Adult Basic Education

Level III Science

Science 3107
Environmental Science I
Curriculum Guide

Credit Value: 1

Text: *Toward A Sustainable Future: Challenges, Changes and Choices*. Department of Education. Province of Newfoundland and Labrador. 2009. ISBN: 978-1-55146-367-4.

Science Courses [General College Profile]

Science 2100A
Science 2100B
Science 2100C
Science 3101
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Science 3106
Science 3107
Science 3108

Newfoundland Labrador

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To the Instructor

Introduction to Science 3107

This course is intended to help students acquire the basic knowledge of Environmental Science and is a part of the ABE Level III General College Profile (GCP). This course must be completed first before students can complete **Science 3108: Environmental Science II**. These two ABE Science courses are based on **Environmental Science 3205** offered in Newfoundland and Labrador high schools.

Science 3107: Environmental Science I is divided into three units. The outcomes for this course are given below.

The first unit, ***Introduction to Environmental Science***, will cover the following course outcomes:

1.01 Understand how the Earth can be compared to a spaceship.
1.02 Recognize that the human population growth of Newfoundland and Labrador is in contrast to the global human population growth.
1.03 Understand negative consequences of a high human growth rate.
1.04 Understand scientific methodologies.
1.05 Understand the limitations of science in solving the Earth's environmental problems.
1.06 Understand that Environmental Science is a multi-disciplinary field.
1.07 Understand the difference between a conservationist and an environmentalist.
1.08 Identify producers, primary consumers, secondary consumers, and tertiary consumers on a food web.
1.09 Understand how balance is obtained in an ecosystem as represented by a food web.
1.10 Understand how the following ethics impact the environment: (i) development ethic, (ii) preservation ethic and (iii) conservation ethic.
1.11 Define sustainable development.
1.12 Recognize that sustainable development is a concept impossible to achieve.
1.13 Understand things that individuals can do to decrease their ecological footprint.
1.14 Define precautionary principle.
1.15 Understand what is meant by a socially sustainable society.
1.16 Recognize the role of legislation in guiding stewardship and sustainability.
1.17 Understand the difference between renewable and non-renewable resources.
1.18 Understand the responsibility of the Multi Materials Stewardship Board (MMSB) in Newfoundland and Labrador.
1.19 Identify the five action items associated with the Waste Management Strategy.
1.20 Understand how to correctly dispose of Household Hazardous Wastes.
1.21 Define ecosystem.
1.22 Define ecoregion.
1.23 Understand the purpose of the Ecoregion Classification System.
1.24 Define biodiversity.
1.25 Understand and recognize biodiversity.

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1.26 Describe the importance of species diversity and genetic diversity in an ecosystem.
1.27 Identify reasons why some organisms become species at risk.
1.28 Recognize the importance of protecting species.
1.29 Distinguish between natural extinctions and anthropogenic extinctions.
1.30 Describe the impacts of introduced species.
1.31 Recognize the process of classifying an organism as a species at risk.
1.32 Identify the COSEWIC listings that categorize species at risk.
1.33 Define protected area.
1.34 Identify types of protected areas in Newfoundland and Labrador.
1.35 Explain the benefits of protected areas.

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The second unit, ***Recreation and the Environment***, will cover the following course outcomes:

2.01 Define wilderness.
2.02 List values associated with wilderness.
2.03 Identify traditional and non-traditional outdoor recreational activities popular in Newfoundland and Labrador.
2.04 Recognize some growing environmental concerns related to tourism in Newfoundland and Labrador.
2.05 Understand what is meant by sustainable tourism and why it is a valuable approach to both conservation and tourism.
2.06 Understand how access to the interior of Newfoundland and Labrador has expanded over the years.
2.07 Understand how access roads can affect the environment.
2.08 Identify negative environmental impacts caused by ATV use in Newfoundland and Labrador.
2.09 Identify the negative environmental impacts of two-stroke engines.
2.10 Understand the environmental impact of using outboard engines.
2.11 Understand the environmental impact of using personal watercrafts.
2.12 Understand the environmental impact of snowmobile use.
2.13 Understand the effects of soil compaction.
2.14 Understand ways to reduce recreational impacts on soils.
2.15 Understand how game populations are managed.
2.16 Recognize the role of hunters, fishers and trappers in conservation.
2.17 Understand the role of the provincial Inland Fish and Wildlife Division in managing the big-game population in Newfoundland and Labrador.
2.18 Identify the goals of big-game management.
2.19 Identify the coyote's main source of food in Newfoundland and Labrador.
2.20 Define fish habitat and identify its three components.
2.21 Identify some pressures on the recreational fishery in Newfoundland and Labrador.

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The third unit, ***Water Use and the Environment***, will cover the following course outcomes:

- 3.01 Compare fresh water and salt water in relation to quantity and quality.
- 3.02 Describe the water/hydrological cycle.
- 3.03 Understand the pressure on water resources caused by pollution and contamination.
- 3.04 Define watershed and identify the five drainage basins in Canada.
- 3.05 Understand why wetlands are considered important for the health of the environment.
- 3.06 List the types of wetlands found in Newfoundland and Labrador.
- 3.07 Understand the four major types of water-quality indicators used by Environment Canada laboratories.
- 3.08 Understand the Real Time Water Quality (RTWQ) Network in Newfoundland and Labrador.
- 3.09 Understand how forestry operations affect water quality and aquatic habitat.
- 3.10 Understand how road construction and maintenance affect fresh water resources.
- 3.11 Understand the impact of mining activity on fresh water resources.
- 3.12 Understand the potential environmental impacts of large-scale hydroelectric development.
- 3.13 Understand how urbanization influences the amount of water entering surrounding rivers.
- 3.14 List the main sources of drinking water in Newfoundland and Labrador.
- 3.15 List common pathogens found in drinking water.
- 3.16 Understand why communities are sometimes subject to a boil water advisory.
- 3.17 List the main components of the multi-barrier approach for ensuring drinking water quality.
- 3.18 List and briefly describe the different types of treatment systems used to remove different types of chemical and physical contaminants from drinking water.
- 3.19 Understand the advantages and disadvantages of adding different states of chlorine to a water system.
- 3.20 Understand why Newfoundland and Labrador does not allow people to use community water sources for recreational activities.

Students are required to complete assignments and core labs in this course. Instructors have flexibility to substitute another assignment and/or core lab if it is felt that the ones included in the Study Guide are inappropriate.

The theme of sustainable development should be embedded in the entire course content. The issues and topics raised should be discussed through this lens.

A copy of the Teacher Resource Guide for the high school **Environmental Science 3205** course is available on the Department of Education website at the following link:
http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html#envsci3205

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Instructors are encouraged to read this Teacher Resource Guide and be familiar with its contents. There are a number of useful Blackline Masters (BLM's) which will be helpful in all parts of the course, including the core labs.

Curriculum Guide

Each ABE Level III Science course has a Curriculum Guide for the instructor and a Study Guide for the student. For **Science 3107** and **Science 3108**, both of these guides include the specific curriculum outcomes for the course. The Curriculum Guide provides suggestions for teaching, learning and assessment to support student achievement of the outcomes. Some suggestions for teaching, learning and assessment will be repeated in the different units when appropriate. Each course is divided into units.

Curriculum Guide Organization

Unit Number – Unit Title

Outcomes	**Suggestions for Teaching, Learning and Assessment**
Specific curriculum outcomes for the unit.	Suggested activities, elaboration of outcomes, and background information.

Study Guide

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the **Required Work** for the course. The student text is also available on the Department of Education website at the link given earlier. The Study Guide is designed to give students some degree of independence in their work. Instructors should note, however, that there is material in the Curriculum Guide in the *Suggestions for Teaching, Learning and Assessment* column that is not included in the Study Guide, and instructors will need to review this information and decide how to include it.

To the Instructor

Resources

Recommended student resources for this course:

- *Toward A Sustainable Future: Challenges, Changes and Choices*. Department of Education. Province of Newfoundland and Labrador. 2009. ISBN: 978-1-55146-367-4.
- This resource is available on the Department of Education Website under the heading **Environmental Science 3205** at the following link: http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html#envsci3205

Recommended instructor resources:

- *Environmental Science 3205 Teacher Resource.* To be used in conjunction with the student text referenced above.
- This resource is available on the Department of Education Website under the heading **Environmental Science 3205** at the following link: http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html#envsci3205

Note: Instructors may have to adapt the content of these instructor resources to meet the needs of their individual ABE students.

Recommended Evaluation

Written Notes	10%
Labs/Assignments/Test(s)	20%
Unit Test(s)	20%
Final Exam (entire course)	50%
	100%

The overall pass mark for the course is 50%.

Note: The evaluation scheme recommended above is presented as a suggestion. Institutions/instructors may choose an alternate evaluation scheme in order to meet the individual needs of adult learners.

Unit 1: Introduction to Environmental Science—Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
1.01 Understand how the Earth can be compared to a spaceship. 1.02 Recognize that the human population growth of Newfoundland and Labrador is in contrast to the global human population growth. 1.03 Understand negative consequences of a high human growth rate. 1.04 Understand scientific methodologies. 1.05 Understand the limitations of science in solving the Earth's environmental problems. 1.06 Understand that Environmental Science is a multi-disciplinary field. 1.07 Understand the difference between a conservationist and an environmentalist. 1.08 Identify producers, primary consumers, secondary consumers, and tertiary consumers on a food web. 1.09 Understand how balance is obtained in an ecosystem as represented by a food web. 1.10 Understand how the following ethics impact the environment: (i) development ethic, (ii) preservation ethic and (iii) conservation ethic.	• Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 1 of the Teacher Resource Guide (TR). • Instructors may discuss the concept of "Spaceship Earth" with students. Google Earth may be helpful in providing a visual of Earth as a spaceship. • Instructors may discuss that the Earth's increasing population and the need for resources to sustain the population is the foundation of all the Earth's environmental problems. • Students can search "global population growth" online to find tools to help visualize the global population growth. • Students should understand that sustainable practices are human attempts to minimize the negative impacts caused by human interaction with ecosystems. • Discuss with students what sustainability means and how the environment, society and economy are connected. • Instructors may introduce and define the precautionary principle as a moral and political principle which states that if an action or policy might cause severe or irreversible harm to the public, in the absence of a scientific consensus that harm would ensue, the burden of proof falls on those who advocate taking the action. • Instructors can refer students to examples of legislation that has been developed to protect the environment. • The ecological footprint is a method of quantifying one's impact on the Earth. • Students may search "ecological footprint" online and use of the web-based tools to calculate their ecological footprint. • Instructors may wish to obtain a copy of the Newfoundland and Labrador Sustainable Development Act, available on Government of Newfoundland and Labrador website.

Unit 1: Introduction to Environmental Science—Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
1.11 Define sustainable development. 1.12 Recognize that sustainable development is a concept impossible to achieve. 1.13 Understand things that individuals can do to decrease their ecological footprint. 1.14 Define precautionary principle. 1.15 Understand what is meant by a socially sustainable society. 1.16 Recognize the role of legislation in guiding stewardship and sustainability. 1.17 Understand the difference between renewable and non-renewable resources. 1.18 Understand the responsibility of the Multi Materials Stewardship Board (MMSB) in Newfoundland and Labrador. 1.19 Identify the five action items associated with the Waste Management Strategy. 1.20 Understand how to correctly dispose of Household Hazardous Wastes. 1.21 Define ecosystem. 1.22 Define ecoregion.	• Explain to students that as citizens they may need to review and understand environmental legislation and policy documents if they wish to be heard and to respond effectively to environmental issues. • Instructors should ensure students recognize the diversity of ecoregions that exist within Newfoundland and Labrador. Refer to and examine the local ecoregion, paying attention to unique biotic and abiotic factors found there. • Discuss factors that relate to biodiversity. Include ecosystems, species diversity and genetic diversity. • Instructors may wish to point out that in an Arctic ecosystem the biodiversity is low because of the number and types of species are all specialized for survival. In the Boreal forest ecosystem, there is greater biodiversity because there are a greater number of species living there. • Discuss with students that greater diversity is crucial to the survival of a species. • Instructors will find notes related to the **Mini-Lab Activity: What Ecoregion do I Live in?** in Unit 1 of the TR. • Discuss species at risk. The Newfoundland Marten is an example of a species at risk that many in Newfoundland and Labrador are familiar. • Students should understand how humans have caused species to become extinct. The Great Auk is another local example of how humans caused a species extinction. • Have students think about why there were so few animals on the island portion of the province and why they think some of the animals were introduced (see table on p. 67 of the TR). • Instructors may wish to point out that climate change is now recognized as perhaps the greatest potential threat to species on the planet.

Unit 1: Introduction to Environmental Science—Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
1.23 Understand the purpose of the Ecoregion Classification System. 1.24 Define biodiversity**.** 1.25 Understand and recognize biodiversity. 1.26 Describe the importance of species diversity and genetic diversity in an ecosystem. 1.27 Identify reasons why some organisms become species at risk. 1.28 Recognize the importance of protecting species. 1.29 Distinguish between natural extinctions and anthropogenic extinctions. 1.30 Describe the impacts of introduced species. 1.31 Recognize the process of classifying an organism as a species at risk. 1.32 Identify the COSEWIC listings that categorize species at risk. 1.33 Define protected area. 1.34 Identify types of protected areas in Newfoundland and Labrador. 1.35 Explain the benefits of protected areas.	• The flowchart given in BLM 4-3 on page 76 of the TR is helpful for understanding COSEWIC. • Students should understand that protected areas in Newfoundland and Labrador are essential for biodiversity conservation. • Instructors can use BLM 5-1 on page 8 of the TR to help present values and benefits of protected areas. • Instructors are encouraged to review the BLM's on pages 85-89 of the TR for possible use in the classroom.

Unit 2: Recreation and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
2.01 Define wilderness. 2.02 List values associated with wilderness. 2.03 Identify traditional and non-traditional outdoor recreational activities popular in Newfoundland and Labrador. 2.04 Recognize some growing environmental concerns related to tourism in Newfoundland and Labrador. 2.05 Understand what is meant by sustainable tourism and why it is a valuable approach to both conservation and tourism. 2.06 Understand how access to the interior of Newfoundland and Labrador has expanded over the years. 2.07 Understand how access roads can affect the environment. 2.08 Identify negative environmental impacts caused by ATV use in Newfoundland and Labrador. 2.09 Identify the negative environmental impacts of two-stroke engines. 2.10 Understand the environmental impact of using outboard engines.	• Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 2 of the Teacher Resource Guide (TR). • In the past, the wilderness was a source of raw materials, food and possibly a threat. Today, many people, especially in Newfoundland and Labrador, see the wilderness as a source of recreation. • Instructors can initiate a discussion of the wilderness by asking students what their concept of wilderness is and why maintaining the wilderness is fundamental to sustaining biodiversity. • Students should be able to link the wilderness, the economy, environmental issues, culture and personal/spiritual enhancement. • Instructors may discuss examples of consumptive activities in the wilderness with students. • Students should understand the impacts of consumptive and non-consumptive recreational activities on the environment. • The topic of identifying the environmental impacts of cottage/cabin development is not covered directly in the text. It is intended that students use and apply their own personal knowledge and experiences to complete **Assignment #2**. • As an alternative to **Assignment #2**, students who own cabins might wish to consider surveying the environmental impacts around their cabins and surrounding areas, and then explain ways of reducing or eliminating those impacts. • Instructors may discuss ecotourism using examples of ecotourism companies in Newfoundland and Labrador. • Instructors may wish to give students a copy of BLM 6-1 on page 102 of the TR. Students can then indicate whether they participate in any of the listed outdoor recreational activities.

Unit 2: Recreation and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
2.11 Understand the environmental impact of using personal watercrafts. 2.12 Understand the environmental impact of snowmobile use. 2.13 Understand the effects of soil compaction. 2.14 Understand ways to reduce recreational impacts on soils. 2.15 Understand how game populations are managed. 2.16 Recognize the role of hunters, fishers and trappers in conservation. 2.17 Understand the role of the provincial Inland Fish and Wildlife Division in managing the big-game population in Newfoundland and Labrador. 2.18 Identify the goals of big-game management. 2.19 Identify the coyote's main source of food in Newfoundland and Labrador. 2.20 Define fish habitat and identify its three components. 2.21 Identify some pressures on the recreational fishery in Newfoundland and Labrador.	• Instructors may wish to share **BLM 6-3 Gros Morne Mountain Trail Guide** on page 108 of the TR with students for discussion. • Instructors may wish to discuss the impact of increased access to the wilderness on the environment. GPS, satellite phones and other technology now provide greater security while travelling in the wilderness and thus has increased access. Likewise, greater access to the wilderness is available through access roads. • There are two excellent questions to discuss with students: 1) Is there a responsibility associated with use and access? and 2) What is the relationship between access and sustainability? • Ask students if they are aware of any access roads in their local area and if they have used any. • The two-stroke engine has had a significant impact on the environment. Discuss with students whether they operate snowmobiles that are two-stroke or four-stroke. Ask these students to explain the difference between these two types of snowmobile engines. • Discuss with students how ATV's, snowmobiles and outboard engines negatively impact wildlife, waterways, soils, etc. • Discuss with students the impacts of soil compaction and erosion that are directly caused by ATV and other mechanical vehicle use in the wilderness. • Instructors may wish to use **BLM 7-1 Impacts of ATV's on the Environment** on page 125 in the TR as a supplement to the questions in the Study Guide. • Instructors may wish to discuss moose as an example of how a management issue has economic, social and ecological links.

Unit 2: Recreation and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	• Instructors may wish to discuss the difference between small game and big-game hunting in terms of species hunted, hunting methods, management methods and regulations. • Instructors may wish to discuss the impacts of moose and big-game hunting in terms of economics (equipment sales, lodge rentals, guided trips, supplies, etc.), culture/social (recreation, source of food, etc.) and environmental issues (population dynamics, wilderness access, etc). • Instructors can point out to students that a copy of the *Hunting and Trapping Guide* is available on the Government of Newfoundland and Labrador website. • Instructors may need to help students with the math component of **Core Lab #3** (Moose Population Census). • Instructors are encouraged to read the Case Study and Activity Notes related to the **Core Lab #3** on pages 142-144 of the TR. • Instructors may wish to allow students an opportunity to research more information on the coyote in Newfoundland and Labrador. Coyotes have been continually increasing their range north and unlike many species that shy away from human settlement, coyotes do not. • Instructors may wish to encourage students to tell their own "coyote stories" to find out if and where coyotes have been sighted. • Instructors should ensure students recognize that coyotes represent the first winter predator for moose and caribou. • As a result, the coyote has increased predation pressures on the moose and caribou populations. • Instructors will find unit review items on page 148 of the TR which may be helpful for test/exam development.

Unit 3: Water Use and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
3.01 Compare fresh water and salt water in relation to quantity and quality. 3.02 Describe the water/hydrological cycle. 3.03 Understand the pressure on water resources caused by pollution and contamination. 3.04 Define watershed and identify the five drainage basins in Canada. 3.05 Understand why wetlands are considered important for the health of the environment. 3.06 List the types of wetlands found in Newfoundland and Labrador. 3.07 Understand the four major types of water-quality indicators used by Environment Canada laboratories. 3.08 Understand the Real Time Water Quality (RTWQ) Network in Newfoundland and Labrador. 3.09 Understand how forestry operations affect water quality and aquatic habitat. 3.10 Understand how road construction and maintenance affect fresh water resources.	• Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 4 of the Teacher Resource Guide (TR). • Instructors should emphasize that water is essential for life on Earth as we know it. • Students should understand that water is a resource like trees and fish, and that water needs to be managed in a sustainable manner. • Instructors may discuss with students the properties of water and the water cycle. • Students should understand the interconnectedness of fresh water and salt water. This can be discussed and visualized using the water cycle. • Discuss with students that even though Newfoundland and Labrador has numerous lakes, ponds, rivers, streams and wetlands, there is still a need to manage those water resources in a sustainable manner. • BLM 13-1 on page 252 of the TR can be used to compare bogs and fens. Bog and fens cover approximately 18% in Newfoundland and Labrador. • BLM 13-2 on page 253 of the TR can be used to compare ponds and flowing waters. • Instructors may discuss the use of Water Quality Index (WQI) as a determination of water quality. Various biological factors such as coliform, fecal coliform (Walkerton, ON), water born parasites (Giardia) and chemical factors (acidity, dissolved oxygen) are used to determine water quality. • As an extension, instructors can provide students with the opportunity to choose a water body that has real-time monitoring near their own community. Students can download data sets every day over a set period of time period (http://www.env.gov.nl.ca/wrmd/RTWQ/Desc_History.asp). Notice any differences after a major rain.

Unit 3: Water Use and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
3.11 Understand the impact of mining activity on fresh water resources. 3.12 Understand the potential environmental impacts of large-scale hydroelectric development. 3.13 Understand how urbanization influences the amount of water entering surrounding rivers. 3.14 List the main sources of drinking water in Newfoundland and Labrador. 3.15 List common pathogens found in drinking water. 3.16 Understand why communities are sometimes subject to a boil water advisory. 3.17 List the main components of the multi-barrier approach for ensuring drinking water quality. 3.18 List and briefly describe the different types of treatment systems used to remove different types of chemical and physical contaminants from drinking water. 3.19 Understand the advantages and disadvantages of adding different states of chlorine to a water system. 3.20 Understand why Newfoundland and Labrador does not allow people to use community water sources for recreational activities.	• Instructors may discuss the impacts of humans on water quality. Students should understand that there are trade offs when considering the impact of hydroelectric development. In the long run, hydroelectricity is sustainable and with the exception of the initial development (access roads, damming, flooding, etc.), it is very clear. • Students should understand that municipal water supplies undergo regular testing for coliforms. If coliforms are found then mitigation strategies are taken such as increasing chlorine levels. If coliform counts cannot be lowered, then boil water advisories are put into place. • Instructors may ensure students understand that most forestry operations in Newfoundland and Labrador involve clear cutting. This practice creates the possibility of greater runoff. • Instructors may also wish to discuss the increased siltation due to tree harvesting and the crossing of streams. Removal of trees that surround a river or pond will result in a temperature increase of the water. Removal of trees will reduce the “sponge effect” and will result in greater flooding and erosion around aquatic ecosystems. • Instructors may discuss the impact of mining on aquatic ecosystems. The main impacts are acid rain waste, siltation, and chemical pollution. The Hope Brook gold mine is an excellent example to discuss. • Instructors may wish to discuss the change in pH that result from tailings. • Instructors can discuss with students that while hydroelectricity is seen as a clean energy supply, the development of these projects does have significant environmental impacts such as the loss of habitat due to flooding large areas of land, the release of mercury from underlying soil into the water column, blocking natural migration of fish, destroying spawning habitats, and increasing the downstream water temperatures.

Unit 3: Water Use and the Environment —Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	• Examples of existing hydroelectric development projects in Newfoundland and Labrador are Bay D'Espoir, Gull Island, Churchill Falls, and Star Lake. An example of a future potential hydroelectric development as of 2012 is Muskrat Falls. • Instructors may wish to discuss eutrophication as a result of fertilizer and animal waste runoff from agriculture operations. Chemical pollution will occur from pesticide runoff. • Instructors may discuss the impacts of increased public access, road salt runoff and hydroelectric runoff from vehicles.