UNIT 5:
CONSERVATION OF BIODIVERSITY

Unit 5: Conservation of Biodiversity

Specific Learning Outcomes

B12-5-01: Discuss a variety of reasons for maintaining biodiversity. (GLOs: B2, B5, D2)

Include: maintaining a diverse gene pool, economic value, and sustainability of an ecosystem

B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

B12-5-03: Select and use appropriate tools or procedures to determine and monitor biodiversity in an area. (GLOs: C1, C2, C7)

Examples: field guides, dichotomous keys, quadrats, transects, mark and recapture . . .

B12-5-04: Investigate an issue related to the conservation of biodiversity. (GLOs: C4, C6, C8, D2, E2)

Examples: heritage seeds, water quality in Lake Winnipeg, land-use designations, hydroelectric development . . .

MAINTAINING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-01: Discuss a variety of reasons for maintaining biodiversity. (GLOs: B2, B5, D2)

Include: maintaining a diverse gene pool, economic value, and sustainability of an ecosystem

SLO: B12-5-01

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 6 Science, students were introduced to the concept of biodiversity and they observed and described the variety of living things in their local environment.

Students identified environmental, social, and economic factors that should be considered in the management and preservation of ecosystems in Grade 7 Science.

In Grade 10 Science, students examined the complex relationships present in ecosystems and explained how the biodiversity of an ecosystem contributes to its sustainability. They investigated how human activities affect an ecosystem and used the decision-making model to propose a course of action to enhance its sustainability.

TEACHER NOTE

Values clarification is an effective way for students to reflect on what their values are, why they value certain things, and how they can look beyond themselves into the worlds around them. You may first wish to discuss the definition of *value*. The teacher's role in the learning activities is that of a facilitator who does not impose his or her own values on the discussion.

When discussing an environmental issue, it is important to present more than just the conservationist side (i.e., save the planet). Students need to realize that there is not just one "right" answer to a problem, and that decisions are often based on priorities. What is one person's priority may not be that of another. This difference in priorities can lead to conflict.

BACKGROUND INFORMATION

This learning outcome provides the opportunity to integrate cultural/local and community perspectives/values into the discussion of biodiversity. Students should understand that values may vary from one group to another. For example, sweetgrass (*Hierochloe odorata*) is of great sacred (inherent) value to First Nations peoples. The smoke of burning sweetgrass is used to purify and cleanse objects, places, and people. Sweetgrass is also of utilitarian value in that it can be used to keep clothing fresh when stored. It has also been used to make baskets. Tea made from its leaves has been used to treat fever, coughs, and sore throats.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-S1: Use appropriate scientific problem-solving or inquiry strategies when answering a question or solving a problem. (GLOs: C2, C3)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B12-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B12-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

Resource Links

- Canadian Water Resources Association (CWRA). *Project WET*. <www.cwra.org/branches/ProjectWet/>.

  This is an interdisciplinary water-based environmental and conservation education program for elementary and secondary school educators. Project WET curriculum and activity guides are supplied to all who attend workshops.

- Canadian Wildlife Federation (CWF). "Wild Education." *CWF Education*. <www.cwf-fcf.org/en/educate/ed_resources/for-educators/>.

  This website provides elementary and secondary school educators with conservation education programs such as Project WILD, Fish Ways, and Below Zero. Activity guides are supplied to all who attend WILD workshops.

MAINTAINING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-01: Discuss a variety of reasons for maintaining biodiversity. (GLOs: B2, B5, D2)

Include: maintaining a diverse gene pool, economic value, and sustainability of an ecosystem

ACTIVATE

KWL Chart

To activate students' prior knowledge, use the KWL (know, want to know, learned) strategy (Ogle). Provide students with a KWL Chart at the start of the unit and ask them to fill in the What I Know and What I Want to Learn columns. See Appendix 5.1: Conserving Biodiversity—KWL Chart (BLM). At the end of the unit, ask students to return to their KWL Charts and complete the What I Learned column.

Utilitarian and Inherent Value—Think-Pair-Share

Have students, individually, think of and list items they use in their everyday lives that come from natural sources. Students then find a partner and share their lists. Lists may include items such as leather shoes, milk, vegetables, vitamins, gasoline, and so on.

Ask the pairs to think of and record a list of things they appreciate in nature. Lists may include items such as bird songs, flowers, sunsets, clean air, walking on a beach or in a forest, and so on.

Pose the following question to the groups:

- How would you describe the difference between the two lists?

Students' responses should indicate that the first list contains items we consider to be useful or practical (utilitarian), while the second list contains items of intrinsic or natural beauty (inherent).

ACQUIRE/APPLY

Maintaining Biodiversity—Class Discussion (U1)

Discuss with students the terms *utilitarian* (useful, practical) and *inherent* (intrinsic, natural) and provide definitions. Based on the definitions and the Think-Pair-Share learning activity, students list examples of items of personal utilitarian value (e.g., cow—leather and food) and personal inherent value (e.g., robin's song—cheerful sound).

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-S1: Use appropriate scientific problem-solving or inquiry strategies when answering a question or solving a problem. (GLOs: C2, C3)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B12-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B12-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

Suggestion for Assessment

Scan the lists to assess students' understanding of the meaning of utilitarian and inherent value. The information gathered can be used to plan further instruction (formative assessment).

Values Clarification (U2, P3, P4, D3, D4, G2)

This learning activity will introduce students to values clarification and assist them with determining how they value biodiversity. See Appendix 5.2: Values Clarification (BLM) for the student handout.

MAINTAINING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

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Suggestion for Assessment

Use the discussion and written responses from the Values Clarification learning activity to assess whether students can

- identify potential conflicts that may arise when making decisions on environmental issues
- explain the logic and validity involved in forming personal opinions

Group work skills can be assessed with a checklist. See Appendix 1.13: Collaborative Process—Assessment (BLM).

Preserving Biodiversity—Demonstrating Understanding (U1)

Pose the following questions to students at the end of the class:

> Should we preserve only those things in nature that have utilitarian value? Why or why not?

Give students five minutes to respond in their notebooks.

Suggestion for Assessment

This learning activity provides a quick formative assessment of what students learned in a particular lesson. Assess students' responses, checking for logic and clarity in the following areas:

- the students' position on the issue
- the rationale explaining the position

Envirothon (U2, P1, P2, G1)

Envirothon is a hands-on environmental problem-solving competition for high school students. Participating teams complete training and testing in five natural resource categories:

- soils and land use
- aquatic ecology
- forestry
- wildlife
- current environmental issues

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-S1: Use appropriate scientific problem-solving or inquiry strategies when answering a question or solving a problem. (GLOs: C2, C3)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B12-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B12-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

Resource Links

- Canon Envirothon. Home Page. <www.envirothon.org/>.
  This is an annual competition in which the winning state/provincial teams compete for recognition and scholarships by demonstrating their knowledge of environmental science and natural resource management.

- Manitoba Forestry Association. "Manitoba Envirothon." *ThinkTrees*. <www.thinktrees.org/Envirothon.aspx>.
  Visit this website for information on the Manitoba Envirothon.

MAINTAINING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-01: Discuss a variety of reasons for maintaining biodiversity. (GLOs: B2, B5, D2)

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Suggestion for Assessment

Have students complete an "I Used to Think, But Now I Know" reflection after participating in the Envirothon. Ask students to recall their ideas about current environmental issues prior to the competition, and have them explain how their ideas changed or became more detailed as a result of their participation (Keeley). Students can discuss their reflections with a partner.

Riparian Zone Assessment—Culminating Task
(U2, S1, D1, D2, D3, D4, D5, I1, I4)

The Riparian Zone Assessment task is designed to integrate the four Conservation of Biodiversity learning outcomes and a number of skills and attitudes outcomes into one major assignment. Refer to Appendix 5.3A: Riparian Zone Assessment (Teacher Background) and Appendix 5.3B: Riparian Zone Assessment (BLM). This task can be done in one class, or it can be expanded to several classes, depending on the amount of fieldwork incorporated or the number of case studies examined. A general conservation dilemma (e.g., the clearing of riparian zones for beach property) or a local riparian issue (e.g., local stream/riverbank erosion or development) could be presented.

Suggestions for Assessment

Have students prepare a scientific report incorporating technical writing to address a local riparian issue they have investigated. The report should

- identify the issue and its parameters
- describe possible courses of action and resulting consequences
- make a recommendation that is the most ecologically sustainable

For more information about the decision-making process, refer to Appendix 1.12: Decision Making (Teacher Background). Fieldwork and group work skills can be assessed with checklists. See Appendix 5.4A: Fieldwork Skills Checklist—General Skills (BLM), Appendix 5.4B: Fieldwork Skills Checklist—Thinking Skills (BLM), and Appendix 1.13: Collaborative Process—Assessment (BLM).

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-S1: Use appropriate scientific problem-solving or inquiry strategies when answering a question or solving a problem. (GLOs: C2, C3)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B12-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B12-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

Create an assessment rubric for the report by developing the assessment criteria and performance levels in collaboration with students. Refer to Appendix 5.7: Co-constructing Assessment Criteria with Students (Teacher Background) for more information on the collaborative process. Alternatively, provide students with exemplars of strong and weak reports, and have them work in groups to identify possible assessment criteria and define levels of performance. The exemplars can be anonymous samples of student work done in previous years.

CONSERVATION STRATEGIES

SPECIFIC LEARNING OUTCOME

B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

SLO: B12-5-02

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 7 Science, students identified environmental, social, and economic factors that should be considered in the management and preservation of ecosystems. Students proposed a course of action to protect the habitat of a particular organism within an ecosystem. In Grade 9 Science, students investigated how human activities affect an ecosystem and used the decision-making model to propose a course of action to enhance its sustainability.

TEACHER NOTE

Various biodiversity conservation strategies are in use in Manitoba. Some programs focus on the conservation of a particular species, while others focus on preserving or restoring a habitat in order to conserve the biodiversity of the ecosystem. A local or regional focus on the conservation of Manitoba's biodiversity is recommended.

BACKGROUND INFORMATION

Students often confuse conservation with preservation. Clarify the concepts, indicating that *conservation* focuses on maintaining species biodiversity through sustainable management of wild plants and animals and their habitats. Indicate that management does not necessarily mean a "no-kill" policy. For example, the deer population of Manitoba is managed in part through hunting. A species *preservation* program generally concentrates on protecting a particular endangered plant or animal from extinction (e.g., captive breeding programs in zoos).

The term *stewardship* refers to the wide range of voluntary actions that we can take to care for the environment. Activities range from monitoring and conserving wildlife species and their habitat to protecting and improving the quality of soil, water, air, and other natural resources.

ACTIVATE

Habitat Conservation/Species Preservation Programs—Brainstorming

Students will have some familiarity with a variety of conservation/preservation programs. Lead a class brainstorming session on habitat conservation/species preservation programs and record suggestions generated by students.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

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B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Examples of habitat conservation/species preservation programs:

- seed banks
- zoos
- captive breeding programs
- adopt an animal (e.g., World Wildlife Fund program)
- species recovery (e.g., bison in the Chitek Lake area of Manitoba)
- habitat protection (e.g., developing parks and preserves)
- prevention of illegal trade of wildlife (e.g., bear gallbladders, rare orchids)
- habitat restoration (e.g., restoring wetlands, removing toxic waste)
- public education (e.g., identifying species at risk)
- wildlife corridors
- forest management
- bag/creel limits for hunters, fishers, and trappers

CONSERVATION STRATEGIES

SPECIFIC LEARNING OUTCOME

B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

ACQUIRE/APPLY

Habitat Conservation/Species Preservation Programs—Class Discussion (U2, P3, P4)

Using the list of habitat conservation/species preservation programs generated by the class, differentiate between habitat conservation and species preservation. Have students review the list of programs and identify which programs focus on habitat conservation and which focus on species preservation. Students could create Venn diagrams, placing habitat conservation programs (e.g., habitat restoration, forest management) on one side of the diagram, species preservation programs (e.g., zoos, bag limits) on the other side of the diagram, and programs that do both (e.g., public education) in the overlapping part of the diagram.

Suggestion for Assessment

Venn diagrams can be assessed by the teacher to monitor students' understanding (formative assessment), or shared and discussed with other students/groups (peer assessment). For more information on peer assessment, refer to Appendix 4.2A: Peer Assessment (Teacher Background) and Appendix 4.2B: Guidelines for Peer Assessment (BLM).

Strategies for Conserving Biodiversity—Class Discussion (U1, P2, P3)

Discuss strategies used to conserve biodiversity. A wealth of information can be found in a variety of multimedia formats.

Resource Links

- Assiniboine Park Zoo. "Conservation Corner." *Programs: Education and Experience.* <www.zoosociety.com/programs/conservation-corner.php>.
  The Zoo's Education Centre promotes the concept of endangered species and wildlife conservation through education and interactive learning. Refer to this website for links related to environmentalism, conservation, and zoos. To book group programs, seasonal camps, and guided tours, call the Park Programming Office at 204-927-6070 or email <parkprograms@assiniboinepark.ca>.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

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Include: print and electronic sources, resource people, and different types of writing

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

- Canadian Wildlife Federation (CWF). Home Page. <www.cwf-fcf.org/>.
  CWF advocates for the protection of Canada's wild species and spaces and is dedicated to fostering awareness and enjoyment of our natural world. This website contains information on programs, resources, current issues, and actions, and has links to other websites.

- Environment Canada. "Education and Awareness." Canadian Biodiversity Information Network (CBIN). <www.cbin.ec.gc.ca/education/>.
  CBIN promotes awareness of biodiversity. This website provides educators with links to interactive resources such as *Hinterland Who's Who* and the Museum of Nature.

- ———. *EnviroZine.* <www.ec.gc.ca/envirozine/>.
  This online news magazine addresses a wide range of environmental issues of interest to Canadians.

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B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

- Manitoba Conservation. Home Page. <www.gov.mb.ca/conservation/>. This provincial website contains information on sustainable resource management, Manitoba species at risk, wildlife protection, the protected areas initiative, and other topics.
- NatureNorth.com. Home Page. <www.naturenorth.com/>. Manitoba's online nature magazine is dedicated to celebrating Manitoba's biodiversity.
- World Wildlife Fund (WWF)—Canada. Home Page. <www.wwf.ca/>. WWF is dedicated to conserving the world's biological diversity, ensuring that the use of renewable resources is conducted in a sustainable manner, and promoting the reduction of pollution and wasteful consumption. This website contains information on conservation programs and resources, and has links to other websites.

Suggestion for Assessment

During the last five minutes of the class, have students complete an Exit Slip, reflecting on questions such as the following:

- What do you know now that you didn't know before class today?
- What did you already know?
- What questions do you still have?

Review students' responses, looking for areas of confusion, and address the questions during the next class (formative assessment). For information on Exit Slips, see *SYSTH* (p. 13.9).

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Biodiversity Conservation Strategies—Guest Speaker (P2, P3, I1)

Invite a speaker to discuss biodiversity conservation strategies with the class. Speakers could include the following:

- conservation officer
- Elder
- National Park Warden Association representative
- Conservation District manager
- Manitoba Wildlife Federation representative
- Canadian National Trappers Alliance member

Students should prepare questions for the guest speaker in advance of the visit. This is a good opportunity for students to explore related careers.

CONSERVATION STRATEGIES

SPECIFIC LEARNING OUTCOME

B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

Suggestion for Assessment

Have students summarize highlights of the guest speaker's presentation in their notebooks. Summaries can then be shared with classmates and peer assessed for content. For more information on peer assessment, refer to Appendix 4.2A: Peer Assessment (Teacher Background) and Appendix 4.2B: Guidelines for Peer Assessment (BLM).

Species Preservation or Habitat Conservation—Public Awareness Campaign and Presentation (U2, P3, I2, I3, I4)

Students individually select and research a species preservation or habitat conservation program and design a campaign to promote public awareness of the issue. The campaigns should include information on the type of program, the characteristics of the program, and the source of funding. They present their work in a format of their choice.

Suggestions for Assessment

Students prepare and present their public awareness campaigns. Campaigns can be presented in a variety of formats:

- multimedia presentation (e.g., PowerPoint, wiki, podcast, website)
- oral presentation
- written report (e.g., pamphlet, brochure)
- visual display (e.g., poster, bulletin board)

Presentation components may vary, depending on the type of presentation. Refer to Appendix 5.8: Checklist for Creating Visuals (BLM) for use with visuals (e.g., posters, collages, graphic organizers) and Appendix 5.9: Oral Presentation—Observation Checklist (BLM).

Develop assessment criteria for the public awareness campaign presentation in collaboration with students. Refer to Appendix 5.7: Co-constructing Assessment Criteria with Students (Teacher Background) for more information on the collaborative process. The assessment criteria should include both content and presentation components. The content criteria should include the use of key terms and understandings from the unit.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Alternatively, provide students with exemplars of effective and ineffective public awareness campaigns. Students can then work in groups to identify assessment criteria and levels of performance for a rubric. The exemplars can be teacher-generated or anonymous samples of student work done in previous years.

Take a Stand—Decision Making (U2, D1, D3, D4)

This learning activity encourages open-mindedness and demonstrates the range of possible views on a controversial topic. It enables students to explore the grey areas that lie between the polar opposites of an issue, and helps them develop an appreciation for the spectrum of possible views. Refer to Appendix 5.5A: Take a Stand (Teacher Background) for information on using the learning activity with your class. For decision-making issues, see Appendix 5.5B: Take a Stand—Scenarios.

CONSERVATION STRATEGIES

SPECIFIC LEARNING OUTCOME

B12-5-02: Describe strategies used to conserve biodiversity. (GLOs: B2, B5, D2)

Examples: habitat preservation, wildlife corridors, species preservation programs, public education . . .

Suggestion for Assessment

Students individually reflect on their participation in the Take a Stand learning activity and describe the values (utilitarian and/or inherent) they used in determining their decision. The reflection should

- describe the initial position the student took on the issue
- identify the values used in determining his or her position
- indicate whether or not his or her position on the issue changed during the learning activity
- explain why his or her position changed or did not change

Assess students' responses for accuracy and clarity.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and different types of writing

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

NOTES

MONITORING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-03: Select and use appropriate tools or procedures to determine and monitor biodiversity in an area. (GLOs: C1, C2, C7)

Examples: field guides, dichotomous keys, quadrats, transects, mark and recapture . . .

SLO: B12-5-03

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 6 Science, students identified living things using an existing classification key, and they observed and described the diversity of living things in the local environment. In Grade 10 Science, students observed and documented a range of organisms that illustrate the biodiversity within a local or regional ecosystem. Statistical sampling procedures are introduced in Grade 11 Applied Mathematics.

TEACHER NOTE

This learning outcome provides an opportunity to incorporate fieldwork into the unit. However, if the weather or resources do not permit fieldwork, various sampling methods can be simulated. Refer to Appendix 5.6A: Investigating Population Size (BLM) and Appendix 5.6B: Investigating Population Size (Answer Key).

BACKGROUND INFORMATION

Field guides and *dichotomous keys* are tools used to identify organisms in the field. Plant populations can be sampled with *transects* or *quadrats*, which are plots within which the number or type of species is counted in randomly selected areas. The size of a mobile animal population can be estimated using the *mark and recapture* technique in which the organism of study is tagged or banded.

These techniques are based on random sampling statistical procedures. Care must be taken to assure that randomness occurs when the sampling is performed; otherwise, erroneous population estimates will result. Biologists can then determine whether a population is growing or declining by repeating sampling procedures over time.

ACTIVATE

Turn to Your Neighbour

Pose the following question to students:

- How do biologists working in the field identify the different species of organisms they find?

Students turn to their neighbours to discuss their ideas.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-S2: Demonstrate work habits that ensure personal safety, the safety of others, and consideration of the environment. (GLOs: B3, B5, C1, C2)

B12-0-S3: Record, organize, and display data and observations using an appropriate format. (GLOs: C2, C5)

B12-0-S4: Evaluate the relevance, reliability, and adequacy of data and data-collection methods. (GLOs: C2, C4, C5, C8)

Include: discrepancies in data and sources of error

B12-0-S5: Analyze data and/or observations in order to explain the results of an investigation, and identify implications of these findings. (GLOs: C2, C4, C5, C8)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Students' responses may include the following:

- field guides
- reference books
- dichotomous keys
- knowledge of experts
- personal knowledge
- knowledge of Elders

ACQUIRE/APPLY

Using a Dichotomous Key/Field Guide—Samples and Demonstration (U2)

Provide students with samples of dichotomous keys and field guides and demonstrate their use. Dichotomous keys are readily available in textbooks, in lab manuals, and on the Internet.

MONITORING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-03: Select and use appropriate tools or procedures to determine and monitor biodiversity in an area. (GLOs: C1, C2, C7)

Examples: field guides, dichotomous keys, quadrats, transects, mark and recapture . . .

Resource Links

Sources of field guides and keys for local flora and fauna are suggested below.

- Lone Pine Publishing. Home Page. <www.lonepinepublishing.com/>.
  This publisher produces books focusing on local wildlife, history, and the outdoors. Field guides include the following:
  - *Animal Tracks of Manitoba* (Sheldon and Eder)
  - *Manitoba Birds* (Bezener and De Smet)
  - *Manitoba Wayside Wildflowers* (Kershaw)
  - *Saskatchewan and Manitoba Nature Guide* (Kagume)
  - *Reptiles and Amphibians of Canada* (Fisher and Brooks)
- Manitoba Conservation. *Field Guide: Native Trees of Manitoba*. Winnipeg, MB: Manitoba Conservation, n.d. Available online at <www.gov.mb.ca/conservation/forestry/pdf/health/fieldguidefinal.pdf>.
  This field guide, available on the Forestry Branch website, explains how to identify native Manitoba trees using leaves and twigs.
- ———. *Key to Manitoba's Sport Fish*. Winnipeg, MB: Manitoba Conservation, n.d. Available on the Manitoba Water Stewardship website at <www.gov.mb.ca/waterstewardship/fisheries/education/fishkey1.pdf>.
  This document has a dichotomous key to Manitoba's sport fish.

Suggestion for Assessment

Students use a dichotomous key or a field guide to identify organisms. The responses can be used as formative assessment to determine students' levels of understanding and to guide further teaching/learning activity selection (if needed).

Building Vocabulary (U1)

Introduce new vocabulary to students as required. The use of a variety of strategies (e.g., Three-Point Approach, Sort and Predict, Word Clusters) can aid students in developing both conceptual and contextual knowledge of the vocabulary of monitoring biodiversity. Refer to *SYSTH* (Chapter 10) for more information on building a scientific vocabulary and for think-sheet frames.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-S2: Demonstrate work habits that ensure personal safety, the safety of others, and consideration of the environment. (GLOs: B3, B5, C1, C2)

B12-0-S3: Record, organize, and display data and observations using an appropriate format. (GLOs: C2, C5)

B12-0-S4: Evaluate the relevance, reliability, and adequacy of data and data-collection methods. (GLOs: C2, C4, C5, C8)

Include: discrepancies in data and sources of error

B12-0-S5: Analyze data and/or observations in order to explain the results of an investigation, and identify implications of these findings. (GLOs: C2, C4, C5, C8)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Suggestion for Assessment

Review students' think-sheet frames to ensure accuracy. As this learning activity is intended as a formative assessment to check student understanding, no mark is required.

Ecological Field Studies—Field Work/Trip (U2, P2, S2, S5)

A variety of organizations across Manitoba offer programs that provide students with the opportunity to engage in ecological field studies. This is also a good opportunity for students to explore related careers.

Resource Links

- FortWhyte Alive. Home Page. <www.fortwhyte.org/>.
  The Fort Whyte Centre in Winnipeg offers a variety of hands-on field research programs for high school students. For more information, visit the website or call the centre at 989-8364.
- Manitoba Conservation. "Teacher's Corner." *Educational Opportunities.* <www.gov.mb.ca/conservation/parks/education/teachers.html>.
  The Parks and Natural Areas Branch of Manitoba Conservation offers free-of-charge school programs in some provincial parks across Manitoba.

MONITORING BIODIVERSITY

SPECIFIC LEARNING OUTCOME

B12-5-03: Select and use appropriate tools or procedures to determine and monitor biodiversity in an area. (GLOs: C1, C2, C7)

Examples: field guides, dichotomous keys, quadrats, transects, mark and recapture . . .

- Oak Hammock Marsh. <www.oakhammockmarsh.ca/>.
  This interpretive centre is open year-round and offers a variety of curriculum-based programs for students. For more information, visit this website or call 1-888-506-2774 (toll-free).

Suggestions for Assessment

Have students complete an assignment based on their fieldwork. Alternatively, have students complete an I Used to Think, But Now I Know reflection after the field trip. Ask them to recall their ideas at the start of the topic study, and have them explain how their ideas changed or became more detailed compared to what they knew at the beginning of instruction (Keeley). Students can discuss their reflections with a partner.

Fieldwork and group work skills can be assessed with checklists. See Appendix 5.4A: Fieldwork Skills Checklist—General Skills (BLM), Appendix 5.4B: Fieldwork Skills Checklist—Thinking Skills (BLM), and Appendix 1.13: Collaborative Process—Assessment (BLM).

Estimating Population Size—Investigation (U2, P1, S3, S4, I4)

Refer to Appendix 5.6: Investigating Population Size (BLM) for an investigation that introduces students to quadrat and transect sampling, as well as the mark and recapture method. **Note:** Use 800 to 1000 grains of rice per jar when preparing the jars for the mark and recapture exercise in the investigation.

Suggestion for Assessment

Assessment of this investigation can be summative (written responses to the questions posed) or formative. The RERUN strategy (Keeley 172–73) can be used for formative assessment of student learning in place of a formal summative lab report.

After students have completed the investigation and answered questions about it, ask them to reflect on their lab experience (individually or in groups) by writing a sentence or two for each letter of the acronym, **RERUN**: **R**ecall (what you did), **E**xplain (why you did it), **R**esults (what you found out), **U**ncertainties (what remains unclear), and **N**ew (what you learned).

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P1: Demonstrate confidence in ability to carry out investigations. (GLOs: C2, C5)

B12-0-P2: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. (GLO: B4)

B12-0-S2: Demonstrate work habits that ensure personal safety, the safety of others, and consideration of the environment. (GLOs: B3, B5, C1, C2)

B12-0-S3: Record, organize, and display data and observations using an appropriate format. (GLOs: C2, C5)

B12-0-S4: Evaluate the relevance, reliability, and adequacy of data and data-collection methods. (GLOs: C2, C4, C5, C8)

Include: discrepancies in data and sources of error

B12-0-S5: Analyze data and/or observations in order to explain the results of an investigation, and identify implications of these findings. (GLOs: C2, C4, C5, C8)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

NOTES

INVESTIGATING A CONSERVATION ISSUE

SPECIFIC LEARNING OUTCOME

B12-5-04: Investigate an issue related to the conservation of biodiversity. (GLOs: C4, C6, C8, D2, E2)

Examples: heritage seeds, water quality in Lake Winnipeg, land-use designations, hydroelectric development . . .

SLO: B12-5-04

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 7 Science, students identified and described positive and negative examples of human interventions that have an impact on ecosystems. They identified environmental, social, and economic factors that should be considered in the management and preservation of ecosystems.

In Grade 10 Science, students explained how the biodiversity of an ecosystem contributes to its sustainability. They investigated how human activities affect an ecosystem and used the decision-making model to propose a course of action to enhance its sustainability.

BACKGROUND INFORMATION

A range of issues relate to the conservation of biodiversity in Manitoba. A local or regional focus is recommended. The issue of water quality, particularly in Lake Winnipeg, is an ongoing concern. Newspaper articles are readily available on the topic. A variety of topics related to agriculture could be examined, including the grazing of livestock in riparian zones, draining of potholes, and maintenance and planting of shelterbelts. The impact of logging in the boreal forest is another possible area of discussion.

ACTIVATE

Brainstorming

Pose the following question to students:

- A number of issues related to the conservation of biodiversity are being discussed in Manitoba today. Which issues, if any, are you aware of?

Lead a class brainstorming session on current issues related the conservation of biodiversity in Manitoba and record the suggestions generated by students. Students' responses could include the following:

- polar bears in Churchill threatened by climate change
- logging in the boreal forest
- invasive species (e.g., purple loosestrife, zebra mussels, rusty crayfish)
- decline of Lake Winnipeg

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

- at-risk species (e.g., sturgeon, piping plover, peregrine falcon, burrowing owl)
- possible introduction of foreign species through diversion of water from Devil's Lake, North Dakota, into the Red River
- shelterbelts in agricultural areas

The resulting list can be used by students to select a current issue to investigate related to the conservation of biodiversity in Manitoba (see Investigating a Local Conservation Issue—Decision Making, another learning activity suggested for learning outcome B12-5-04).

INVESTIGATING A CONSERVATION ISSUE

SPECIFIC LEARNING OUTCOME

B12-5-04: Investigate an issue related to the conservation of biodiversity. (GLOs: C4, C6, C8, D2, E2)

Examples: heritage seeds, water quality in Lake Winnipeg, land-use designations, hydroelectric development . . .

ACQUIRE/APPLY

Conserving Manitoba's Woodland Caribou (U2, P3, P4, D1)

The Manitoba Model Forest offers educational resources related to conserving Manitoba's woodland caribou.

Resource Links

- Manitoba Model Forest, Inc. Home Page. <www.manitobamodelforest.net/>.
- ———. *The Wonderful World of the Boreal Woodland Caribou*. <www.manitobamodelforest.net/publications/Wonderful%20World%20of%20the%20Boreal%20Woodland%20Caribou%20Curriculum.%20PDF.pdf>.

  This resource contains educational material on the life requisites of woodland caribou and their status as a threatened species, information on First Nations peoples' relationship to caribou, educational games, and a video.
- *Shadows of the Forest*. Prod. Eastern Region Woodland Caribou Advisory Committee. 2004. Video.

  This video tells the story of Manitoba's threatened caribou and the work being done to protect them. The 25-minute video introduces the woodland caribou and some of the factors that make it a species at risk. The second half of the video documents research activities, including state-of-the-art collaring and computer mapping that the Eastern Region Woodland Caribou Advisory Committee has undertaken to protect caribou habitat. Copies of this video are available in DVD or VHS format by contacting the Manitoba Model Forest office at 204-340-5013.

Conservation of Biodiversity—Case Study (U1, P4, D2, D3, I2)

Have students use case studies to investigate an issue related to the conservation of biodiversity.

Resource Link

- National Center for Case Study Teaching in Science, University at Buffalo. Home Page. <http://sciencecases.lib.buffalo.edu/cs/>.

  This website contains a variety of case studies, which teachers can modify or adapt for classroom use, subject to the specified usage guidelines. Teaching notes and answer keys for the case studies are available free of charge. To access the answer keys, users are required to register for a password.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Suggestion for Assessment

Assessment will depend on the type of learning activity undertaken. Whatever the form of assessment used, students should be made aware of the criteria beforehand.

INVESTIGATING A CONSERVATION ISSUE

SPECIFIC LEARNING OUTCOME

B12-5-04: Investigate an issue related to the conservation of biodiversity. (GLOs: C4, C6, C8, D2, E2)

Examples: heritage seeds, water quality in Lake Winnipeg, land-use designations, hydroelectric development . . .

Investigating a Local Conservation Issue—Decision Making (D1, D2, D4, D5, I3, I4)

Have students investigate a current issue related to the conservation of biodiversity in Manitoba. This investigation should include some type of decision-making process. The types of decisions can vary greatly. For example, they could include

- personal/individual decisions (e.g., Should I fill in a pothole on my land for additional farmland, or should I preserve it as a nesting site for birds?)
- community decisions (e.g., Should our community raise its tax rate to pay for an improved waste water treatment plant that would improve the water quality in Lake Winnipeg?)
- societal decisions (e.g., Should we continue to build hydroelectric dams in Manitoba, or should we explore other alternatives?)

A variety of approaches can be used to simulate a real-life context or to promote interactions among students. For more details, refer to Appendix 1.12: Decision Making (Teacher Background).

Suggestions for Assessment

Have students prepare a scientific report, incorporating technical writing, to address the Manitoba conservation issue they have investigated. The report should

- identify the issue and its parameters
- describe possible courses of action and resulting consequences
- make a recommendation that is the most ecologically sustainable

Create an assessment rubric for the report by developing the assessment criteria and performance levels in collaboration with students. Refer to Appendix 5.7: Co-constructing Assessment Criteria with Students (Teacher Background) for more information on the collaborative process. Alternatively, provide students with exemplars of strong and weak reports, and have them work in groups to identify possible assessment criteria and define levels of performance. The exemplars can be anonymous samples of student work done in previous years.

SKILLS AND ATTITUDES OUTCOMES

B12-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: use concept maps, sort-and-predict frames, concept frames . . .

B12-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concept to someone else, make generalizations, compare/contrast, identify patterns, apply knowledge to new situations/contexts, draw inferences, create analogies, develop creative presentations . . .

B12-0-P3: Recognize the importance of maintaining biodiversity and the role that individuals can play in this endeavour. (GLO: B5)

B12-0-P4: Recognize that humans have had and continue to have an impact on the environment. (GLOs: B1, B2)

B12-0-D1: Identify and explore a current issue. (GLOs: C4, C8)

Examples: clarify the issue, identify different viewpoints and/or stakeholders, research existing data/information . . .

B12-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position, ethical dilemmas . . .

B12-0-D3: Recognize that decisions reflect values, and consider own and others' values when making a decision. (GLOs: C4, C5)

B12-0-D4: Recommend an alternative or identify a position, and provide justification for it. (GLO: C4)

B12-0-D5: Propose a course of action related to an issue. (GLOs: C4, C5, C8)

B12-0-I2: Evaluate information to determine its usefulness for specific purposes. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, relevance, balance of perspectives, bias . . .

B12-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B12-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

KWL Chart (U2)

Ask students to return to their KWL Charts (which they started at the beginning of this topic study) and complete the "What I learned" column. See learning outcome B12-5-01 and Appendix 5.1: Conserving Biodiversity—KWL Chart (BLM).

Suggestion for Assessment

After students have completed the What I Learned column in their KWL Charts, ask them to compare the three columns and self-assess and reflect on how their conceptual understanding of the conservation of biodiversity has progressed. The information from the KWL Charts can be used to identify whether further lessons are required (formative assessment).

NOTES

UNIT 5:
CONSERVATION OF BIODIVERSITY
APPENDICES

Appendix 5.1:
Conserving Biodiversity—KWL Chart (BLM)

Name _____

What I Know	What I Want to Learn (state as questions)	What I Learned
Reasons for maintaining biodiversity		
Strategies used to preserve biodiversity		
Methods used to determine and monitor biodiversity		

Appendix 5.2: Values Clarification (BLM)

Introduction

What do you value? What is important to you? Scientists, economists, and policy makers are attempting to determine how important biodiversity is to humans and how it is of value. In this learning activity, you will decide how you value biodiversity.

Procedure

Step 1

With a learning partner, discuss the following questions on how your life is affected by biological diversity.

a) Which would have a greater impact on your life—if all the bears in the world became extinct or if all the snails in the world became extinct?

b) Bacteria, fungi, and other micro-organisms are decomposers in ecosystems. What would happen if these organisms no longer existed on Earth?

Step 2

Answer the following questions individually, and then discuss your answers with your learning partner.

a) To build a shopping mall and a parking lot, a developer wants to build on a field that contains one of the few remaining stands of tall grass prairie in Manitoba. Would you be for or against this development? Explain your answer.

b) What if the land was to be developed as housing for low-income families and senior citizens? Would your answer be different? Why or why not?

c) If you won a lottery prize of $1 million, how much of the money would you give to save one hectare of endangered forest?

d) Was it hard for you to put a dollar value on the endangered forest? Why or why not?

Appendix 5.2:
Values Clarification (BLM) *(continued)*

Step 3

a) Rank the five species listed below in order of their value to you by arranging them on the continuum from high to low value.

Species: snail, fox, moss, tuna, rattlesnake

High Value **Low Value**

b) Now place the species with the highest value at the top of the list in the chart below. Then provide your rationale for your ranking.

Species	Reason for Ranking

Reason for Ranking Species

Suppose the organisms above were endangered and you had to save them from extinction. Which would you save, and why?

Reference

Blair, Robert. B. et al. *Ecology: Teacher's Guide*. Chicago, IL: Everyday Learning, 1999.

Appendix 5.3A: Riparian Zone Assessment (Teacher Background)

Introduction

> Riparian areas, especially those in prairie environments, support high levels of natural biodiversity. The combination of water, lush vegetation and connections to other landscapes provides opportunities for many species . . . . Riparian areas create important corridors that link a variety of ecosystems together. Species and genetic material travel easily through these small, but unique, pieces of the landscape. (Alberta Riparian Habitat Management Society, *Biodiversity and Riparian Areas* 2)

The Riparian Zone Assessment is designed to integrate the conservation of biodiversity learning outcomes into one major assignment. It can be used in one class or expanded to several classes, depending on the amount of fieldwork incorporated or the number of case studies examined. A general conservation dilemma (e.g., the clearing of riparian zones for beach property) or a local riparian issue (e.g., local stream/riverbank erosion or development) could be presented.

The learning activity is based on the work done by the Alberta Riparian Habitat Management Society (commonly known as Cows and Fish) to promote riparian awareness. Their focus is on agricultural issues related to riparian zones, which may appeal to students in agricultural communities. Many resources for this learning activity are available on the Cows and Fish website. Other riparian issues may have a recreational or industrial focus. Development along the banks of the Red River in Winnipeg is one such example.

Resource Links

The following resources are available from the Alberta Riparian Habitat Management Society, also known as Cows and Fish.

Alberta Riparian Habitat Management Society—Cows and Fish. Home Page. <www.cowsandfish.org>.

———. *Cows and Fish Fact Sheets*. <www.cowsandfish.org/publications/fact_sheets.html>.

Fact sheet on a variety of topics are available in the *Publications* section of the Cows and Fish website, including the following:

- *Biodiversity and Riparian Areas: Life in the Green Zone*
- *Crops, Creeks and Sloughs: Managing Riparian Areas in and around Cropland*
- *The Economic, Social and Environmental Value of Wetlands*
- *Facing the Issues*
- *Lakes and Wetlands*
- *Looking at My Lakeshore: Riparian Health Checklist*
- *Looking at My Streambank: Riparian Health Checklist*
- *Riparian Health Assessment and Inventory*
- *Water Quality and Riparian Areas*

These Cows and Fish fact sheets focus on the practical aspects of assessing the health of a riparian zone. The simplest forms are the two checklists. Students can be trained in using the checklists.

Fitch, Lorne, and Norine Ambrose. *Riparian Areas: A User's Guide to Health*. Lethbridge, AB: Cows and Fish Program, 2003. Available on the Alberta Riparian Habitat Management Society—Cows and Fish website at <www.cowsandfish.org/riparian/usersguide.html>.

This publication is promoted by Manitoba Habitat Heritage Program, Manitoba Agriculture and Food, Riparian Health Council, and local conservation districts to promote sustainable land management practices involving cattle grazing and riparian areas.

Along the Water's Edge. Prod. Fisheries and Oceans Canada, with input from Cows and Fish, 1995. Video.

This video interviews ranchers using riparian zones in their operations. Additional information about this video is available on the Land Stewardship Centre of Canada website at <www.landstewardship.org/resources/resource/387/>.

Part 1: Importance of Riparian Zones

Students are to

- identify what a riparian zone is
- describe what healthy riparian areas do
- give examples of how riparian zones conserve biodiversity

Teaching Tips

- Provide students with the following Cows and Fish fact sheet for general discussion and background information:
  - *Biodiversity and Riparian Areas: Life in the Green Zone*
- Show pictures/slides of various landscapes and ask students to identify riparian zones based on the three criteria identified in *Riparian Areas: A User's Guide to Health* (Fitch and Ambrose 4):
  - "Clue 1: Lots of water is present, seasonally or regularly and that water is either on the surface or it's close to the surface."
  - "Clue 2: Vegetation is present that responds to, requires and survives in abundant water."
  - "Clue 3: Soils have been modified by abundant water (as in high water tables), stream or lake processes (like sediment deposition) and lush, productive vegetation."
- Discuss key ideas such as the following:

  Healthy riparian zones
  - trap and store sediment
  - build and maintain banks and shorelines
  - store water and energy
  - recharge aquifers
  - filter and buffer water
  - reduce and dissipate energy
  - maintain biodiversity
  - create primary productivity

Part 2: Riparian Zone Assessment

Students are to

- examine a local riparian zone (stream bank or lakeshore)
- determine whether the riparian zone is healthy

Teaching Tips

- Provide students with one or both of the following Cows and Fish fact sheets:
  - *Looking at My Lakeshore: Riparian Health Checklist*
  - *Looking at My Streambank: Riparian Health Checklist*

  The checklists contain information on assessing the health of riparian zones. They focus on the vegetation, streambank and stream channel, water quality, and wildlife in the riparian area.

- Demonstrate how to use the checklists by showing pictures/slides of riparian zones and discuss with students what the scores from the checklists mean.
- This is an excellent opportunity to integrate a fieldwork component into the course. Students can use their checklists to assess an area, survey plant populations with transects or quadrats, and identify species with field guides and dichotomous keys.
- If you choose not to go on a field trip, present a new area to students with pictures/slides and plant samples. Students can complete the checklists and determine what the riparian health score means for ecosystem biodiversity.

Part 3: Issue Analysis

Students are to investigate an issue related to a riparian zone, focusing on

- identifying the issue and its parameters
- describing possible courses of action and resulting consequences
- making a recommendation that is the most ecologically sustainable

Teaching Tips

- "Today, riparian areas attract a variety of urban, recreational, industrial and agricultural activities" (Alberta Riparian Habitat Management Society, *Biodiversity and Riparian Areas 4*). Some of these uses contribute to the health of the riparian zone, while others do not. Work through a case study of one particular situation in a riparian zone.
- Key management ideas:
  - Prevent potential problems by maintaining healthy riparian zones.
  - Reduce pressures or stresses on the area.
  - Encourage and protect native vegetation.
  - Fix problem areas (e.g., improved paths, fencing).
  - Monitor progress in maintaining riparian health (long term).
  - Work as a community of stakeholders to improve the area.
- If you wish to examine an agricultural issue, consider the grazing of livestock in riparian zones. The Cows and Fish website has numerous consumer and producer stories that could be used. The video A*long the Water's Edge* (Fisheries and Oceans Canada) interviews ranchers using riparian zones in their operations.
- The issue of water quality, particularly in Lake Winnipeg, is an ongoing concern. Newspaper articles are readily available on the topic. Issues include the alteration of the lakeshore, erosion, and agricultural runoff.
- The impact of recreation on a riparian zone (e.g., motorboat wave action on shorelines, cottage and resort development) could be analyzed. The management plan for a lake in a provincial park could be examined, as the plans set out the type of recreation allowed on the lake (e.g., motorized boats, no cottage development). Create a scenario in which a developer makes a proposal to develop a resort hotel on a lake. What impact would such a development have? How could it be done to maintain a sufficient riparian zone?

Appendix 5.3B: Riparian Zone Assessment (BLM)

Introduction

> Riparian areas, especially those in prairie environments, support high levels of natural biodiversity. The combination of water, lush vegetation and connections to other landscapes provides opportunities for many species . . . . Riparian areas create important corridors that link a variety of ecosystems together. Species and genetic material travel easily through these small, but unique, pieces of the landscape. (Alberta Riparian Habitat Management Society, *Biodiversity and Riparian Areas 2*)

This three-part learning activity is intended to promote riparian awareness. The focus is on agricultural issues related to riparian zones.

Part 1: Importance of Riparian Zones

You will

- identify what a riparian zone is
- describe what healthy riparian areas do
- give examples of how riparian zones conserve biodiversity

Part 2: Riparian Zone Assessment

You will

- examine a local riparian zone (stream bank or lakeshore)
- determine whether the riparian zone is healthy

Part 3: Issue Analysis

You will investigate an issue related to a riparian zone, focusing on

- identifying the issue and its parameters
- describing possible courses of action and resulting consequences
- making a recommendation that is the most ecologically sustainable

Appendix 5.4A:
Fieldwork Skills Checklist—General Skills (BLM)

Name _____

General Skills	Expectations	Meeting Expectations	Not Yet Meeting Expectations
The student			
is prepared to conduct the fieldwork	reads the pre-lab outline before the task, creates tables, and asks questions that clarify the task, instead of asking "What do I do next?"		
sets up and uses equipment properly	chooses the correct equipment, sets up properly (e.g., transect line), and uses equipment properly (e.g., quadrats, field guide)		
follows safety procedures	demonstrates general safety procedures, as well as specifics outlined in the pre-lab		
records observations	records own observations as the work is occurring, uses quantitative and qualitative approaches as directed, and records in an organized fashion (e.g., uses a table or key)		
works independently (individual tasks) or works cooperatively (group tasks)	knows task and gets right to work or shares tasks and observations, is a good listener, and is receptive to other students' points of view		
manages time efficiently	divides and orders tasks to meet deadlines		
demonstrates consideration for the environment	minimizes disturbance to the site and species studied, leaves site clean, and takes away equipment		

Appendix 5.4B: Fieldwork Skills Checklist—Thinking Skills (BLM)

Name _____

Thinking Skills	Questions	Understanding of Lab		
		Specific	General	Limited
Knowledge/ Comprehension	• What is the purpose of doing this work? • How does this relate to what you are studying in class? • What is the rationale for your hypothesis? • Why do you need special safety considerations for fieldwork?			
Application/ Analysis	• How did you decide on this procedure? • Are you having any difficulties with this procedure? • Are you getting the results that you expected? • How would you set up a graph, diagram, or flow chart to depict these results? • Do you see a pattern in your data? • Do any data points not follow the pattern?			
Synthesis/ Evaluation	• What can you conclude from your results? • Give a specific piece of evidence to support your conclusion. • What sources of error occurred in this trial? • What would you do differently in a second trial? What would you do the same? • How do your two trial results compare?			

Appendix 5.5A: Take a Stand (Teacher Background)*

Using a space large enough to accommodate the class, designate one end of the space as "Totally Agree" and the other end as "Totally Disagree." A line connecting the two opposite poles can be marked with masking tape to represent the continuum of positions that lie between.

Read an issue scenario out loud, providing students with a paper copy or using the overhead if needed. Then ask students to find a position on the line that reflects their opinion on the issue. Once students are in place, ask for explanations of why they chose their particular stand. Encourage students to respond to the opinions stated by others, but do not permit them to attack another's position.

Explain to students they are free to adjust their positions on the line as they hear ideas they have not previously considered, as a reflection of their changing views on the issue.

This learning activity can be used at the beginning of a topic of study to stimulate interest, discussion, and research, and does not depend on students having any special expertise on the issue. Repeated at the end of the topic, this learning activity can be used to assess what students have learned over a period of time, and how their views have changed as a result of their learning.

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* Source: Greene, Alanda. "Where Do You Stand?" *Green Teacher 54* (Winter 1997–98): 19–21. Adapted with permission. For information about this non-profit Canadian magazine, visit <www.greenteacher.com> or call 888-804-1486.

Appendix 5.5B: Take a Stand—Scenarios*

1. Fish Now or Later?

Mike has made a living for himself and his family for the last 20 years as a commercial fisherman on Lake Winnipeg. He recently purchased a new, larger fishing boat. The payments on his boat are high, but Mike and his crew can work more safely and efficiently.

Mike's neighbour Ramon is a freshwater biologist who works for the government. He has been studying fish populations in the lake over the past 10 years and is supporting a large reduction in the amount of commercial species (pickerel and whitefish) that can be caught in a year. Ramon says "My research shows that the numbers of fish in the lake is declining. We need to cut back on the quotas assigned to fishers."

"I can't have my quota cut back," replies Mike. "I have to make my payments on my boat, and have a family to support. My crew needs their jobs as well. Why don't you do something about the pollution in the lake that is causing the fish stocks to decline?"

Ramon replies to Mike's concerns by saying, "If we don't act now, there won't be any fish left in a few years. The fish are at great risk. Look what happened to the East Coast cod fishery."

"There still are lots of fish in the lake," answers Mike, "and I expect to catch my fair share, which is why I bought my new boat. How else can I pay for it? How else can I earn a living?"

Where do you stand on the question of cutting back on fishing quotas? (Mike's position)

2. Wolves and Cattle

Wolves are natural inhabitants of Yellowstone National Park in Montana and Wyoming, but humans killed off all the wolves in the region in the early 1900s. After many years of work, environmental groups convinced the US government to release a pack of wolves in the park in order to re-establish a wolf population in the area.

Sarah works for Wolves in the Wild. She says that wolves must return to these wild areas because they are an important part of the ecosystem, and will help restore the natural population balance of many wildlife species. "We destroyed these animals in what was their natural habitat. It's only right that we return the wolves to their natural habitat. It isn't the same country without the wolves."

Pete is a rancher. He points out wolves don't know about park boundaries, and says there's no way to protect his cattle from them. "They're as happy to bring down a heifer as they are to kill a deer," claims Pete, "and I shouldn't have to have my cattle's lives threatened. This is now, not 75 years ago. The wolves are gone. Let them stay away. I have to make a living."

Where do you stand on the question of introducing wolves back into the park? (Sarah's position)

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* Source: Greene, Alanda. "Where Do You Stand?" *Green Teacher 54* (Winter 1997–98): 19–21. Adapted with permission. For information about this non-profit Canadian magazine, visit <www.greenteacher.com> or call 888-804-1486.

Appendix 5.5B:
Take a Stand—Scenarios *(continued)*

Note: In 1995 and 1996 wolves were captured from Canada and released in Yellowstone National Park. An additional 10 were moved from northern Montana into the park in 1997. Tracking and scat analysis has shown that concerns over cattle predation by wolves have not materialized.

For more information on the Yellowstone Wolf Project, visit the following website:
U.S. National Park Service. "Wolves of Yellowstone." Y*ellowstone National Park*.
<www.nps.gov/yell/naturescience/wolves.htm>

Appendix 5.6A: Investigating Population Size (BLM)

Problem

What methods are used to estimate the size of plant and animal populations?

Introduction

It can be difficult to determine the size of plant and animal populations. This is why biologists use a variety of sampling strategies to estimate the size of populations in an area. Plant populations can be sampled with *transects* or *quadrats*, which are plots within which the number or type of species are counted in randomly selected areas. The size of a mobile animal population can be estimated by *mark and recapture*, in which the organism of study is tagged or banded.

These techniques are based on random sampling statistical procedures. Care must be taken to assure that randomness occurs when the sampling is performed, otherwise the erroneous population estimates will result.

Biologists can then determine whether a population is growing or declining by repeating sampling procedures over time.

Purpose

In this investigation, you will estimate population size using transect and quadrat sampling and the mark and recapture method.

Materials (per student group)

- biology textbook
- ruler
- microscope slide cover slip
- opaque jar or coffee can with a lid containing rice grains
- felt-tip marker
- calculator

Procedure

Part 1: Transect Sampling

1. Select one page at random from your biology textbook.
2. Hold the ruler flat over the page at a height of 10 cm. Close your eyes and drop the ruler.
3. Slide the ruler so that it extends the length or width of the page. One side of the length of the ruler is the transect line.
4. Count the number of letter *e*'s (small and capital) along the transect line. Record this in your Data Table.
5. Select another page at random in your textbook. Repeat steps 2 to 4 an additional four times, recording your data after each trial.

Part 2: Quadrat Sampling

1. Obtain a microscope slide cover slip. This is the quadrat.
2. Select one page at random from your biology textbook.
3. Hold the cover slip 10 cm away from the textbook. Gently toss the cover slip onto the page.
4. Count the number of letter *e*'s (small and capital) in the quadrat. Record this in your Data Table.
5. Select another page at random in your textbook. Repeat steps 2 to 4 an additional four times, recording your data after each trial.

Part 3: Mark and Recapture

1. Obtain a jar or can containing grains of rice. The rice represents an animal population. Your teacher will assign your group a specific number of rice grains to be picked out and marked. The number will be 50, 100, or 150, and will represent the number of animals captured for the first time and marked (M). Record this number in your Data Table.
2. Take turns removing your assigned number of rice grains from the can. Use a marker to colour the grains of rice you removed.
3. After allowing the ink to dry, place the coloured rice grains back into the container. Shake the container well.
4. Your teacher will assign you a specific number of rice grains to be picked out a second time. The number will be either 60 or 120, and will represent the number of animals captured a second time (C). Record this in your Data Table.
5. Remove the cover of the can and, without looking into the can, draw out the number of assigned rice grains from the can. Count how many grains of rice are the marked ones (recaptured). Record this as R Trial 1 in your Data Table.
6. Return all the rice grains to the container. Shake the can well and repeat step 5, removing the same number of rice grains. Record the number of marked rice grains as R Trial 2.
7. Repeat step 6. Record the number of marked rice grains as R Trial 3.
8. Determine the average of your three recapture trials and record this in your Data Table as the average R value.
9. With your group partners, count the total number of rice grains in the can. Record this in your Data Table as the actual number of rice grains.

Appendix 5.6A:
Investigating Population Size (BLM) *(continued)*

Data Table

Part 1: Transect Sampling

Trial	Number of Letter *e*'s
1	
2	
3	
4	
5	

Part 2: Quadrat Sampling

Trial	Number of Letter *e*'s
1	
2	
3	
4	
5	

Part 3: Mark and Recapture

Step	Number
M (number of rice grains picked the first time and marked)	
C (total number of rice grains picked the second time)	
R Trial 1 (number of rice grains recaptured)	
R Trial 2 (number of rice grains recaptured)	
R Trial 3 (number of rice grains recaptured)	
Average R value	
Actual number of rice grains in the can	

Analysis

Part 1: Transect Sampling

1. Calculate the average number of letter *e*'s on a page of your textbook.
2. Calculate the number of *e*'s in your textbook. Multiply the average number of *e*'s per page by the number of pages in the book.

Part 2: Quadrat Sampling

1. Calculate the average number of letter *e*'s on a page of your textbook.
2. Calculate the number of *e*'s in your textbook. Multiply the average number of *e*'s per page by the number of pages in the book.
3. Share your results with the class by placing your calculation of the number of *e*'s in the textbook on the board, and record them in the table below.

Group	Number of Letter e's in Textbook

Part 3: Mark and Recapture

1. Calculate the estimated size of your population using the following formula:

   $N = \frac{MC}{R}$ where

   N = total number of individuals in a population
   M = number of animals marked and released (50, 100, or 150)
   C = total number of animals caught in the second sample (60 or 120)
   R = average number of marked animals caught in the second sample (recaptured)
2. How does your population estimate compare to the actual number of rice grains?

3. Calculate the percent error in your estimation using the following formula:

$$\text{percent error} = \frac{\text{estimate} - \text{actual}}{\text{actual}} \times 100$$

4. Share your results with the class by placing your percent error values on the board, and record them in the table below.

	Recapture Sample Size	
Size of Marked Sample	60	120
50		
100		
150		

5. What is the effect of a large marked sample size on the percent error?
6. What is the effect of a large recapture sample size on the percent error?

Conclusions

1. Compare your quadrat estimate with your transect estimate of the number of *e*'s in the textbook. Why might your results differ?
2. Compare your quadrat estimate with that of your classmates. Why might the estimates vary?
3. If you were conducting a mark and recapture population estimate in the field, what sampling sizes would you choose to optimize your results? Explain.
4. Why is random sampling important in the techniques used to estimate the sizes of populations?
5. Manitoba Hydro is building a dam on a river that has a lake sturgeon population. This rare species has been declining in numbers across the province. You are the wildlife biologist in charge of determining how the sturgeon population would be affected when the river is dammed.
   a) How would you go about making an estimate of the existing sturgeon population?
   b) How would you determine whether or not the dam had an impact on the sturgeon population in the river?

Appendix 5.6B: Investigating Population Size (Answer Key)

Analysis

Part 1: Transect Sampling

1. Calculate the average number of letter *e*'s on a page of your textbook.

   Answers will vary.

2. Calculate the number of *e*'s in your textbook. Multiply the average number of *e*'s per page by the number of pages in the book.

   Answers will vary.

Part 2: Quadrat Sampling

1. Calculate the average number of letter *e*'s on a page of your textbook.

   Answers will vary.

2. Calculate the number of *e*'s in your textbook. Multiply the average number of *e*'s per page by the number of pages in the book.

   Answers will vary.

3. Share your results with the class by placing your calculation of the number of *e*'s in the textbook on the board, and record them in the table below.

   Answers will vary.

Part 3: Mark and Recapture

1. Calculate the estimated size of your population using the following formula:

   $N = \frac{MC}{R}$ where

   N = total number of individuals in a population
   M = number of animals marked and released (50, 100, or 150)
   C = total number of animals caught in the second sample (60 or 120)
   R = average number of marked animals caught in the second sample (recaptured)

   Answers will vary.

2. How does your population estimate compare to the actual number of rice grains?

   Answers will vary.

3. Calculate the percent error in your estimation using the following formula:

   $\text{percent error} = \frac{\text{estimate} - \text{actual}}{\text{actual}} \times 100$

   Answers will vary.

4. Share your results with the class by placing your percent error values on the board, and record them in the table below.

   Answers will vary.

5. What is the effect of a large marked sample size on the percent error?

   The larger the marked sample size is, the lower the percent error will be.

6. What is the effect of a large recapture sample size on the percent error?

   The larger the recapture sample size is, the lower the percent error will be.

Conclusions

1. Compare your quadrat estimate with your transect estimate of the number of *e*'s in the textbook. Why might your results differ?

   The results may differ due to the samples selected (whether they were truly selected randomly) and the small sample size (only five trials).

2. Compare your quadrat estimate with that of your classmates. Why might the estimates vary?

   The estimates could vary because each group used small samples and a small number of trials.

3. If you were conducting a mark and recapture population estimate in the field, what sampling sizes would you choose to optimize your results? Explain.

   I would use large sample sizes for both marking and recapture, as they tend to give results closer to the actual numbers.

4. Why is random sampling important in the techniques used to estimate the sizes of populations?

   If samples are not randomly selected, estimates could be significantly higher or lower than the actual population.

5. Manitoba Hydro is building a dam on a river that has a lake sturgeon population. This rare species has been declining in numbers across the province. You are the wildlife biologist in charge of determining how the sturgeon population would be affected when the river is dammed.

   a) How would you go about making an estimate of the existing sturgeon population?

   I could use a mark and recapture method before the dam is built. I would capture a number of sturgeon, tag them, and release them. Then, I could advertise to people who fish in the area, asking anyone catching sturgeon in the lake to let me know, and, if a tagged sturgeon was caught, to send me the tag number. People wouldn't need to take the tag off the fish. Because it is illegal to keep any sturgeon you catch in Manitoba, I know the sturgeon will be released.

   b) How would you determine whether or not the dam had an impact on the sturgeon population in the river?

   I would use a mark and recapture method again a few years after the dam was built. Because the tags would still be on the sturgeon, I could use the same method as I used previously. Then I would compare the population sizes I calculated before and after the dam was built. If the population size increased or decreased significantly, then I could say the hydro dam did have an effect on the size of the sturgeon population.

Appendix 5.7: Co-constructing Assessment Criteria with Students (Teacher Background)

> "Introducing students to the criteria by which their work will be evaluated enables students to better understand the characteristics of good performance."
>
> (White and Frederiksen 28)

By providing students with the opportunity to construct the criteria by which an assignment will be judged, students are better able to understand the goals of the assignment, are more likely to engage in the task, and are better able to produce quality work.

In their book *Setting and Using Criteria: For Use in Middle and Secondary School Classrooms*, Gregory, Cameron, and Davies outline a four-step process for developing assessment criteria with students:

1. Brainstorm a list of ideas.
2. Sort and categorize the ideas.
3. Make a T-chart.
4. Use, revise, and refine.

To be most effective in guiding students to complete the task successfully, the first three steps of the process should be done as students are introduced to the assignment, or are beginning work on the assignment.

Appendix 5.7:
Co-constructing Assessment Criteria with Students (Teacher Background) *(continued)*

Step 1: Brainstorm

After introducing the assignment, lead the class in brainstorming a list of ideas of what is important in the assignment. Questions such as "What is important to include in a research report?" or "What defines quality work in a lab report?" or "What counts in an oral presentation?" will help students generate ideas. Record students' ideas and contribute your own ideas to ensure the important assignment features are included.

What is important to include in a quality research report?

A research report should include

- different sources of information (e.g., websites, magazines, books)
- minimum of three sources of information (teacher input)
- organization into paragraphs
- introductory, body, and concluding paragraphs
- thesis statement
- bibliography
- standard style of citation and documentation (teacher input)
- details supporting thesis statement
- good spelling and grammar
- clear sentences
- conclusion
- word processing or neat writing
- title page
- expository writing

Appendix 5.7:
Co-constructing Assessment Criteria with Students
(Teacher Background) *(continued)*

Step 2: Sort and Categorize

Have students examine the list generated in the first step to determine whether any of the ideas are related. Ask probing questions such as, "Can you find any ideas that seem to fit together?" or "Does this idea fit better with this group, or should it be in a new group?"

As the class comes to agreement on the groupings of ideas, develop headings that describe the groupings. Limiting the number of criteria to between three and five will help students focus on a manageable number of aspects of quality.

What is important to include in a quality research report?

A research report should include

1. different sources of information (e.g., websites, magazines, books)
2. minimum of three sources of information (teacher input)
3. organization into paragraphs
4. introductory, body, and concluding paragraphs
5. thesis statement
6. bibliography
7. standard style of citation and documentation (teacher input)
8. details supporting thesis statement
9. good spelling and grammar
10. clear sentences
11. conclusion
12. word processing or neat writing
13. title page
14. expository writing

Communicating information: 9, 10, 12, 13, 14
Organizing information: 3, 4, 6, 7
Using information: 1, 2, 5, 8, 11

Appendix 5.7:
Co-constructing Assessment Criteria with Students (Teacher Background) *(continued)*

Step 3: Make a T-Chart

Create a T-chart listing the criteria and specific details of the criteria. Clarify details or add more specific details if needed. The T-chart can be posted on the classroom wall or copied into notebooks for student reference.

Criteria for Research Report	Specific Details
Communicating Information	good spelling and grammar clear sentences word processing or neat writing title page expository writing
Organizing Information	organization into paragraphs introductory, body, and concluding paragraphs standard style of citation and documentation
Using Information	minimum of three different sources of information thesis statement details supporting thesis statement conclusion summarizing the report (more specific detail)

Appendix 5.7:
Co-constructing Assessment Criteria with Students (Teacher Background) *(continued)*

Step 4: Use, Revise, and Refine

As students work on the assignment, have them review the T-chart and examine their work in relation to the criteria and specific details. Are they meeting the criteria? Work should be revised to meet the criteria. If necessary, additional details can be added to further refine the criteria. A rubric can be created by defining levels of performance for each of the criteria.

Criteria for Research Report	Specific Details
Communicating Information	good spelling and grammar clear sentences word processing or neat writing title page expository writing
Organizing Information	organization into paragraphs introductory, body, and concluding paragraphs standard style of citation and documentation
Using Information	minimum of three different sources of information thesis statement details supporting thesis statement conclusion summarizing the report (more specific detail)

Appendix 5.8:
Checklist for Creating Visuals (BLM)

(Collages, Graphic Organizers, Posters)

Name _____

Criteria	Yes	Could Be Improved
Instructions for the assignment were followed carefully.		
Visuals are appropriate for the audience.		
All components of the visuals relate specifically to the topic.		
Visuals are clearly identified by a prominent title.		
Visuals are large enough to be easily viewed by all.		
Images are clear, effective, and complete.		
The most important points are near the top.		
Text (writing, labelling) is kept to a minimum.		
Font is uniform and appropriately sized.		
Visuals are appropriately placed and spaced.		
Colour scheme helps promote intended message.		
Overall appearance is effective and draws attention.		
Things that are done well:		
Things that could be improved:		

Appendix 5.9:
Oral Presentation—Observation Checklist (BLM)

Name _____

Criteria	Check If Observed	Comments
Organization		
Introduction and statement of purpose were included.		
Ideas were organized in a meaningful way.		
Necessary background information was provided.		
A strong conclusion was included.		
Content		
Topic was clearly defined and explained.		
Main points were clearly presented.		
Details to support main points were included.		
Appropriate vocabulary was used.		
Speaker was well-informed on the topic.		
Speaker stayed focused on the topic.		
Delivery		
Volume was appropriate for audience.		
Enunciation was clear and precise.		
Speech was appropriately paced.		
Speaker maintained frequent eye contact.*		
Body language was not too relaxed or too stressed.		
Speaker was sensitive to audience reaction, and adapted if necessary.		
Presentation Support		
Speaker used appropriate visual aids and supports.		
Visual aids and supports were integrated in the presentation.		
Pronunciation, spelling, and grammar were accurate.		
Overall presentation was enthusiastic and effective.		

* Consider cultural appropriateness.

Additional Comments