

Canon Envirothon Curriculum Guidelines

Canon Envirothon spans the length and breadth of North America – from the deserts of the southwestern United States to the frozen tundra near the Arctic Circle in Canada; from the Everglades to the Olympic peninsula. It is a large territory with many different habitats and remarkable biological and cultural diversity. The Curriculum Guidelines have been developed to accommodate as much educational diversity as possible. They are not meant to replace any state or provincial Envirothon curriculum, but rather to provide a standard framework for students and advisors headed to the Canon Envirothon.

Curriculum Guidelines are available for the four major Canon Envirothon topic areas.

AQUATICS ECOLOGY

Key Point 1: Abiotic Factors

Learning Objectives:

1. Know the processes and phases for each part of the water cycle and understand the water cycle's role in soil nutrient erosion, salinization of agricultural lands, and climatic influences.
2. Understand the concept and components of a watershed and be able to identify stream orders and watershed boundaries. Know the features of a healthy watershed and an unhealthy watershed.
3. Know how to perform and interpret chemical water quality tests and understand why aquatic organisms and water quality is affected by the physical, chemical and biological conditions of the water.

Suggested Activities:

1. Use topographic maps to investigate the concept of a watershed, identify a river's watershed system, and delineate the watershed of a given area. Be able to describe how different land uses and watershed characteristics can affect water runoff, water flow, types of stream habitats and management approaches.
2. Investigate and find out who is using the water in your watershed and become familiar with historic stream and river levels to learn if levels are increasing or decreasing. Use stream assessment data to determine the health of your watershed.
3. Conduct chemical water quality tests to determine the temperature, dissolved oxygen, pH, phosphorus, alkalinity, nitrogen, and dissolved oxygen percent saturation of a water sample and explain why these test results are indicators of water quality and can be used to assess and manage aquatic environments.

Resources:

1. [USGS Water Science Basics: What is the Water Cycle?](#)
2. [Basic concepts on Watersheds](#)
3. [How to Read a Topographic Map and Delineate a Watershed](#)
4. [Georgia Adopt a Stream Manual on Biological and Chemical Stream Monitoring](#)

Key Point 2: Biotic Factors

Learning Objectives:

1. Understand the dependence of all organisms on one another and how energy and matter flow within an aquatic ecosystem.
2. Understand the concept of carrying capacity for a given aquatic ecosystem, and be able to discuss how competing water usage may affect the ability of the system to sustain wildlife, forestry and anthropogenic needs.
3. Identify common, rare, threatened and endangered aquatic species as well as Aquatic Nuisance Species (ANS) through the use of a key.
4. Know how to perform biological water quality monitoring tests and understand why these tests are used to assess and manage aquatic environments.

Suggested Activities:

1. Describe the habitat needs of three specific aquatic animals, and compare and contrast the flow of energy in three different aquatic food chains.
2. Create a visual display of rare and endangered aquatic species. Explain how human activities are causing species imperilment and specify actions being taken to protect these species.
3. Conduct a biological stream assessment by collecting macro-invertebrates. Stream Data sheets (key point 1, resource 4) should be used to record and analyze information. Explain why these organisms are biological indicators that help us determine the health of a stream or waterway.

Resources:

1. [Introduction to Watershed Ecology: Watershed Academy Web](#)
2. [NOAA The Endangered Species Act: Marine Species](#)
3. [EPA An Introduction to Freshwater Fishes as Biological Indicators, pages 3-12](#)
4. [Georgia Adopt a Stream Manual on Biological and Chemical Stream Monitoring](#)
5. [WV Save Our Streams' Benthic Macro-invertebrate field guide](#)

Key Point 3: Aquatic Environments

Learning Objectives:

1. Identify aquatic and wetland environments based on their physical, chemical and biological characteristics.
2. Know characteristics of different types of aquifers, and understand historical trends and threats to groundwater quantity and quality.
3. Understand societal benefits and ecological functions of wetlands.
4. Understand the functions and values of riparian zones and be able to identify riparian zone areas.

Suggested Activities:

1. Describe the physical, chemical and biological characteristics of a stream, river, pond, lake and wetland.
2. Explain how different types of aquifers are indicators of water quantity and water quality. Describe how subsidence and salt water intrusion are related to the falling water table in many aquifers.
3. Describe three functions of wetlands, and explain how these functions are met in the absence of wetlands.
4. Describe three functions of riparian zones and explain how the removal of or damage to the riparian zone would affect water quality and specific aquatic food chains.

Resources:

1. [USGS Ground water](#)
2. [Types of Wetlands](#)
3. [Wetland Functions and Values](#)
4. [Benefits of Riparian Zones](#)
5. [Riparian Zones: Managing Early-Successional Habitats near the Water's Edge](#)

Key Point 4—Water Protection and Conservation

Learning Objectives:

1. Understand how education programs and enforcement agencies are working together to protect aquatic habitats and preventing those who use our waterways from inadvertently transporting Aquatic Nuisance Species ANS from one river to another.
2. Interpret major provincial and /or federal laws and methods used to protect water quality (i.e. surface and ground water). Utilize this information to propose management decisions that would improve the quality of water in a given situation.
3. Be familiar with the Federal, Provincial and state agencies that provide oversight of water resources, and understand that Geographic Information Systems (GIS) is a useful and important tool in the management of water resources.
4. Identify global and local sources of point and non-point source pollution and be able to discuss methods to reduce point and non-point source pollution.
5. Understand the interaction of competing uses of water for water supply, hydropower, navigation, wildlife, recreation, waste assimilation, irrigation, and industry.
6. Know the meaning of water conservation, and understand why it is important every time you turn on a faucet.

Suggested Activities:

1. List at least 3 Aquatic Nuisance Species ANS, and describe their effects on an aquatic ecosystem. Consider what can happen when predator ANS are imported, and develop a plan for the eradication of a target ANS.
2. Site water protection laws at a mock hearing to decide whether a permit should be given to build a new shopping mall along a river.
3. Explain how Geographic Information Systems (GIS) are being used to help communities assess water quality and watershed health information.
4. Compare water usage in different regions of Canada and the United States and propose actions to help countries strike a balance between supply and demand in order to realize maximum benefit from our water resources.
5. Design a comprehensive water conservation plan for your home and the watershed below your home. This should include groundwater replenishment, securing sediment on your property, managing non-point source pollution and following the path of good quality water as it leaves your property on its way to the sea.
6. Many dams are used to provide low cost electricity at the critical time of day when there is peak demand for electricity. Today a major issue is deciding which is more important to the economy, low cost energy or improving/restoring the ecology of a river. Evaluate the issue and develop recommendations for conservation groups and utility executives.

Resources:

1. [What are Aquatic Nuisance Species \(ANS\)?](#)
2. [ANS Task Force](#)
3. [Conservation of Great Lakes Wetlands: Environment Canada](#)
4. [Summary of the Federal Clean Water Act: \(SDWA\)](#)
5. [The Quality of Our Nation's Water](#)
6. [GIS and Hydrology](#)

7. [Water Resources](#)
8. [Water Conservation](#)
9. [Polluted Runoff: Nonpoint Source Pollution](#)

Aquatic Ecology Guidelines Correlated to National Science Standards

Key National Science Standard (NSS)

UC	Unifying Concepts
I	Inquiry
P	Physical Science
L	Life Science
E	Earth & Space Science
ST	Science & Technology
SP	Personal & Social Perspective
H	History & Nature of Science

Learning Objectives:	Key Point 1: Abiotic Factors	Activity	NSS	Topic
1.	Know the processes and phases for each part of the water cycle and understand the water cycle's role in soil nutrient erosion, salinization of agricultural lands, and climatic influences.	Study	I, P, E, UC, SP, ST	Natural Resources, Environmental Quality
2.	Understand the concept and components of a watershed and be able to identify stream orders and watershed boundaries. Know the features of a healthy watershed and an unhealthy watershed.	Use topographic maps	E, UC, SP	Earth Science, Natural Resources

3.	Know how to perform and interpret chemical water quality tests and understand why aquatic organisms and water quality is affected by the physical, chemical and biological conditions of the water.	Chemical stream assessment	I, UC, P, E, L, ST, SP	Physical, Earth, and Life Sciences, Environmental quality
Learning Objectives:	Key Point 2: Biotic Factors	Activity	NSS	Topic
1.	Understand the dependence of all organisms on one another and how energy and matter flow within an aquatic ecosystem.	Compare and Contrast different food chains	I, UC, E, L, SP	Interdependence of Organisms, Environmental quality
2.	Understand the concept of carrying capacity for a given aquatic ecosystem, and be able to discuss how competing water usage may affect the ability of the system to sustain wildlife, forestry and anthropogenic needs.	Analyze and discuss human actions	I, UC, L, SP	Matter, Energy and Organization in Living Systems
3.	Identify common, rare, threatened and endangered aquatic species as well as Aquatic Nuisance Species (ANS) through the use of a key.	Visual display	I, UC, L, SP	Interdependence of Organisms, Behavior of Organisms
4.	Know how to perform biological water quality monitoring tests and understand why these tests are used to assess and manage aquatic environments.	Biological stream assessment	I, UC, P, E, L, ST, SP	Environmental quality
Learning Objectives:	Key Point 3: Aquatic Environments	Activity	NSS	Topic
1.	Identify aquatic and wetland environments based on their physical, chemical and biological characteristics.	Study and Presentation	I, P, E, L, UC, SP	Systems, order & organization Environmental quality

2.	Know characteristics of different types of aquifers, and understand historical trends and threats to groundwater quantity and quality.	Study and analysis	I, E, SP, H	Natural Resources, Environmental Quality
3.	Understand societal benefits and ecological functions of wetlands.	Study	I, UC, SP,	Environmental quality, Personal and Social perspective
4.	Understand the functions and values of riparian zones and be able to identify riparian zone areas.	Study and analysis	I, P, E, L, UC, SP	Natural Resources, Environmental Quality
Learning Objectives:	Key Point 4: Water Protection and Conservation	Activity	NSS	Topic
1.	Understand how education programs and enforcement agencies are working together to protect aquatic habitats and preventing those who use our waterways from inadvertently transporting Aquatic Nuisance Species ANS from one river to another.	Study of Aquatic Nuisance Species	I, UC, SP	Environmental quality Personal and Social perspective
2.	Interpret major provincial and /or federal laws and methods used to protect water quality (i.e. surface and ground water). Utilize this information to propose management decisions that would improve the quality of water in a given situation.	Interpreting water quality laws	I, SP, H	Environmental Quality, Personal and Social perspective
3.	Be familiar with the Federal, Provincial and state agencies that provide oversight of water resources, and understand that Geographic Information Systems (GIS) is a useful and important tool in the management of water resources.	Study of how GIS is used in Natural resources management	E, ST, SP	Natural resources Science and Technology
4.	Identify global and local sources of point and non-point source pollution and be able to discuss methods to reduce point and non-point source pollution.	Discussion and field study	E, UC	Environmental quality Natural & human hazards Personal and social perspective

5.	Understand the interaction of competing uses of water for water supply, hydropower, navigation, wildlife, recreation, waste assimilation, irrigation, and industry.	Compare water usage in Canada and U.S.	E, UC, SP	Natural Resources, Personal and Social Perspective
6.	Know the meaning of water conservation, and understand why it is important every time you turn on a faucet.	Design a water conservation plan	E, UC, SP	Natural resources, Environmental Quality, Personal and Social Perspective

FORESTRY

Key Point 1—Tree Physiology and Tree and Shrub Identification

Learning Objectives:

1. Know the parts and tissues of a tree, and be able to explain the growth cycle and life cycle of a tree.
2. Understand the processes of photosynthesis and respiration and how they are important to the growth and reproduction of trees.
3. Identify common tree species without a key, and identify specific or unusual trees and shrubs through the use of a key.

Suggested Activities:

1. Identify trees and shrubs using leaf and seed samples.

Suggested Resources:

1. [Tree Physiology](#)
2. [Parts of a Tree](#)
3. [Glossary of Tree Terms](#)
4. [How Does a Tree Grow](#)
5. [Key for Tree ID](#)

Key Point 2—Forest Ecology

Learning Objectives:

1. Know the typical forest structure: canopy, understory and ground layers and crown classes.
2. Understand forest ecology concepts and factors affecting them, including the relationship between soil and forest types, tree communities, regeneration, competition, and primary and secondary succession.
3. Identify the abiotic and biotic factors in a forest ecosystem, and understand how these factors affect tree growth and forest development. Consider factors such as climate, insects, microorganisms, and wildlife.

Suggested Activities:

1. Identify and describe the life cycle of forest pests and invasive plants and describe their impact to a forest ecosystem. Research integrated pest management strategies for selected pests.
2. Draw food webs of a mature deciduous forest and a mature coniferous forest. Explain how wildlife habitat relates to the forest community and describe the niches of various organisms that live in both of these forest ecosystems.
3. Examine a “tree cookie” or core sample taken with an increment borer to determine the age, growing conditions, insect and disease damage, and past weather conditions.
4. Project Learning Tree Activity 7, Understanding Fire: Explore patterns of change brought about by fires in a forest ecosystem.

Suggested Resources:

1. [Managing Forests for Fish and Wildlife](#)
2. [Dendrochronology](#)
3. [Project Learning Tree Activity 7: Understanding Fire](#)

Key Point 3—Sustainable Forest Management

Learning Objectives:

1. Understand the term silviculture, and be able to explain the uses of the following silviculture techniques: thinning, prescribed burning, single tree and group tree selection, shelterwood method, clear-cutting with and without seed trees, and coppice management.
2. Explain the following silviculture systems: clear-cutting , seed tree method, evenaged management, unevenaged management, shelterwood and selection.
3. Understand the methodology and uses of the following silviculture treatments: Planting, weeding, pre-commercial thinning (PCT), commercial thinning and harvesting.
4. Know how to use forestry tools and equipment in order to measure tree diameter, height and basal area.
5. Understand how the following issues are affected by forest health and management: biodiversity, forest fragmentation, forest health, air quality, aesthetics, fire, global warming and recreation.
6. Understand how forestry management practices and policy affect sustainability.
7. Understand how economic, social and ecological factors influence forest management decisions.
8. Learn how science and technology are being utilized in all aspects of forest management.

Suggested Activities:

1. Use the following forestry tools and know how they are used in forest management. clinometer, increment borer, diameter tape, biltmore stick, abney level, and compass, prism and relescope.
2. Use a variety of volume tables to calculate the volume of lumber for several different tree species.
3. Project Learning Tree Activity 8, Fire Management: Learn the many interdependencies of forests and fire in healthy ecosystems.
4. Compare two different forest types. For example: an eastern hardwood forest in PA to a conifer forest in Oregon. Identify economic, social and ecological factors that affect how both of these forests are managed.
5. Explain the Information Technology used to monitor and productively manage forests, and give specific examples of how this technology is being utilized in all aspects of forest management.

Suggested Resources:

1. [Woodland Management: Measuring your Forests](#)
2. [Forest Stewardship -Timber Harvesting: PSU Bulletin 7](#)
3. [Forest Stewardship –BMPs: PSU Bulletin 12](#)
4. [Project Learning Tree Activity 8, Fire Management](#)
5. [Forest Health](#)
6. [Technology in the Forest](#)

Key Point 4—Trees as an Important Renewable Resource

Learning Objectives:

1. Understand the importance and value of trees in urban and community settings, and know the factors affecting their health and survival.
2. Understand the economic value of forests and know many of the products they provide to people and society.
3. Explain the “Ecosystem Services” provided by trees, and understand why trees and forests are important to human health, recreation, wildlife, and watershed quality.

Suggested Activities:

1. Create a display showing the value of trees in both urban and suburban settings. Identify the factors that affect their health and survival, and explain how to properly care for trees in an urban environment.
2. Make a list of products and by-products that come from your home and are made from trees. Describe the chemical and physical properties of trees used in making these products.

Suggested Resources:

1. [Products from Trees](#)
2. [Benefits of Community Trees and Forests](#)
3. [Trees and Ecosystem Services](#)
<http://www.naturewithin.info/UF/UFdefined.html>

Forestry Correlation to National Science Standards

Key National Science Standard (NSS)

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Learning Objectives:	Key Point 1: Tree Physiology and Tree and Shrub ID	Activity	NSS	Topic
1.	Know the parts and tissues of a tree, and be able to explain the growth cycle and life cycle of a tree.	Study	I, L, UC,	Inquiry, Life Science
2.	Understand the processes of photosynthesis and respiration and how they are important to the growth and reproduction of trees.	Study	E, L, UC	Cell Functions, Matter, Energy and Organization in Living Systems
3.	Identify common tree species without a key, and identify specific or unusual trees and shrubs through the use of a key.	Field study, classification and ID	P,E, L,U C	Life Science
Learning Objectives:	Key Point 2: Forestry Ecology	Activity	NSS	Topic
1.	Know the typical forest structure: canopy, understory and ground layers and crown classes.	Study of living systems	I, E, L,U C	Matter and energy and organization in living systems
2.	Understand forest ecology concepts and factors affecting them, including the relationship between soil and forest types, tree communities, regeneration, competition, and primary and secondary succession.	Study, Drawing and presentation	E, L, UC	Cycles, order & organization, Environmental quality
3.	Identify the abiotic and biotic factors in a forest ecosystem, and understand how these factors affect tree growth and forest development. Consider factors such as climate, insects, microorganisms, and	Project Learning Tree Activity	P, E, L, UC, SP	Interdependence of Organisms, Behavior of organisms, Environmental Quality

Learning Objectives:	Key Point 3: Sustainable Forestry Management	Activity	NSS	Topic
1.	Understand the term silviculture, and be able to explain the uses of the following silviculture techniques: thinning, prescribed burning, single tree and group tree selection, shelterwood method, clear-cutting with and without seed trees, and coppice management.	Field study	I, P, L, UC, SP	Natural Resources, Interdependence of organisms, Behavior of organisms
2.	Explain the following silviculture systems: clear-cutting, seed tree method, even-aged management, uneven-aged management, shelterwood and selection.	Field study	I, L, UC, SP	Natural Resources, Matter, Energy, and Organization in Living Systems
3.	Understand the methodology and uses of the following silviculture treatments: Planting, weeding, pre-commercial thinning (PCT), commercial thinning and harvesting.	Field study	I, L, UC, SP	Environmental quality, Science and Technology
4.	Know how to use forestry tools and equipment in order to measure tree diameter, height and basal area.	Field study using tools	I, SP	Science as a Human Endeavor
5.	Understand how the following issues are affected by forest health and management: biodiversity, forest fragmentation, forest health, air quality, aesthetics, fire, global warming and recreation.	Project Learning Tree Activity	I, E, L, UC, SP	Natural Resources, Environmental quality
6.	Understand how forestry management practices and policy affect sustainability.	Research	I, UC, SP	Natural Resources, Environmental quality
7.	Understand how economic, social and ecological factors influence forest management decisions.	Compare and Contrast	I, UC, SP	Humans modify ecosystems, Natural Resources
8.	Learn how science and technology are being utilized in all aspects of forest management.	Study	I, SP	Nature of Scientific Knowledge, Science and Technology in local, national and global challenges

Learning Objectives:	Key Point 4: Trees as an Important Renewable Resource	Activity	NSS	Topic
1.	Understand the importance and value of trees in urban and community settings, and know the factors affecting their health and survival.	Create a display and make presentation	I, E, L, UC, SP	Natural Resources, Environmental quality
2.	Understand the economic value of forests and know many of the products and by-products they provide to people and society.	Make a list of tree products & by-products	I, P, E, L, UC, SP	Natural Resources, Environmental quality
3.	Explain the “Ecosystem Services” provided by trees, and understand why trees and forests are important to human health, recreation, wildlife, and watershed quality.	Study	I, P, E, L, UC, SP	Natural Resources, Environmental quality

SOILS AND LAND USE

Key Point 1—Physical Properties of Soil and Soil Formation

Learning Objectives:

1. Understand the importance of soils and appreciate the relatively small amount of usable soil that exists on Earth.
2. Know the five soil forming factors, and understand how they influence soil properties.
3. Understand the origin and types of soil parent materials.
4. Understand basic soil forming processes: additions, losses, translocations, and transformations.
5. Recognize and understand features of Soil Profiles, and be able to use this information to determine basic soil properties and limitations.
6. Identify and describe soil characteristics (texture, structure, and color- using Munsell color charts).

Suggested Activities:

1. Generate a list of reasons why soils and the study of soil science is important to sustaining life on Earth, and explore how much soil available on Earth is for human use.
2. Describe the five factors of soil formation and be able to explain how each factor affects the soil profile.
3. Conduct a field analysis by digging or using an auger to examine a soil pit. Determine soil characteristics and properties, by describing soil horizons and recording data.
4. Use soil profile information to compare soil samples from agriculture cropland, wetland, forest and an urban area, and explain why there are differences in water table, permeability, runoff, infiltration and water holding capacity.
5. Estimate percent sand, silt, and clay for soil samples collected and determine texture class using the texture triangle. Explain how texture is important in soil fertility and soil management.

Resources:

1. [Why Soil is Important](#)
2. [How Much Soil is there?](#)
3. [From the Surface Down](#)
4. [Soil Formation and Classification](#)
5. [Factors Affecting Soil Development](#)
6. [Guide to Texture by Feel](#)
7. [Soil Field Analysis](#)
8. [Description of Soils: Soil Surveys, Chapter 3](#)
9. [State Soils: NRCS](#)
10. [Soil Landscapes of Canada](#)

Key Point 2—Soil Ecosystems

Learning Objectives:

1. Recognize that biological diversity is important for soil health and hence plant, human and environmental health.
2. Understand how the hydrologic, carbon and nutrient cycles relate to soil management.
3. Recognize that understanding soil ecosystems is important to soil management.

Suggested Activities:

1. Construct a Burlese funnel to learn about the diversity of life living in the soil. Draw a soil food web showing the 5 trophic levels and discuss why biodiversity is important to healthy soil. (note: some important soil organisms will not show up in the Burlese funnel, but they should be included in the trophic level diagram.)
2. Draw the nitrogen, carbon and phosphorus cycles and identify the types of organisms (flora and fauna) involved in these cycles. Identify their roles in decomposition and nutrient cycling.
3. Discuss the decomposition and transformations of organic matter, toxins and pesticides. Discuss the importance of microorganisms, and what would occur if they were not present in the food chain.
4. Discuss how Integrated Pest Management can affect biological diversity.

Resources:

1. [Instructions for making a Burlese Funnel](#)
2. [Nutrient Cycles](#)
[Carbon](#)
[Phosphorus](#)
[Nitrogen](#)
3. [Soil Biology](#)
[Chapter 1: The Soil Food Web](#)
[Chapter 2: The Food & Web Soil Health](#)
[Chapter 3: Bacteria](#)
[Chapter 4: Soil Fungi](#)
[Chapter 5: Soil Protozoa](#)
[Chapter 6: Nematodes](#)
[Chapter 7: Arthropods](#)
[Chapter 8: Earthworms](#)
4. [Integrated Pest Management](#)
5. [Soil Biology and Land Management](#)

Key Point 3—Chemical Properties of Soil and Soil Fertility

Learning Objectives:

1. Understand the procedure for taking a soil sample and conducting nutrient analysis.
2. Know that plants must receive essential micronutrients and macronutrients from the soil in order to be healthy, and understand that soil fertility relates to the physical and chemical properties of the soil in addition to the quantity of nutrients.
3. Understand why soil fertility reflects the physical, chemical and biological state of the soil.

Suggested Activities:

1. Collect a representative soil sample from a piece of land (preferably your own) as an introduction to soil testing. Conduct soil test experiments to measure pH and determine the amounts of plant available nitrogen (N), Phosphorus (P), and Potassium (K) in soil samples collected from different locations such as: cropland, forested area, and in a flood plain. Record your data, and analyze and compare results.
2. Explain the ABC's of Nutrient Management, and how Nutrients and Plant Health, Pest, Profits and the Environment relate to healthy soil.
3. Explain why soil fertility reflects the physical, chemical and biological state of the soil.
4. Compare and contrast the benefits and risks of using nutrients from a synthetic fertilizer with those from a natural source.

Resources:

1. [Soil Testing](#)
2. [Plant Nutrients](#)
3. [GLOBE Soil Fertility Protocol](#)
4. [Nutrient Management](#)

Key Point 4—Soil Conservation and Land Use Management

Learning Objectives:

1. Compare different land uses and conservation practices and their impact on soils and erosion.
2. Understand how soil is impacted by point & non-point source pollution & the importance of soil management to agriculture and clean water.
3. Understand that soil management and environmental protection requires agricultural and resource managers to use spatial tools such as Geographic Information Systems (GIS), and Global Positioning Systems (GPS) in order to make the best possible resource decisions.
4. Learn about career opportunities and the role of government in the management of natural resources.

Suggested Activities:

1. Identify or recommend Best Management Practices to maximize agriculture production and control water movement to prevent erosion and pollution on construction sites, residential development and cropland.
2. In a land use planning discussion, identify types of soil erosion and explain how soil is a factor in non-point source pollution, and describe how soils can be used to clean up pollutants.
3. Become familiar with the Universal Soil Loss Equation (USLE), and learn how it used to estimate the soil erosion rates of a selected construction site and cropland field.
4. Practice using topographic and thematic maps to uncover mysteries about the cultural and physical geography of the Earth. [USGS Map Mysteries Activities](#).

Resources:

1. [Urban Soil Primer](#)
2. [Soil Erosion: Causes and Effects](#)
3. [Using the Universal Soil Loss Equation \(USLE\)](#)
4. [The National Topographic System of Canada: Access and interpret topographic maps](#)
5. [The U.S. Geological Survey Rocky Mountain Mapping Center: Access and interpret topographic maps](#)
6. [Careers in Soil Science](#)

Key Point 5—Web soil surveys & Soil Surveys

Learning Objectives:

1. Access and use published and on-line soil data and other resources to learn how land use affects soil, and the limitations of local soils.
2. Understand the eight Land Capability Classes and how they are important in determining appropriate land use.
3. Understand soil drainage classes and be able to recognize the characteristics of hydric soils and know how soils fit into the definition of wetlands.

Suggested Activities:

1. Download your local area's soil survey map to learn the limitations that local soils have for septic systems, foundations, agriculture, and future development.
2. Describe the eight Land Capability Classes and use a soil profile and site description to determine land capability class.
3. Visit your local land planning office and ask how GIS and GPS systems are used in making land use planning and development decisions. Explain how GIS and GPS can be used in learning about the soil characteristics in a wetland soil.

Resources:

1. [Web Soil Survey: know how to access and use soil data](#)
2. [National Soils Data Base \(NSDB\): know how to access and use soil and landscape data of Canada](#)
3. [Land Capability Classification](#)
4. [Hydric Soils](#)
5. [Site Fingerprinting](#)

Additional Soil Resources

Additional soils information may be found at:

www.soils.org/about-soils/lessons/resources

Do you have a soil related question? [Ask a Soil Scientist.](#)

Soils/Land Use Guidelines Correlated to the National Science Standards

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Learning Objectives:	SOILS: Key Points			
	1. Physical Properties of Soil and Soil Formation	Activity	NSS	Topic
1.	Understand the importance of soils and appreciate the relatively small amount of usable soil that exists on Earth.	Study	I, SP	Inquiry, History & Nature of Science
2.	Know the five soil forming factors, and how these factors influence soil properties.	Study and Presentation	E	Geochemical cycles
3.	Understand the origin and types of soil parent materials.	Study	UC, P, E, H	Earth Science
4.	Understand basic soil forming processes: additions, losses, translocations, and transformations.	Field analysis	I, UC, L, E	Systems, order and organization
5.	Recognize and understand features of Soil Profiles,	Field analysis	UC, I, P,	Environmental quality

	and be able to use this information to determine basic soil properties and limitations.		SP	
6.	Identify and describe soil characteristics: (texture, structure, and color- using Munsell color charts.	Field study and soil analysis	UC	Form and Function
	2. Soil Ecosystems:			
1.	Recognize that biological diversity is important for soil health and human, plant and environmental health.	Study Model building	I, UC	Matter and energy in living systems
2.	Understand how the hydrologic, carbon and nutrient cycles relate to soil management.	Study and analysis, Drawing	E, L,UC, SP	Cycles, order & organization, Environmental quality
3.	Recognize that soil ecosystems are important to good soil management.	Study and Presentation	L, UC, SP	Systems, order & organization Environmental quality
	3. Chemical Properties of Soil and Soil Fertility			
1.	Understand the procedure for taking a soil sample and conducting nutrient analysis.	Soils chemical test and soils analysis, collecting and recording data	I, P, L, UC	Form and Function
2.	Know that plants must receive essential micronutrients and macronutrients from the soil in order to be healthy.	Study and analysis	I, L, UC	Matter and energy in living systems
3.	Understand how soil fertility relates to the physical and chemical properties of the soil in addition to the quantity of nutrients.	Study and analysis	P, E, L, UC,	Geochemical cycles, and Environmental quality

	4. Soil Conservation and Soil Management:			
1.	Compare different land uses and conservation practices and their impact on soils and erosion.	Study of land use and BMP	E, SP	Environmental quality Personal and social perspective
2.	Understand how soil is impacted by point & non-point source pollution & the importance of soil management to agriculture and clean water.	Discussion and field study	E, UC	Environmental quality Natural & human hazards Personal and social perspective
3.	Understand that soil management and environmental protection requires agricultural and resource managers to use spatial tools such as Geographic Information Systems (GIS), and Global Positioning Systems (GPS) in order to make the best possible resource decisions.	Map study	E, ST, U	Unifying concepts Science and Technology
4.	Learn about career opportunities & the role of government in natural resources management.	Inquiry and study	SP, ST	Personal and Social Perspective
	5. Web Soil Surveys and Soil Surveys:			
1.	Access and use published and on-line soil data and other resources to learn how land use affects soil, and the limitations of local soils.	Map studies.	UC, ST	Models, form & function Science and Technology
2.	Understand the eight Land Capability Classes and how they are important in determining appropriate land use.	Study of land use	E, UC	Systems, order and organization
3.	Understand soil drainage classes and be able to recognize the characteristics of hydric soils and know how soils fit into the definition of wetlands.	Site fingerprinting	E, UC	Systems, order and organization

WILDLIFE

Key Point 1—Knowledge of Wild Birds, Mammals and Herps

Learning Objectives:

1. Identify wildlife species using mounted specimens, skins/pelts, pictures, skulls, silhouettes, decoys, wings (waterfowl), scats, tracks, animal sounds, or other common signs. Animal tracks may be original or molds made of the prints. Wildlife signs may be real or reproduced.
2. Use a key or field guide to identify wildlife species or signs. Wildlife species or signs may be presented in any form as described above.
3. Identify general food habits (herbivore, omnivore, carnivore), habitats (terrestrial, aquatic, fossorial), and habits (diurnal, nocturnal) using skull morphology and/or teeth.

Resources:

1. This resource to be used as a reference: [Smithsonian National Museum of Natural History: North American Mammals](#)
2. This resource to be used as a reference: [e-Nature Field Guide to Birds](#)
3. [Outdoor Action Guide to Animal Tracking: pages 1 – 6](#)

Key Point 2—Wildlife Ecology

Learning Objectives:

1. Know the meaning of “habitat”, and be able to name the habitat requirements for wildlife and the factors that affect wildlife suitability.
2. Know and understand basic ecological concepts and terminology.
3. Understand the difference between an ecosystem, community and population. Be able to explain how communities interact with their non-living surroundings to form ecosystems.
4. Understand wildlife population dynamics such as birth, mortality, age-structure, sex ratio, and mating systems. Understand the impact of limiting and decimating factors of common wildlife species on wildlife management.
5. Recognize that all living things must be well-adapted to their native environment in order to survive. Be able to identify, describe and explain the advantages of specific anatomical, physiological and/or behavioral adaptations of wildlife to their environment.
6. Know the meaning of the term “Biodiversity”, and understand why biodiversity is important to people and wildlife.
7. Understand the importance of the 3 levels of biodiversity: genetics, species and ecosystem or community, and understand the implications of biodiversity loss at each level.

Suggested Activities:

1. Draw a map of an area and identify sources of food, water and shelter available to wildlife. Select a wildlife species, and assess whether the area on your map will provide suitable habitat for this species. If any part of the habitat is lacking, explain what you could do to improve the habitat for this species?
2. Explain the relationship between the Pyramid of Numbers and the Pyramid of Biomass. Relate this exercise to an actual habitat to help you understand how much land area is needed to support life at each level of the food chain. Lesson: [Ecological Pyramids](#).
3. Create a detailed display to show examples of different types of food chains and illustrate the interdependence of organisms within a food web. Include terms such as trophic levels, predator, prey, scavengers, decomposers, omnivore, insectivore, herbivore, carnivore, producer, primary consumer, secondary consumer and tertiary consumer.
4. Explain the term “ecosystem” and give examples of different types of ecosystems. Describe a type of ecosystem and explain the importance of a keystone species. Draw food chains that include a specific keystone species and discuss what might happen if this species were removed from the food chain or if their populations diminished.
5. Select several wildlife species common to your area and list potential limiting and decimating factors for each. Visit a natural area, park, forest, and/or farm and assess the area to determine which of the limiting and decimating factors on your list would actually impact your selected species. For example, water may be a potential limiting factor, but the area you visit may have an abundance of water. Therefore, water would not be a limiting factor on this area and would have no impact.
6. Explain why your state or province is so diverse and explain what is being done to protect the biodiversity of wildlife. Include the following vocabulary to help you explain your answer: biodiversity, keystone species, native, endemic, habitat, biome, and food web.
7. Compare and contrast the behavioral and physiological adaptations of specific animals that live in two different environments. Explain why these animals are well-adapted to survive in their particular environment and include wildlife biology terms to describe specific adaptations.
8. Web Lesson: [Measuring Biodiversity across North America](#) As a result of completing an investigation into the biodiversity of North American Mammals, students should develop an understanding of the concept of biodiversity, and learn ways to measure the diversity of organisms. In addition, students

should become more familiar with the mammal communities and eco-regions in their residential areas and the biomes and ecoregions across North America.

9. Explain the three levels of biodiversity and give several reasons why biodiversity is important to wildlife and people. Select examples of species in your area that have become locally extinct and explain what causes loss of biodiversity. What can be done to gain biodiversity?

Resources:

1. [4-H Wildlife Project: The Wildlife Ecologist, pages 8-16](#)
2. [Wildlife Terms: Working with Wildlife pages 1-3](#)
3. [Glossary of Important Wildlife Terms](#)
4. [Organization of Life: Species, Population, Communities and Ecosystems](#)
5. [Clemson University: The Basics of Population Dynamics](#)
6. [Winter Adaptations of Animals](#)
7. [Wildlife Ecology Basics](#)
8. [Canadian Biodiversity Website: An Introduction to Biodiversity Theory](#)

Key Point 3—Conservation and Management of Wildlife

Learning Objectives:

1. Know the preferred habitat types and specific habitat requirements of common wildlife species. Understand how this knowledge helps us to better protect both the land and the wildlife species that depend on it.
2. Understand the difference between biological and cultural carrying capacity, and be able to identify social and ecological considerations where human use of land conflicts with wildlife habitat needs.
3. Identify common wildlife management practices and methods that are being used to manage and improve wildlife habitat.
4. Understand the role of federal, state and provincial Fish and Wildlife Agencies in the management, conservation, protection, and enhancement of fish and wildlife and their habitats.
5. Know that all states and provinces have a hunting safety course and mandatory hunter education program developed specifically for each state or provincial government's hunting and wildlife agency.

Suggested Activities:

1. Explain the meaning of the terms "migration route" and "flyway". Know the four major North American flyways and understand the importance of these routes to migratory land, water and shore birds.
2. Determine which common wildlife species in your area depend on open land, woodland and wetland habitat for their survival. Identify the various types of habitat within open lands, woodlands, and wetlands, and explain the importance of these specific habitats to common wildlife species within your area.
3. Explain why human use of land is the major reason for habitat loss. Provide examples of habitat destruction, fragmentation, and degradation and explain how wildlife species survival is threatened by habitat loss in your area.
4. Research and analyze controversial issues in order to understand the relationship between wildlife, economics and society. Penn. State School of Forest Resources: [The Social and Economic Impact of Wildlife and Natural Resource Management Lesson Plan](#)
5. Make a list of wildlife management practices and strategies that will restore or improve habitat for each of the following land uses: cropland, grassland, woodland, wetland, pond/lake, and urban setting (backyards, greenways, urban parks). Include specific wildlife species that will benefit from each wildlife practice or strategy.
6. Make a list of the Federal and State Fish and Wildlife Agencies within your state or province. Determine how each protects and manages the wildlife resources of your area, and describe activities and programs that are undertaken to protect and manage wildlife and their habitats.
7. Explain regulated trapping procedures and discuss the issues that are involved in trapping furbearing animals. Research and explain the dilemma of biological carrying capacity vs. cultural carrying capacity in your discussion.
8. Explain how Wildlife Managers are using Satellite Remote Sensing, GPS and GIS in Conservation and Wildlife Management. Give an example explaining the benefits of using this technology in remote areas.

Resources:

1. [North American Migration Flyways](#)
2. [USFWS Migratory Birds and Habitat Program: Migratory Bird Treaty Act](#)

3. [Woodland Fish and Wildlife](#)
4. [Wildlife Management Concepts and Terms](#)
5. [Refer to Forestry Key Point 2, Resource 1: Managing Forests for Fish and Wildlife](#)
6. [This resource is to be used as a reference: Online Hunting Safety Classes and Hunter Certification Tests](#)
7. [Trapping and Furbearer Management in North American Wildlife Conservation pages 4-20](#)
8. [Canada's Wild Places Seen From Far-Off Spaces](#)

Key Point 4—Issues Involving Wildlife and Society

Learning Objectives:

1. Understand how non–native (exotic), invasive species threaten our environment and the biodiversity of many wildlife species. Understand that non–native (exotic), invasive plants impact wildlife habitat and thus have a tremendous impact on native wildlife.
2. Learn about the complexities of decision–making in making land use decisions that affect wildlife, and understand that wildlife resources are under constant pressure caused by human population growth, environmental degradation, and habitat reduction.
3. Know that Wildlife species are subject to diseases resulting from exposure to microbes, parasites, toxins, and other biological and physical agents.
4. Understand the terminology and factors that affect threatened and endangered wildlife species. Know the meaning of extinct, extirpated, endangered, threatened, candidate species and reintroduction.
5. Identify the characteristics that many extinct and endangered species possess, and be able to identify many species wildlife that are endangered and threatened.
6. Understand the role of the Endangered Species Act in helping to conserve endangered and threatened species. Know the organizations and agencies responsible for listing and protecting endangered species on global, federal, state and provincial levels.

Suggested Activities:

1. Give specific examples of non–native (exotic), invasive species in your area and describe how they have altered habitats, threatened ecosystems, and impacted wildlife. Explain what is being done to increase awareness and facilitate effective prevention and management of non–native (exotic) invasive species.
2. Explain the three major kinds of habitat loss. Give examples of how human activity is the biggest threat to wildlife habitat and also discuss how people can have a positive impact on wildlife habitat and biodiversity.
3. HIPPO is an acronym that represents the five major threats to biodiversity, which are caused by human activity. Design a poster to illustrate the HIPPO concept and factors that bring about the loss of biodiversity.
4. Name and describe two examples of diseases that are critically impacting Wildlife and explain why controlling emerging wildlife diseases have become a high–priority concern in the United States and Canada. Explain the life cycles of these diseases and how they can be transmitted to humans.
5. Identify and describe factors that threaten and endanger wildlife species in your area. Explain what actions are being taken by various agencies and interest groups to improve the chance of survival for specific threatened and endangered species. Also, determine what practical measures private citizens can take to assist in the recovery of threatened and endangered species.
6. Select several endangered species and create a display to describe the characteristics that have made these species more vulnerable. Discuss state, provincial and federal efforts being taken to protect these species.

Resources:

1. [Introduced Species: The Threat to Biodiversity and What Can Be Done](#) (see [learnmorelinks](#) at the end of article for additional information)
2. [National Wildlife Federation: Habitat Loss](#)
3. [National Geographic Society: HIPPO, pages 7– 9](#)
4. [USGS National Wildlife Health Center: Diseases of Wildlife in the United States](#) (first paragraph)
5. This resource is to be used as a reference: [USGS Vector-borne Diseases and Zoonotic \(transmitted between animals and humans\) Diseases](#)
6. [Defenders of Wildlife: Protection of Endangered Species](#)
7. [USFW Service Endangered Species Act \(ESA\)](#)

Wildlife guidelines correlated to the National Science Standards

Key National Science Standard (NSS)

UC	Unifying Concepts
I	Inquiry
P	Physical Science
L	Life Science
E	Earth & Space Science
ST	Science & Technology
SP	Personal & Social Perspective
H	History & Nature of Science

Learning Objectives	Key Point 1. Knowledge of Wild Birds, Mammals and Herps	Activity	NSS	Topic
1.	Identify wildlife species using mounted specimens, skins/pelts, pictures, skulls, silhouettes, decoys, wings (waterfowl), scats, tracks, animal sounds, or other common signs. Animal tracks may be original or molds made of the prints. Wildlife signs may be real or reproduced.	Use models and signs to identify wildlife species	I, L, UC, SP	Biological Evolution, Behavior of Organisms
2.	Use a key or field guide to identify wildlife species or signs. Wildlife species or signs may be presented in any form as described above.	Use field guides to identify wildlife species	I, L, UC, SP, H	Interdependence of Organisms, Biological Evolution, Behavior of Organisms
3.	Identify general food habits (herbivore, omnivore, carnivore), habitats (terrestrial, aquatic, fossorial), and	Use specimens and signs to	I, P, E, L, UC, SP, H	Molecular Basis of Heredity, Biological Evolution,

	habits (diurnal, nocturnal) using skull morphology and/or teeth.	identify wildlife species		Interdependence of Organisms, Behavior of Organisms
Learning Objectives	Key Point 2: Wildlife Ecology	Activity	NSS	Topic
1.	Know the meaning of “habitat”, and be able to name the habitat requirements for wildlife and the factors that affect wildlife suitability.	Draw a map and identify habitat for a species	I, E, L, UC, SP	Interdependence of Organisms, Biological Evolution, Behavior of Organisms
2.	Know and understand basic ecological concepts and terminology.	Study and apply knowledge of concepts and terminology	I, E, L, UC, SP	Science as human endeavor, Nature of scientific knowledge, Behavior of Organisms
3.	Understand the difference between an ecosystem, community and population. Be able to explain how communities interact with their non-living surroundings to form ecosystems.	Create a visual display of various food chains and use to explain an ecosystem	I, E, L, UC, SP	Interdependence of Organisms, Behavior of Organisms
4.	Understand wildlife population dynamics such as birth, mortality, age-structure, sex ratio, and mating systems. Understand the impact of limiting and decimating factors of common wildlife species on wildlife management.	Visit an area and list limiting and decimating factors of wildlife species	I, P, E, L, UC, SP	Biological Evolution, Interdependence of Organisms, Population Growth
5.	Recognize that all living things must be well-adapted to their native environment in order to survive. Be able to identify, describe and explain the advantages of specific anatomical, physiological and/or behavioral adaptations of wildlife to their environment.	Compare and contrast behavioral and physiological adaptations	I, P, E, L, UC	Molecular Basis of Heredity, Biological Evolution. Interdependence of Organisms, Behavior of Organisms
6.	Know the meaning of the term “Biodiversity”, and understand why biodiversity is important to people and wildlife.	Web Lesson: Measuring Biodiversity	I, E, L, UC, SP, ST	Interdependence of Organisms, Behavior of Organisms, Natural Resources, Environmental Quality

		across North America		
7.	Understand the importance of the 3 levels of biodiversity: genetics, species and ecosystem or community, and understand the implications of biodiversity loss at each level.	Select and study examples of species in your area	I, E, L, UC, SP	Biological Evolution, Interdependence of Organisms, Natural Resources
Learning Objectives	Key Point 3: Conservation and Management of Wildlife	Activity	NSS	Topic
1.	Know the preferred habitat types and specific habitat requirements of common wildlife species. Understand how this knowledge helps us to better protect both the land and the wildlife species that depend on it.	Study and Presentation	I, E, L, UC, SP	Systems, order & organization Environmental quality, Natural Resources
2.	Understand the difference between biological and cultural carrying capacity, and be able to identify social and ecological considerations where human use of land conflicts with wildlife habitat needs.	Provide examples of human impact on habitat loss	I, E, L, UC SP	Interdependence of Organisms, Natural Resources, Environmental Quality
3.	Identify common wildlife management practices and methods that are being used to manage and improve wildlife habitat.	List practices and strategies to improve wildlife habitats	I, E, L, UC, SP,	Natural Resources, Environmental quality, Science & Technology in Local, National & Global Challenges
4.	Understand the role of federal, state and provincial Fish and Wildlife Agencies in the management, conservation, protection, and enhancement of fish and wildlife and their habitats.	List state and federal agencies and understand their role in protecting and managing wildlife resources	I, SP, ST,H	Natural Resources, Natural & Human Induced Hazards, Science & Technology in Local, National & Global Challenges
5.	Know that all states and provinces have a hunting	Research and learn about	SP, ST,H	Natural Resources, Natural & Human Induced Hazards,

	safety course and mandatory hunter education program developed specifically for each state or provincial government's hunting and wildlife agency.	Hunter Safety education program		Science & Technology in Local, National & Global Challenges
Learning Objectives	Key Point 4: Issues Involving Wildlife and Society	Activity	NSS	Topic
1.	Understand how non-native (exotic), invasive species threaten our environment and the biodiversity of many wildlife species. Understand that non-native (exotic), invasive plants impact wildlife habitat and thus have a tremendous impact on native wildlife.	List examples of Aquatic Nuisance Species	I, P, E, L, UC, SP	Natural Resources, Environmental quality, Natural & Human Induced Hazards, Population Growth
2.	Learn about the complexities of decision-making in making land use decisions that affect wildlife, and understand that wildlife resources are under constant pressure caused by human population growth, environmental degradation, and habitat reduction.	Give examples of habitat loss. Design a poster to illustrate the HIPPO concept.	I, UC, SP, H	Population Growth, Natural Resources, Environmental Quality, Nature of Scientific Knowledge
3.	Know that Wildlife species are subject to diseases resulting from exposure to microbes, parasites, toxins, and other biological and physical agents.	Explain the life cycle of diseases and how they are transmitted to humans.	P, E, L, UC, ST, SP	Natural resources, Environmental Quality, Natural & Human hazards, Science and Technology
4.	Understand the terminology and factors that affect threatened and endangered wildlife species. Know the meaning of extinct, extirpated, endangered, threatened, candidate species and reintroduction.	Study and understand terminology	P, E, L, UC, SP, H	Natural Resources, Population Growth, Natural Resources, Environmental Quality, Natural & Human-Induced Hazards
5.	Identify the characteristics that many extinct and endangered species possess, and be able to identify many species of wildlife that are endangered and threatened.	Create a display of endangered species	I, P, E, L, UC, SP	Natural Resources, Population Growth, Natural Resources, Environmental Quality, Natural & Human-Induced Hazards

6.	Understand the role of the Endangered Species Act in helping to conserve endangered and threatened species. Know the organizations and agencies responsible for listing and protecting endangered species on global, federal, state and provincial levels.	Describe actions being taken to protect endangered species	UC, SP, ST, H	Natural resources, Environmental Quality, Population Growth, Natural Resources, Environmental Quality, Natural & Human-Induced Hazards, Science & Technology in Local, National & Global Challenges
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