance of the process.

Process/Skill Questions

- What are the mitosis phases?
- What happens during each phase?
- What is the significance of mitosis as it relates to wildlife?
- What is mitosis the division of?
- What is cytokinesis the division of?

Task Number 48

Define the phases in the process of meiosis.

Definition

Definition should include explanation of the three phases:

- Growth 1 (G1)
- Synthesis (S)
- Growth 2 (G2)

Process/Skill Questions

- What happens in each phase?
- What is the main difference between mitosis and meiosis?
- What is being produced by meiosis (germ/sex cells) vs. mitosis (somatic or all body cells)?
- What is the significance of proper meiosis?
- How does mutation during the process of meiosis affect species' ability to survive?

Exploring the History of Wildlife Management

Task Number 49

Describe the history of wildlife management in the United States.

Definition

Description should include

- evolution of wildlife management in the United States
- lack of management during Colonial times (e.g., exploitation)
- role of hunting and fishing
- hunting reserves (e.g., for European royalty)
- agricultural practices that affect wildlife
- era of exploitation of U.S. wildlife
- predator control

- institution of game law
- wildlife refuges
- farm-raised wildlife
- habitat improvement
- national parks
- national forests
- conservation movement.

Process/Skill Questions

- How did Colonial agriculture affect wildlife habitat?
- How did early hunting impact wildlife management (e.g., passenger pigeon, bison, great auk, Labrador duck, dodo bird)?
- How did farming and ranching impact wildlife management (e.g., fencing off private lands, Great Plains conversion to agriculture)?
- How did Theodore Roosevelt's push for conservation impact wildlife management?
- Why is Aldo Leopold known to many as the father of modern wildlife management?
- What are some of the major events/policies that influence Virginia wildlife management?
- How have modern agricultural practices affected wildlife populations?
- Why did wildlife management evolve?
- What groups led the fight for conservation? Why?

Task Number 50

Define the era of abundance, era of over-exploitation, era of protection, era of game management, era of environmental management, and era of conservation biology.

Definition

Definitions should include

- the impact(s) of colonization
- the impact(s) of industrialization
- legislation within each era
- land use
- market hunting vs. modern and recreational hunting
- use of forest products.

Process/Skill Questions

- How does land exploitation affect wildlife habitat today?
- How do land and residential development negatively affect habitat and wildlife populations?
- What role does modern hunting play in wildlife management?
- What role does fire play in wildlife management?
- What wildlife species were affected by market hunting?
- When did market hunting end?

- What is the current impact of the Pittman-Robertson Act?
- What influence did market hunting have on legislation and policy regarding wildlife?
- How does the legislative process work in regard to wildlife management policy?
- How can regional planning assist in controlling loss and fragmenting of wildlife habitat? How can it limit control? How did market hunting affect various wildlife species?

Task Number 51

Identify the private and nonprofit organizations focused on stewardship of fisheries and wildlife.

Definition

Identification should include

- National Wild Turkey Federation
- Boone and Crocket Club
- Audubon Society
- Trout Unlimited
- Ducks Unlimited
- Sierra Club
- The Nature Conservancy
- National Wildlife Federation
- Virginia Herpetological Society
- Chesapeake Bay Foundation
- Quality Deer Management
- Pope & Young Club
- Wildlife Management Institute
- Rocky Mountain Elk Foundation.

Process/Skill Questions

- What role did the Boone and Crocket Club have in the development of wildlife management practices in the United States?
- How have these organizations affected public law and policy?
- What career opportunities exist within these agencies?
- What are some changes that were demanded or influenced by conservation organizations?
- How do these organizations help educate the public?
- How are these organizations funded?
- What benefits/contributions did these organizations bring to fisheries and wildlife management?
- What are some programs put in place by Ducks Unlimited that have helped stabilize migratory waterfowl populations?
- How can private organizations influence policy on game management issues?

Task Number 52

Describe the benefits brought about by outdoor enthusiasts and wildlife organizations.

Definition

Description should include

- changes in laws and policies for the betterment of the natural world
- protection and restoration of wildlife habitat
- wildlife conservation
- funding for conservation and restoration of wildlife habitats
- education
- reintroduction of wildlife (e.g., wolves, bears, elk, swans) to historic ranges
- establishing food resources and green corridors for wildlife
- restoration of game and nongame species
- recognition of fluctuations in wildlife populations
- recognition of disease.

Process/Skill Questions

- What effect(s) did the Lacey Act of 1900 have on wildlife conservation?
- How are birds protected through the Migratory Bird Treaty Act?
- How does the North American Model of Wildlife Conservation influence wildlife management?
- What are the personal benefits of being a member of a wildlife organization?
- What challenges do wildlife managers face today?
- What challenges has Virginia faced in restoring wild turkeys, white-tailed deer, and elk?
- Why is restoration of game important to ecosystems?
- How is computer modeling used in wildlife management?

Examining Wildlife Protection Organizations and Agencies

Task Number 53

Identify conservation agencies in Virginia.

Definition

Identification should include

- Department of Game and Inland Fisheries (DGIF)
- Department of Conservation and Recreation (DCR)

- Department of Environmental Quality (DEQ)
- Virginia Marine Resources Commission (VMRC)
- Department of Forestry (DOF)
- Virginia Outdoors Foundation (VOF)
- Natural Heritage Program (administered by the DCR)
- Scenic Rivers Program (administered by the DCR).

Process/Skill Questions

- What is the role of the Virginia Department of Game and Inland Fisheries (VDGIF) in nongame protection? The Virginia Marine Resources Commission?
- What educational outreach programs are provided by these agencies?
- What career opportunities exist within these agencies?
- What services does the Department of Environmental Quality (DEQ) provide to land and business owners?
- How do Virginia’s conservation agencies work together to manage wildlife?

Task Number 54

Describe the roles of federal agencies in the protection of fisheries and wildlife.

Definition

Description should include

- identification of agencies involved in protection of fish and wildlife (e.g., the U.S. Fish and Wildlife Service, the U.S. Forest Service, the Bureau of Land Management, the U.S. Department of Agriculture)
- responsibilities of each agency
- relationships/interactions with state agencies.

Process/Skill Questions

- What are some of the major responsibilities of each agency?
- How have the agencies benefited wildlife conservation efforts?
- What management tools are available to the U.S. Fish and Wildlife Service to protect fish and wildlife species?
- How is the responsibility for wildlife management divided between the state and federal wildlife agencies?
- How are issues between state and federal wildlife agencies resolved?
- What is the Conservation Reserve Program? How has it benefited wildlife?

Task Number 55

Explain funding sources for wildlife management agencies.

Definition

Explanation should include

- federal and state government funding (e.g., excise tax on hunting and fishing equipment, Endangered Species Act [Section 6])
- license fees.

Process/Skill Questions

- How are federal funds budgeted to the U.S. Fish and Wildlife Service?
- How does the Pittman-Robertson Act provide funds for fisheries and wildlife projects? The Dingell-Johnson Act?
- What are the primary sources of funding for wildlife and habitat enhancement in the U.S.?
- How can the U.S. Forest Service use federal funding to protect wildlife habitat?
- What are some grant opportunities for local efforts to improve habitat?
- What wildlife (fisheries) projects are supported by the Wallop-Beaux Act?
- How does an individual or agency apply for a grant?

Understanding North American Biomes

Task Number 56

Describe the relationship between an ecosystem and a biome.

Definition

Description should include

- definition of *ecosystem*
- definition of *biome*
- the types of biomes in North America.

Process/Skill Questions

- What are the similarities between biomes and ecosystems?
- How does a problem in one ecosystem affect neighboring ecosystems that share its boundaries?
- What are the characteristics of a biome?
- Which biomes are the most threatened?
- Why are certain biomes disappearing?
- What is the difference between a habitat and a range?

Task Number 57

Describe ecosystem overlap.

Definition

Description should include

- definition of *ecosystem overlap*
- ecosystem overlap in your community.

Process/Skill Questions

- What are examples of ecosystem overlap in your community?
- Why is it important to understand the benefits of ecosystem overlap in wildlife management?
- What are ecotones?
- What might hinder ecosystem overlap and/or ecosystem isolation? What might foster it?

Task Number 58

Describe the cleansing role of wetlands.

Definition

Description should include

- how plants filter contaminants
- absorption of solids
- addition of oxygen
- importance of clean water.

Process/Skill Questions

- What state/federal standards determine the definition of a wetland?
- What are physical characteristics of a wetland?
- What are examples of wetlands in your community?
- How do plants filter contaminants?
- What plant species are commonly found in a wetland?
- How would the loss of a wetland affect water quality?
- How do wetlands improve wildlife habitats?
- How do fresh and brackish water wetlands/estuaries function as nurseries for marine species?

Task Number 59

Compare the similarities and differences of the terrestrial biomes found in North America.

Definition

Comparison should include

- desert
- tundra
- grasslands
- temperate rain forests
- tropical rain forests
- coniferous forests (e.g., taiga, boreal)
- deciduous forests.

Process/Skill Questions

- How are the animal populations different in the various biomes?
- How are the plant populations different in the various biomes?
- Which biome would offer the most diversity of plant and animal life?
- How are the animal populations similar in the various biomes?
- How are the plant populations similar in the various biomes?
- How have biomes been altered by human activity?
- What factors affect population levels?
- What environmental factors influence the species of flora and fauna found in each of the biomes?
- How does climate play a role in biomes?
- What adaptations do species have to survive variations in biomes?

Protecting Wildlife Resources

Task Number 60

Explain the value of wildlife to society.

Definition

Explanation should include the following benefits:

- Health
- Economic
- Recreational
- Social
- Aesthetic

Process/Skill Questions

- How does wildlife contribute to the health of the environment? To people?

- How does the local economy benefit from the wildlife resource?
- What social conflicts can arise when people benefit differently from the same wildlife resource?
- How can wildlife resources contribute to the aesthetic value of the community?
- What is cultural carrying capacity?
- How does cultural carrying capacity influence local resources and laws?
- How can education and planning help foster the preservation of wildlands and wildlife habitat?

Task Number 61

Identify the benefits of wildlife to humans.

Definition

Identification should include

- aesthetic
- recreational
- economic
 - food
 - clothing
 - hunting
 - fishing
 - ecotourism
- medical and scientific
- ecological
- intrinsic value.

Process/Skill Questions

- What are some recreational activities associated with wildlife?
 - Why is the intrinsic value of wildlife species important?
 - What is the monetary value of wildlife species in your area?
-

Task Number 62

Describe successful stewardship practices.

Definition

Description should include

- recycling
- crop rotation
- conservation easements
- riparian zones

- management of wildlife populations
- reforestation
- responsible use of pesticides and herbicides
- reintroduction of native plant and animal species to increase biodiversity
- control and eradication of introduced aggressive exotics
- best management practices (BMPs) of plant/animal resources (e.g., crop rotation, conservation easements, riparian zones, rain barrels)
- wildlife highways for road crossing.

Process/Skill Questions

- What practices could a local farmer use to improve water quality?
- What responsibility does a homeowner have to practice good stewardship of the environment?
- What strategies could a local government use to control urban wildlife populations?
- Why is it illegal to collect rainwater in some states?
- How does one improve habitat?
- What practices can citizens implement to positively impact wildlife populations?
- What are some practices local governments can put into place to have a positive impact on wildlife (e.g., fencing, trash pickup)?
- How can local governments keep populations from becoming isolated?
- What influence can wildlife highways have on populations?

Task Number 63

Examine the importance of protection and preservation of species.

Definition

Examination should include

- importance of diversity
- assurance of wildlife populations for the future
- guarantee of the enjoyment and economic benefits provided by plants and wildlife
- importance of zoos and wildlife parks in the preservation of endangered species.

Process/Skill Questions

- What is the definition of *anthropogenic*?
- Why is biodiversity good for ecosystems?
- What anthropogenic factors affect wildlife and plant populations?
- What natural factors affect wildlife and plant populations?
- How do biologists determine the biodiversity in any given ecosystem?
- What factors led to the development of modern zoos?

Task Number 64

Describe the United States Endangered Species Act (ESA).

Definition

Description should include

- history of the act
- criteria used to classify endangered and threatened species
- funding of the act
- penalties for violation of the act.

Process/Skill Questions

- How are endangered and threatened species managed in Virginia?
- What are some factors that cause wildlife populations to decline?
- What are some controversial issues that have arisen from the implementation of the ESA (e.g., classifying the spotted owl as an endangered species)?
- How does the federal Endangered Species list differ from Virginia's Species in Greatest Conservation Need list?

Task Number 65

Explain the effects of the Endangered Species Act requirements on agriculture.

Definition

Explanation should include

- economic impact
- benefits to agriculture
- regulations that affect agriculture.

Process/Skill Questions

- How can the protection of plant and animal species be beneficial to farmers?
- What are some ways the ESA can cause an increase in production costs for farmers?
- What controversy exists within the agricultural community regarding the protection of endangered animals and plants?
- When can protection of species become a detriment to agricultural pursuits?

Task Number 66

Identify species protected by the Endangered Species Act.

Definition

Identification should include

- endangered species
- threatened species.

Process/Skill Questions

- What is the difference between threatened and endangered species?
 - What are some factors that have contributed to the endangerment of some species?
 - What species are currently on the threatened or endangered list in the United States?
 - What measures are being taken to protect endangered species in the United States?
 - What North American species have benefited from protection provided by the ESA?
 - What are the levels of the ESA?
 - How can the state list be different than the federal list?
 - What is the process for adding a species to the Endangered Species list?
-

Task Number 67

Identify threatened and endangered (T&E) species in Virginia.

Definition

Identification should include both plant and animal species.

Process/Skill Questions

- What measures are being taken to protect endangered and threatened animals and plants in Virginia?
 - How does the conservation of endangered and threatened species affect agriculture in your area? How does it affect local economic development?
 - What resources exist to learn more about these species?
 - How does the ESA foster regional planning?
 - How do invasive/introduced species affect threatened and endangered species?
-

Task Number 68

Describe environmental factors that lead to the extinction of certain species.

Definition

Description should include

- habitat destruction
- inability to adapt to changes in the environment
- loss of food supply

- predation
- climate change
- invasive species.

Process/Skill Questions

- What does low biotic potential mean?
- How can habitat fragmentation lead to a decline in wildlife populations?
- How have humans contributed to the decline of species by poaching?
- How has overharvesting led to the decline of commercial marine species?
- How can we balance the commercial harvest of marine species with the interests of recreational fishermen?
- How does control of predator populations impact wildlife populations?
- How can poaching affect the pet trade?
- What is Aldo Leopold’s cultural harvest idea? How can it lead to poaching?

Task Number 69

Explain how agricultural research can help protect vulnerable wildlife species.

Definition

Explanation should include

- current government and nongovernment research being done
- the role of zoos, wildlife parks, and conservation centers
- the role of farms and research institutions, including colleges (e.g., Virginia State University, Ferrum College, Virginia Tech).

Process/Skill Questions

- What role(s) do government agencies play regarding research designed to protect endangered species?
- What type of research is being done at zoos to protect endangered and threatened species?
- How is research conducted in zoos different from research conducted in wildlife parks?
- What type of research is being done at wildlife parks to protect endangered and threatened species?
- How is research data shared with the public?

Preserving Wildlife Habitats

Task Number 70

Describe the different types of habitats.

Definition

Description should include freshwater, marine, and terrestrial habitat requirements of wildlife, including

- food
- cover
- water
- space
- arrangement.

Process/Skill Questions

- What are the major characteristics of terrestrial habitats? Aquatic habitats? Fossorial habitats?
- What are the characteristics of habitats that overlap between terrestrial and aquatic habitats?
- What types of animals prefer terrestrial habitats? Aquatic habitats?
- How can you improve habitat for species in your neighborhood?
- How do bogs, wetlands, and swamps differ from one another?
- Why are each of the habitat elements of equal importance?

Task Number 71

Explain factors that cause a species to become threatened and/or endangered.

Definition

Explanation should include

- extinction factors
- adaptability
- the importance of saving endangered species
- the Endangered Species Act
- management practices for endangered species
- effects of nonindigenous, invasive, or nonnative species
 - plants
 - amphibians and reptiles
 - birds
 - mammals
- non-use or restricted use
- changes in human behaviors
- habitat enhancement.

Explanation should also include the factors that caused each of the following species to become threatened or endangered:

- West Indian manatee
- California condor
- Peregrine falcon

- Red wolf
- Black-footed ferret
- Whooping crane

Process/Skill Questions

- How can habitat be enhanced to protect endangered species?
- What is an example of a controversial issue that has surfaced as a result of implementing the Endangered Species Act?
- Should private landowners be compensated when land use is restricted due to species protection? Why, or why not?
- How do wildlife managers account for human activities near habitat for T&E species?
- What is the purpose of the Endangered Species Act?
- Why is an animal's adaptability an important factor in its ability to survive?
- What are some nonindigenous species?
- How do invasive pest species cost U.S. consumers?
- How do nonindigenous species harm native wildlife?

Task Number 72

Describe the loss of habitat in Virginia.

Definition

Description should include examples related to

- habitat destruction
- habitat fragmentation
- habitat degradation
- agriculture (farming methods)
- land conversion for development
 - urban development
 - suburban housing projects
- water development (dams and other water diversions)
- harvesting forest products
- global warming
- loss of wetlands
 - prairie potholes
 - forested wetlands
 - coastal wetlands
- pollution
 - industrial development
 - mining operations.

Process/Skill Questions

- What early farming methods destroyed wildlife habitat? Benefited wildlife habitat?
- What current farming practices destroy wildlife habitat?

- How have agricultural practices changed for the better? For the worse?
- How has urban development been detrimental to wildlife habitat?
- How has human population growth affected aquatic habitat?
- Which species would benefit if a forest was harvested to create a golf course? Which species would be harmed?
- How has eminent domain affected the loss of habitat in Virginia?
- What are three ways humans affect wildlife habitat?
- Why are wetlands vital to wildlife? How are they beneficial to humans?
- How has urban development changed the diversity of species (e.g., raccoons, opossums, rodents, exotic species)?
- How has strip mining impacted topography and habitat?

Task Number 73

Explain the importance of each element of habitat.

Definition

Explanation should include

- air quality
- food
- water quality
- cover
- space needs.

Process/Skill Questions

- What are the space needs of various species of wildlife?
- What are the implications of water quality on wildlife? Plants?
- What is the importance of cover for wildlife?
- Why is space a necessity?
- How does the availability of food vary from one season to the next?
- What is the definition of home range?
- How do animals' home ranges change during certain times of the year?

Task Number 74

Describe the anthropogenic impact on habitat.

Definition

Description should include

- human impacts on marine habitats
- human development and activities' impact on wildlife (e.g., amphibians, reptiles, birds, mammals)
- activists' concern for natural environment(s).

Process/Skill Questions

- How can human population growth affect wildlife habitat?
- What farming practices have affected wildlife habitat?
- How can human actions affect fish habitat?
- How can human actions affect mammalian habitat?
- How does habitat fragmentation affect wildlife?
- What are some examples of organizations that support natural environment(s)?
- What are some of the consequences of leaving food out for wildlife? Is it helpful or harmful? Why, or why not?
- What consequences would occur if logging reductions were enacted to protect the endangered spotted owl in the northwestern states?
- What are some of the ecological benefits to not harvesting old growth forest?

Task Number 75

Explore the adaptation of various wildlife species to human development.

Definition

Exploration should include

- structural
- behavioral
- food sources
- cover and protection
- nesting and brooding sites
- natural travel and migration routes.

Process/Skill Questions

- What is an adaptation?
- How has wildlife been affected by human food sources?
- How do humans provide cover and protection for certain types of wildlife?
- How have humans affected the nesting and brooding sites of wildlife?
- How have humans affected the natural travel and migration of animals?
- How have successful exotic species (e.g., starlings) disrupted wildlife management?
- How have specific rodent populations adapted to human development?

Task Number 76

Identify specific activities in which humans harm or destroy wildlife habitat.

Definition

Identification should include various activities (e.g., construction, agriculture, mining, timber harvesting, and pollution of air, water, and land) and their corresponding impact.

Process/Skill Questions

- What is the impact of housing development on habitat?
- What are sources of water pollution (point and non-point sources)?
- How do pesticides/fertilizers affect wildlife habitat?
- What is the edge effect? How does it influence wildlife range and population?

Task Number 77

Evaluate habitat protection and improvement efforts.

Definition

Evaluation should include the difference between protection (e.g., limiting grazing, restricting traffic) and improvement (e.g., planting trees, developing watering facilities) efforts.

Process/Skill Questions

- What are some benefits of a wildlife refuge vs. a wildlife preserve?
- How does a forest riparian area promote wildlife habitat?
- What are the benefits of the Conservation Reserve Program?
- What are examples of human activities that benefit wildlife?
- What is the purpose of the Nature Conservancy's barrier island program?

Examining Mammalian Species

Task Number 78

Identify characteristics specific to mammals.

Definition

Identification should include

- production of milk to feed their young (mammary glands)
- single bone comprising their lower jaw
- three tiny bones in the middle portion of the ear (stirrup, anvil, and hammer)
- a diaphragm
- fur or hair
- a four-chambered heart

- complex brain function.

Process/Skill Questions

- What species of mammalian wildlife are prevalent in North America?
- What are characteristics of the different families of mammals that occur in North America?
- What differences exist between wild species and domestic species of the same family (e.g., wolves, coyotes, and dogs; bison and cows; mountain goats and goats)?
- What are reproductive differences of marsupial mammals and placental mammals?
- How do bats navigate safely as they fly in darkness?

Task Number 79

Describe the biology, ecology, and importance of mammals.

Definition

Description should include

- bodies that maintain constant temperature
- variety of ecosystems (e.g., forests, meadows, rivers, oceans)
- various means of locomotion
- well-developed senses of hearing and smell
- fur/hair used for insulation, protection of the skin, camouflage, and sensory feedback.

Process/Skill Questions

- How does a mammal adapt to different environments?
- What is the effect of declining or expanding populations of predators on the population of rodents?
- Why are wild mammals important to humans?
- What are some examples of locomotion?
- What does a mammal's morphology indicate about its role in an ecological niche?
- What impacts might the loss of a mammalian species have on an ecosystem?

Task Number 80

Identify species of rodents and lagomorphs in Virginia and North America.

Definition

Identification should include

- examples of various species
- physical characteristics of rodents
- physical characteristics of lagomorphs
- roles of rodents and lagomorphs in the ecosystem

- distribution of rodents and lagomorphs in Virginia.

Process/Skill Questions

- What is the definition of *lagomorph*?
 - Why must a rodent and lagomorph gnaw on wood or other materials?
 - Why are beavers considered to be valuable animals? Why are they sometimes considered to be pests?
 - What is malocclusion? How can it affect rodents or lagomorphs in the wild?
 - How can rodents spread zoonotic diseases (e.g., hantavirus, plague)?
-

Task Number 81

Identify species of ungulates (hoofed mammals) in Virginia and North America.

Definition

Identification should include

- examples of various species
- physical characteristics
- similarities and differences among species, including their behaviors
- roles of ungulates in the ecosystem
- distribution of ungulates in Virginia and North America.

Process/Skill Questions

- What are similarities and differences between pronghorns and members of the deer family?
 - What are the differences between wild sheep and wild goats?
 - What are the common hoofed mammals found in Virginia?
 - What is the definition of *ungulate*?
 - Why is hunting an important tool for controlling ungulate populations?
 - How has the reintroduction of decimated ungulate species been beneficial? How has it been harmful?
 - How do farm-raised ungulates affect the wild population?
 - What economic impacts do farm-raised ungulates cause?
 - What ungulate species are considered ruminants?
-

Task Number 82

Describe the ungulate ruminant digestive system.

Definition

Description should include

- mouth
- esophagus
- four stomach compartments (reticulum, rumen, omasum, abomasum) function and characteristics
- small intestine (duodenum, jejunum, and ileum)
- large intestine (cecum, colon, and rectum)
- digestive fluids
- microbial fermentation
- esophageal groove
- rumination
- bloat.

Process/Skill Questions

- How do ruminant animals digest their food?
- What are some examples of high-fiber food?
- What is the diet of the white-tailed deer?
- How are the diets of deer impacted by suburbanization? Loss of habitat? Overpopulation?
- How can the overpopulation of deer and other species be humanely controlled?

Task Number 83

Describe the positive and negative impacts of the white-tailed deer population on Virginia residents.

Definition

Description should include

- role in ecosystem (keystone species)
- ecological effects of high deer densities (vegetation and other species of wildlife)
- effects on agriculture
- economic considerations
- vehicle traffic
- urban settings
- anthropogenic effects
- biological carrying capacity and cultural carrying capacity
- management challenges.

Process/Skill Questions

- Why have white-tailed deer numbers increased greatly since the early 1900s? How was this increase accomplished?
- How would an abundance of deer impact vehicular traffic?
- What is biological carrying capacity (BCC)?
- What is cultural carrying capacity (CCC)?
- What groups of people dictate CCC?

- What conflicts could be encountered in urban settings?
- What makes an urban setting a good habitat for white-tailed deer?
- What economic benefits would a healthy deer herd have on the local economy?
- What is a keystone species?
- Why are deer considered to be a keystone species in their ecosystem?
- What impact does the white-tailed deer population have on the presence of bears?
- What diseases are present in the white-tailed deer population?

Task Number 84

Evaluate hunting as a tool for managing wildlife populations.

Definition

Evaluation should include

- hunting seasons and bag limits
- game species populations
- carrying capacity
- damage control.

Process/Skill Questions

- What are the procedures for setting hunting seasons and bag limits?
- What groups influence these procedures/seasons/limits?
- How are populations of game species determined?
- What indications would a wildlife biologist use to determine if a population has exceeded its biological carrying capacity?
- What types of funding are provided by the purchase of hunting licenses?
- What challenges do localities face when regulating hunting in heavily populated areas?
- How can urban and suburban settings be designed to accommodate wildlife?

Task Number 85

Investigate the role of predatory mammals in Virginia and North America.

Definition

Investigation should include

- list of predatory mammals
- roles of predators in the food chain
- impact on animal populations due to food supplies, diseases, and natural disasters.

Process/Skill Questions

- How do predators help stabilize populations of primary consumers?
- What impact would the removal of all predators have on other animal populations?
- What would happen to rodent populations if fox populations declined?
- What are the procedures for reintroducing a predator back into an ecosystem?
- What concerns are associated with large predator reintroduction?
- How are predator populations affected by prey populations?
- Why would the reintroduction of a predator species be considered a negative change by certain stakeholders?

Task Number 86

Identify unusual mammal species in Virginia and North America.

Definition

Identification should include

- examples of unusual mammal species
- physical characteristics
- living circumstances
- reproductive characteristics.

Process/Skill Questions

- What are the reproductive differences between marsupial and placental mammals?
- How do bats navigate safely as they fly in darkness?
- How is the opossum unique among mammals of North America?
- How is the flying squirrel morphologically different from the gray squirrel? How does its role in the ecosystem differ from the gray squirrel's?
- How has the presence of white-nose syndrome affected bat populations?
- How can human activities be managed to limit carrying white-nose syndrome?

Task Number 87

Describe the role that each group of mammals plays in its ecosystems.

Definition

Description should include

- large mammals
- small mammals
- its place in the food web
- niche
- terrestrial and marine mammals
- monotremes, marsupials, and placental mammals
- unusual mammals in each ecosystem.

Process/Skill Questions

- What is the definition of *niche*?
- What is the role of rodents in the ecosystem of North America?
- What is the role of ungulates in their ecosystem?
- What role do seals play in the marine ecosystems?
- What are the three groups of mammals?

Task Number 88

Explain the extirpation of certain mammal species from Virginia and their possible reintroduction.

Definition

Explanation should include a list of mammals that have been extirpated from Virginia and the factors that led to the eradication of these mammals.

Process/Skill Questions

- Why are there no buffaloes in the Shenandoah Valley?
- What would be the impact(s) of reintroducing buffalo and elk into the mountains of Virginia?
- What factors led to the disappearance of the cougar from Virginia?
- What are some examples of mammals that have been reintroduced in Virginia?
- What are some of the concerns wildlife managers must address before considering the reintroduction of a species?

Task Number 89

Describe management activities and practices used to control mammal populations.

Definition

Description should include

- hunting and trapping, including bounty hunting
- environmental management (altering the landscape)
- wildlife management plans
- habitat management
- grazing management
- prescribed burning
- range enhancement
- brush management
- forest management
- poisoning

- riparian management and enhancement
- wetland enhancement
- prescribed control of native, exotic, and feral species
- wildlife restoration
- habitat protection for species of concern.

Process/Skill Questions

- What tools are used to manage mammal populations?
- How are hunting and management used to control mammal populations?
- When are the hunting seasons for various game species in your county/city?
- What are the restrictions specific to your county/city for unlawful game harvest methods?
- What are the concerns associated with feral pigs to the native game populations?
- What impact(s) do feral cats have on small-game populations?

Examining Reptilian and Amphibian Species

Task Number 90

Identify species of reptiles and amphibians in Virginia and North America.

Definition

Identification should include examples of species and description of

- frogs, toads, newts, salamanders, and caecilians
- snakes, lizards, crocodiles, turtles, and tortoises
- amphibian and reptile circulatory system
- anatomy of the heart
- reptile and amphibian integumentary system
- amphibian and reptile respiratory system
- amphibian and reptile excretory system
- methods of reproduction, including breeding seasons
- offspring
- differences in feet.

Process/Skill Questions

- What is the definition of *ectothermic*?
- What are the similarities and differences between amphibians and reptiles?
- What are the main types of reptiles and amphibians found in Virginia?
- How do reptiles reproduce? What reptiles use courtship rituals?
- What is the distribution/territory range of the venomous snakes found in Virginia?

- How can venomous snakes be identified?
- What reproductive strategies are used by amphibians?
- Why are vernal pools important to amphibians for reproduction?
- What is the difference between a turtle and a tortoise?
- What are the legal possession limits for the harvest of amphibians and reptiles?
- What is the importance of the hellbender to Virginia's mountainous regions?
- What is estivation and why is it important to amphibians?
- What are the four orders of the class Reptilia?
- What is a tetrapod?
- How is habitat loss impacting the populations of amphibians, such as the hellbender?

Task Number 91

Describe the biological and ecological importance of reptiles and amphibians.

Definition

Description should include identifying the similarities and differences of reptiles and amphibians and their contributions to mankind.

Process/Skill Questions

- How have humans been impacted by reptiles? Amphibians?
- How are reptiles and amphibians important to our ecology?
- Why are amphibians considered a keystone species?
- How does the chytrid fungus affect amphibian species?

Task Number 92

Describe methods of managing reptile and amphibian species.

Definition

Description should include

- improving habitats
 - ponds (e.g., adding fences, plant life, logs, rocks)
 - prairies (e.g., adding wet areas, native grasses, hay)
 - woodlands (e.g., adding ponds near edge of timberland, opening up spaces)
- using natural resources
- controlling use of chemicals/pesticides
- enforcing laws and regulations to protect animals and their environments
- monitoring programs of indicator species (e.g., FrogWatch USA)
- protection, conservation, and restoration projects.

Process/Skill Questions

- How does temperature affect the management of reptiles and amphibians?
- How does the breeding season affect the management of reptiles and amphibians?
- What are some organizations that help with the management of reptiles and amphibians?
- What practices can you implement to help protect the reptiles and/or amphibians that live in your community? In your state?
- What is a herpetologist? Why are they important to fisheries and wildlife management?
- What role does the Virginia Herpetological Society play in the protection of reptiles and amphibians?
- How has pollution impacted reptile and amphibian populations locally? Globally?
- Why are amphibian populations considered to be accurate gauges of environmental health?
- What is citizen science?
- How can citizen science help reptile and amphibian species?

Examining Avian Species

Task Number 93

Explore avian physiology and biology.

Definition

Exploration should include

- reproduction
- physical characteristics
- behavioral characteristics
- digestion.

Process/Skill Questions

- What do *avian*, *oviparous*, *incubation*, and *down plumage* mean?
- What are the similarities and differences in the mating and reproductive habits of various game birds?
- What are the feeding habits of various avian species?
- What are the reasons for sexual dichromatism in most bird species?
- What is the purpose of the crop and the gizzard?
- How do beak and bill adaptations determine diet and habitat requirements?

Task Number 94

Identify waterfowl species common to Virginia.

Definition

Identification should include

- examples of waterfowl species, including
 - Ducks
 - Puddle (surface-feeding)
 - Divers (bottom-feeding)
 - Geese
 - Swans
 - Cranes
- specific characteristics of species
- location of regions for species
- economic importance
- social importance
- mating behavior
- current and historical population numbers of Chesapeake Bay waterfowl.

Process/Skill Questions

- Which species of waterfowl can be found in Virginia year-round? What are their identifying characteristics?
- Which species of waterfowl are commonly found in suburban ponds? Urban ponds?
- What is the importance of each species to the economy and people of Virginia?
- How are the different regions in Virginia suitable habitats for a wide variety of birds?
- Which species of waterfowl are you more likely to find in Virginia's rivers?
- Which species of waterfowl are you more likely to find on the Bay?
- Which species are more likely to be found in Virginia's shallow wetlands?
- Which species are more likely to be found in Virginia's ponds?
- How can wildlife managers working with land stewards reverse dwindling wildlife populations?
- What physical characteristics allow waterfowl species to thrive in a particular habitat?

Task Number 95

Explain modern waterfowl management practices.

Definition

Explanation should include

- identification of regulations specific to waterfowl
- the migratory nature of waterfowl and how it affects their management
- factors that limit waterfowl numbers
- why international cooperation and coordination are necessary to manage waterfowl successfully
- how hunting regulations assist in the management of waterfowl
- the benefits of regulation.

Process/Skill Questions

- What methods are used to inventory waterfowl populations in order to set bag limits along the different flyways?
- What methods have the U.S. and other countries developed for managing migratory birds?

- Why are treaties between the U.S. and its neighboring countries important to waterfowl management?
- How is Duck Stamp revenue used in wildlife conservation?
- What hunting regulations are specific to waterfowl?
- What are the seasons and bag limits for Virginia waterfowl?
- How does the U.S. Fish and Wildlife Service, in conjunction with the Virginia Department of Game and Inland Fisheries, set bag limits?
- What are the benefits of using steel shot for waterfowl hunting?
- Why has lead shot been banned for the use of hunting waterfowl?
- What specific techniques are used to manage waterfowl? How are they implemented?

Task Number 96

Describe the benefits provided by groups like Ducks Unlimited and the Audubon Society.

Definition

Description should include the history, purpose, scope, and benefits of the organizations.

Process/Skill Questions

- How have conservation organizations affected wildlife legislation?
- What are some benefits of membership in groups like Ducks Unlimited?
- What is the basic history and scope of conservation organizations?

Task Number 97

Identify game bird species common to Virginia.

Definition

Identification should include examples of species and physical descriptions of each of the following:

- Quails
- Partridges
- Pheasants
- Grouse
- Turkeys
- Ducks
- Guinea fowl
- Pigeons and doves.

Process/Skill Questions

- What are some physical characteristics of game birds in Virginia?
- How do these characteristics determine the bird's habitat?

- How does Virginia's geography determine the different species of game birds found throughout the state?
- Why are some birds considered game birds, while others are not?
- What are some of the benefits of membership in groups like Quail Forever?
- What challenges are game birds facing in Virginia?

Task Number 98

Describe game bird habitat and ecology.

Definition

Description should include

- habitat needs for common Virginia game birds
- habitat protection
- carrying capacity
- anthropogenic impact on habitats.

Process/Skill Questions

- What are the cover, food, space, and water requirements for game birds in Virginia?
- How can game bird habitats be protected from anthropogenic influences?

Task Number 99

Evaluate hunting regulations and their impact on game bird management.

Definition

Evaluation should include

- identification of hunting regulations specific to birds
- exploration of how regulations are developed
- benefits of regulation.

Process/Skill Questions

- What are the similarities and differences of the methods used to limit harvest of game birds?
- What are the hunting regulations for game birds in Virginia?
- Why are regulations beneficial to game bird species?

Task Number 100

Describe raptor species common to Virginia.

Definition

Description should include

- definition of *raptor*
- examples of raptors (e.g., hawks, owls, vultures, falcons, eagles)
- characteristics of habitats occupied by raptors.

Process/Skill Questions

- What role do raptors have in the ecosystem of Virginia?
- What are six species of raptors native to Virginia?
- How do the families of raptors differ from one another?
- What role does the Virginia Raptor Conservancy play in raptor management?
- What niches are filled by raptor species (e.g., open woodland, fields, streamsides)?

Task Number 101

Describe characteristics of raptors.

Definition

Description should include

- nesting and reproductive habits
- diurnal vs. nocturnal
- food requirements
- hunting techniques.

Process/Skill Questions

- What are the identifying physical characteristics of common raptors in Virginia?
- What would a raptor prey on in an urban setting? In a suburban setting? In a rural setting?
- What are the types of prey for each species of raptor?
- How are raptors' long curved talons beneficial in capturing prey?
- What are the similarities and differences among raptors' eyesight and that of other families of birds?
- How does the flat shape of the owl's face aid in echolocation?

Task Number 102

Describe the role of raptors in urban, suburban, and rural habitats.

Definition

Description should include

- types of raptor prey
- benefits of raptor presence in rural, suburban, and urban environments
- raptors as indicators of ecosystem health.

Process/Skill Questions

- What are the benefits of raptors?
- Why is it important to maintain raptors' habitat?

Task Number 103

Describe the impact on "secondary consumers" (e.g., raptors) of chemicals used in agricultural, industrial, and domestic settings.

Definition

Description should include

- history of chemical use and its effect on raptors
- restoration efforts
- current status of chemical use.

Process/Skill Questions

- What are the effects of pesticides on raptors?
- What progress has been made to stabilize and restore raptor populations?
- How did dichlorodiphenyltrichloroethane (DDT) affect raptor populations?
- How have captive breeding programs improved endangered raptor populations?

Task Number 104

Investigate perching bird species in Virginia.

Definition

Investigation should include

- definition of *perching birds*
- examples of perching birds
- characteristics of perching birds
- importance of calls and territory.

Process/Skill Questions

- What perching birds are common to Virginia?
- What are some characteristics of songbirds, kingfishers, and hummingbirds?
- How do songbirds use calls to define their territory during the breeding season?
- How do birds navigate over long distances?

Task Number 105

Explain habitat requirements of perching birds.

Definition

Explanation should include

- a variety of habitat needs for Virginia perching birds
- protection of habitats
- anthropogenic impact on habitats
- restoring and establishing songbird habitat
- advantages and disadvantages of nesting systems
 - ground nests
 - cavity nests
 - tree nests
 - brush nests.

Process/Skill Questions

- What are the similarities and differences of habitat requirements for songbirds and hummingbirds?
- How can homeowners create suitable habitats for perching birds on their property?
- What regulations protect the habitat of perching birds in Virginia?
- Why are native plant species better food sources for native game birds, as compared to many exotic introduced landscape plants?

Task Number 106

Evaluate the anthropogenic impact on songbird populations in Virginia.

Definition

Evaluation should include

- history of songbird populations
- impact of forest fragmentation
- impact of brood parasitism
- efforts for conservation.

Process/Skill Questions

- How has the Audubon Society played a role in songbird population recognition and restoration?
- How do forest fragmentation and urbanization affect songbird populations?
- What effect does deforestation in other countries have on songbird populations in Virginia?
- How do cowbirds interact with songbirds?
- What improvements can be made to backyard habitats to help attract birds?
- How does the Migratory Bird Treaty Act of 1918 protect birds on the North American continent?
- What impacts have introduced species (e.g., cowbirds, starlings) had on native songbird populations?
- What role have pesticides played in the decline of songbird populations?

Task Number 107

Investigate the variety of shorebirds found in Virginia during different seasons.

Definition

Investigation should include

- definition of *shorebirds*
- physical characteristics of common shorebirds (e.g. long-legged wading birds, gull-like birds, upright perching water birds, duck-like birds, sandpiper-like birds, cranes, herons, egrets).

Process/Skill Questions

- What are common shorebirds in Virginia?
- What effect does coastal development have on local shorebird populations?
- How does habitat diversity help stabilize some shorebird populations?

Task Number 108

Describe characteristics of shorebirds.

Definition

Description should include

- nesting and reproductive habits
- food requirements
- bill length and shape
- length of legs
- migratory habits.

Process/Skill Questions

- What groups of food are eaten by shorebirds?
- How does the length of a shorebird's legs determine where they would hunt for food?
- How could arctic ice-melts and rising global temperatures affect shorebirds in Virginia?

- Why are stopover habitats important to migratory birds? What are some examples of stopover habitats?
- How do drought conditions affect shorebirds?

Examining the Principles of Aquatic Zoology

Task Number 109

Describe skeletal structures found in aquatic species.

Definition

Description should include

- endoskeleton vs. exoskeleton
- body shapes
- crustaceans, mollusks, and finfish.

Process/Skill Questions

- What is the difference between an endoskeleton and an exoskeleton?
- How does skeletal structure identify the type of aquatic species?
- How does the skeletal structure or system impact classification/taxonomy?

Task Number 110

Describe muscle structures found in aquatic species.

Definition

Description should include muscles of varying strengths and functions used for movement to obtain food, oxygen, and eliminate body wastes.

Process/Skill Questions

- What is the purpose of red muscles? White muscles?
- What are pink muscles?

Task Number 111

Describe the external anatomy of aquatic species, including fins and scales.

Definition

Description should include

- gills
- lateral line
- skin
- pectoral fin
- pelvic fin
- anal fin
- dorsal fins
- caudal fins (single-lobed and forked)
- vent
- nostrils/nares
- peropercle
- opercle
- mucus glands.

Process/Skill Questions

- How does the external anatomy help distinguish between sexes of aquatic species?
- What is the difference between fish with scales and those without?
- What is the purpose of the lateral line on fish?
- Keeping in mind that fisheries managers use scales and otoliths to age fish, why is it important for biologist to know the age structure in a lake or river?

Task Number 112

Identify adaptations of aquatic species to habitat.

Definition

Identification of adaption or changes should include

- color
- body shape
- fin location
- mouth size and orientation
- oxygen intake
- reproduction.

Process/Skill Questions

- What are examples of why aquatic species would have to adapt to a habitat?
- How does the location and shape of a fin help a fish survive in its habitat?
- How could changing mouth size help an aquatic species survive in its habitat?
- What does the shape, location, and size of the mouth tell you about a fish species?
- What aquatic species live in the unique ecosystem of Virginia's Clinch River?

- Why should specific river systems receive protection? Why?

Task Number 113

Describe digestive systems of aquatic species.

Definition

Description should include

- bottom feeders
- surface feeders
- filter feeders
- predatory fish.

Process/Skill Questions

- What are some examples of aquatic species in the herbivore category? Carnivore, Piscivore, and Omnivore category?
- What is the diet of a carnivorous bottom feeder? An herbivorous bottom feeder?
- What is the diet of a carnivorous top feeder? An herbivorous top feeder?

Task Number 114

Describe respiratory systems of aquatic species.

Definition

Description should include

- purpose of gills
- function of gills
- function of gill lamellae.

Process/Skill Questions

- What is the countercurrent system? How does it work?
- What is the function of gills in respiration?
- What is the function of the gill lamellae?
- How does a fish's respiratory system differ from a mammal's?

Managing Water Quality

Task Number 115

Examine water characteristics.

Definition

Examination should include

- physical properties of water
 - suspended solids
 - turbidity
 - color
 - taste and odor
 - temperature
- chemical properties of water
 - inorganic minerals
 - carbonate equilibrium
 - pH
 - acidity
 - alkalinity
 - inorganic indicators of water quality
 - hardness
- biological characteristics of water
 - bacteria
 - protozoa
 - viruses
 - algae
 - fungi
- water quality.

Process/Skill Questions

- What are aquifers?
- How does water temperature impact the health of fish?
- How do the physical properties of water impact wildlife?
- How do the chemical properties of water impact wildlife?
- How do the biological characteristics of water impact wildlife?
- How do trees help with water quality?

Task Number 116

Describe water quality indicators and standards.

Definition

Description should include

- biological indicators
- chemical testing
- temperature
- pH
- dissolved gasses
- dissolved solids
- wastes
- hardness
- salinity
- nitrates
- nitrites
- Clean Water Act
- existing or potential uses of water
- water pollution.

Process/Skill Questions

- What are the standards set forth by the Clean Water Act?
- How do changes in water quality affect aquatic species?
- How can the water quality of a pond be improved?
- How has the Clean Water Act impacted native vs. invasive species?
- What aquatic plants and animals indicate a healthy water system?
- How might increasing annual temperatures impact water quality? How might fish habitats and populations be affected?
- How does Virginia Save Our Streams (VASOS) use biological indicators to determine water quality?
- How is VASOS data used by government agencies?

Task Number 117

Explain the importance of water quality management practices.

Definition

Explanation should include

- water testing
- monitoring
- assessment
- data collection
- best management practices (BMPs).

Process/Skill Questions

- How can the pH of a body of water affect aquatic life?
- What is an example of a water quality BMP?
- What governmental agencies assist landowners with water quality management?
- How do extended droughts affect fresh/saltwater gradients? How does this relate to the stability of fish and fish fry populations?

Task Number 118

Describe methods for raising levels of dissolved oxygen in water.

Definition

Description should include

- increases in flow rate of water
- changes in water temperature
- methods used to incorporate oxygen into water
- effects of photosynthesis on dissolved oxygen.

Process/Skill Questions

- What effect does water temperature have on dissolved oxygen levels in water?
- How can dissolved oxygen levels be measured?
- How can more air be incorporated into the water?
- How do algae population levels affect the level of oxygen in water?
- How do temperature gradients in the water impact nutrient availability?

Task Number 119

Identify management practices that protect water systems from pollution.

Definition

Identification should include

- riparian zones
- buffer/filter strips
- total maximum daily load (TMDL)
- point source and nonpoint source pollution
- nutrient and sediment management.

Process/Skill Questions

- What is the difference between point and nonpoint source pollution?
- How do TMDLs relate to impaired waterways?
- Which government agencies help landowners improve water quality?
- How does government legislation affect management practices used to improve water quality?

Task Number 120

Identify agencies that assist in protecting water systems.

Definition

Identification should include

- Department of Environmental Quality
- Natural Resource Conservation Service
- Environmental Protection Agency
- Department of Conservation and Recreation
- Department of Forestry
- Soil and Water Conservation District.

Process/Skill Questions

- Why are agencies that protect water systems important?
- What role does the EPA play in maintaining stream quality?
- What are some examples of threats to source water?
- What are current management practices used by these organizations to enhance or restore stream quality?

Examining Freshwater Fish Species

Task Number 121

Describe the anatomy and physiology of fish.

Definition

Description should include the following systems:

- Skeletal
- Nervous
- Muscular
- Digestive
- Respiratory
- Sensory

Process/Skill Questions

- What is the purpose and function of the swim bladder in fish?
- How does the muscle structure of fish allow for movement through water?
- How does the sensory system of fish impact its role in the ecosystem?

Task Number 122

Describe the metabolic process of freshwater fish species.

Definition

Description should include

- carbon dioxide output
- oxygen intake
- excretion of nitrogen.

Process/Skill Questions

- How do fish obtain oxygen from fresh water?
- How do fish release carbon dioxide and nitrogen in water?
- How is the rate of metabolism in freshwater fish affected by external factors such as temperature and water quality?
- How is the rate of metabolism in freshwater fish affected by factors such as the fish's age and reproductive cycle?
- How are certain species of fish (e.g., carp, catfish, bowfin) able to live in oxygen-depleted water?

Task Number 123

Describe physical differences between saltwater and freshwater fish species.

Definition

Description should include

- level of salinity in saltwater and freshwater fish
- level of sensitivity to changes in water quality in saltwater and freshwater fish.

Process/Skill Questions

- How are different species of fish affected by salinity?
- What are the main differences between freshwater and saltwater fish?
- How do freshwater and saltwater fish consume and use water?
- What are some examples of fish common to Virginia that can live in brackish water?

Task Number 124

Describe the spawning processes and reproduction of fish species.

Definition

Description should include

- egg
- alevin
- fry
- fertilization
- incubation
- environmental factors.

Process/Skill Questions

- What environmental factors affect spawning?
- What are the different ways that fish eggs are fertilized?
- What are some ways in which freshwater fish protect their eggs from predation?
- What are some of the challenges of raising sturgeon from eggs to adults?

Task Number 125

Describe the importance of species diversity within a water system.

Definition

Description should include

- biodiversity
- food webs
- ecosystems.

Process/Skill Questions

- How are habitats with less diversity more vulnerable to collapse?
- How can food webs add to the diversity of a water ecosystem?
- How can habitats become more diverse?
- What impact do humans have on the diversity of a water ecosystem?
- How does sedimentation adversely affect stream bottoms and the necessary substrate for fish reproduction?

Task Number 126

Explain the role of predator species and the benefits of predation.

Definition

Explanation should include

- definition of a *predator*
- role of predation in biodiversity
- list of potential benefits of predation.

Process/Skill Questions

- How can predation have a positive effect on biodiversity?
- How can the removal of predation damage biodiversity?
- How can introducing a non-native species damage biodiversity?
- What are forage fish?
- What does *keystone species* mean?
- What is the impact of an invasive species on an aquatic environment?
- What are some examples of invasive species?

Task Number 127

Explain the difference between Virginia's warm-water and cold-water fish species.

Definition

Explanation should include

- examples of warm-water fish
- examples of cold-water fish
- habitat of warm-water fish
- habitat of cold-water fish
- temperature requirements of cold-water fish
- temperature requirements of warm-water fish.

Process/Skill Questions

- What are the temperature requirements of cold-water fish species?
- What is dissolved oxygen? Why is it important to cold-water fish species?
- What species of cold-water fish are found in Virginia?
- In which of Virginia's bodies of water would you find cold-water species?
- What are the temperature requirements of warm-water fish species?
- What species of warm-water fish are found in Virginia?
- What are the creel (harvest) and length limits for select species?
- What impact does monofilament line have on the environment?
- What is the proper cleaning method to reduce exposure to polychlorinated biphenyls (PCBs) when consuming fish?
- What are the restrictions on river herring?

Examining Anadromous, Diadromous, and Catadromous Fish

Task Number 128

Identify characteristics of diadromous, anadromous, and catadromous fish species.

Definition

Identification should include

- defining *anadromous*, *diadromous*, and *catadromous*
- being able to live in both freshwater and saltwater
- stresses of going from one environment to another
- pelagic spawners.

Process/Skill Questions

- What are the differences between anadromous and catadromous fish?
- What are some examples of anadromous, diadromous, and catadromous fish?
- What is an estuary?
- Why are estuaries so vital to the aquatic ecosystem?
- What is the definition of *pelagic*?

Task Number 129

Describe the life cycle and spawning process of anadromous, diadromous, and catadromous fish.

Definition

Description should include the following information:

- Anadromous fish are born in freshwater and then migrate as juveniles to the ocean, where they grow into adults before migrating back into freshwater to spawn.
- Diadromous fish migrate between freshwater and saltwater. The migration patterns differ for each species and have seasonal and lifecycle variations. Only one percent of all fish in the world are diadromous and include both anadromous and catadromous fish species.
- Catadromous fish are born in saltwater, then migrate as juveniles into freshwater, where they grow into adults before migrating back into the ocean to spawn.

Process/Skill Questions

- How do the anadromous fish find the stream where their lives began?
- What are some of the dangers the anadromous fish face when migrating?
- What are some reasons for the decline of the anadromous species?
- What are some challenges of the diadromous fish?
- What is a fish ladder? How does it impact fish migration?

Task Number 130

Describe the internal guidance systems of migratory fish.

Definition

Description should include

- magnoreception
- salinity
- water movement.

Process/Skill Questions

- How do fish use the earth's magnetic fields to find their spawning grounds?
- What other methods do fish use to find their natal river?
- What are some examples of fish that travel great distances to spawn?
- What are examples of other animals that travel great distances to reproduce?
- What are some examples of obstructions to fish migration?

Task Number 131

Explain management techniques used to improve fish populations.

Definition

Explanation should include

- identifying key habitat characteristics and how they function
- controlling off-shore catch of these species
- improving water quality
- removing obstructions to fish migration
- ensuring adequate stream flow
- protecting fish habitat.

Process/Skill Questions

- What are some ways to improve water quality?
- What laws or policies could benefit management techniques?

Examining Mollusks and Crustaceans

Task Number 132

Describe the classification system of freshwater mollusks and crustaceans.

Definition

Description should include

- gastropods
- bivalves
- cephalopods
- crustaceans.

Process/Skill Questions

- What is an example of bivalve mollusks?
- An octopus is an example of what type of mollusk?
- What are examples of cephalopods?

Task Number 133

Describe biological and physiological characteristics of mollusks and crustaceans.

Definition

Description should include characteristics of mollusks and crustaceans, to include the following:

- invertebrates
- shell hardness
- number of arms and legs
- methods of movement
- methods of obtaining food

Process/Skill Questions

- How does the body of a mollusk differ from a crustacean?
- How does a mussel obtain food?
- How many legs are there on a crab? Crayfish?

- What are the functions of the various pairs of legs on crustaceans? How does the function of the legs of crustaceans differ from that of cephalopods?

Task Number 134

Explain freshwater mollusks' role as water quality indicators.

Definition

Explanation should include the following:

- Mussels' response to changes in water quality
- Gradual mussel die-offs or sudden mussel kills are reliable indicators of water quality problems
- Mussels are extremely susceptible to pollutants (e.g., ammonia, heavy metals, chlorine) in the water
- Stable and diverse mussel populations generally indicate clean water.

Process/Skill Questions

- Why are mussels good indicators of water quality?
- How would mussels respond to extremes in water pH?
- What can one do to protect the water quality?
- How do mussels help the environment?
- What are zebra mussels? How do they impact water quality?
- What are some economic issues that result from zebra mussels inhabiting a body of water?
- What species of invasive freshwater mollusks are found in Virginia?
- How do the reproductive methods of native and invasive species (e.g., zebra mussels, Asiatic clam) differ?

Task Number 135

Describe the diversity of freshwater mollusks found in Virginia's streams.

Definition

Description should include that Virginia has between 70 and 80 species of freshwater mollusks. Virginia's streams rank fifth in the number of different types of freshwater mollusks.

Process/Skill Questions

- What are the most common species of freshwater mollusks in Virginia?
- Why does Virginia have such a large diversity of freshwater mollusks?
- How do mollusks and fish impact one another?
- Why are fish essential to the reproduction of Virginia's freshwater mussels?
- What is being done to restore Virginia's freshwater mussel populations?
- What Virginia river system is the most diverse in terms of mussels?

Managing Fisheries

Task Number 136

Describe sound practices in fisheries management.

Definition

Description should include

- protecting fishery resources
- managing the actions of people (e.g., workers, fishermen, stakeholders)
- using quality data.

Process/Skill Questions

- What are some examples of destructive fishing practices?
- What is the difference between a natural fishery and fish farming?
- What are the differences in management practices for recreational and commercial fisheries?
- What are some possible goals of fisheries?
- What factors should be considered before opening a fishery?

Task Number 137

Describe parameters used in indices of fish populations, including the utility of these indices.

Definition

Description should include estimating

- fish populations
- growth rates
- catch rates
- mortality rates
- statistical analysis of fish populations over a period of time
- age/class distribution.

Process/Skill Questions

- How are the populations of fisheries determined by using existing data?
- What effects do hatcheries have on existing natural populations?
- What effects do overfishing or natural disasters have on existing fishery populations?

- Why are menhaden important in the Chesapeake Bay ecosystem?
- What controversy surrounds the menhaden in Virginia?
- What are some fish sampling methods?

Task Number 138

Describe fish structures and habitats.

Definition

Description should include

- definition of *fishery*
- location of fisheries
- habitat features of existing fisheries
- artificial structures.

Process/Skill Questions

- How do fishery management goals vary based on the species?
- What are the typical features of the different types of fisheries?
- How are fishery habitats affected by human interventions?
- What are the functions of artificial structures?

Task Number 139

Describe harvesting methods.

Definition

Description could include

- trawls
- seines
- lines
- gillnets
- nets and traps
- pots.

Process/Skill Questions

- What are some benefits of harvesting fish?
- What types of fish are harvested by trolling?
- What is a benefit of using gillnets?
- What are the potential consequences of using gillnets?
- What are turtle exclusion devices?
- What is bycatch?

Task Number 140

Describe population management tools used in fisheries.

Definition

Description could include

- stocking
- harvesting
- fish farming
- overfishing
- sustainability.

Process/Skill Questions

- What anthropogenic factors influence fish population rates?
- How can humans manage fish populations?
- What are some management methods used to maintain fishery populations?
- Why is sustainability of fish species important to Virginia's economy?

Task Number 141

Identify the uses of fisheries.

Definition

Identification should include

- the function of fisheries
- the importance of fisheries in maintaining aquatic populations
- the people involved in fisheries management.

Process/Skill Questions

- How are fisheries used to maintain aquatic populations?
- What are other functions of fisheries?
- Who is involved in the management of a fishery?

Exploring Careers in Fisheries and Wildlife Management

Task Number 142

Research career opportunities within the fisheries and wildlife management field.

Definition

Research should include

- listing careers related to fisheries and wildlife management (e.g., entrepreneurial, governmental, and private industry)
- determining the education and experience required for specific careers
- examining the working conditions associated with specific jobs in the fisheries and wildlife management industry
- developing a plan to gain the necessary education and experience for a career in fisheries and wildlife management
- determining trends in fisheries and wildlife management careers (e.g., increase or decrease in available positions, job security).

Process/Skill Questions

- What careers are available in the fisheries and wildlife management industry?
- What types of fisheries and wildlife careers are available locally?
- What are the working environments/conditions of fisheries and wildlife management employees?
- How can the level of education required for a specific career in fisheries and wildlife management be determined?
- Why is a career plan important?
- Which Virginia schools offer postsecondary degree programs in a bachelor's or master's in the field of fisheries and/or wildlife management?

SOL Correlation by Task

39	Identify the role of supervised agricultural experiences (SAEs) in agricultural education.	English: 11.3, 11.5, 12.3, 12.5
40	Participate in an SAE.	English: 11.5, 11.8, 12.5, 12.8
41	Identify the benefits and responsibilities of FFA membership.	English: 11.5, 11.6, 11.7, 11.8, 12.5, 12.6, 12.7, 12.8
42	Describe leadership characteristics and opportunities as they relate to agriculture and FFA.	English: 11.5, 12.5 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: 11.5, 12.5

44	Explain how anatomy contributes to an animal's ability to survive in given habitats.	English: 11.5, 12.5 Science: BIO.4
45	Examine classification levels within the science of taxonomy.	English: 11.5, 11.8, 12.5, 12.8 Science: BIO.6
46	Examine cell structure and cell function in animals.	English: 11.5, 12.5 Science: BIO.3
47	Describe the process of mitosis.	English: 11.5, 12.5 Science: BIO.5
48	Define the phases in the process of meiosis.	English: 11.3, 11.5, 12.3, 12.5 Science: BIO.5
49	Describe the history of wildlife management in the United States.	English: 11.5, 12.5 History and Social Science: VUS.2, VUS.3, VUS.8
50	Define the <i>era of abundance</i> , <i>era of over-exploitation</i> , <i>era of protection</i> , <i>era of game management</i> , <i>era of environmental management</i> , and <i>era of conservation biology</i> .	English: 11.3, 11.5, 12.3, 12.5 History and Social Science: GOVT.16, VUS.2, VUS.3, VUS.8
51	Identify the private and nonprofit organizations focused on stewardship of fisheries and wildlife.	
52	Describe the benefits brought about by outdoor enthusiasts and wildlife organizations.	English: 11.5, 12.5 History and Social Science: GOVT.16, VUS.8
53	Identify conservation agencies in Virginia.	
54	Describe the roles of federal agencies in the protection of fisheries and wildlife.	English: 11.5, 12.5 History and Social Science: GOVT.16
55	Explain funding sources for wildlife management agencies.	English: 11.5, 12.5
56	Describe the relationship between an ecosystem and a biome.	English: 11.3, 11.5, 11.8, 12.3, 12.5, 12.8 Science: BIO.8
57	Describe ecosystem overlap.	English: 11.3, 11.5, 12.3, 12.5
58	Describe the cleansing role of wetlands.	
59	Compare the similarities and differences of the terrestrial biomes found in North America.	English: 11.5, 12.5 Science: BIO.8
60	Explain the value of wildlife to society.	English: 11.5, 12.5
61	Identify the benefits of wildlife to humans.	
62	Describe successful stewardship practices.	English: 11.5, 12.5

		History and Social Science: GOVT.16
63	Examine the importance of protection and preservation of species.	English: 11.5, 12.5 History and Social Science: GOVT.16
64	Describe the United States Endangered Species Act (ESA).	English: 11.5, 12.5
65	Explain the effects of the Endangered Species Act requirements on agriculture.	English: 11.5, 12.5
66	Identify species protected by the Endangered Species Act.	
67	Identify threatened and endangered (T&E) species in Virginia.	
68	Describe environmental factors that lead to the extinction of certain species.	English: 11.5, 12.5 History and Social Science: GOVT.16 Science: BIO.8
69	Explain how agricultural research can help protect vulnerable wildlife species.	English: 11.5, 12.5
70	Describe the different types of habitats.	English: 11.5, 12.5 Science: BIO.8
71	Explain factors that cause a species to become threatened and/or endangered.	English: 11.5, 12.5 History and Social Science: GOVT.16 Science: BIO.7, BIO.8
72	Describe the loss of habitat in Virginia.	English: 11.5, 12.5 Science: BIO.8
73	Explain the importance of each element of habitat.	English: 11.5, 12.5 Science: BIO.8
74	Describe the anthropogenic impact on habitat.	English: 11.5, 12.5 Science: BIO.8
75	Explore the adaptation of various wildlife species to human development.	English: 11.5, 12.5 Science: BIO.8
76	Identify specific activities in which humans harm or destroy wildlife habitat.	English: 11.5, 12.5 History and Social Science: GOVT.16 Science: BIO.7, BIO.8
77	Evaluate habitat protection and improvement efforts.	English: 11.5, 12.5
78	Identify characteristics specific to mammals.	Science: BIO.4

79	Describe the biology, ecology, and importance of mammals.	English: 11.5, 12.5 Science: BIO.4
80	Identify species of rodents and lagomorphs in Virginia and North America.	
81	Identify species of ungulates (hoofed mammals) in Virginia and North America.	
82	Describe the ungulate ruminant digestive system.	English: 11.5, 12.5
83	Describe the positive and negative impacts of the white-tailed deer population on Virginia residents.	English: 11.5, 12.5
84	Evaluate hunting as a tool for managing wildlife populations.	English: 11.5, 12.5
85	Investigate the role of predatory mammals in Virginia and North America.	English: 11.5, 12.5 Science: BIO.8
86	Identify unusual mammal species in Virginia and North America.	English: 11.5, 12.5 Science: BIO.8
87	Describe the role that each group of mammals plays in its ecosystems.	English: 11.5, 12.5 Science: BIO.8
88	Explain the extirpation of certain mammal species from Virginia and their possible reintroduction.	English: 11.5, 12.5
89	Describe management activities and practices used to control mammal populations.	English: 11.5, 12.5
90	Identify species of reptiles and amphibians in Virginia and North America.	Science: BIO.8
91	Describe the biological and ecological importance of reptiles and amphibians.	English: 11.5, 12.5 Science: BIO.8
92	Describe methods of managing reptile and amphibian species.	English: 11.5, 12.5
93	Explore avian physiology and biology.	English: 11.5, 12.5 Science: BIO.4
94	Identify waterfowl species common to Virginia.	Science: BIO.8
95	Explain modern waterfowl management practices.	English: 11.5, 12.5
96	Describe the benefits provided by groups like Ducks Unlimited and the Audubon Society.	English: 11.5, 12.5
97	Identify game bird species common to Virginia.	Science: BIO.8
98	Describe game bird habitat and ecology.	English: 11.5, 12.5 History and Social Science: GOVT.16 Science: BIO.8
99	Evaluate hunting regulations and their impact on game bird management.	English: 11.5, 12.5
100	Describe raptor species common to Virginia.	English: 11.3, 11.5, 12.3, 12.5 Science: BIO.8

101	Describe characteristics of raptors.	English: 11.5, 12.5 Science: BIO.8
102	Describe the role of raptors in urban, suburban, and rural habitats.	English: 11.5, 12.5 Science: BIO.8
103	Describe the impact on "secondary consumers" (e.g., raptors) of chemicals used in agricultural, industrial, and domestic settings.	English: 11.5, 11.8, 12.5, 12.8
104	Investigate perching bird species in Virginia.	English: 11.3, 11.5, 12.3, 12.5 Science: BIO.8
105	Explain habitat requirements of perching birds.	English: 11.5, 12.5 Science: BIO.8
106	Evaluate the anthropogenic impact on songbird populations in Virginia.	English: 11.5, 11.8, 12.5, 12.8
107	Investigate the variety of shorebirds found in Virginia during different seasons.	English: 11.3, 11.5, 12.3, 12.5 Science: BIO.8
108	Describe characteristics of shorebirds.	English: 11.5, 12.5 Science: BIO.8
109	Describe skeletal structures found in aquatic species.	English: 11.5, 12.5 Science: BIO.4
110	Describe muscle structures found in aquatic species.	English: 11.5, 12.5 Science: BIO.4
111	Describe the external anatomy of aquatic species, including fins and scales.	English: 11.5, 12.5 Science: BIO.4
112	Identify adaptations of aquatic species to habitat.	Science: BIO.8
113	Describe digestive systems of aquatic species.	English: 11.5, 12.5 Science: BIO.8
114	Describe respiratory systems of aquatic species.	English: 11.5, 12.5 Science: BIO.8
115	Examine water characteristics.	English: 11.5, 12.5 Science: BIO.2
116	Describe water quality indicators and standards.	English: 11.5, 12.5
117	Explain the importance of water quality management practices.	English: 11.5, 12.5
118	Describe methods for raising levels of dissolved oxygen in water.	English: 11.5, 12.5
119	Identify management practices that protect water systems from pollution.	
120	Identify agencies that assist in protecting water systems.	History and Social Science: GOVT.9, GOVT.15

121	Describe the anatomy and physiology of fish.	English: 11.5, 12.5 Science: BIO.4
122	Describe the metabolic process of freshwater fish species.	English: 11.5, 12.5 Science: BIO.4
123	Describe physical differences between saltwater and freshwater fish species.	English: 11.5, 12.5 Science: BIO.4
124	Describe the spawning processes and reproduction of fish species.	English: 11.5, 12.5
125	Describe the importance of species diversity within a water system.	English: 11.5, 12.5 Science: BIO.8
126	Explain the role of predator species and the benefits of predation.	English: 11.5, 12.5 Science: BIO.7
127	Explain the difference between Virginia's warm-water and cold-water fish species.	English: 11.5, 12.5 Science: BIO.8
128	Identify characteristics of diadromous, anadromous, and catadromous fish species.	
129	Describe the life cycle and spawning process of anadromous, diadromous, and catadromous fish.	English: 11.5, 12.5
130	Describe the internal guidance systems of migratory fish.	English: 11.5, 12.5
131	Explain management techniques used to improve fish populations.	English: 11.5, 12.5 History and Social Science: GOVT.16
132	Describe the classification system of freshwater mollusks and crustaceans.	English: 11.5, 12.5 Science: BIO.4
133	Describe biological and physiological characteristics of mollusks and crustaceans.	English: 11.5, 12.5 Science: BIO.4
134	Explain freshwater mollusks' role as water quality indicators.	English: 11.5, 12.5
135	Describe the diversity of freshwater mollusks found in Virginia's streams.	English: 11.5, 12.5 Science: BIO.8
136	Describe sound practices in fisheries management.	English: 11.5, 12.5
137	Describe parameters used in indices of fish populations, including the utility of these indices.	English: 11.5, 12.5
138	Describe fish structures and habitats.	English: 11.3, 11.5, 12.3 Science: BIO.8
139	Describe harvesting methods.	English: 11.5, 12.5
140	Describe population management tools used in fisheries.	Science: BIO.7
141	Identify the uses of fisheries.	

142	Research career opportunities within the fisheries and wildlife management field.	English: 11.5, 11.6, 11.7, 12.5, 12.6, 12.7 History and Social Science: GOVT.8, GOVT.15, GOVT.16
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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](#)
- [Employment Skills](#)
- [Extemporaneous Public Speaking](#)
- [Parliamentary Procedure](#)
- [Prepared Public Speaking](#)

The following career development events are available for this course:

- [Agricultural Communications](#)
- [Agricultural Sales](#)
- [Agronomy](#)
- [Agricultural Technology & Mechanical Systems](#)
- [Dairy Cattle Evaluation and Management](#)
- [Environmental & Natural Resources](#)
- [Farm and Agribusiness Management](#)
- [Floriculture](#)
- [Food Science and Technology](#)
- [Forestry](#)
- [Horse Evaluation](#)
- [Marketing Plan](#)
- [Meats Evaluation and Technology](#)
- [Nursery/Landscape](#)
- [Poultry Evaluation](#)
- [Veterinary Science](#)

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
- 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)
- 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)
- Forestry Management (8042/36 weeks)
- Forestry Management, Advanced (8044/36 weeks)
- Introduction to Animal Systems (8008/36 weeks)
- Introduction to Natural Resources and Ecology Systems (8040/36 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
Animal Systems	Animal Geneticist Animal Nutritionist Animal Scientist Aquacultural Manager Veterinarian Veterinary Technician
Environmental Service Systems	Environmental Sampling and Analysis Technician Water Conservationist
Natural Resources Systems	Ecologist Fish and Game Officer Fisheries Technician Forest Manager, Forester Forest Technician

Career Cluster: Agriculture, Food and Natural Resources	
Pathway	Occupations
	Park Manager Park Technician Range Technician Wildlife Manager
Plant Systems	Botanist Farm, Ranch Manager Farmer/Rancher Forest Geneticist Plant Breeder/ Geneticist Secondary School Teacher Soil and Plant Scientist Tree Surgeon
Power, Structural, and Technical Systems	Agricultural Engineer