

Adult Basic Education
Level III Science

**Science 3108
Environmental Science II
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
Science 3102
Science 3103
Science 3104
Science 3105
Science 3106
Science 3107
Science 3108



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Students are required to do ONE of the following three units

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To the Instructor

Introduction to Science 3108

This course is a continuation of **Science 3107: Environmental Science I**, which is a prerequisite for this course. **Science 3107** and **3108** are based on **Environmental Science 3205** offered in Newfoundland and Labrador high schools.

Science 3108: Environmental Science II is divided into five units. The first two units are compulsory, but students are required to complete only one unit from units 3 to 5. Students should select their unit based on interest and/or career goals. The outcomes for this course are given below.

The first unit, ***The Marine Ecosystem***, will cover the following course outcomes:

- 1.01 Define estuaries.
- 1.02 Know the kinds of vegetation found in salt marshes and swamps.
- 1.03 Understand why the Grand Banks of Newfoundland and Labrador are a rich resource area on the continental shelf.
- 1.04 Understand pressure placed on marine resources.
- 1.05 Understand issues that are a contributory to the decline in global fishing stocks.
- 1.06 List some of the possible reasons for the demise of the northern cod stock.
- 1.07 Understand the history and role of ICNAF and NAFO.
- 1.08 Understand reasons why federal jurisdiction of the fisheries is sometimes challenged.
- 1.09 Understand why fish stocks are assessed.
- 1.10 List and describe the different sources of data that scientists use when assessing fish stocks.
- 1.11 Understand the purpose of the sentinel fishery.
- 1.12 Understand issues surrounding getting an accurate measurement of fish population size.
- 1.13 Understand how the status of one fish population can affect other fish populations.
- 1.14 Understand how the biological characteristics of a fish species are important in deciding how well a fish population can sustain fishing pressure.
- 1.15 Understand how changes in the environment may cause populations of marine wildlife to fluctuate over time.
- 1.16 Understand how fishing pressure can impact marine wildlife.
- 1.17 Understand how by-catch impacts the population of marine wildlife.
- 1.18 Understand how habitat destruction can have significant impacts on marine ecosystems.
- 1.19 Understand how responsible fishing is promoted in Canada's fishing industry.
- 1.20 Understand environmental impacts of mobile bottom fishing gear.
- 1.21 Understand how ghost fishing negatively impacts marine ecosystems.
- 1.22 Understand some of the difficulties in determining the impact of seals on fish stocks.
- 1.23 Understand the environmental impact of using gillnets in the fishery.
- 1.24 Understand ways that coastal activities can impact marine habitat.
- 1.25 Understand the concerns associated with invasive species.

To the Instructor

- 1.26 Understand the negative environmental impact caused by drilling fluids or “muds”.
- 1.27 Understand how production water negatively impacts the marine environment.
- 1.28 Understand how the transportation of oil negatively impacts the marine environment.
- 1.29 Identify sources of oil pollution.
- 1.30 Understand how oil kills seabirds.
- 1.31 Understand the importance of Marine Protected Areas.
- 1.32 Understand components of Canada’s Marine Protected Areas Strategy.

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

- 2.01 Identify the four layers of the atmosphere.
- 2.02 Understand how the atmosphere supports life on Earth.
- 2.03 Recognize the importance of studying the atmosphere.
- 2.04 List common pollutants in the atmosphere.
- 2.05 Understand why Newfoundland and Labrador is a relatively high emitter of sulfur dioxide.
- 2.06 List sources of volatile organic compounds in the home.
- 2.07 Define smog.
- 2.08 List effects of smog on human health.
- 2.09 List effects of smog on the environment.
- 2.10 Understand the effects of heavy metals in organisms.
- 2.11 Understand actions that can be taken to improve air quality in the community.
- 2.12 Understand how acid rain is created.
- 2.13 List sources of acid precipitation in Newfoundland and Labrador.
- 2.14 Understand effects of acid rain on human health.
- 2.15 Understand effects of acid precipitation on economic activities.
- 2.16 Understand how certain chemicals deplete ozone in the atmosphere.
- 2.17 Identify sources of greenhouse gas emissions in your community.
- 2.18 Understand how people can respond to climate change in an ecologically sustainable manner.
- 2.19 Understand opposing viewpoints on climate change.
- 2.20 Distinguish between weather, climate and climate change.
- 2.21 Understand the effect of solar radiation on the Earth.
- 2.22 Identify natural causes of climate change.
- 2.23 Understand the greenhouse potential of common greenhouse gases.
- 2.24 Recognize historic global temperature trends.
- 2.25 Understand the potential impacts of climate change on Newfoundland and Labrador.
- 2.26 Recognize what is expected to be the largest contributor to global sea-level rise over the next hundred years.
- 2.27 Recognize two threats that climate change poses to human health.
- 2.28 Identify possible measures that could be taken to adapt to sea-level rise.
- 2.29 List economic approaches to reducing greenhouse gases.
- 2.30 Understand ways to reduce greenhouse gas emissions.
- 2.31 Evaluate wind turbine technology as an option for Newfoundland and Labrador.

To the Instructor

Students are only required to complete ONE of the next three units. Students should select ONE of these units based on their interest in the subject matter.

The third unit, *Forests*, will cover the following course outcomes:

- 3.01 Understand the ecological value of forests.
- 3.02 Understand pressures facing the world's forests.
- 3.03 Understand challenges facing people who manage the forests of Newfoundland and Labrador.
- 3.04 Identify the dominant forest type in Canada and in Newfoundland and Labrador.
- 3.05 List ways that Canadians use the forest.
- 3.06 List and summarize the ecological, economical and social value that relates to forests.
- 3.07 List the characteristics of the boreal forest.
- 3.08 Distinguish between primary and secondary succession.
- 3.09 Distinguish between seasonal and successional changes in the boreal forest.
- 3.10 Identify two important roles of forest fires.
- 3.11 Understand some disadvantages of preventing forest fires.
- 3.12 List the characteristics of an old-growth forest.
- 3.13 List values of old-growth forests.
- 3.14 Define silviculture.
- 3.15 Understand issues responsible for the shift in resource management approaches.
- 3.16 Understand the information provided by aerial photographs of a forest and the kinds of decisions this information might support.
- 3.17 Understand the purpose of permanent sample plots and ground-truthing plots.
- 3.18 Understand why clear-cutting is the preferred method of tree harvesting in Newfoundland and Labrador.
- 3.19 Understand some problems associated with clear-cutting.
- 3.20 Understand the components of integrated pest management.
- 3.21 Understand two advantages of biological control agents for controlling forest pests over traditional chemical use.
- 3.22 List positive and negative effects of dealing with insects and pesticides in the boreal forest.
- 3.23 List innovations in harvesting technology used in the forest industry.
- 3.24 List some advantages of using walking mechanized harvesters over wheeled harvesters.
- 3.25 Identify types of activities that involve the use of forests.

To the Instructor

The fourth unit, ***Mining***, will cover the following course outcomes:

- 4.01 Distinguish between a mineral and an ore.
- 4.02 Understand why mines today use a community workforce rather than develop a town around the mine.
- 4.03 List examples of historic mining activities in Newfoundland and Labrador.
- 4.04 List and briefly describe the four main stages of the mining process.
- 4.05 Explain the difference between underground and open pit mining.
- 4.06 Identify two commonly used mineral separation techniques.
- 4.07 Recognize the purpose of scrubbers in a smelter stack.
- 4.08 List three forms of waste produced by the mining industry.
- 4.09 Understand the risk associated with tailings.
- 4.10 Understand the purpose of environmental assessment in relation to the mining industry.

The fifth unit, ***Agriculture***, will cover the following course outcomes:

- 5.01 Define agriculture.
- 5.02 Understand factors that limit the range of agriculture in Newfoundland and Labrador.
- 5.03 Understand why the soils of Newfoundland and Labrador are shallow and stony.
- 5.04 List common crops raised in Newfoundland and Labrador.
- 5.05 List historical crops grown in Newfoundland and Labrador.
- 5.06 List challenges facing Christmas tree farming in Newfoundland and Labrador.
- 5.07 Define and give examples of forage.
- 5.08 Identify environmental challenges that had to be overcome to get corn to grow in Newfoundland and Labrador.
- 5.09 List the main animals raised by livestock farmers in Newfoundland and Labrador.
- 5.10 Identify the group of animals raised for meat that have had the greatest impact on the planet.
- 5.11 List the impacts of livestock production.
- 5.12 List and briefly describe the livestock raised in the poultry industry in Newfoundland and Labrador.
- 5.13 List methods used to prevent frost damage.
- 5.14 Understand how spraying water on a crop can prevent frost damage even when the temperature dips below freezing.
- 5.15 Define the term “agrometeorology” and give some examples of how climate influences agriculture.
- 5.16 Define a growing-day.
- 5.17 Understand how growing degree-days are used to determine (i) what crops can be grown in a specific area and (ii) predicting harvest time.
- 5.18 Understand the four components of soil.
- 5.19 List and briefly explain the factors influencing soil formation.
- 5.20 Define tillage.
- 5.21 List the common practices of soil management.

- 5.22 Understand how adding limestone to soil helps improve overall soil quality.
- 5.23 Distinguish between inorganic and organic fertilizers.
- 5.24 List methods that can be used to reduce the effects of soil erosion.
- 5.25 Identify three types of pesticides used in Newfoundland and Labrador.

To the Instructor

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>

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.

To the Instructor

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.

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.

To the Instructor

Recommended Evaluation

Written Notes	10%
Labs/Assignments/Test(s)	20%
Unit Test(s)	20%
Final Exam (entire course)	<u>50%</u>
	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: The Marine Ecosystem-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>1.01 Define estuaries.</p> <p>1.02 Know the kinds of vegetation found in salt marshes and swamps.</p> <p>1.03 Understand why the Grand Banks of Newfoundland and Labrador are a rich resource area on the continental shelf.</p> <p>1.04 Understand pressure placed on marine resources.</p> <p>1.05 Understand issues that are a contributory to the decline in global fishing stocks.</p> <p>1.06 List some of the possible reasons for the demise of the northern cod stock.</p> <p>1.07 Understand the history and role of ICNAF and NAFO.</p> <p>1.08 Understand reasons why federal jurisdiction of the fisheries is sometimes challenged.</p> <p>1.09 Understand why fish stocks are assessed.</p> <p>1.10 List and describe the different sources of data that scientists use when assessing fish stocks.</p> <p>1.11 Understand the purpose of the sentinel fishery.</p> <p>1.12 Understand issues surrounding getting an accurate measurement of fish population size.</p>	<ul style="list-style-type: none"> • 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 may wish to discuss with students that the fishery is the primary reason why Europeans visited Newfoundland and Labrador. The settlement pattern in Newfoundland and Labrador was historically based on the fishery, and the fishery makes a significant economic and cultural contribution. • Instructors may discuss that large estuarial systems and salt marshes are recognized for their important ecological function and societal value. These areas provide habitat and nursery grounds for commercial and recreational fin and shell fish. These areas also absorb energy from storms protecting the land from hurricanes. • Estuaries are considered good indicators of marine health because of their closeness to land where many ocean bound pollutants originate. Observing plant and animal life in estuaries provide scientists with indicators of environmental degradation. • Estuaries can also act as toxin collectors. Although this can cause problems for estuaries, if estuaries are flushed sufficiently with tidal currents, pollutants move into deeper waters affecting life there by spreading the toxic effects over a broader area. • The intertidal zone of Newfoundland and Labrador is quite extensive and varied since it covers approximately 17, 542 Km². Because of its closeness to human settlements and activities, the intertidal zone is very sensitive to land and marine pollutants. • The intertidal zone is also a very productive marine zone despite many daily and seasonal changes in abiotic factors like salinity, temperature, and nutrient availability. In Newfoundland and Labrador, this zone is where many aquaculture activities occur. • The subtidal zone or sublittoral zone extends from the intertidal zone to the continental slope. This area is also referred to as the shelf zone, and this is commonly called the Grand Banks in Newfoundland and Labrador.

Unit 1: The Marine Ecosystem-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>1.13 Understand how the status of one fish population can affect other fish populations.</p> <p>1.14 Understand how the biological characteristics of a fish species are important in deciding how well a fish population can sustain fishing pressure.</p> <p>1.15 Understand how changes in the environment may cause populations of marine wildlife to fluctuate over time.</p> <p>1.16 Understand how fishing pressure can impact marine wildlife.</p> <p>1.17 Understand how by-catch impacts the population of marine wildlife.</p> <p>1.18 Understand how habitat destruction can have significant impacts on marine ecosystems.</p> <p>1.19 Understand how responsible fishing is promoted in Canada's fishing industry.</p> <p>1.20 Understand environmental impacts of mobile bottom fishing gear.</p> <p>1.21 Understand how ghost fishing negatively impacts marine ecosystems.</p> <p>1.22 Understand some of the difficulties in determining the impact of seals on fish stocks.</p> <p>1.23 Understand the environmental impact of using gillnets in the fishery.</p> <p>1.24 Understand ways that coastal activities can impact marine habitat.</p>	<ul style="list-style-type: none"> • The Grand Banks are one of the world's largest and richest resource areas, known for their valuable fish and oil resources. • The Grand Banks are actually a series of raised submarine plateaus with a water depth ranging between 36.5 and 185 meters. The relative shallowness of the water allows extensive marine animal and plant life to flourish on the bottom. • Instructors may wish to use BLM 15- Estuaries and BLM 15-2 Intertidal Zone. • Instructors can encourage students to use Google Earth to view the continental shelf and the abyssal plain. • Instructors may discuss the importance the ocean played on Newfoundland and Labrador settlement by humans from the times of ancient indigenous people (Maritime Archaic, Paleo-Eskimo) to the present. • Instructors may discuss the economic importance of the ocean to the economy of Newfoundland and Labrador and how the ocean has influenced settlement patterns around the province. Instructors may also wish to discuss the lead up and impacts of the 1992 moratorium on cod fishing. • Instructors may discuss an overview of the present state of the global fishing industry. Students that they can consult the United Nations Food and Agriculture Organization (FAO) for the most recent data on the global fishery. • Instructors may wish to use BLM 15-3 Global Capture Fisheries and Exploitation Levels to supplement the material in the Study Guide. This BLM should help students understand trends in the global fishery. • Instructors may wish to use BLM 15-4 The Northern Cod to help students understand the history and causes that led up to the collapse of the northern cod fishery. • Instructors should emphasize through discussion that resource management and its role in sustainable development is an important theme in this unit.

Unit 1: The Marine Ecosystem-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>1.25 Understand the concerns associated with invasive species.</p> <p>1.26 Understand the negative environmental impact caused by drilling fluids or “muds”.</p> <p>1.27 Understand how production water negatively impacts the marine environment.</p> <p>1.28 Understand how the transportation of oil negatively impacts the marine environment.</p> <p>1.29 Identify sources of oil pollution.</p> <p>1.30 Understand how oil kills seabirds.</p> <p>1.31 Understand the importance of Marine Protected Areas.</p> <p>1.32 Understand components of Canada’s Marine Protected Areas Strategy.</p>	<ul style="list-style-type: none"> • Instructors may discuss that fisheries management is more challenging than wildlife management because unlike moose, caribou and other animal wildlife, fish are rarely seen. • Instructors may wish to use BLM 15-5 Determine Fish Populations: Mark and Recapture to supplement material in the Study Guide. • Instructors may discuss how the sentinel fishery works. This program actively gets fisherpersons involved in making a valuable contribution to the understanding and management of the fishery. Some ABE students may have participated in the sentinel fishery. • Instructors can discuss sustainable fishing by mentioning the following good sustainable fishing practices; respecting limits and seasons, reporting catch, and respecting the habitat and surrounding environment. • Instructors may also discuss threats to sustainability such as: pollution of local streams and ponds, not reporting catches, poaching, netting, not respecting catch limits, environmental change, bycatch, habitat loss and destruction, and disease. • Instructors can discuss mobile bottom fishing gear with some examples. BLM 15-6 A Typical Bottom Trawl can be used to supplement material in the Study Guide. • Instructors may use BLM 15-3 Harp Seal Mean Population Estimates and TAC 1971-2000 as a supplement to the material in the Study Guide. • Instructors may discuss that one of the greatest threats facing the world’s fishery is climate change. Small fluctuations in water temperatures can have significant impacts on a fish species ability to survive. • Instructors may discuss aquaculture with students. It is possible that an aquaculture operation (salmon/mussel) is available near the ABE site and students may have visited or worked at it.

Unit 1: The Marine Ecosystem-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	<ul style="list-style-type: none">• Instructors may explain that ocean currents act as distributors of ocean contaminants. Land based pollution can therefore be dispersed over a large area through current action.• Instructors may discuss that habitat destruction occurs along coastal areas due to human activities, such as resource extraction and pollution.• Pollution arrives in coastal areas via two primary routes—shore based activities and direct dumping in the oceans. Some pollution may be accidental as in the case of oil spills, but other pollution can be intentional as in the case of ships bilge dumping at sea.• Communities along coastal regions also significantly affect the natural habitats and this is particularly true in areas of high population densities.• Instructors may discuss invasive species and how these species find their way into Newfoundland and Labrador waters. With increased shipping traffic to Newfoundland and Labrador, the risk of new species being introduced is highlighted.• Instructors may explain that oil has been naturally seeping into the ocean for millions of years and that nature has effectively dealt with these low volume seeps.• Instructors may use BLM 16-1 Average Annual Contribution from major sources of petroleum in worldwide marine waters 1900-2000 to supplement material in the Study Guide.• Pages 303-304 in the TR outlines impacts on humans, the fishery and fauna caused by the Exxon Valdez oil spill that occurred on March 24, 1989. This could be an interesting discussion.• Instructors may discuss the four specific mitigation strategies for marine oil pollution as outlined in the text. These are: preparedness, containment, recovery and disposal.

Unit 2: The Atmosphere and the Environment-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>2.01 Identify the four layers of the atmosphere.</p> <p>2.02 Understand how the atmosphere supports life on Earth.</p> <p>2.03 Recognize the importance of studying the atmosphere.</p> <p>2.04 List common pollutants in the atmosphere.</p> <p>2.05 Understand why Newfoundland and Labrador is a relatively high emitter of sulfur dioxide.</p> <p>2.06 List sources of volatile organic compounds in the home.</p> <p>2.07 Define smog.</p> <p>2.08 List effects of smog on human health.</p> <p>2.09 List effects of smog on the environment.</p> <p>2.10 Understand the effects of heavy metals in organisms.</p> <p>2.11 Understand actions that can be taken to improve air quality in the community.</p> <p>2.12 Understand how acid rain is created.</p> <p>2.13 List sources of acid precipitation in Newfoundland and Labrador.</p>	<ul style="list-style-type: none"> Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 5 of the Teacher Resource Guide (TR). Instructors may wish to discuss what students already know about the atmosphere. Students may already know that the atmosphere has different layers, each serving a particular function. <ul style="list-style-type: none"> Instructors may use the analogy of a blanket to describe how the atmosphere insulates the Earth. This blanket protects the Earth from extremes of temperatures and solar radiation. It is possible that this blanket can retain too much heat and during this time the earth undergoes a warming period. The atmosphere is also a vehicle by which energy, precipitation and gases circulate the Earth. There are some misconceptions about the atmosphere that instructors may wish to discuss with students. These are: <ol style="list-style-type: none"> Land plants are not responsible for most of the oxygen generated in the atmosphere. Approximately 70% of the Earth's oxygen comes from the oceans. It's not direct sunlight that heats the atmosphere. The atmosphere is heated from the ground up by conduction, convection and radiation. Greenhouse gases do not make up a major portion of the atmosphere. The major constituents in the atmosphere are nitrogen and oxygen, which make up approximately 99% by volume. Instructors may discuss the effect of aerosols on the atmosphere with students. Aerosols are minute particles suspended in the atmosphere. When these particles are sufficiently large, they scatter and absorb sunlight. The scattering of light can result in reduced visibility (haze) and redder sunrises/sunsets.

Unit 2: The Atmosphere and the Environment-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
2.14 Understand effects of acid rain on human health.	<ul style="list-style-type: none"> Instructors may point out that the combustion of fossil fuels/firewood releases CO₂ and other gases that can impact the ozone layer and contribute to the Greenhouse Effect.
2.15 Understand effects of acid precipitation on economic activities.	<ul style="list-style-type: none"> Industrial sources from burning fuels and the gases released can also affect the ozone layer. Domestic sources such as the propellants used in aerosols may contain CFC's, herbicides, pesticides, etc., which may affect the atmosphere.
2.16 Understand how certain chemicals deplete ozone in the atmosphere.	
2.17 Identify sources of greenhouse gas emissions in your community.	<ul style="list-style-type: none"> Instructors should understand that the amount of particles and various gases in the atmosphere will directly affect its quality. For example, a high amount of CO₂ or dust will result in lower air quality.
2.18 Understand how people can respond to climate change in an ecologically sustainable manner.	<ul style="list-style-type: none"> Many ABE students will be familiar with smog first-hand from their travels, especially if they visited larger cities outside Newfoundland and Labrador. Instructors may ask students to share some smog stories.
2.19 Understand opposing viewpoints on climate change.	<ul style="list-style-type: none"> Instructors may encourage students to do some extra research on how smog affects humans, specifically seniors and children.
2.20 Distinguish between weather, climate and climate change.	<ul style="list-style-type: none"> Instructors may review the role of ozone in protecting the Earth from harmful ultraviolet radiation and how ground level ozone is formed. Students can Google the topic online to find more information.
2.21 Understand the effect of solar radiation on the Earth.	<ul style="list-style-type: none"> Instructors may wish to discuss the Grasshopper Effect and bioaccumulation. The Grasshopper Effect is also referred to as global distillation. Bioaccumulation is a build up of or increase in concentration of a substance. One example of this is the bioaccumulation that occurred with DDT and predatory birds.
2.22 Identify natural causes of climate change.	<ul style="list-style-type: none"> Instructors can encourage students to research more information on these two effects online.
2.23 Understand the greenhouse potential of common greenhouse gases.	<ul style="list-style-type: none"> The table on p. 319 of the TR lists common atmospheric pollutants and their sources. Instructors may wish to copy this table as a handout.
2.24 Recognize historic global temperature trends.	<ul style="list-style-type: none"> Instructors may discuss with students that the “teepee” garbage incinerators in Newfoundland and Labrador has resulted in the province being the largest producer of dioxins and furans in Canada. Other sources of dioxins and furans include backyard burning and the burning of plastics.
2.25 Understand the potential impacts of climate change on Newfoundland and Labrador.	
2.26 Recognize what is expected to be the largest contributor to global sea-level rise over the next hundred years.	

Unit 2: The Atmosphere and the Environment-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>2.27 Recognize two threats that climate change poses to human health.</p> <p>2.28 Identify possible measures that could be taken to adapt to sea-level rise.</p> <p>2.29 List economic approaches to reducing greenhouse gases.</p> <p>2.30 Understand ways to reduce greenhouse gas emissions.</p> <p>2.31 Evaluate wind turbine technology as an option for Newfoundland and Labrador.</p>	<ul style="list-style-type: none"> • Instructors may discuss with students that often people in Newfoundland and Labrador believe that because we have less vehicles and lower levels of industrial activity than other areas of North America, that our air is relatively clean of pollutants. However, the prevailing air currents transport large quantities of airborne pollutants from the eastern regions of the USA and central Canada. Instructors may refer students to look at the jet stream online or on weather forecasts for a visual of this effect. • Instructors may explain to students that UV radiation can be divided into three groups based on wavelength. UV-A is not absorbed by ozone, UV-B is mostly absorbed by ozone (some reaches the Earth), and UV-C is completely absorbed by ozone and natural oxygen. • BLM 17-1 A bag house and BLM 17-2 An Electrostatic Precipitator in the TR may be useful resources to use in this unit. • Instructors may wish to discuss with students that climate change and its impact on humans is perhaps one of the most debated environmental issues. Likewise, it is perhaps the most significant environmental issue facing the Earth. • Instructors may discuss with students that the term “climate change” is used interchangeably with “global warming” and “the greenhouse effect”, but it is a more descriptive term. Climate change refers to the long-term changes in the “average weather” in a given region. This can lead to changes in weather patterns on a global scale with such effects as changes in rainfall patterns, sea level rise, potential droughts, habitat loss, and heat stress. • The greenhouse gases that are of most concern are carbon dioxide, methane, and nitrous oxides. • Instructors may discuss with students that there may be a natural cyclic event on Earth causing global warming. Some sources include volcanic activity, ocean currents, solar variability, Earth’s orbit and tilt, plate tectonics and biological evolution.

Unit 2: The Atmosphere and the Environment-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	<ul style="list-style-type: none">• Instructors may have students review BLM 18-2 The Hockey Stick Graph. This graph was developed by Michael Mann, a US climatologist.• This graph was developed as a result of a statistical compilation of tree ring data. This data suggest that air temperatures had been stable for 900 years and then soared dramatically in the 20th century. More information on the Hockey Stick Graph can be found online.• Instructors can suggest to students to search “Windows to the Universe” online for additional information on the Earth’s atmosphere.• Instructors may suggest to students that they search “NRCan Atlas of Canada” and follow links to find sensitivity maps of the coastlines of Canada. These maps are provided by Natural Resources Canada and can be helpful in studying the impact of climate change on coastal zones.• Instructors may find BLM 18-1 Greenhouse Gases and Human Activity and BLM 18-3 Sensitivity to Sea-Level Rise useful resources for this unit.• Instructors may use BLM 19-1 Principles of the Rio Declaration and BLM 19-2 Principles of the Kyoto Protocol as useful resources.• Instructors may suggest that students do some independent research to find out what subsidies are presently available to residents of Newfoundland and Labrador to support initiatives of reduced energy and retro-fit homes to conserve energy.• Instructors may suggest to students to research Energy Star Certification to understand the criteria to obtain this label.• Instructors may discuss with students the use of alternate fuels and technologies. The following may be considered: biofuels, electric cars, fuel cells, diesel-fuelled vehicles, and gas-electric hybrids.

Unit 2: The Atmosphere and the Environment-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	<ul style="list-style-type: none">• Instructors may discuss the benefits and restrictions involved with each alternate energy source. Include the following: wind, tidal, solar, biomass fuel and nuclear.• Solar energy is a clean energy source that requires the installation of solar panels to generate electricity or to heat water that can be stored for future use. The water can also be turned into steam to generate electricity.• Wind energy is one of the fastest growing methods of electrical generation in the world. Kinetic energy from moving air is converted into electricity by wind turbines that are mounted in locations where the weather is favorable. Students may be familiar with the wind turbines located in St. Lawrence.• Wind turbines may be used individually but are often grouped together in wind farms.• Using wind energy reduces the environmental impact of generating electricity because it requires no fuel and does not create pollution or greenhouse gases.• Tidal power, often called tidal energy, converts the energy from tidal motion into electricity and other energy forms. It works similar to a hydroelectric station except the rising tide fills the water reservoir.• Biomass fuel is biological material derived from living, or recently living organisms, such as wood, waste, hydrogen gas and alcohol fuels.• Direct incineration is the most conventional way in which biomass is used. Biodegradable waste can also be burned as a fuel.• BLM 19-3 Energy Use at Your House, BLM 19-4 Heat Pump and BLM 19-4 Solar Panel may be used to supplement the material in the Study Guide.

Students are required to do ONE of the following three units

Unit 3: Forests-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>3.01 Understand the ecological value of forests.</p> <p>3.02 Understand pressures facing the world's forests.</p> <p>3.03 Understand challenges facing people who manage the forests of Newfoundland and Labrador.</p> <p>3.04 Identify the dominant forest type in Canada and in Newfoundland and Labrador.</p> <p>3.05 List ways that Canadians use the forest.</p> <p>3.06 List and summarize the ecological, economical and social value that relates to forests.</p> <p>3.07 List the characteristics of the boreal forest.</p> <p>3.08 Distinguish between primary and secondary succession.</p> <p>3.09 Distinguish between seasonal and successional changes in the boreal forest.</p> <p>3.10 Identity two important roles of forest fires.</p> <p>3.11 Understand some disadvantages of preventing forest fires.</p> <p>3.12 List the characteristics of an old-growth forest.</p> <p>3.13 List values of old-growth forests.</p>	<ul style="list-style-type: none"> Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 3 of the Teacher Resource Guide (TR). Instructors may discuss with students that forest management can be compared to farming 'in the wild'. Forest management practices are similar to agricultural practices. Instructors may explain the criteria used for measuring success of sustainable forest management (SFM). <p>Include:</p> <ul style="list-style-type: none"> conservation of bio-diversity maintenance of forest ecosystems conservation of soil and water contributions to global cycles economic and social benefits <ul style="list-style-type: none"> Instructors may discuss with students that sound decision making in forest management is based on sound data. Research and discuss the importance and role of GIS, satellite imagery and computer modeling in forest management. Instructors may wish to discuss forest management planning in Newfoundland and Labrador emphasizing the role of public consultation. Use the Eco Spotlight: Clarenville Forest Management District on page 305 of the student text and refer back to the Mini-Lab Activity: Age-Class Distribution on page 302 of the student text to emphasize one of the major problems, management for sustainability, faced by forest managers. Instructors may wish to discuss the difference between full-tree harvesting and short wood harvesting in terms of reducing the environmental impact on forest habitat. Point out that in the past when trees were harvested with a buck saw and hauled out on a 'slide', the short wood method was used. It should be noted that in short wood harvesting the harvester, which already has wide low pressure tires to reduce ground pressure, lays down a 'bed' of branches and travels on them further reducing ground pressure to the point where young balsam fir are not damaged.

Unit 3: Forests-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>3.14 Define silviculture.</p> <p>3.15 Understand issues responsible for the shift in resource management approaches.</p> <p>3.16 Understand the information provided by aerial photographs of a forest and the kinds of decisions this information might support.</p> <p>3.17 Understand the purpose of permanent sample plots and ground-truthing plots.</p> <p>3.18 Understand why clear-cutting is the preferred method of tree harvesting in Newfoundland and Labrador.</p> <p>3.19 Understand some problems associated with clear-cutting.</p> <p>3.20 Understand the components of integrated pest management.</p> <p>3.21 Understand two advantages of biological control agents for controlling forest pests over traditional chemical use.</p> <p>3.22 List positive and negative effects of dealing with insects and pesticides in the boreal forest.</p> <p>3.23 List innovations in harvesting technology used in the forest industry.</p> <p>3.24 List some advantages of using walking mechanized harvesters over wheeled harvesters.</p> <p>3.25 Identify types of activities that involve the use of forests.</p>	<ul style="list-style-type: none"> Instructors may wish to distinguish between clear cutting and selective cutting as forest harvesting techniques in Newfoundland and Labrador. Instructors may point out that despite the perception of the negative impacts that clear-cutting has on forest ecosystems, many improvements have been made to reduce these. For example, students should be aware that the edges of cut-overs are no longer cut straight so as to replicate natural open spaces, cutting debris is left where the trees are cut to create habitat for small animals and plants, harvesting machines use tracks instead of tires to reduce soil disturbance, and access roads are no longer built using bulldozers that remove topsoil. Instructors are encouraged to read “Agriculture and silviculture compared” on p. 169 of the TR. Instructors may wish to use BLM 10-1 Measuring the Height of a Tree and BLM 10-3 Domestic Fuelwood/sawlog survey in the TR as a supplement to the material contained in the Study Guide. Instructors may point out that although insect infestations and fires are an integral part of the natural forest cycle, they can have drastic impacts on forest resources and on long term forest management plans. Instructors may use the Case Study: Managing Balsam fir Stands Infested by Balsam Wolly Adelgid as a supplement to the content in the Study Guide or as an alternate assignment/core lab.

Unit 4: Mining-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>4.01 Distinguish between a mineral and an ore.</p> <p>4.02 Understand why mines today use a community workforce rather than develop a town around the mine.</p> <p>4.03 List examples of historic mining activities in Newfoundland and Labrador.</p> <p>4.04 List and briefly describe the four main stages of the mining process.</p> <p>4.05 Explain the difference between underground and open pit mining.</p> <p>4.06 Identify two commonly used mineral separation techniques.</p> <p>4.07 Recognize the purpose of scrubbers in a smelter stack.</p> <p>4.08 List three forms of waste produced by the mining industry.</p> <p>4.09 Understand the risk associated with tailings.</p> <p>4.10 Understand the purpose of environmental assessment in relation to the mining industry.</p>	<ul style="list-style-type: none"> 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). BLM 12-1 List of Common Minerals, BLM 12-4 Mining Site and Quarries and BLM 12-5 Partial List of Companies Incorporated to Work Minerals in Newfoundland and Labrador may be used as a supplement to the Study Guide. Instructors may discuss some examples of how mineral resources have contributed to the development of human civilization; for example, the development of tools, weapons, jewelry and technology. Point out to students that not all impacts regarding mining are negative. Economic impacts can benefit the entire province and country. If the ABE class is located in a community that is a mining town, try to relate the content of this unit to the local context. Ensure students understand the mining process by first looking at exploration. Instructors may discuss with students the reasons why an environmental impact assessment is needed before an ore body is mined. Voisey's Bay is an example to discuss. Other mine sites in Newfoundland and Labrador can be studied to gain an understanding into the mining process, especially Labrador City. Instructors may discuss that it is the extraction of minerals from ore and the resulting tails that has the greatest potential impact on the environment. Instructors may discuss the mining process by distinguishing between above ground and underground mining. Instructors may help students understand ore concentration by discussing examples of everyday concentrates like orange juice, canned soup, sugar in tea, etc.

Unit 4: Mining-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	<ul style="list-style-type: none">• Instructors may wish to demonstrate mining separation processes with simple apparatus. Gravity separation can be demonstrated by stirring a heterogeneous soil sample in a jug of water and letting it settle. Magnetic separation can be demonstrated by passing a magnet through a mixture of sand and iron fillings. Heap leaching can be demonstrated by dripping water through a mixture of sand and salt. Floatation can be demonstrated by shaking a mixture of powdered charcoal, mineral ore, water, and liquid detergent (resulting bubbles should contain a coating of charcoal).• Instructors may wish to discuss the effects of not treating mine wastes, and why it is important for the environment to properly treat mine wastes.• Instructors may make students aware of the different kinds of mine waste, such as acid mine waste, leachate, dust, etc.• Instructors may wish to discuss mining in underdeveloped countries where environmental regulations are lax or non-existent.• The mineral extraction site in Long Harbour (smelting) can be used as a basis for exploring the differences between hydromet and pyromet smelting.• The hydromet process is an alternative to traditional smelting and eliminates harmful emissions. Instructors may have students research the process along with pros and cons online.• Instructors may discuss with students that the greatest environmental challenge faced by the mining sector is rehabilitating the site and dealing with wastes that remain for many years after the mining operation is closed.• Some potential environmental impacts of mining along with sources and remediation techniques are found on pages 214-215 of the TR (Unit 3).• Instructors may point out to students that today metals are vital to society and there cannot be metals without mines.

Unit 4: Mining-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
	<ul style="list-style-type: none">• The environmental problems associated with mining arise when mining companies lose sight of some ethical considerations, such as desire for profits and lack of legislative standards. These are often most lacking in underdeveloped countries.

Unit 5: Agriculture-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>5.01 Define agriculture.</p> <p>5.02 Understand factors that limit the range of agriculture in Newfoundland and Labrador.</p> <p>5.03 Understand why the soils of Newfoundland and Labrador are shallow and stony.</p> <p>5.04 List common crops raised in Newfoundland and Labrador.</p> <p>5.05 List historical crops grown in Newfoundland and Labrador.</p> <p>5.06 List challenges facing Christmas tree farming in Newfoundland and Labrador.</p> <p>5.07 Define and give examples of forage.</p> <p>5.08 Identify environmental challenges that had to be overcome to get corn to grow in Newfoundland and Labrador.</p> <p>5.09 List the main animals raised by livestock farmers in Newfoundland and Labrador.</p> <p>5.10 Identify the group of animals raised for meat that have had the greatest impact on the planet.</p> <p>5.11 List the impacts of livestock production.</p> <p>5.12 List and briefly describe the livestock raised in the poultry industry in Newfoundland and Labrador.</p>	<ul style="list-style-type: none"> Instructors will find useful notes, BLM's, review questions, and answers related to the questions in the Study Guide in Unit 3 of the Teacher Resource Guide (TR). Instructors may ask students what their understanding is of agriculture in Newfoundland and Labrador. This understanding will vary depending on where students live. Instructors may discuss with students that agriculture has been practiced for approximately 10, 000 years and is perhaps humankind's first large scale interaction with the environment. Instructors may ask students to discuss the major crops grown in Newfoundland and Labrador, particularly in their local area. Instructors may point out to students that agriculture is difficult in Newfoundland and Labrador due to soil and climate. BLM 11-1 Agriculture Land Use can be used to show the agriculture distribution on the island. Instructors may discuss with students the major types of animals raised in Newfoundland and Labrador, especially in the local area. Instructors may discuss with students the impacts of raising livestock on water quality; for example, impacts of the run-off from manure storage and deposits and livestock access to water bodies. Instructors may discuss with students all of the agricultural activities ongoing in and around their communities. Instructors may point out that with increasing pressure being placed on the world's food supply, there is growing increase in farming in the more northern parts of the planet. Instructors may discuss methods that can be employed by farmers to protect crops from frost damage. Instructors may wish to discuss with students how soil is formed and how soil quality affects agriculture.

Unit 5: Agriculture-- Suggestions for Teaching, Learning and Assessment

Outcomes	Suggestions for Teaching, Learning and Assessment
<p>5.13 List methods used to prevent frost damage.</p> <p>5.14 Understand how spraying water on a crop can prevent frost damage even when the temperature dips below freezing.</p> <p>5.15 Define the term “agrometeorology” and give some examples of how climate influences agriculture.</p> <p>5.16 Define a growing-day.</p> <p>5.17 Understand how growing degree-days are used to determine (i) what crops can be grown in a specific area and (ii) predicting harvest time.</p> <p>5.18 Understand the four components of soil.</p> <p>5.19 List and briefly explain the factors influencing soil formation.</p> <p>5.20 Define tillage.</p> <p>5.21 List the common practices of soil management.</p> <p>5.22 Understand how adding limestone to soil helps improve overall soil quality.</p> <p>5.23 Distinguish between inorganic and organic fertilizers.</p> <p>5.24 List methods that can be used to reduce the effects of soil erosion.</p> <p>5.25 Identify three types of pesticides used in Newfoundland and Labrador.</p>	<ul style="list-style-type: none"> • Point out to students that that soil in agricultural areas is different from soil in forest areas. • Instructors may discuss with students factors that contribute to agricultural land degradation. Include loss of organic matter, erosion and acidification. • Note that organic matter acts as a source of nutrients and helps inspire the water holding capacity of the soils. It is composed of the dead and decaying plant and animal materials. • Instructors may use a pile of sand and peat to demonstrate the difference between organic and non-organic (mineral soils). This demonstration can be taken another step by showing how organic matter can hold water better than mineral soils. • To do this, place a sample of peat in a funnel and a sample of mineral soil in another funnel. Pour equal volumes of water in each and measure the volume of water that exits each funnel. Students should observe that more water is retained in the peat sample. • Instructors may wish to point out that acid soils are common in Newfoundland and Labrador, and treatment with lime is a common practice. • Instructors may wish to discuss with students common agriculture pests. Point out that animals such as moose and rodents can be agriculture pests. Clarify that many insects are essential for crop growth (e.g. pollinating insects). • Instructors may recommend that students read the Eco Spotlight, The Hairy Chinch Bug: Integrated Pest Management in Your Own Backyard.