



## Ontario Envirothon

# LEARNING OBJECTIVES

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# Overall Objectives

Students must be able to...

## Aquatics

- A. Understand and describe the abiotic characteristics and processes of aquatic ecosystems
- B. Understand and describe the biotic characteristics and processes of aquatic ecosystems
- C. Describe the variety of aquatic environments, their characteristics and succession, and how they are affected by internal and external processes.
- D. Understand and describe practices involved in the conservation and management of healthy aquatic ecosystems and water resources

## Forestry

- A. Understand and describe the physiology of trees
- B. Understand and describe the various characteristics and processes involved in forest ecology
- C. Understand and describe the methods and practices of the forest industry and of sustainable forest management
- D. Understand and describe practices involved in the conservation and management of healthy forest ecosystems and forest resources

## Soils

- A. Understand and describe the functions of soil in ecosystems and soil formation
- B. Understand and describe the physical properties of soil
- C. Understand and describe the chemical properties of soil
- D. Understand and describe the biological properties of soil
- E. Understand and describe soil water movement and content
- F. Understand and describe the Canadian System of Soil Classification

## Wildlife

- A. Understand and use identification tools to identify local mammal, bird, fish and herptile species
- B. Understand and describe the characteristics and processes of wildlife ecology, including habitat and community dynamics
- C. Understand and describe the impact of humans and human development on wildlife and wildlife ecology, and vice versa
- D. Understand and describe practices involved in the conservation and management of wildlife

# Aquatic Ecology

Lakes, rivers, streams, and oceans are full with a vast diversity of life. These water bodies provide numerous wildlife habitats. The soils and trees surrounding water bodies affect water quality and run off into aquatic wildlife habitats. Aquatic environments tell us a lot about overall environmental health and how everything in nature is connected. So, WATER you waiting for? Get HOOKED on aquatics!

## Overall Objectives

**Students must be able to...**

- A. Understand and describe the abiotic characteristics and processes of aquatic ecosystems
- B. Understand and describe the biotic characteristics and processes of aquatic ecosystems
- C. Describe the variety of aquatic environments, their characteristics and succession, and how they are affected by internal and external processes
- D. Understand and describe practices involved in the conservation and management of healthy aquatic ecosystems and water resources

## Specific Objectives

**Students must be able to...**

- A. Understand and describe the abiotic characteristics and processes of aquatic ecosystems**
  - 1. Identify the physical characteristics of water and explain how those characteristics relate to or affect aquatic organisms
  - 2. Identify the chemical properties of water and explain how those properties relate to or affect aquatic organisms
  - 3. 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
  - 4. 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
  - 5. 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
- B. Understand and describe the biotic characteristics and processes of aquatic ecosystems**
  - 1. Describe the flow of energy through aquatic systems, emphasizing aquatic food chains and webs

2. Describe the cycling of nutrients within aquatic systems, including additions from upland systems, with particular attention to carbon phosphorous and nitrogen
3. Describe normal succession in Ontario's lakes, streams and wetlands
4. Define and illustrate carrying capacity, including the importance and effects of critical habitat
5. Know how to perform and interpret biological water quality tests, using benthic macroinvertebrate testing, and understand why aquatic organisms and water quality is affected by the physical, chemical and biological conditions of the water

**C. Describe the variety of aquatic environments, their characteristics and succession, and how they are affected by internal and external processes**

1. Describe with detail the composition of Ontario's aquatic communities (lakes, rivers, streams, wetlands, etc)
2. Relate the elements of aquatic communities to the physical characteristics and processes of their environments
3. Define habitat requirements for a variety of aquatic plant and animal species and illustrate with specific examples
4. Explain or show how a range of aquatic organisms have adapted to the characteristics of aquatic environments
5. Identify simple and diverse aquatic systems found in Ontario, and illustrate the advantages of biological diversity
6. Define a wetland and identify and describe the four major types of wetlands: swamps, marshes, fens, and bogs
7. Describe the values and benefits of wetlands
8. Understand the functions and values of riparian zones and identify riparian zone areas

**D. Understand and describe practices involved in the conservation and management of healthy aquatic ecosystems and water resources**

1. Identify the rights of Ontario's first nations with regard to aquatic resources
2. Identify Ontario's rare, threatened and endangered aquatic species, as identified by COSEWIC, and explain how and why selected species were reduced to those levels
3. Identify and describe a variety of non-native and invasive aquatic species affecting Ontario's aquatic ecology
4. Identify local and global sources of point and non-point source pollution and discuss methods to reduce pollution in Ontario's aquatic ecosystems
5. Understand and describe the effects that climate change has on aquatic ecology
6. Interpret a variety of laws, agreements, treaties, etc. that govern Ontario's water resources and aquatic environments
7. Identify a variety of major stakeholders and agencies, including Federal, Provincial and Municipal government bodies, that provide oversight of water resources in Ontario

## Experiential Skills/Application/Analysis

**Students must be able to...**

1. Identify, using a field guide, dichotomous key or index, plants and animals commonly found in Ontario wetlands
2. Identify site-specific plants and animals that would be found in a given wetland
3. Identify a specific aquatic community (lake, river, stream, wetland, etc) based a small sample cluster of aquatic plant and animal species
4. Identify the habitat requirements of common Ontario aquatic plants and animals on site

5. Collect and interpret data using a variety of tools, including, but not limited to:
  - hand lens
  - secchi disk
  - ekman dredge
  - D-net
  - pH testing kit or pH meter
6. Carry out a number of tests (visual, water, soil, vegetation, etc) to determine if a site is best described as a swamp, marsh, fen or bog
7. Compare and contrast the physical characteristics of lakes and streams, as well as the adaptations of life to those environments
8. Understand and illustrate carrying capacity
9. Use a variety of tools to carry out water quality assessments (alkalinity, CO<sub>2</sub>, nitrate, phosphate, chloride, turbidity, pH, hardness)
10. Calculate stream velocity and flow rate
11. Understand and report on the effects of point and non-point source pollutants on aquatic life

## Synthesis/Evaluation

### Students must be able to...

1. Demonstrate, using examples from Ontario, how current water use affects aquatic resources
2. Examine the effect of the introduction of non-native species in aquatic ecosystems, including origin, means of introduction, methods of control, and results (success/failure) of methods
3. Assess the application of current aquatic ecosystem and water resource management and control
4. Recommend plans for aquatic ecosystem and water resource management and control

# Forestry

Forests provide us with clean air and numerous wildlife habitats and help to prevent soil erosion and improve water quality. They also provide us with over 5,000 products we use in our daily lives. By studying this module, you will understand the physiology and ecology of trees and forests, the steps taken to achieve balance between forest ecology and the forest industry, and the intricacies of managing one of Canada's most renewable resources.

## Overall Objectives

**Students must be able to...**

- A. Understand and describe the physiology of trees
- B. Understand and describe the various characteristics and processes involved in forest ecology
- C. Understand and describe the methods and practices of the forest industry and of sustainable forest management
- D. Understand and describe practices involved in the conservation and management of healthy forest ecosystems and forest resources

## Specific Objectives

**Students must be able to...**

- A. Understand and describe the physiology of trees**
  1. Describe the parts of a tree
  2. Explain how trees grow, from the process of photosynthesis through branch growth to trunk growth
  3. Understand the method of and terminology required to utilise a dichotomous tree identification key
  4. Know and identify the principle tree species of each of Ontario's forest regions
- B. Understand and describe the various characteristics and processes of forest ecology**
  1. Identify and describe the major forest regions of Ontario and Canada
  2. Identify how much of Ontario and Canada's land surface area is forests and describe how much forested land is Crown land and how much is privately owned
  3. Understand and illustrate the process and stages of succession
  4. Describe the process of photosynthesis and cellular respiration as they relate to the cycling of energy, carbon, and oxygen through abiotic and biotic components of the forest ecosystem
- C. Understand and describe the methods and practices of the forest industry and of sustainable forest management**

1. Identify the major types of forest products that are produced in Ontario and Canada
2. Identify and describe the various cutting styles and silvicultural principles that are appropriate for and applied to various forestry sites
3. Explain the concepts of even-aged and uneven-aged stands
4. Explain the role wildfire plays in sustainable forest management, including causes, prevention methods, forest destruction, and forest regeneration
5. Describe the economic importance of forest-related industries to provincial, national and international economies
6. Explain how environmental concerns such as water quality, habitat, recreation and aesthetics are incorporated into forest management

**D. Understand and describe practices involved in the conservation and management of healthy forest ecosystems and forest resources**

1. Examine the historical importance of Ontario's forests, including their value to First Nations Peoples and to the natural environment
2. Identify Ontario's rare, threatened and endangered tree and plant species, as identified by COSEWIC, and explain how and why selected species were reduced to those levels
3. Identify and describe the main insects and diseases (both native and non-native) that affect Ontario's forests
4. Understand and describe the effects that climate change has on forest ecology
5. Interpret a variety of laws, agreements, treaties, etc. that govern Ontario's forest resources and ecosystems
6. Identify a variety of major stakeholders and agencies, including Federal, Provincial and Municipal government bodies, that provide oversight of forest resources in Ontario

### Experiential Skills/Application/Analysis

**Students must be able to...**

1. Identify common Ontario tree species by leaf type, branching, bark, buds scales, twigs, site type, etc. using a dichotomous key, field guide or index
2. Identify harmful forest insects and evidence of their presence in a forest
3. Collect and interpret data using the following forestry equipment:
  - Dot planimeter / grid
  - Tree calipers (dbh)
  - Compass
  - Prism
  - Caliper tape
  - Increment borer / tree cookie
4. Illustrate the classification of a variety of trees and plants by identifying similar and different characteristics
5. Explain the forest management cycle and each of its component parts: planning, harvesting, site preparation, regeneration, tending and protection
6. Consider the impact of certification on sustainable forest management (using the Sustainable Forestry Initiative, Forest Stewardship Council, and the Programme for the Endorsement of Forest Certification as examples)
7. Analyse issues related to environmental sustainability and the impact of technology on the forest ecosystem

## Evaluation/Synthesis

### Students must be able to...

1. Critique the perspectives of various stakeholders (industry, environment, government) as they relate to forest issues
2. Summarise the history of a tree by looking at growth rings (periods of drought, faster growth, scarring)
3. Recommend a management plan for a forested area
4. Construct the history of a forest site (e.g. Has the site been harvested? What style of cutting was used? What stage of succession is the site currently experiencing?)
5. Address current forestry issues from different perspectives (clear-cut vs old growth, prescribed burns in protected areas, pesticide use, etc)

# Soils

Don't treat soil like dirt! Soil allows plants to grow, which in turn provide wildlife and vegetation habitat, food and oxygen. Soil is the foundation of all ecosystems. Understanding soil is vital to understanding environment health. Can you dig it?

## Overall Objectives

**Students must be able to...**

- A. Understand and describe the functions of soil in ecosystems and soil formation
- B. Understand and describe the physical properties of soil
- C. Understand and describe the chemical properties of soil
- D. Understand and describe the biological properties of soil
- E. Understand and describe soil water movement and content
- F. Understand and describe the Canadian System of Soil Classification

## Specific Objectives

**Students must be able to...**

### **A. Understand and describe the functions of soil in ecosystems and soil formation**

- 1. Understand the importance of soil and its functions in ecosystems
- 2. Understand what soil is, and describe the rock cycle, glaciation and weathering
- 3. Understand and describe the soil forming factors and processes
- 4. Understand and describe organic and mineral soil horizons and their development

### **B. Understand and describe the physical properties of soil**

- 1. Understand and describe soil colour using the Munsell soil colour system
- 2. Understand and describe soil texture and how it affects soil properties and behaviour
- 3. Understand and describe soil structure and why it is important to soil
- 4. Understand and describe soil bulk density and its relationship with soil pore space

### **C. Understand and describe the chemical properties of soil**

- 1. Understand and describe soil colloids, cation exchange capacity and base saturation
- 2. Understand and describe soil pH and how it affects soil properties and plant growth
- 3. Identify soil macro and micro nutrients and how they are utilized by plants
- 4. Understand and describe nutrient cycles and the role of soil in recycling nutrients for plant growth

### **D. Understand and describe the biological properties of soil**

- 1. Identify the types of macro, meso and microorganisms within the soil ecosystem

2. Understand and describe the relationship between soil organic matter and soil biodiversity
3. Understand and describe the functions of soil organisms
4. Understand and describe how soil organisms interact in the soil food web

**E. Understand and describe soil water movement and content**

1. Understand and describe the properties of water
2. Understand and describe the forces that affect the movement of water in soil
3. Understand and describe the role of macro and micropores in terms of soil drainage and water holding capacity
4. Understand and describe the types of soil water

**F. Understand and describe the Canadian System of Soil Classification**

1. Understand and describe the purpose of soil classification
2. Understand and describe the hierarchical categories of the Canadian System of Soil Classification
3. Understand and describe the diagnostic horizons used to determine soil Order
4. Understand and describe the soil Orders of Canada

## **Experiential Skills/Application/Analysis**

**Students must be able to:**

1. Identify and measure soil horizons in a soil pit, photograph or sample
2. Describe and classify a soil profile using the Characterizing Sites, Soils and Substrates in Ontario and the Canadian System of Soil Classification
3. Collect soil samples using a soil pit or soil auger
4. Determine/measure and interpret the following soil properties:
  - a. soil colour using the Munsell Soil Colour Charts
  - b. soil textural class using the soil textural by feel method
  - c. soil structure according to aggregate kind (i.e. single grain, massive, granular, blocky, prismatic or columnar and platy)
  - d. soil bulk density
  - e. soil pH using field test kits or a pH meter in the classroom
  - f. soil macronutrient (i.e. nitrogen, phosphorus, potassium) levels using field test kits

## **Evaluation/Synthesis**

**Students must be able to:**

1. Understand how soil mineral material, organic material, water and air are interrelated
2. Understand that productive soil is a limited non-renewable resource in human time frames and that preserving soil is an important issue
3. Use soil observations and data to recommend the suitability of a particular soil type for human activities
4. Use soil observations and data to make on-site recommendations on how to improve soil quality

# Wildlife

Discover the call of the wild! The biodiversity of animal species in Ontario and Canada is vast. Each species has a specific ecological niche in order for them and their ecosystem to thrive. Wildlife species depend on the soil, water and forest ecosystems to survive. It is important to understand wildlife as key indicators of environmental quality.

## Overall Objectives

**Students must be able to...**

- A. Understand and use identification tools to identify common Ontario mammal, bird, fish and herptile species
- B. Understand and describe the characteristics and processes of wildlife ecology, including habitat and community dynamics
- C. Understand and describe the impact of humans and human development on wildlife and wildlife ecology, and vice versa
- D. Understand and describe practices involved in the conservation and management of wildlife and wildlife resources

## Specific Objectives

**Students must be able to...**

- A. Understand and use identification tools to identify common Ontario mammal, bird, fish and herptile species**
  - 1. Understand and use a field guide, dichotomous key, or index to identify a variety of wildlife, including, but not limited to: insects and larvae (aquatic and terrestrial), reptiles, mammals (terrestrial and aquatic; large and small), birds, amphibians, and fish
  - 2. Identify the presence of wildlife based on a variety of indicators, including, but not limited to: scat, eggs, tracks, patterns on trees, sounds and calls, pest evidence, feathers, and nests
  
- B. Understand and describe the characteristics and processes of wildlife ecology, including habitat and community dynamics**
  - 1. Identify specific biotic and abiotic habitat components for common Ontario wildlife species
  - 2. Identify the requirements for survival for common Ontario wildlife species
  - 3. Know and explain why a certain species' habitat requirements might change and describe the changes
  - 4. Understand and describe the concept of carrying capacity with reference to a variety of common Ontario wildlife species
  - 5. Understand and describe succession in terrestrial (bare ground) and aquatic (pond) environments
  - 6. Define predator, prey, herbivore, carnivore and omnivore, and explain how each of them interact with each other

7. Understand and explain how predator-prey relationships and carrying capacity are related and give examples
8. Compare and contrast the difference between adaptable (generalized) and non-adaptable (specialized) wildlife

**C. Understand and describe the impact of humans and human development on wildlife and wildlife ecology, and vice versa**

1. Identify and explain reasons for wildlife habitat loss in Ontario
2. Explain how a change in weather/climate, topography or land use might modify the process of succession
3. Examine the factors (natural and external) that affect the survival and equilibrium of populations in an ecosystem
4. Understand and describe the effects that climate change has on wildlife ecology
5. Identify Ontario's rare, threatened and endangered wildlife species, as identified by COSEWIC, and explain how selected species were reduced to those levels
6. List examples of wildlife species that are non-native to Ontario
7. Identify and explain how non-native species arrived in Ontario
8. Describe how various non-native species have naturalized to Ontario and if and how they have been harmful

**D. Understand and describe practices involved in the conservation and management of wildlife and wildlife resources**

1. Identify the rights of Ontario's first nations with regard to wildlife resources
2. Understand and describe how the impacts of climate change on wildlife populations are being mitigated
3. Explain how Ontario's rare, threatened and endangered wildlife species, as identified by COSEWIC, are being managed to return populations to healthy levels
4. Recommend measures to remove/reduce impact of non-native species on Ontario Ecosystems
5. Interpret a variety of laws, agreements, treaties, etc. that govern Ontario's wildlife resources
6. Identify a variety of major stakeholders and agencies, including Federal, Provincial and Municipal government bodies, that provide oversight of wildlife resources in Ontario

## **Experiential/Application/Analysis**

**Students must be able to...**

1. Identify wildlife species common to Ontario using a field guide, dichotomous key, or index
2. Classify wildlife as rare, threatened or endangered species based on COSEWIC status categories
3. Analyse and evaluate population case studies by producing population growth curves for each of the populations in the study, and use the graphs to explain how different factors affect population size
4. Identify wildlife signs and describe their significance
5. Identify animals as predator, prey, herbivore, carnivore and omnivore
6. Identify an area as suitable habitat for certain wildlife species
7. Draw and explain food chains and food webs

## Evaluation/Synthesis

### Students must be able to...

1. Evaluate and assess a site as suitable habitat for common Ontario wildlife species
2. Describe and evaluate factors contributing to environmental resistance and the carrying capacity of ecosystems
3. Investigate sites for evidence of common Ontario wildlife species
4. Analyse how the change in one species' population can affect the entire ecosystem's food web