

## WATER AND AQUATIC ECOSYSTEMS

| Major Topics                                     | Code | Manitoba Envirothon Outcomes                                                                                                                                                                 |
|--------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Water and Aquatic Ecosystems as Resources        | A1   | Describe the ecological, economic and social benefits of aquatic ecosystems and riparian zones.                                                                                              |
|                                                  | A2   | Describe the ecological functions of riparian zones.                                                                                                                                         |
|                                                  | A3   | Describe the different types of aquatic ecosystems.                                                                                                                                          |
|                                                  | A4   | Describe the different types of aquifers.                                                                                                                                                    |
|                                                  | A5   | Explain how each type of aquifer relates to water quality and quantity.                                                                                                                      |
|                                                  | A6   | Describe historical trends in groundwater use, quantity and quality on the Canadian prairies.                                                                                                |
|                                                  | A7   | Describe factors affecting water quality and quantity, and aquatic ecosystems, including biodiversity, non-native species, habitat reduction, climate change, pollution, and human activity. |
| Properties of Water, Water Bodies and Watersheds | A8   | Describe the physical and chemical properties of water.                                                                                                                                      |
|                                                  | A9   | Explain how physical and chemical properties of water affect aquatic ecosystems.                                                                                                             |
|                                                  | A10  | Describe the water cycle including the processes and phases of water involved.                                                                                                               |
|                                                  | A11  | Explain the relationship between climate and water.                                                                                                                                          |
|                                                  | A12  | Describe the physical, chemical and biological properties of different types of aquatic ecosystems.                                                                                          |
|                                                  | A13  | Name the zones of a lake.                                                                                                                                                                    |
|                                                  | A14  | Describe zones and structure of a lake.                                                                                                                                                      |
|                                                  | A15  | Describe a riparian zone.                                                                                                                                                                    |
|                                                  | A16  | Explain how a riparian zone affects the physical, chemical and biological properties of the adjacent water body.                                                                             |
|                                                  | A17  | Describe a watershed, including its components.                                                                                                                                              |
|                                                  | A18  | Delineate the boundary of a watershed on a topographic map.                                                                                                                                  |

| Major Topics    | Code | Manitoba Envirothon Outcomes                                                                                                        |
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|                 | A19  | Describe features of healthy and unhealthy watersheds.                                                                              |
|                 | A20  | List common solutes and particulates found in water bodies.                                                                         |
|                 | A21  | Describe how watershed geography and land use practices influence common solutes and particulates in surface and ground waters.     |
|                 | A22  | Explain how common solutes and particulates affect water quality and aquatic ecosystems                                             |
|                 | A23  | Differentiate between point and non-point source pollution.                                                                         |
|                 | A24  | Predict the general water quality of a specific body of water based on information about nearby sources of pollution.               |
|                 | A25  | Describe how to perform physical, chemical and biological water quality tests, including sampling techniques and equipment used.    |
|                 | A26  | Interpret results of physical, chemical and biological water quality tests.                                                         |
|                 | A27  | Calculate parameters related to flowing water, including velocity, volume and rate of flow.                                         |
| Aquatic Ecology | A28  | Describe the nitrogen cycle, phosphorus cycle, and carbon cycle in aquatic ecosystems.                                              |
|                 | A29  | Describe an aquatic food web, including interactions between organisms and energy flow within the web.                              |
|                 | A30  | Give examples of aquatic organisms at different trophic levels.                                                                     |
|                 | A31  | Explain why biodiversity is important in aquatic ecosystems.                                                                        |
|                 | A32  | Discuss the roles that groups of aquatic species play in the ecosystem.                                                             |
|                 | A33  | Describe relationships of organisms within an aquatic ecosystem, including predation, competition and different types of symbiosis. |
|                 | A34  | Describe the preferred habitats of different types of aquatic species.                                                              |
|                 | A35  | Identify native and non-native aquatic species using keys, including plants, invertebrates and fish.                                |
|                 | A36  | Identify external and internal features of fish anatomy.                                                                            |
|                 | A37  | Explain how features of fish anatomy relate to age and sex.                                                                         |

| Major Topics                                                | Code | Manitoba Envirothon Outcomes                                                                                                                                                       |
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|                                                             | A38  | Explain the concept of carrying capacity within an aquatic ecosystem.                                                                                                              |
|                                                             | A39  | Explain how aquatic ecosystems are affected by climate change, non-native species, pollution and human activity.                                                                   |
|                                                             | A40  | Name aquatic species and ecosystems that are at risk.                                                                                                                              |
|                                                             | A41  | List factors contributing to the status of at risk aquatic species and ecosystems.                                                                                                 |
|                                                             | A42  | Give examples of invasive aquatic species in Manitoba.                                                                                                                             |
|                                                             | A43  | List characteristics of invasive species that contribute to their success over native species.                                                                                     |
| Conservation and Management of Water and Aquatic Ecosystems | A44  | Explain why it is important to conserve and manage water and other aquatic resources.                                                                                              |
|                                                             | A45  | Describe different methods of conserving water.                                                                                                                                    |
|                                                             | A46  | Discuss the relationship between sustainable development and aquatic ecosystems.                                                                                                   |
|                                                             | A47  | Discuss the interaction of competing uses of water, including industry, hydropower, irrigation, agriculture, transportation, navigation, recreation/sport, wildlife and fisheries. |
|                                                             | A48  | Discuss the impact of competing water uses on the ability of an ecosystem to sustain wildlife, forestry, fisheries and other human needs.                                          |
|                                                             | A49  | Describe pressures on fish populations.                                                                                                                                            |
|                                                             | A50  | Explain the importance of fishery management.                                                                                                                                      |
|                                                             | A51  | Use the Manitoba Angler's Guide to determine provincial fishing regulations                                                                                                        |
|                                                             | A52  | Describe how Geographic Information Systems (GIS) are used in the management of water resources.                                                                                   |
|                                                             | A53  | Describe how to perform a riparian health assessment.                                                                                                                              |
|                                                             | A54  | Interpret the results of a riparian health assessment to determine what needs improvement for a riparian area to function optimally.                                               |
|                                                             | A55  | Describe role of physical, chemical and biological tests in assessing and managing aquatic ecosystems.                                                                             |

| Major Topics | Code | Manitoba Envirothon Outcomes                                                                                                                                |
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|              | A56  | Use results of physical, chemical and biological tests to assess water quality and make recommendations to improve aquatic ecosystem health.                |
|              | A57  | Propose management decisions to address the conflicts between competing water uses.                                                                         |
|              | A58  | Propose management decisions that would improve and protect water quality in in the face of various environmental stresses.                                 |
|              | A59  | Name government agencies responsible for overseeing water resources.                                                                                        |
|              | A60  | Describe laws and other methods used to protect water quality, aquatic ecosystems and fisheries from pollution, non-native species and other human impacts. |

## NATIVE PLANTS AND FORESTRY

| Major Topics                     | Code | Manitoba Envirothon Outcomes                                                                                                                                                            |
|----------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trees and Forests as Resources   | F1   | Describe the ecological, economic and social benefits of trees and forests.                                                                                                             |
|                                  | F2   | List products provided by trees and forests.                                                                                                                                            |
|                                  | F3   | Differentiate between timber and non-timber products.                                                                                                                                   |
|                                  | F4   | Describe the ecosystem services provided by trees and forests.                                                                                                                          |
|                                  | F5   | Describe factors affecting health and survival of trees and forests, including biodiversity, non-native species, habitat reduction, pollution, climate change, fire and human activity. |
| Plant Biology and Identification | F6   | Name the parts and tissues of a plant.                                                                                                                                                  |
|                                  | F7   | State the function of parts and tissues of a plant.                                                                                                                                     |
|                                  | F8   | Describe the annual growth cycle of a tree.                                                                                                                                             |
|                                  | F9   | Describe the processes of photosynthesis and respiration.                                                                                                                               |
|                                  | F10  | Explain how photosynthesis and respiration are important to the growth and reproduction of plants.                                                                                      |
|                                  | F11  | Identify the common trees and shrubs of Manitoba by common name without a key.                                                                                                          |

| Major Topics                       | Code | Manitoba Envirothon Outcomes                                                                                                                                                                                                  |
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|                                    | F12  | Use a key or identification guide to identify other trees and shrubs by scientific and common names.                                                                                                                          |
|                                    | F13  | Identify distinctive indicator plant species using a key.                                                                                                                                                                     |
|                                    | F14  | Identify distinctive at risk plant species without a key.                                                                                                                                                                     |
|                                    | F15  | Give examples of how native plants have been used traditionally.                                                                                                                                                              |
|                                    | F16  | Name Manitoba's provincial tree.                                                                                                                                                                                              |
| Forest and Grassland Ecology       | F17  | Describe typical forest structure, including canopy, understory and ground layers, and crown classes.                                                                                                                         |
|                                    | F18  | Describe concepts related to forest ecology, including soil, forest types, tree communities, biodiversity, competition, succession, forest fire, regeneration, snag, climate change and riparian zone.                        |
|                                    | F19  | Discuss relationships between those concepts.                                                                                                                                                                                 |
|                                    | F20  | Explain the importance of those concepts to ecosystem health.                                                                                                                                                                 |
|                                    | F21  | List abiotic and biotic factors in a forest ecosystem.                                                                                                                                                                        |
|                                    | F22  | Explain how abiotic and biotic factors affect forests, including climate, insects, microorganisms and wildlife.                                                                                                               |
|                                    | F23  | Give examples of how trees have evolved or adapted to their environments, including boggy soil, steep slopes, rocky terrain and extreme climate.                                                                              |
|                                    | F24  | List the eco-regions of Manitoba.                                                                                                                                                                                             |
|                                    | F25  | Describe the eco-regions of Manitoba including their geographical location.                                                                                                                                                   |
|                                    | F26  | Name the dominant tree species and key indicator species associated with each eco-region.                                                                                                                                     |
|                                    | F27  | Name plant species that are endangered or at risk in Manitoba.                                                                                                                                                                |
| Silviculture and Forest Management | F28  | Describe silviculture practices for planting, tending and harvesting.                                                                                                                                                         |
|                                    | F29  | Explain how silviculture practices are used, including tree improvement, seedling production, weeding, herbiciding, thinning, burning, even-aged and uneven-aged stands, selection, clearcutting, seed-tree and shelter wood. |

| Major Topics | Code | Manitoba Envirothon Outcomes                                                                                                                |
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|              | F30  | Identify basic forestry tools, including calipers, increment borer, clinometers, prism, compass, diameter tape and tables.                  |
|              | F31  | Describe how to use basic forestry tools.                                                                                                   |
|              | F32  | Measure dimensions of trees, including DBH and height.                                                                                      |
|              | F33  | Determine tree volume and board feet using tables.                                                                                          |
|              | F34  | Determine tree age from a tree cookie or core.                                                                                              |
|              | F35  | Describe the status of forestry in Manitoba and Canada.                                                                                     |
|              | F36  | Describe threats to forest resources in Manitoba and Canada.                                                                                |
|              | F37  | Describe how forest management and health affect biodiversity, habitat reduction, air quality, climate change, fire and aesthetics.         |
|              | F38  | Discuss the relationship between sustainable development and forest management.                                                             |
|              | F39  | Describe sustainable forestry management.                                                                                                   |
|              | F40  | Describe Best Management Practices (BMPs) for forestry, including those for water quality, fire and aesthetics.                             |
|              | F41  | Determine general goals and practices for a particular forestry situation based on principles and methods of sustainable forest management. |
|              | F42  | Give examples of Traditional Ecological Knowledge (TEK).                                                                                    |
|              | F43  | Explain the role TEK plays in sustainable forest management.                                                                                |
|              | F44  | Describe the uses of forest surveys, including silviculture surveys, inventories, wood supply analysis and pre-harvest surveys.             |
|              | F45  | Describe methods and procedures used in a forest survey, including PSPs/ TSPs, GIS/GPS, mapping and sampling.                               |
|              | F46  | Describe forest certification including its components.                                                                                     |
|              | F47  | Name the forest certification systems in use in North America, including CSA, FSC, and SFI.                                                 |
|              | F48  | Explain why certification of sustainable management forests is important to Canada's forest industry.                                       |

## SOILS AND LAND USE

| Major Topics                         | Code | Manitoba Envirothon Outcomes                                                                                                                           |
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| Soil as a Resource                   | S1   | Describe the ecological, economic and social benefits of soil.                                                                                         |
|                                      | S2   | Explain why soil is a dynamic and limited resource.                                                                                                    |
|                                      | S3   | Describe the five soil forming factors.                                                                                                                |
|                                      | S4   | Explain how these factors affect soil properties.                                                                                                      |
|                                      | S5   | Describe the different types, origins and deposition of soil parent material.                                                                          |
|                                      | S6   | Name common parent materials in Manitoba.                                                                                                              |
|                                      | S7   | Describe the four basic soil forming processes (additions, losses, translocations, and transformations).                                               |
|                                      | S8   | Describe factors affecting the health and fertility of soil, including biodiversity, non-native species, pollution, climate change and human activity. |
| Properties of Soil and Soil Profiles | S9   | Describe physical and chemical properties of soil, including texture, color, structure, CEC, pH, porosity, density.                                    |
|                                      | S10  | Perform tests and calculations to determine physical and chemical properties of soil, including texture, porosity and density.                         |
|                                      | S11  | Relate soil properties to soil limitations.                                                                                                            |
|                                      | S12  | Identify features of a soil profile.                                                                                                                   |
|                                      | S13  | Define soil profile symbols.                                                                                                                           |
|                                      | S14  | Determine soil characteristics and limitations from a soil profile, including fertility, water movement, permeability, carbonates).                    |
|                                      | S15  | Identify soil to sub-group using Canadian System of Soil Classification.                                                                               |
|                                      | S16  | Describe the major soil orders found in Manitoba including their geographic and ecosystem distribution.                                                |
|                                      | S17  | Describe how water moves into and through soil and into plants.                                                                                        |
|                                      | S18  | Explain how soil properties affect availability of water to plants.                                                                                    |

| Major Topics                                                | Code | Manitoba Envirothon Outcomes                                                                                                                   |
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|                                                             | S19  | Describe different types of soil water including their availability to plants.                                                                 |
| Soil Ecology and Soil Fertility                             | S20  | Describe the soil portion of the water, carbon and nutrient cycles.                                                                            |
|                                                             | S21  | Explain how these cycles affect soil management.                                                                                               |
|                                                             | S22  | Explain why biological diversity is important for soil, plant, environmental and human health.                                                 |
|                                                             | S23  | Give examples of beneficial soil organisms.                                                                                                    |
|                                                             | S24  | Explain how the soil ecosystem affects and is affected by soil management.                                                                     |
|                                                             | S25  | List essential plant nutrients.                                                                                                                |
|                                                             | S26  | Describe how nutrients are held in soil.                                                                                                       |
|                                                             | S27  | Explain how soil fertility depends on the physical, chemical and biological state of the soil.                                                 |
|                                                             | S28  | Explain how soil fertility relates to soil properties and limitations.                                                                         |
|                                                             | S29  | Explain how soil properties and limitations affect fertilizer use.                                                                             |
|                                                             | S30  | Describe the procedure for taking a soil sample and conducting nutrient analysis.                                                              |
| Soil Conservation and Management, Soil Surveys and Land Use | S31  | Discuss the relationship between sustainable development and soil conservation.                                                                |
|                                                             | S32  | Describe different types of soil degradation, including erosion, salinity and compaction.                                                      |
|                                                             | S33  | Explain how soil properties and other factors affect erosion, salinity and compaction.                                                         |
|                                                             | S34  | Describe methods to prevent or reduce soil degradation.                                                                                        |
|                                                             | S35  | Describe how agriculture is affected by climate change.                                                                                        |
|                                                             | S36  | Compare the impact of different soil conservation practices and land uses on soil health, climate change and sustainability.                   |
|                                                             | S37  | Explain why soil management is important to agriculture, water quality and climate change.                                                     |
|                                                             | S38  | Describe how Global Information Systems (GIS) are used by agricultural and resource managers for soil management and environmental protection. |

| Major Topics | Code | Manitoba Envirothon Outcomes                                                                                                 |
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|              | S39  | Determine the best land use for a particular parcel of land based on soil knowledge and data.                                |
|              | S40  | Locate information in published and on-line soil data, including soil survey reports, soil capability maps and ortho photos. |
|              | S41  | Interpret data from such sources.                                                                                            |
|              | S42  | Explain the section-township-range system.                                                                                   |
|              | S43  | Describe the role of government in soil management.                                                                          |

## WILDLIFE AND WILDLIFE MANAGEMENT

| Major Topic                       | Code | Manitoba Envirothon Outcomes                                                                                                                                      |
|-----------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wildlife as a Resource            | W1   | Describe the ecological, economic and social benefits of wildlife.                                                                                                |
|                                   | W2   | Explain the importance of the three components of biodiversity to wildlife and to humans.                                                                         |
|                                   | W3   | Describe factors affecting wildlife and wildlife habitat, including biodiversity, non-native species, habitat loss, pollution, climate change and human activity. |
| Animal Biology and Identification | W4   | Identify basic features of external and internal anatomy of birds and mammals.                                                                                    |
|                                   | W5   | List the components of the main organ systems of animals.                                                                                                         |
|                                   | W6   | Describe the functions of the main organ systems of animals.                                                                                                      |
|                                   | W7   | Give examples of anatomical, physiological and/or behavioral adaptations of common wildlife.                                                                      |
|                                   | W8   | Determine an animal's general diet, habitat, and daily activity pattern from its gross anatomy.                                                                   |
|                                   | W9   | Differentiate between pathogens and parasites.                                                                                                                    |
|                                   | W10  | Give examples of pathogens and parasites found in Manitoba wildlife.                                                                                              |
|                                   | W11  | Describe key characteristics of common phyla.                                                                                                                     |

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|                  | W12 | Determine major mammal and bird groups from skulls without a key.                                                               |
|                  | W13 | Identify common wildlife species using a field guide or key from specimens, dental formulae, pictures, decoys, scats or tracks. |
|                  | W14 | Identify common mammal, bird and herp species from recordings of animal sounds without a key.                                   |
|                  | W15 | Determine dental formula from skull.                                                                                            |
|                  | W16 | Identify common invasive species present or anticipated in Manitoba.                                                            |
| Wildlife Ecology | W17 | Describe the five main habitat needs of all wildlife.                                                                           |
|                  | W18 | Describe the specific needs and preferred habitat of common wildlife species in Manitoba.                                       |
|                  | W19 | Explain how abiotic and biotic factors affect an animal's ability to obtain resources.                                          |
|                  | W20 | Explain how specific adaptations contribute to the survival of wildlife species.                                                |
|                  | W21 | Describe a food web, including interactions between organisms and energy flow in the web.                                       |
|                  | W22 | Give examples of wildlife species at different trophic levels.                                                                  |
|                  | W23 | Describe the role of a particular species in the ecosystem.                                                                     |
|                  | W24 | Describe relationships of organisms in an ecosystem, including predation, competition and different types of symbiosis.         |
|                  | W25 | Give examples of types of symbiosis.                                                                                            |
|                  | W26 | Differentiate between an ecosystem, a community and a population.                                                               |
|                  | W27 | Explain how carrying capacity affects wildlife populations.                                                                     |
|                  | W28 | Give examples of limiting factors for wildlife populations.                                                                     |
|                  | W29 | Describe how birth, mortality, age structure, sex ratio, and mating systems affect wildlife populations.                        |
|                  | W30 | Name wildlife species that are at risk in Manitoba and Canada.                                                                  |
|                  | W31 | List factors that contribute to the status of species at risk.                                                                  |
|                  | W32 | Describe common characteristics of at risk species that contribute to their status.                                             |

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|                                         | W33 | Name common invasive species present or anticipated in Manitoba.                                                                                                                                                       |
|                                         | W34 | Explain how non-native plant and animal species can affect wildlife and wildlife habitat.                                                                                                                              |
|                                         | W35 | Describe common characteristics of invasive species that contribute to their success over native species.                                                                                                              |
|                                         | W36 | Describe the impact of succession on ecosystems.                                                                                                                                                                       |
| Conservation and Management of Wildlife | W37 | Explain the importance of wildlife management in addressing factors that affect wildlife and wildlife habitat, including biodiversity, non-native species, habitat loss, pollution, climate change and human activity. |
|                                         | W38 | Describe the relationship between sustainable development and wildlife management.                                                                                                                                     |
|                                         | W39 | Describe role of government and wildlife managers in conserving and managing wildlife and wildlife habitat, including planning, regulation, education and enforcement.                                                 |
|                                         | W40 | Describe information and approaches that wildlife managers use to create management goals.                                                                                                                             |
|                                         | W41 | Describe common practices and methods for managing wildlife and wildlife habitat, including population control, hunting and trapping regulations and habitat restoration.                                              |
|                                         | W42 | Evaluate habitats for a particular species according to its specific requirements.                                                                                                                                     |
|                                         | W43 | Describe strategies used to manage issues involving wildlife in Manitoba, including non-native species, problem wildlife, wildlife pathogens and disease, and species at risk.                                         |
|                                         | W44 | Differentiate between problem wildlife and invasive species.                                                                                                                                                           |
|                                         | W45 | Give examples of species that are considered problem wildlife.                                                                                                                                                         |
|                                         | W46 | Name organizations and agencies responsible for listing and protecting species at risk at the provincial, federal and international level.                                                                             |
|                                         | W47 | Describe the role of laws in conserving species at risk.                                                                                                                                                               |
|                                         | W48 | Explain how the IUCN Red List of Threatened Species is used.                                                                                                                                                           |
|                                         | W49 | Differentiate between the main categories for species at risk.                                                                                                                                                         |
|                                         | W50 | Describe common research methods used by wildlife biologists, including population monitoring, diet reconstruction and ethology.                                                                                       |

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|  | W51 | Determine appropriate method for a particular research study.                                                        |
|  | W52 | Describe how to perform research methods used by wildlife biologists, including sampling methods and field journals. |
|  | W53 | Calculate populations using quadratic sampling and mark recapture.                                                   |