

Unit 3
LAND USE AND THE ENVIRONMENT

Suggested Time: (20 hours)

Do ONE complete section:

EITHER

“Forests” OR “Mining” OR “Agriculture”

Introductory Comments

There are a great number of activities such as portfolios, journals, newsletters, website postings, etc., that can be integrated throughout this unit and following units. It is not intended that students would do every suggested activity. For example, where it is suggested that students be divided into groups to research and present on a topic, not all students would need to be involved in that activity. Groups could be assigned specific topics to research so that over the course of the unit, all students would have an opportunity to work as a group to research and present of various topics. Teachers could identify the particular activities and projects in which they would like their students to engage and determine a set number of these written activities for each student to engage in over the course of the unit. (Likewise, individual students could be assigned topics to research and then present to the class.) Thus, rather than have every student complete each of the written activities, part of the student's assessment could require that each student/group complete a set number of tasks that could be included in a portfolio/newsletter/website. This could then be compiled for the entire class in the form of a newsletter, website, class display, etc.. Where possible, students should be engaged in at least one long term project or activity throughout the unit or the whole course. This could be an individual or group project.

For topics that contain a great deal of factual information, it would be very helpful for students to use the "mind mapping" technique ([refer to Appendix](#)) to help them summarize and consolidate this information. References and suggestions for how students could create the mind map will be made throughout this unit. As students become more proficient with the use of mind maps they should be encouraged to create their own without teacher suggestions. Teachers could have students create one mind map for the entire unit or a series of small maps for discrete sections. It is important that students refer to their notes and text when completing their mind maps to ensure the map is completely accurate (i.e. this is a learning strategy and is not appropriate for use as an assessment technique). Teachers should note that mind maps are most effective when students create them from scratch and when colour and sketches/picture are used along with their written text. In the absence of coloured pencils, etc., teachers could supply students with one of several different coloured high-lighters. While individual students would create their own mind maps, the teacher could a "class mind map". Several sheets of large paper or poster board could be posted on the wall. The teacher could add to the class mind map each day as a summary of the day's lesson or at the beginning of the next class as a bridge between the current and previous lesson. Student mind maps could be used in Think-Pair-Share activities in which each student explains their mind map to their partner.

Teachers could use rubrics and/or checklists to assess student products and learning. Refer to Appendix for samples.

As Students Progress through this unit, they should develop a list of careers associated with forestry, mining and agriculture.

Introducing the Forest

Outcomes

Students will be expected to

- 3.01 identify the role that forest ecosystems have in the supporting life in the biosphere. Include:
- (i) climate regulation
 - (ii) water cycle
 - (iii) reducing air pollution
 - (iv) soil stabilizers
 - (v) animal habitats
- 3.02 list types of global forest ecosystems. Include:
- (i) boreal
 - (ii) temperate deciduous
 - (iii) temperate rainforest
 - (iv) tropical rainforest
- 3.03 list and locate the forest regions of Canada. Include:
- (i) boreal
 - (ii) deciduous
 - (iii) subalpine
 - (iv) Great Lakes - St. Lawrence
 - (v) montane
 - (vi) acadian
 - (vii) coastal

Elaborations—Strategies for Learning and Teaching

Teachers could have students brainstorm the various roles that forest ecosystems play in the support of life on Earth.

As students have encountered many of these factors in previous courses, this should be done as a review.

Students could create a mind map to use throughout this unit. Students would put “forest ecosystems” at the center of the map. From this, they could draw the first branch and label this “Role in Biosphere” and add the roles to this branch.

Students will have encountered this information in previous science courses. While it is not the intent that they learn the different characteristics of each of these forest ecosystems, teachers should review the main characteristics between these ecosystems (e.g. flora, fauna, average temperature, and average rainfall). Teachers should treat this as a very brief review.

Teachers could use a world map to visually represent the location of the global forest ecosystems. Students should note that Newfoundland and Labrador is primarily boreal forest.

Students could add a branch to their mind map called “types” and add the four types of forest ecosystems to the map.

Teachers could use a map to visually represent the location of the global forest ecosystems. Students should note that Newfoundland and Labrador is primarily boreal forest. This outcome should receive brief coverage. Teachers could limit this to looking at a map that displays the various forest regions of Canada.

Students could develop a colour key for each forest region and using this, indicate on a map the location of each forest region. This could be added to their portfolio.

Students could complete the case study “Garden of Official Tree Species” from the Futures from Forests Resource.

Introducing the Forest

Tasks for Instruction and/or Assessment

Journal

- Ask students what they think the role of forest ecosystems are in terms of supporting and maintaining life on Earth. Students' responses could be used to determine the level of understanding and the need for subsequent instruction.

Presentation

- Shade in the different global forest ecosystems on a map of the world. Use a different colour for each ecosystem.
- Shade in the different forest regions of Canada and indicate on a map of Canada. Use a different colour for each region.
- Search “ecoregions Canada” on the Internet to compare the characteristics of the forest regions of Canada. Create a table to summarize your results.

Conventions used in Resource/Notes column

ST - Student Textbook

FFP - Future from Forests Power Point

FFCS - Future from Forest Case Study

L&S - Land and Sea Episode

TR - Teacher Resource Package

LSRG - Land and Sea Resource Guide

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 251

FFP “Forest Ecology”

ST p. 254

ST p. 255

FFP “Forest Ecology” and “Old Growth Forests”

FFCS “Garden of Official Tree Species”

Introducing the Forest (continued)

Outcomes

Students will be expected to

3.04 outline the value of forest ecosystems. Include:

- (i) economic
- (ii) ecological
- (iii) social

Elaborations—Strategies for Learning and Teaching

Teachers could have students brainstorm about the values of the boreal forest. The teacher could write each of the student's suggestions on the board in random order. Students could then be asked to take the list the class has generated and to classify them under one of the three headings (economic, ecological, and social). Teachers should make links back to Unit 1 and the initial discussion of sustainable development. As they discuss and study the remaining topics in this unit, students should do so through the lens of sustainable development.

Teachers could have students think about the three values that we can put on a forest ecosystem and to choose the one they see as most important. Following the Think-Pair-Share approach, students could then partner with a student next to them and explain which they think is most important. Students could then make a journal entry about which of the three is the most valuable and the most important to the citizens of Newfoundland and Labrador. This could be included in their portfolio.

Teachers could begin this with a discussion by asking students to brainstorm the different ways they think a forest ecosystem can be maintained. Students should be divided into groups of three or four for this activity. Each group would report back to the class. The teacher could then introduce the concepts of silviculture, urban forests and trail developments locally, provincially and internationally. Using the ideas generated by the students, the teacher could then help the students classify their ideas under each of these concepts. The main emphasis here should be toward understanding the human efforts that recognize the merits of sustaining our forests both in our province and globally. Students could complete the case study "Forest Values" from Futures From Forests Resources.

Students could add a new branch to their mind map called "value" and add the three values and supporting detail.

Teachers could have students complete the mini Lab Activity "Forest Values Mapping".

Introducing the Forest (continued)

Tasks for Instruction and/or Assessment

Paper and Pencil

- Complete the “Forest Values Mapping” activity from page 258-261 of the textbook.

Presentation

- Create a collage that communicates the importance of the boreal forest of Newfoundland and Labrador.

Performance

- Teachers could have students work as groups to complete the table using the text. When the students finish this task, teachers could then review to create a final version. Students could add this table to their portfolio. Students could use the Internet to locate photographs and descriptions of the various forest types and create a poster/collage or web page.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 256-261

FFP “Forest Values”

Introducing the Forest (continued)

Outcomes

Students will be expected to

- 3.06 list forest usage in Newfoundland and Labrador. Include:
- (i) recreational
 - (ii) domestic and commercial harvesting,
 - (iii) other alternate uses (e.g. berry picking, woodworking, fungus picking, etc.)

Elaborations—Strategies for Learning and Teaching

Teachers could highlight the varying uses of the forests in our province. Students could generate a list of uses they are familiar with as a means of beginning this topic. Since there are many alternate uses, the list of uses should not be limited to those in the outcome. This will be further covered through the activity “Domestic Use Survey”.

Teachers could have students engage in a role play activity to represent a situation in which members of a community are at odds over how a local forest resource may or may not be utilized. Students could be divided into groups to represent the various recreational/ economic interests (e.g. logger, business person, berry picker, hunter, etc.). Each group develops a plan or proposal that will be presented to their town council. One member in the group will present the plan. The students who do not present will represent the Council and will identify the strengths and weaknesses in each proposal. At the end, students could vote on which of the proposals (or modified proposals) should be awarded the use of the forest resource.

Students could complete the case study “Taking the Paper out of Newspaper” in the Futures from Forests Resources.

Introducing the Forest (continued)

Tasks for Instruction and/or Assessment

Performance

- Collect photographs that illustrate the different ways forests are used in Newfoundland and Labrador. Present them in a photo album with a brief description of each.
- Create a visual product (e.g. collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) that describes how we use forests in Newfoundland and Labrador.
- Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) that outlines the main characteristics of the Boreal Forest. Indicate how these characteristics create an ecosystem that could be easily threatened by human activities.
- Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) that illustrates the dominant flora and fauna in the Boreal Forest of Newfoundland and Labrador.
- Create a visual product (e.g. collage, poster, website) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to show the various ways we use forests in Newfoundland and Labrador

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 263

FFP “Forest management” and “Forest Values”

FFCS “Taking the Paper out of Newspaper

The Boreal Forest

Outcomes

Students will be expected to

3.07 list the characteristics of the boreal forest ecosystem.
Include:

- (i) size (largest)
- (ii) climate (coldest)
- (iii) growth rate (slowest growing)
- (iv) low biodiversity
- (v) soil conditions (poorest soil drainage)

3.11 outline the role of fire in boreal forest succession

Elaborations—Strategies for Learning and Teaching

Teachers should emphasise that physical and geographical features determine the characteristics of an ecosystem (i.e. latitude, temperature, rainfall, etc.). It is important to remember that the boreal forest ecosystem has many plants and animals with specific adaptations to these characteristics. Teachers could point out that the plants and animals adapted to living in the boreal forest would not necessarily be able to survive in a different forest area (and vice versa). If global changes occur (e.g. increased temperature) This could threaten the existence of the boreal forest). Teachers could have students create a new Mind Map for the boreal forest with 3 branches (characteristics, trees, animals) to summarize the information. Students will continue to add information to this map as they complete the rest of this unit.

In terms of biodiversity, the major flora of the boreal forest includes balsam fir, black spruce, and eastern larch (often called tamarack or juniper in this province). Teachers could have students read the Enviro-focus “Tuckamore Forest”.

Common mammals include moose, black bear, woodland caribou, lynx, snowshoe hare, red squirrel, and little brown bat, Common birds include sparrow, chickadee, and owls. Teachers could provide examples of these animal (e.g. photograph, etc.) to help students recognize them as not all students will be familiar with each of these animals. Students will have examples of flora and fauna common to their areas within Newfoundland and Labrador to add to the list.

Teachers could have students read the Enviro-focus “The Plight of Boreal Birds”.

Teachers could have students complete the mini Lab Activity “Trends in Grey-cheeked Thrush Population”.

Most students will think of fire as having a negative impact on forests. While this may be true in the short term, particularly for economic considerations, the boreal forest ecosystem has evolved so that forest fires are a necessary part of the development cycle. In the boreal forest, fire is the normal mechanism by which old or insect-damaged forests are removed and replaced by new growth. Some trees, such as the black spruce, require fire for their seed cones to open so new black spruce will grow. In addition, burning returns the nutrients to the soil faster than the decay process can in this climate. As a result, fire prepares the soil for a faster secondary succession.

The Boreal Forest

Tasks for Instruction and/or Assessment

Presentation

- Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) that illustrates the dominant flora and fauna in the Boreal Forest of Newfoundland and Labrador.
- Alternatively, students could be asked to develop a visual presentation to show why the Boreal forest ecosystem is vulnerable to human activity.

Pencil and Paper

- Sketch an outline of a conifer tree from the boreal forest and list inside the outline the adaptations of conifers to the ecosystem.
- Construct a table that summarizes the major characteristics of the forest ecosystem.

Performance

- Students could create an information brochure or poster that outlines the main characteristics of the Boreal forest. They could also indicate how these characteristics create an ecosystem that could be easily threatened by human activities. This could be included in their portfolio.
- Create a collage which shows a representation of Boreal forest animals.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 264-266

FFP “Forest Ecology”

ST pp. 272-274

FFP “Forest Ecology” and
“Forest Management”

Old Growth Forests

Outcomes

Students will be expected to

- 3.13 identify regions of old growth forest in Newfoundland and Labrador.
- 3.12 describe the unique forest succession in the Main River old growth forest.
- 3.14 list characteristics of old growth forests. Include:
- (i) multi-age trees
 - (ii) multi-layered vegetation
 - (iii) presence of significantly older trees
 - (iv) lacks natural and human disturbance
 - (v) presence of snags and deadfalls

Elaborations—Strategies for Learning and Teaching

Teachers could use a map to indicate the old growth regions in this province. While there are pockets of very old trees in many areas of the province (e.g., recent investigation has uncovered 370 year old stunted spruce trees in the Labrador Highlands) for the purposes of this course the discussion of old growth forest should be limited to the areas of Main River and Little Grand Lake.

Students should recognize that a primary old growth forest has not been directly influenced by human activity, whereas secondary old growth forests show signs of recovering from some disturbance. Students will have encountered the concept of succession in previous science courses and they should apply this concept in this case to understand how old growth forest can develop, given time, from disturbances.

The Main River old growth forest demonstrates uniqueness in terms of forest succession. In this forest, gap replacement occurs whereby a single tree that dies is typically replaced by a small number of trees creating a truly multi-aged forest.

Students could view the CBC Archives video clip on clearcutting in the Main River area to gain an understanding of the significance of old growth forests to Newfoundland and Labrador. (Search for “Main River” at the CBC Archive site).

The website of Natural Resources Canada (Foresr Services) provides numerous photographs that could be used to show the characteristics of old growth forests.

Although there is no specific accepted definition of old growth forests, there are characteristics that distinguish old growth forests from mature forests. Specifically, they are recognized by the absence of recent natural or human disturbance. Using a map of Newfoundland and Labrador, students could be asked to identify areas which they feel might be classified as “old growth forest”. Teachers could reference the importance of the forest industry to the economy of Newfoundland and Labrador and the fact that there are now very few true, old growth forests in Newfoundland and Labrador as a result of forestry activities.

Teachers could have students access the Natural Resources Canada Website for a map of old growth forest locations and photos of old growth forests across Canada.

Old Growth Forests

Tasks for Instruction and/or Assessment

Presentation

- Create a collage that illustrates the characteristics of old growth forests.

Performance

- Create a brochure or poster to explain the role of fire in the boreal forest.

Journal

- What is your personal definition of an old growth forest?
- Students could make a journal entry about their thoughts and feelings as they view the photos of the old growth forest. Students could incorporate this into a poem, short story, or song about old growth forests. This could be added to their portfolio.
- Make a journal entry in which you discuss your personal values as it relates to the concept of an old growth forest.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 275-276
FFP “Old Growth Forests”

ST pp. 278-282
FFP “Old Growth Forests”

ST pp. 267-278
FFP “Old Growth Forests”

Old Growth Forests (continued)

Outcomes

Students will be expected to

3.15 describe the importance of an old growth forest.

Include:

- (i) ecological
- (ii) social
- (iii) economic

3.16 evaluate environmental and social concerns related to the maintenance versus harvesting of old growth forests.

Elaborations—Strategies for Learning and Teaching

These two outcomes provide an excellent opportunity to address sustainable development as it relates to the forest industry. Through discussion, students should come to understand that these three facets of sustainable development are interconnected and that focussing on only one of these facets, when looking at resource utilization, often leads to problems. Teachers could use the following list to describe the importance of old growth forests: natural habitat, source of genetic diversity, models for scientific study, carbon sinks, aesthetics, eco-tourism, spiritual.

Some of the important aspects identified here may be similar to values identified by students in the activity “Mapping Forest Values”. Teachers could take this opportunity to have students recognize some of the commonalities in value and belief systems.

Teachers could have students complete the case study “Logging the Main River Watershed”

Teachers could have students read the Eco Spotlight “Father John McCarthy: Canadian Geographic Magazine’s People’s Choice Award”.

Teachers could have students complete the case study “Maintaining Secondary Mature trees in the Avalon Forest”.

Old Growth Forests (continued)

Tasks for Instruction and/or Assessment

Paper and Pencil

- Shade in the old growth forest areas of Newfoundland and Labrador on a map of the province. Use a different colour for each area.
- Draw two diagrams next to each other. One will communicate the typical forest succession in a boreal forest and the other will communicate forest succession in the Main River old growth forest (gap replacement).

Presentation

- Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) that outlines the main characteristics and importance of old growth forests. Indicate how these characteristics create an ecosystem that could be easily threatened by human activities.

Performance

- Create an information brochure or poster that outlines the main characteristics and importance of old growth forests. Indicate how these areas are threatened by human activities.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 276-284

FFP “Old Growth Forests”

Forest Management

Outcomes

Students will be expected to

- 3.17 outline the history of forest management in Newfoundland and Labrador from the 19th century to present.
- 3.18 recognize the paradigm shift in forest management from exploitation to sustainable development.
- 3.19 describe Sustainable Forest Management (SFM) in terms of:
- (i) supporting multiple forest usage
 - (ii) protecting and manages forest ecosystems
 - (iii) requiring continual scientific practices and monitoring

Elaborations—Strategies for Learning and Teaching

Working in groups, students could create a timeline that represents changes in the management of Newfoundland and Labrador forests. Students could create a poster or collage that demonstrates the changes that have occurred in forest management over time. This outcome requires only a very brief treatment.

Students could complete the case study “A Step back in Time” from Future from Forest resource.

Teachers could have students recall past forest harvesting practices and contrast these with current practices. The intent here is to have students consider a brief historical review of harvesting practices as they relate to the sole means forest management in the past. Students should recognize that initial harvesting, although having less environmental impact, was one of exploiting the forest resources without considerations for future uses of that resource. Current Sustainable Forest Management seeks to establish a balance of exploitation and sustainability.

Students do not need to know the details of these pressures that changed forest management practices. The intent is for them to recognize that a paradigm shift has occurred. The Brundtland Report originated at the 1972 Stockholm Conference on global forests and forest management. Public pressures for sustainable forest management include such things as ISO certifications on consumable products, stricter environmental regulations, and stronger awareness of environmental impacts.

Teachers could refer back to Unit 1 in which the role and importance of Environmental Science was discussed. SFM depends upon the scientific data that is collected and analysed in a systematic manner.

Ecosystem management is the main component of SFM. The elements of ecosystem management are directly infused in SFM. Teachers should identify that both terms, in this context, are often used interchangeably.

Teachers should clarify that the success of SFM is measured in terms of the degree to which it achieves the following:

- (i) conserves the biodiversity of the area
- (ii) helps with the maintenance of forest ecosystems
- (iii) helps conserve soil and water
- (iv) contributes to global cycles
- (v) provides economic benefits
- (vi) provides social benefits

Teachers could have students complete the Mini Lab Activity “Age-Class Distribution”.

Students could complete the case study “Sustainable Forests” from the Future from Forests resource.

Forest Management

Tasks for Instruction and/or Assessment

Presentation

- Create a timeline outlining the history of forest management practices in Newfoundland and Labrador. Include graphics that communicate the different management methods.
- Research the views of past forest management practices and compare them with the practices that are being used today. Which are considered more damaging? Present the results of your research with the class as a newspaper article, poster, or multimedia presentation.
- Give examples of how forests could be managed to meet the needs of all users (e.g. non-consumptive and consumptive recreational users, cabin owners, and industry). Present the results of your research with the class as a newspaper article, poster, or multimedia presentation.

Performance

- Students could interview elderly people in their community to assess their views of past forest management practices to compare those practices with today's harvesting practices. Which are considered more damaging?
- In a group of 3 or 4, use what you have already learned in the course to identify the various items or issues you feel should be considered in the sustainable management of a forest ecosystem. Categorize your ideas according to the six measures of SFM success and present to the class. Are there issues or themes that appear more often than others? Are some measures of SFM success more important than others? Is there general agreement among your classmates on the relative importance of the various items? Why/why not?
- Students could create a collage, poster, brochure, web site, presentation in which they describe the strategy of SFM. They could present their work to the class.

Paper and Pencil

- Create a table that shows the six criteria used to guide sustainable forest management. Include what you think a forest harvester might have to do to meet these criteria.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 288-290

FFP "Forest Management"

ST pp. 290-292

FFP "Forest Management"

ST pp. 295-305

Forest Management (continued)

Outcomes

Students will be expected to

3.21 identify the role of the Canadian Model Forest Network in promoting SFM

3.22 list the components in forest management planning.

Include:

- (i) twenty year forest development plans
- (ii) five year operating plan
- (iii) annual work schedule

3.23 identify the role of the public in the development of a forest management plan.

Elaborations—Strategies for Learning and Teaching

Teachers could refer to the Natural Resources Canada website for more information. Teachers could refer to the Newfoundland Model Forest website for more information.

Teachers should ensure students understand that CMFN brings all stakeholders together to discuss issues relations to forest movement and look for solutions. Teachers should note that there is no physical “model forest”. The model forest is a collaboration or network of stakeholders who have vested interest in structuring forest planning and usage.

Students could complete the case study “Model Forests Network” from Futures from Forests resource.

This could be an opportunity for the teacher to invite a guest speaker from the Department of Environment and Lands or from a local forestry company to discuss these components and how they relate to the topic of forest management planning.

Teachers could use the Eco spotlight “Clarenville Forest Management District” to elaborate on forest management planning.

Public input typically takes the form of membership to district planning teams where individuals from various areas of society contribute interests and concerns related to how a forest management plan may impact on their sector of society.

Teachers could have students read the Enviro-Focus “Forest Management in Labrador-The Forest Process Agreement”.

Forest Management (continued)

Tasks for Instruction and/or Assessment

Presentation

- The Newfoundland Model Forest is one of 11 model forests that make up the Canadian Model Forest Network. Go to the Newfoundland Model Forest webpage (<http://www.wnmf.com/>) to identify research projects that support SFM. Report on one of these projects to the class as a newspaper article, poster, or multimedia presentation.
- Research your community's forest management plan and report to the class.

Journal

- Students would then make a journal entry for inclusion in their portfolio. This entry could be in the "What? So What? Now What?" format, as it related to sustainable forest management.

Paper and Pencil

- List the highlights of the twenty year forest development plan and the five year operating plan.

Performance

- In groups, develop a forest management plan for their community if none exists.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 296-297

ST pp. 297,301-307
FFP "Forest Management"

ST pp. 293-301
FFP "Forest Management" and "Age Class Structure"

Using and Caring for the Forests

Outcomes

Students will be expected to

- 3.24 distinguish between clear cutting and selective cutting as forest harvesting techniques in Newfoundland and Labrador
- 3.25 identify the improvements made to clear cutting to reduce impacts on the forest ecosystem. Include:
- (i) mimicking natural disturbances
 - (ii) creation of buffer zones
 - (iii) improved access road construction
 - (iv) improved harvesting technologies
- 3.26 define silviculture.
- 3.27 describe silviculture techniques. Include:
- (i) pre-commercial thinning
 - (ii) genetic enhancement
 - (iii) introduction of faster growing species
 - (iv) tree plantations
 - (v) integrated pest management
- 3.28 contrast positive and negative effects of silvicultural practices

Elaborations—Strategies for Learning and Teaching

Teachers should limit discussion to the fact that these techniques are intended to mimic natural occurrences in forest e.g. clear cutting (fire, insect infestation) selective cutting (blow down).

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 remove topsoil.

Teachers could have students read the Eco spotlight “Riparian Buffers”.

If silviculture is practiced in their area, teachers should invite a guest speaker to talk about the techniques involved.

Integrated Pest Management (IPM) represents considerations to all areas of an ecosystem when introducing pest controls in forest management. It includes innovative pest management such as natural biological controls, less toxic (water soluble) chemicals, and tools for management strategies.

Teachers could highlight the Envirofocus “Re-greening the Forest” as one component of tree plantations.

Teachers could have students complete the case study “Managing Balsam Fir Stands Infested by Balsam Woody Adelgid”.

Teachers could begin this topic by asking students what they think could be beneficial about silviculture practices and then to brainstorm what could be the possible negative effects of silviculture practices. Students need to keep in mind that although a measure undertaken by people may appear to be beneficial, there may be some repercussions associated with these practices. For example, silviculture practices can reduce the net carbon sink for the planet by cutting and harvesting trees.

Teachers should have students complete the **CORE LAB “How Fast Does This Tree Grow”?**

Using and Caring for the Forests

Tasks for Instruction and/or Assessment

Journal

- Is the term “regenerative harvesting” a better term to use than “clear cutting?” Explain your reasoning.

Performance

- Participate in a role play where students take on the different roles of a forest management team. Members of this team include participants from industry and the general public. In this role play, students will debate the boundaries of a proposed cutting area. A video camera could be used to capture the role play.
- Create a collage, poster, presentation in which you distinguish between clear-cutting and selective cutting, as well as the advantages and disadvantages of each.
- Students could create a collage, poster, brochure, web site, presentation in which they describe the various silviculture techniques, as well as the advantages and disadvantages of each.

Paper and pencil

- Sketch the difference between clear-cutting and selective-cutting.

Presentation

- You are a public service announcer. You must report to the public about the definition of silviculture, silviculture techniques, and the positive and negative effects of silviculture techniques. The announcement could be recorded using a video camera or voice recorder.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 311-313

FFP “Age Class Structure”

ST p. 312

ST pp. 317-319,324-330

FFP “Forests Management”

ST pp. 317-318

Core Lab: “How Fast Does This Tree Grow”, ST pp. 321-324

TR pp. 175-183: BLM 10-1, 10-2

Using and Caring for the Forests (continued)

Outcomes

Students will be expected to

3.30 identify new technologies used in the forest industry. Include:

- (i) soft footprint technologies
- (ii) computerized decision support tools (GIS, GPS, and remote sensing)

3.31 identify various environmentally related careers within the forestry sector.

Elaborations—Strategies for Learning and Teaching

Teachers could introduce this outcome by having students list as many of the older harvesting technologies that they can. This list could include:

- (i) axes and saws
- (ii) horse and sleigh
- (iii) tractors and sleds
- (iv) water transportation
- (v) chain saws

Later technologies relied on larger and more automated equipment that included:

- (i) skidders
- (ii) feller-bunchers (harvesters)
- (iii) full tree systems

These later technologies improved the economic output of the forest industry but tended to be very harmful to the forest ecosystem. As a result, they were not sustainable. Modern forest harvesting equipment has a smaller impact on the ecosystem and tend to be more sustainable. The “soft footprint technologies” include a variety of equipment that reduces the impact on the forest floor. Computerized tools allow for a “bigger picture” view and improve the overall management of the area to be harvested.

Teachers could ask students to identify the positive and negative aspects of each of these technologies (old and new) in terms of the environmental, economic and social impacts each have.

Students could create a list of potential impacts these methods have on the environment for discussion. Teachers could have students complete the mini lab activity “Domestic Fuelwood /Sawlog Survey”.

Teachers could also reference the use of training simulators and environmentally friendly fluids as other new technologies being used in the forest industry as another forest-friendly harvesting technique.

Students should be made aware of the variety of forest-harvesting careers that have environmental linkages. Teachers could have a forester visit the classroom or arrange a visit to a local forestry station, tree nursery, or environmental science station. An in depth Internet research project could also be used to have students choose an area of most interest to them. Students could research the various programs offered at various post secondary institutions along with the entrance requirements. This information could be added to their portfolio.

Using and Caring for the Forests (continued)

Tasks for Instruction and/or Assessment

Presentation

- Draw a map showing a main road, bog, and lake with its associated streams. Shade in the area that could be clear cut (this area should mimic natural disasters such as fires, insect infestations, and wind throw). Demonstrate the correct application of buffer zones, and show an access route that minimizes environmental damage. Recommend appropriate harvesting technologies that would reduce the impact to the environment.
- Research a career associated with forestry. Include the following: education, duties or roles, salary scale, and job satisfaction. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.

Performance

- Create a time line to outline the evolution of forest harvesting technologies in Newfoundland and Labrador. Display the timeline for classmates to observe and study.
- Research one piece of modern forest harvesting technology (e.g. grapple skidder, forwarder, or mechanical harvester) and highlight the design features that reduce the environmental impact of harvesting. Record the information in a table.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 331-335

FFP “Forest Management”

ST pp. 337-341

FFP “Forest Management” and “Forest Values”

Mineral Resources Uses and Exploration Technology

Outcomes

Students will be expected to

describe the importance of minerals and mineral exploration at the local and provincial levels (330-8)

3.32 define ore

3.33 identify some existing and former mining operations in Newfoundland and Labrador, and minerals extracted. Include:

- (i) Labrador West
- (ii) Baie Verte Peninsula
- (iii) Voisey's Bay
- (iv) Buchans
- (v) Bell Island
- (vi) Millertown
- (vii) St. Lawrence

Elaborations—Strategies for Learning and Teaching

The issues surrounding the development, operation, and subsequent closure of a mine are numerous and complex. Teachers should encourage students to consider the three facets of sustainable development (environment, economy, and social/culture) as they discuss the impacts of mining operations. Through their study and discussion of this topic, students should come to appreciate the complexity of the issues. For example, our modern society can not function without many of the materials produced in various mining operations and many communities depend on the income from the jobs created at the various stages of operation. However, the extraction and processing of these minerals can have serious implications to the environment and may also lead to cultural and/or social justice issues.

Teachers could have students brainstorm some examples of how mineral resources have contributed to the development of human civilization. For example, the creation of various tools and weapons like knives and spears or adornments like jewellery allowed human civilizations to flourish.

Student could start a new mind map entitled “mining” and add the information in this section as it is discussed/encountered.

Teachers could use a map of Newfoundland and Labrador or utilize web resources such as the Geologic Survey of Newfoundland and Labrador to indicate present and former mining sites. Students should be able to differentiate between active and inactive mining operations.

Where possible, students could visit either an active or closed mine to visually survey or tour a mine site.

Teachers should clarify for students that not all impacts regarding mining are negative. For example, economic impacts positively impact the entire province. Students could independently or in groups develop a list of economic impacts and report them back to the class for comparisons and discussion.

Teachers could point out the wide range of applications of these metals/minerals. There is no need to develop a detailed list of these applications. The following minerals represent some of the major mining resources of Newfoundland and Labrador: gold, iron, nickel, copper, gypsum, zinc. This list is not meant to be an exhaustive list and students should be encouraged to extend this list as much as possible.

Teachers could have students refer to the Land and Sea episode entitled “Mining and Memories” This video highlights the now inactive Bell Island mines, which provided iron ore.

Mineral Resources Uses and Exploration Technology

Tasks for Instruction and/or Assessment

Presentation

- Create a time line highlighting the following headings: Stone Age, Iron Age, Bronze Age, and Modern Age. Under each heading, list some of the common uses of the minerals available at that time.

Journal

- Define the term ore and list examples of ores mined in Newfoundland and Labrador.
- Use the Google Earth program to locate active and closed mines in Newfoundland and Labrador. What features did you look for to help you find these mines? List these features in a table.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 403-404

ST pp. 406-408, 410

L&S “Mining the Memories”.

LSRG pp. 25-26, 45

Mineral Resources Uses and Exploration Technology (continued)

Outcomes

Students will be expected to

3.34 describe the economic impacts of mining in Newfoundland and Labrador. Include:

- (i) increased Gross Domestic Product (GDP)
- (ii) increased employment
- (iii) improved salary
- (iv) increased secondary services

3.35 list the stages in a mining cycle. Include:

- (i) exploration
- (ii) ore extraction
- (iii) processing
- (iv) closure/rehabilitation/reclamation

3.36 identify different mineral exploration methods.

Include:

- (i) satellite imaging
- (ii) magnetometers
- (iii) core drilling
- (iv) ground exploration (grab samples, panning, geochemical)

Elaborations—Strategies for Learning and Teaching

Teachers should be aware that not all impacts regarding mining are negative. For example, economic impacts positively impact the entire province. Students could independently or in groups develop a list of economic impacts and report them back to the class for comparisons and discussion. Teachers should address this outcome very briefly.

The process in opening and ultimately closing a mine are specific to the type of mineral to be mined and the technique used to extract the ore. As well, the process is strictly monitored.

Students do not need to know the details and processes behind these mineral exploration methods. A general understanding about the methods and how they work is sufficient. These exploration methods result in less environmental impact than historical methods.

Mineral Resources Uses and Exploration Technology (continued)

Tasks for Instruction and/or Assessment*Presentation*

- Draw a circle and divide it in half. Label one side economic and the other side social. Use text and/or graphics to communicate the positive impacts of mining to a community or to the province. Present this as a visual product (e.g. collage, poster, multimedia presentation).
- Research one mineral exploration technology and produce an informational brochure explaining how the technology is used and in particular, what scientific principles are applied.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 405-407

ST p. 411

ST pp. 411-413

Mineral Extraction - Impacts

Outcomes

Students will be expected to

- 3.38 distinguish between above ground and underground mining
- 3.39 identify impacts of open pit mining. Include:
 - (i) disturbance of topography/viewscape
 - (ii) loss of habitat
 - (iii) pollution (noise, dust, water)
 - (iv) erosion
- 3.40 recognize that mitigation efforts are necessary to limit the impacts of open pit mining. Include:
 - (i) mine design
 - (ii) waste rock and tailings management
 - (iii) dust control
 - (iv) remediation planning
- 3.41 identify impacts of underground mining. Include:
 - (i) ground subsidence
 - (ii) human health issues
 - (iii) disturbance of topography/viewscape
 - (iv) loss of habitat
 - (v) pollution (noise, dust, water)
 - (vi) erosion
- compare the impacts of open pit versus underground mining

Elaborations—Strategies for Learning and Teaching

Teachers should note that placer mining is an above ground mining technique.

Teachers should limit the discussion of open pit mining and its techniques to fundamental processes that directly impact on the environment. For example, when moving large quantities of earth material, no discussion is required about the machinery or techniques used, but rather that dust is created from the movement and/or blasting.

Teachers should focus on the example of remediation specific to the tailings plan for the Labrador West mining operations. Teachers should also focus on the preventative measures of the Voisey’s Bay Mine. Students must be reminded that remediation is an ongoing process throughout the mining cycle.

Teachers could refer to the Hope Brook gold mine as an example of mitigation strategies used for a whole mine site.

Teachers should have students complete the **CORE LAB “Simulating a Surface Mining Operation”**.

As an example of human health issues, students could explore health issues for miners. In particular, students could research some past health issues associated with mines in our province. (e.g. St. Lawrence Fluorspar Mine and Baie Verte Asbestos Mine).

Students could summarize and compare the impacts using a table such as the following:

Item	Open Pit	Underground

Mineral Extraction - Impacts

Tasks for Instruction and/or Assessment

Paper and Pencil

- Use four sketches to identify the mining cycle. The sketches could include graphics and text taken from different resources.
- Differentiate between open pit and underground mining. Identify the active mines in NL that practice each type.

Performance

- On a sheet of paper covered with miniature trees, draw a square to represent a shaft, which serves as the entrance to an underground mine. Use this as a starting point to begin to identify the impacts of underground mining (e.g. tailing piles and access roads).
- On a sheet of paper covered with miniature trees, draw a circle to represent an open pit. Use this as a starting point to begin to identify the impacts of open pit mining (e.g. tailing piles and access roads). Look at the identified impacts and suggest ways that they can be mitigated.

Presentation

- In table format, compare the impacts of open pit and underground mining on the environment. The table could be presented as an electronic spreadsheet.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 413-417

ST pp. 415-417

Core Lab: “Simulating a Surface Mining Operation” Page 430-432

TR pp. 221-222; BLM 12-2, 12-3

ST pp. 423-430 , 433-434

ST pp. 423-430

ST pp. 411-428

Processing Ore - Methods

Outcomes

Students will be expected to

- describe the processes and technologies involved in developing an Earth resource (330-11)
- 3.42 distinguish between dry and wet milling processes
- 3.43 define ore concentration
- 3.44 outline physical and chemical concentrating methods. Include:
- (i) gravity separation
 - (ii) magnetic separation
 - (iii) heap leaching
 - (iv) floatation
- 3.45 identify new approaches to waste water/mine waste treatment. Include:
- (i) containment ponds
 - (ii) treatment of effluent
 - (iii) tailings piles

Elaborations—Strategies for Learning and Teaching

Teachers should ensure students understand that wet milling requires water to create a slurry and produces little dust. With dry milling, lots of dust is produced because the ore is crushed in a dry state.

Teachers should concentrate on the environmental impact of each process and clarify that some minerals (e.g. gold, ore) require a wet process even though there is significant potential for environmental impact.

Teachers could ask students to identify some examples of everyday concentrates like orange juice, canned soup, or tomato paste and have them explain the purpose of creating these concentrates. Students could then apply that concept to mineral and ore production and the need to concentrate ore resources for purity and transportation purposes.

It is not expected that students know the specific details of any one method of mineral concentration. Teachers could demonstrate, with simple apparatus, each of these methods. For example, gravity separation could be demonstrated by stirring a heterogeneous soil sample in a jug of water and letting it settle. Magnetic separation could be demonstrated by passing a magnet through a mixture of sand and iron filings. Heap leaching could be demonstrated by dripping water through a mixture of sand and salt. Note that this is a physical separation method, whereas heap leaching is an actual chemical separation method. Floatation can be demonstrated by shaking in a closed container a mixture of powdered charcoal, mineral oil, water, and liquid dish detergent. Resulting bubbles should contain a coating of charcoal.

Prior to the current movement of environmental awareness, little was done to treat mine wastes. Teachers could initiate a brief discussion with students about the effects of not treating mine wastes and why it is important for the environment to properly treat mine wastes.

Teachers should make students aware of the different kinds of mine waste such as acid mine waste, leachate, dust, etc.

Processing Ore - Methods

Tasks for Instruction and/or Assessment

Journal

- What is the difference between dry milling and wet milling?
- Define concentration using examples from your daily life. Include why it is necessary to concentrate certain products.

Presentation

- Identify the health issues associated with dry milling by specifically focusing on the St. Lawrence Fluorspar Mine or the Baie Verte Asbestos Mine. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.
- Given a mixture of iron filings, sugar, powdered charcoal, and fine sand, outline how each of the following chemical and physical methods could be used to separate each of the components. It is possible for a method to be used to separate out more than one component of the mixture. Use a flow chart to communicate the steps in the process that would be used to separate each of the components.
- In a table, list the different potential wastes relating to mining operations (e.g. tailings, slag, wastewater, chemical effluents). Describe the new approaches to dealing with the potential environmental impacts of these wastes.
- Research a new method or technology that is used to treat mine waste. Explain how the method or technology reduces the potential environmental impacts of mine waste. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 418

ST pp. 417-418

ST pp. 418-419

ST pp. 423-430

Processing Ore - Impacts

Outcomes

Students will be expected to

3.46 discuss the potential risks associated with treating and/or containing mine wastewater and mining wastes. Include:

- (i) dam failure
- (ii) leakage

3.47 define smelting

3.48 identify the environmental issues resulting from the separation of minerals from ores. Include:

- (i) heap leaching
- (ii) pyromet (blast furnaces)
- (iii) hydromet

Contrast the traditional method of smelting nickel with the new hydromet method. Include:

- (i) method of extraction
- (ii) energy requirements
- (iii) waste products
- (iv) cost and reliability

Elaborations—Strategies for Learning and Teaching

Most students will be aware of the environmental risks such as release of toxins into the watershed, reduction in plant or animal biodiversity, and so on. Other, more specific examples will be discussed in the subsequent sections. Teachers should encourage students to consider the potential risks in light of the economic and social implications as well as those related to the environment.

Teachers should limit the treatment of this to the definition that smelting is the process that extracts metal from an ore.

Teachers could have students consider the effects of each type of extraction process. Heap leaching and the use of cyanide have potential for effects on aquatic food webs and leaching of cyanide into the water table. Cyanide is an extremely toxic substance that can have devastating effects on the environment. With conventional pyromet technology there are air quality issues such as acid precipitation and SO₂ emissions, which have potential long-term health effects on humans, animals, and plants. As well, both processes produce tailings that must be properly disposed. Although new technologies such as the hydromet process produce fewer by-products during extraction, the production of substances like sulphuric acid during the smelting of nickel can still pose environmental risks for spillage and leakage.

Teachers could address this outcome by assigning groups of students one of the methods and have them prepare a summary poster for presentation to the class. Each group could be responsible for researching one of the four points to be considered. When complete, one member from each group (traditional method and hydromet) could present their posters at the same time to provide the comparison.

Processing Ore - Impacts

Tasks for Instruction and/or Assessment

Journal

- Define smelting. Include the different processes used to extract metals from ores.
- In a table format, compare and contrast the traditional method of smelting nickel from hydrometallurgy. Include a brief description of the method, energy requirements, waste products, cost and reliability.

Performance

- Research the potential environmental impacts of heap leaching, pyrometallurgy, and hydrometallurgy. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.
- Research instances where leakage of mine waste has resulted in serious environmental damage. Outline the extent of the damage and explain how it was resolved, and what measures were put in place to prevent it from occurring again.

Paper and Pencil

- Which method of extraction would be ideally suited for establishment of a processing plant in Newfoundland and Labrador. Which geographic location might be best suited for each of the methods of extraction? Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to describe the potential environmental damage that can result from mine leakage.
- Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.
- Students could research the potential risks associated with treating mine wastes and prepare posters, web pages, powerpoint, etc.. for class presentation and discussion.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 419-423-428

ST pp. 419-420

ST pp. 418-420

ST pp. 418-420

Processing Ore - Impacts (continued)

Outcomes

Students will be expected to

3.49 discuss the implications of putting an ore processing facility in Newfoundland and Labrador. Include:

- (i) social
- (ii) economic
- (iii) environmental

3.37 recognize the need for an environmental impact assessment (EIA) before an ore body is developed

describe the environmental impact assessment process

Compare prevention techniques with remediation/reclamation techniques as a means of dealing with environmental impacts of mining operations

describe the immediate and long term costs and savings associated with prevention techniques

3.50 identify occupations related to the environmental sector of the mining industry

Elaborations—Strategies for Learning and Teaching

Students could consider economic implications such as short/long term employment, availability of skilled trades persons, and revenue to the province. In terms of social implications, students could consider impacts on local communities such as a potential need for increased health care, increased funding to educational facilities, immigration and emigration, as well as possible increases in crime rates as local economies improve. In terms of environmental implications, considerable potential exists for air quality and water quality issues. Pyromet has more air quality issues, whereas hydromet may have more water quality issues. Due to environmental implications, subsequent land use issues arise. These land use issues relate to the future use of the smelting sites and surrounding areas for such things as residential, commercial, or agricultural development.

Students could investigate the reasons why an environmental impact assessment is needed before an ore body is developed. The Voisey Bay nickel discovery went through an extensive EIA and would serve as a good example for this objective.

Students could complete a case study “Voisey’s Bay Environmental Assessment”.

Students should be able to describe the information that is included in an EIA and be able to outline the steps involved in the process.

Teachers could assign student groups to research and debate the prevention versus remediation issue. The main points for students to understand are that prevention involves planning for the potential impacts and identifying strategies that will be used “in the event of”. It also involves the use of funds “up front” before anything has happened and before the mine has made any money for the company. Remediation normally takes place after the mine is closed or after an environmental impact has been made. There are no up front costs but there may be additional fines and penalties imposed if the company has ignored legislation.

Students could research programs offered at post-secondary institutions and the education required for these types of employment opportunities.

Processing Ore - Impacts (continued)

Tasks for Instruction and/or Assessment

Presentation

- In table format, compare and contrast the traditional method of smelting nickel from hydrometallurgy. Include a brief description of the method, energy requirements, waste products, and cost and reliability.
- Which method of extraction would be ideally suited for establishment of a processing plant in Newfoundland and Labrador. Which geographic location might be best suited for each of the methods of extraction? Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.
- A mine has recently been closed down adjacent to your community. The tailings area consists of small ponds surrounded by piles of tailings. Propose a plan for rehabilitating the area into a regional park. Use the Internet to research similar reclamation projects and the techniques used to remediate and reclaim such sites. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information. Include the costs (upfront costs and long-term costs) and savings associated with the techniques studied.
- Research a career associated with mining. Include the following: education, duties or roles, salary scale, and job satisfaction. Create a visual product (e.g. informational brochure, collage, poster, multimedia presentation) or a written product (e.g. an article for a newsletter, poem, song, short story, etc.) to present the information.

Journal

- What components would have to be considered in an environmental impact assessment for a potential mine?
- An ore body is going to be mined in your community. What components of the local environment do you think should be assessed?

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 429-430, 433-434

ST p. 435

Agriculture in Newfoundland and Labrador

Outcomes

Students will be expected to

recognize that agriculture is an integral part of the social, cultural, economic, and environmental life in Newfoundland and Labrador (117-5)

3.51 define agriculture

Elaborations—Strategies for Learning and Teaching

Teachers could begin this topic by having students write their own definition of agriculture. Depending where students live their definitions will vary. Students from small rural communities might have experienced agriculture in small family gardens whereas students from communities where agriculture contributes to the economy will view the value of agriculture in a truer sense.

Teachers could also point out that agriculture is an important part of the economy of this province. While many refer to the island portion of the province as “the rock”, there are substantial farming practices all across the province, including livestock, poultry, berry, as well as a variety of plant crops. Labrador is currently experiencing a growth in the amount of commercial farming.

As students learn about farming practices in this province, teachers should ensure students look at this using the lens of sustainable development, considering the various environmental, economic, and social/cultural aspects.

Teachers should make students aware that the practice of agriculture from the human perspective is a relatively new practice having arisen only about 10,000 years ago (as compared to the approximately 200,000 years that Homo sapiens have been on Earth). Teachers could provide a very short overview of the hunter/gather lifestyle and how this approach to supporting a group of individuals was limited and had a minor impact on the environment from the global perspective. Despite this they still were closely linked with the environment.

Teachers could have students refer to the Land and sea Episode entitled “It’s a Life”. This video highlights the evolution of a current cow farm in the province and will help students appreciate the diversity of agriculture in the province.

Agriculture in Newfoundland and Labrador

Tasks for Instruction and/or Assessment

Presentation

- Create a presentation that shows the variety of agriculture that occurs in Newfoundland and Labrador.
- Break students into small groups and assign them a specific sector (i.e. livestock, berry production, etc.). Then have them prepare a summary and present it as if they were a member of the public sector. Students could create a power point presentation or poster to help communicate their summary.

Performance

- Create a collage or poster to define the term “agriculture”.
- Compose a song, poem, or rap, to explain what is meant by the term “agriculture”.

Journal

- What does the term agriculture mean to you? How do you define it? What do you believe are the defining characteristics?

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 342-345

Major Crops Grown

Outcomes

Students will be expected to

3.53 list the major crops grown in Newfoundland and Labrador. Include:

- (i) berries
- (ii) vegetables
- (iii) turf grass
- (iv) christmas trees
- (v) forage

Elaborations—Strategies for Learning and Teaching

Many students may not be familiar with the variety of cultivated and wild species harvested in Newfoundland and Labrador. Teachers could bring in photographs or samples to help them learn about the plants grown in Newfoundland and Labrador.

Berries have narrow environmental tolerances. Some species, such as cranberries, have been cultivated whereas others, such as the bake apple, are very difficult to cultivate. Learning about these limited tolerances will give students an appreciation of how environment and climate are the ultimate decision makers when it comes to what can be grown in this province.

There are a number of cranberry, turf and vegetable farms on the island and if possible a visit to one should be arranged. This trip can also be combined with a bog ecosystem study. While corn makes up a significant portion of forage crops, greater amounts are being grown for human consumption.

Teachers could have students read the Envirofocus “Creating Growing Environments for Cranberries”. Teachers could have students view the Land and Sea episode entitled “The Fruits of his Labour” which describes a cranberry farm in the province.

When discussing forage, teachers could ask students what farm animals eat; the most common response will be “hay”. Teachers could begin by focusing on the variety of forage available and why there is such a variety. It is important for the students to understand that the forages that contain the highest levels of nutrients and energy are the best for livestock. Teachers should then clarify that, like all crops, different forage will require different environmental conditions for optimum growth.

Teachers should have students complete the **Core Lab “Testing the Effectiveness of Plastic Mulch”** Teachers could have students read the Enviro-focus “Growing Silage Corn in Newfoundland and Labrador” as background to the core lab activity.

Major Crops Grown

Tasks for Instruction and/or Assessment

Presentation

- Conduct a role play or skit involving hunters, farmers, and environmentalists that addresses the problems of “moose in the cabbage patch”.
- Research various methods farmers use to protect their vegetables from wild animals. Present your findings to the class.

Performances

- Create a poster or brochure that describes the measures that can be taken to reduce moose-farmer conflicts.
- Have students prepare a time line (using photos) depicting the transformation of peatland into either: a turf grass, vegetable farm, or cranberry farm. Images may be difficult to get on the web so contacting the Newfoundland and Labrador Department of Agrifoods may be the best source.
- Assign students a specific berry and ask to do research on the internet to learn about the challenges that have been or will have to be overcome to cultivate them

Journal

- What do you think about the ethnics of shooting moose when they encroach on farmer’s land?

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 347-356, 354-355

L&S “The Fruits of his Labour”

LSRG pp. 32-33, 45

Core Lab: “Testing the Effectiveness of Plastic [Mulch]”, ST pp. 357-358

TR pp. 203-205:

BLM 11-2

Poultry and Livestock

Outcomes

Students will be expected to

- 3.59 list the various poultry and livestock raised in Newfoundland and Labrador
- 3.60 identify environmental impacts associated with the raising of livestock and poultry. Include:
- (i) impacts on water quality
 - (ii) reduction of bio-diversity
 - (iii) impacts on climate

Elaborations—Strategies for Learning and Teaching

Teachers should limit this discussion to the major types of animals raised in Newfoundland and Labrador. Teachers should make students aware of the diversity of animals being raised and the purposes for which they are being raised.

Teachers could have students refer to the Land and Sea episode entitled, “The Wooddale Pioneers”. This episode tells a success story relating to agriculture (eg. dairy farming) in the province.

Teachers could have students refer to the Land and Sea episode “It’s a Life”, which highlights the evolution of a dairy farm.

While there are many issues that could be raised when discussing this topic, it is important to keep the focus on what is most important here; the relationship between the raising of livestock and poultry and the environment. Teachers should ensure students understand that, when looking at environmental issues relating to agricultural practices, such as the raising of livestock and poultry, stopping the practice is not an option because many people want or need the protein that is produced and there are economic reasons for continuing the production (i.e. there are no easy answers). When addressing environmental issues relating to livestock the focus must be on ways of reducing and/or mitigating the impacts.

While students would have some background knowledge of aquatic ecosystems from other science courses, teachers should help them make the link between raising livestock and the issues relating to water quality. Focus on specific examples of impacts that include, run off from manure storage and manure deposited on fields and livestock access to water bodies. This will be addressed in more detail in a later unit.

Clearing land for agricultural purposes has resulted in tremendous changes in natural ecosystems. This is best illustrated by having students browsing the globe using “Google Earth” and having them focus on land use for agricultural purposes in the Midwest (United States of America) and the clearing of the rainforests in the Amazon. The latter example will lead into a discussion of the potential impacts on bio-diversity in the tropical rain forest. This activity will also give students an appreciation of the extent to which agriculture is practiced globally.

Poultry and Livestock

Tasks for Instruction and/or Assessment

Paper and Pencil

- Assign students a livestock animal raised in Newfoundland and Labrador and have them prepare a fact sheet on this animal.
- Have students research and report on the methods farmers are using to reduce or mitigate the environment impacts of raising livestock.

Performance

- Have students prepare a power point presentation that addresses issue related to livestock farming and the environment.
- Have students create a class collage that presents some of the environmental issues related to raising livestock.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 359-361, 364-365

L&S “The Wooddale Pioneers”
and “It’s a Life”

LSRG pp. 27, 30-31, 45

ST pp. 361-364

Challenges to Agriculture in Newfoundland & Labrador

Outcomes

Students will be expected to

3.62 list the challenges to agriculture in this province.

Include

- (i) climate
- (ii) frost free days
- (iii) day light
- (iv) soils

Elaborations—Strategies for Learning and Teaching

Teachers could approach this outcome by having students select one or two crops (including silage crops) that are already successfully grown in Newfoundland and Labrador. Using the data students collect, teachers could combine the class data to construct a table that summarizes: the ideal climate, day length, and soils required to grow this crop successfully.

Teachers could have students refer to the Land and Sea episode entitled “The Parsons of Lethbridge”. This video tells the story of a couple who carved out a farm from the forest on the Bonavista peninsula for the purpose of growing crops. This video highlights some challenges associated with the growing of crops in that area of the province. Teachers could also re-visit the episode “The Fruits of his Labour” which discusses the challenges related to growing cranberries.

After frost-free day has been defined, teachers could have students consult a reference such as the [Atlas of Newfoundland and Labrador](#) to find out how many frost-free days are in their region of the province. The data displayed on the map is calculated from an average. Have students ask older members of their community if they can remember times when there were lesser or more frosts than common today.

Teachers could have students look at local trends. This information will be based on their personal observations over the years and from surveying older members of their community. Have students attempt to account for the following:

- Frost in low-lying areas vs. higher areas. (Cold air is more dense and sinks into low lying areas)
- No frost on the forest floor but frost on the open bogs. (The forest canopy, like clouds, reduce the radiation of heat back into the atmosphere at night)
- Little or no frost along the edges of large lakes. (Larger lakes are large thermal masses that hold and release heat thus warming the surrounding air in late fall)

Challenges to Agriculture in Newfoundland & Labrador

Tasks for Instruction and/or Assessment

Presentation

- Students could conduct research to find out how challenges relating to climate, day length and soils are being overcome and present their findings to the class.
- Students could create a poster that outlines the steps being taken to address the various challenges to growing crops in Newfoundland and Labrador.
- Using a power point presentation, students could summarize the research and successes related to overcoming the various challenges of agriculture in Newfoundland and Labrador.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 367-371

L&S “The Fruits of his Labour”
and “The Parsons of Lethbridge”

LSRG pp. 28-29, 32-33, 45

Challenges to Agriculture in Newfoundland & Labrador (continued)

Outcomes

Students will be expected to

3.63 list the environmental and geographic factors that influence the number of frost-free days in a particular area

3.66 define growing degree-day

Elaborations—Strategies for Learning and Teaching

Teachers could begin this topic by having students consult a resource such as the [Atlas of Newfoundland and Labrador](#) for a map of the *Annual number of frost-free days*. Students could use the resource to account for the following trends:

- Higher number of frost-free days along the coast. (Moderating effect of large bodies of water)
- Lower number of frost-free days inland. (These regions are isolated for the moderating effect of the ocean)
- Lower number of frost-free days as one moves further north. (Average lower temperatures and shorter growing seasons)

Teachers could conclude this by asking students how they might reduce the impact of frost on agricultural crops as a lead into the next outcome.

Teachers should limit the definition of growing degree-days as a day on which the mean daily temperature is one degree above a “base” or “threshold” temperature. The “base” temperature, in turn, is defined as the minimum temperature required for the growth of a particular crop. The base temperature for sweet corn, for example, is 10 °C while the base temperature for peas is 5°C. This topic will be covered in greater depth later in the text.

Students should have a good understanding of weather and climate as these topics have been covered in science 1206 and 2200. From an agricultural perspective there is a focus more on micro-climates. For example, farmers who grow strawberries along the Humber Valley are more concerned with the localized conditions rather than the climate of all of western Newfoundland and Labrador. Using the school’s weather station, teachers could have students collect weather data for a region away from the school and compare the data with regional data to determine differences in temperature, etc.. This will give them a general idea of the variation among areas and a better understanding of the concept of microclimate.

Teachers could use the activity “Growing degree days in Newfoundland and Labrador” to help reinforce this topic.

Challenges to Agriculture in Newfoundland & Labrador (continued)

Tasks for Instruction and/or Assessment

Performance

- Create a brochure to educate new farmers about the environmental and geographic factors that will influence the number of frost-free days in an area.
- Create a map which shows the growing degree days and/or frost free days for various regions of the province.

Paper and Pencil

- How is “growing degree day” different from a regular day?

Presentation

- Create a skit that shows how various factors can influence the types of crops a farmer chooses to plant in a particular location.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 367-371

ST p. 369

Challenges to Agriculture in Newfoundland & Labrador (continued)

Outcomes

Students will be expected to

3.64 outline methods that can be employed by a farmer to protect crops from and/or reduce the damage from frost

3.58 investigate the use of plastic mulch as a method for improving plant growth

Elaborations—Strategies for Learning and Teaching

Teachers should not spend too much time on this outcome. Limit discussion to the methods employed by farmers to reduce frost damage to their crops. In this province the use of plastic to cover crops at night and irrigation sprays are the most common methods employed.

The use of plastic to reduce the impact of frost can be easily demonstrated if this unit is being taught in late fall or spring. Wait for a night when frost is predicted. Fall days that are clear will be usually followed by a frost that night. Have students cut off a one square meter of plastic and place it on their lawn or on school property. In the morning have them remove the plastic and compare. At this time you may also have students map where there was frost and where there was no frost.

Teachers should link the concept of growing-days to the use of plastic mulch. It is the use of the plastic mulch in combination with new strains of silage corn that enable many farmers to produce viable crops yields in the province.

Teachers should have students complete **CORE LAB “Testing the Effectiveness of Plastic Mulch”**.

Challenges to Agriculture in Newfoundland & Labrador (continued)

Tasks for Instruction and/or Assessment

Performance

- Create a brochure to educate new farmers on methods they can use to protect their crops from frost.
- Create a poster that explains how plastic mulch works to protect crops from frost.
- Create a poster that describes the various methods of protecting plants from frost damage.

Presentation

- Investigate the use of plastic mulch in agriculture. What are the benefits and limitations of this type of technology?
- Create a skit that describes methods farmers can use to protect their crops from frost.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 368

Core Lab “Testing the Effectiveness of Plastic Mulch”,
ST pp. 357-358

TR pp. 203-205: BLM 11-2

Safe Farm Practices

Outcomes

Students will be expected to

- 3.70 explain the role of Environmental Farm Plans in promoting sound environmental farm management
- 3.69 list measures that have been put in place by legislation and/or guidelines to ensure environmentally safe farm practices

Elaborations—Strategies for Learning and Teaching

Teachers do not need to go into great detail on the regulations and legislation surrounding the establishment of farming enterprises. The intent is for students to realize that one can not simply clear an area of land for a commercial farm. The various legislation and management practices are in place to ensure that commercial farms operate in a safe and environmental sound manner.

Safe Farm Practices

Tasks for Instruction and/or Assessment

Presentation

- Create a multimedia presentation that explains EFPs to the general public.

Journal

- Do you think the current legislation on safe farm practices are sufficient? Why/why not?

Performance

- Create a poster or brochure that explains the role of EFPs in farm management and safety?

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 371-372

Soil Management

Outcomes

Students will be expected to

- 3.71 recognize that soil is a renewable resource
- 3.72 define soil management
- 3.73 list the components of soil management. Include:
- (i) applying fertilizers
 - (ii) preventing erosion
 - (iii) reducing compaction
 - (iv) applying lime
 - (v) improving drainage

Elaborations—Strategies for Learning and Teaching

Since students will have studied soils and soil formation in previous courses, teachers could address this outcome by asking students to describe how soil is formed and then linking this to the notion of renewable resources and sustainable development.

Teachers could ask students to consider whether it is possible that soil could become a non-renewable resource (perhaps in the short term due to mismanagement or changes in the climate, but soils will reform if the conditions are right.)

Teachers could begin by asking students how soil can be managed. While most students will be apply the concept of management to resources such as forestry or the fishery, applying the concept to soils may be new to them. Teachers may have to help them use their understanding of soil fertilization and pest control as they consider the management of soil. Students can gain a good understanding of the role of lime and fertilizers by looking at issues relating to lawn care. There are many excellent resources on the web that can be used to cover this outcome. For example the Turfgrass Science page with Michigan State University hosts a wealth of information. To cover the concept of crop rotation, teachers could use local examples or refer to practices in Prince Edward Island where potatoe fields are often rotated with soybean.

Soil Management

Tasks for Instruction and/or Assessment

Performance

- Choose one of the components of soil management and create a poster or slideshow to explain how it works to protect soil.
- Create a poster or brochure that describes the role of organic matter in producing good soils.
- Create a poster or slide show that describes the factors that contribute to soil degradation and how it can be prevented.

Presentation

- Create and perform an audio visual performance that describes the causes of soil degradation and how it can be prevented.
- Conduct research on the various ways Newfoundland and Labrador Farmers have tried to by-pass the limitations of our soil and climate in an attempt to grow crops that would not normally grow here. Share your results with the class.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 373

ST pp. 379-386

Environmental Impacts of Agriculture

Outcomes

Students will be expected to

3.75 describe the factors that contribute to agricultural land degradation. Include:

- (i) loss of organic matter
- (ii) erosion
- (iii) acidification
- (iv) compaction

3.76 explain how the components of agriculture runoff impacts the local aquatic environment. Include:

- (i) silt
- (ii) bacteria
- (iii) fertilizers
- (iv) pesticides

Elaborations—Strategies for Learning and Teaching

Organic matter acts as a source of nutrients and helps improve the water-holding capacity of the soil. It is composed of the dead and decaying plant and animals materials.

Teachers could use a pile of sand and peat to demonstrate the difference between organic and non-organic (mineral soils). Teachers could take this demonstration a little further 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 soils in another funnel. Pour equal volumes of water in each and measure the volume of water that exits each funnel. Students will observe that a great volume of water is retained in the peat sample. NOTE: dry, bagged peat should be moistened before use.

Students will have covered this outcome in previous courses and should be able to give examples of localized examples of erosion. As a means of demonstrating erosion, teachers could use a setup such as described here: fill a 1-meter square board, framed with 2”x 2”, with soil. Tip the board on a 10-degree slope and use a watering bucket to pour water onto the soil. Students could be challenged to determine ways to reduce the erosion of soil that they will observe.

Acid soils are common in Newfoundland and Labrador and treatment with lime is a common practice. However, an understanding of how acidification impacts plant growth is difficult and should be limited to an understanding that acidic soil will limit plant growth.

The impact of silting, fertilizers, pesticides and herbicides and bacteria on aquatic ecosystems is covered in greater detail in Unit 4 (the “Freshwater and Environment”) of the text. Teachers should limit the discussion of this material to the context of agriculture. Students might be encouraged to go online and search for specific case studies of situations where agricultural runoff has caused serious environmental problems. The impacts on ground water could also be addressed.

Environmental Impacts of Agriculture

Tasks for Instruction and/or Assessment

Performance

- Create a poster or collage that shows the effects of agricultural run-off.
- Create a poster or brochure that describes the factors that contribute to agricultural land degradation.

Presentation

- Research cases where agricultural run-off has had a negative effect on the surrounding environment. What steps could have been taken to prevent the problem from occurring? Share your findings with the class.
- Create a skit which explains the various factors that result in agricultural land degradation.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST pp. 381-385

ST p. 386

Environmental Impacts of Pest Control

Outcomes

Students will be expected to

- 3.77 define agriculture pest
- 3.78 describe the three categories of agriculture pests. Include:
- (i) animals
 - (ii) weeds
 - (iii) diseases
- 3.79 outline the methods used to control agricultural pests in Newfoundland and Labrador. Include:
- (i) quarantine methods
 - (ii) biological control
 - (iii) chemical control
 - (iv) use of resistant strains
- 3.80 recognize the the legislative requirements for pesticide licensing in the agricultural sector
- 3.81 identify the potential environmental impacts of agricultural pesticides and herbicides. Include:
- (i) mortality of non-target species
 - (ii) aquatic ecosystems
 - (iii) ground water
- 3.82 outline alternative approaches to pest management in the agricultural sector. Include:
- (i) cultural control
 - (ii) mechanical/physical control
 - (iii) behavioural control

Elaborations—Strategies for Learning and Teaching

The student text describes insects as a common animal pest. Teachers should ensure that students are aware that other animals such as moose and rodents are, at times, agricultural pests. Teachers should also clarify that many insects are essential for crop growth (e.g., pollinating insects).

Teachers should limit this discussion to addressing pest management in the context of the agricultural sector. Teachers could use potato canker disease as a means of addressing this outcome.

Teachers could have students read the Eco Spotlight “The Hairy Chinchbug : Integrated Pest Management in Your own Backyard”

Students could be asked to create a list from their thoughts on potential impacts as a way of introducing this outcome. Connections to Unit 4 (water) could be made here and this topic can be referenced when addressing Unit 4.

Environmental Impacts of Pest Control

Tasks for Instruction and/or Assessment

Performance

- Select a common agricultural pest in this province and using the internet have them put together a one page fact sheet that includes:
 - A photo of the pest
 - Life cycle
 - Impact on the crop or crops
 - Management of the pes
- Create a wanted poster using the above points as a “criminal profile” of an agricultural pest.
- Create a poster or collage to show how the various methods used to control pests in this province.
- Create a poster or slide show to show the alternative approaches to controlling agricultural pests.

Presentation

- Select an “agricultural pest” and show how it might not always be seen as a pest.
- Create an audio visual presentation that outlines the issues involved in controlling agricultural pest.

Journal

- Are the potential negative effects of a pesticide on the environment justifiable to ensure we have a good food supply? Use the “What? So what? Now what?” format.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 386

ST pp. 387-389

ST pp. 389-394, 397-399

Agriculture - Waste Management

Outcomes

Students will be expected to

3.83 list the positive and negative impacts of animal manure on the environment

3.84 outline alternative uses of manure to reduce negative environmental impacts.

Include:

- (i) use as fertilizers
- (ii) use as a fuel

3.86 identify occupations related to agriculture.

Elaborations—Strategies for Learning and Teaching

Teachers should ensure that students realize that while manure can have many negative impacts on the environment, these impacts are usually a result of the sheer volume of waste rather than the waste itself.

Teachers should focus the discussion of this topic on how farmers in Newfoundland and Labrador work to reduce the impact of animal manure on the environment.

Students could read the career spotlight, “Tara Neal” and “Darryl Martin” as a starting point to learn about the many agricultural-related occupations that involve environmental training/background.

Agriculture - Waste Management

Tasks for Instruction and/or Assessment

Presentation

- Student could research how manure is used to produce methane gas for household use.
- Students could research and then outline the containment systems used in most Newfoundland and Labrador Livestock farms.
- Students could construct a diagram to illustrate the manure handling cycle and what methods are used to reduce environmental damage.
- Students could use to use the Internet to find out the many different ways that manure is used globally.
- Students could be assigned one of the following uses of manure and then to prepare a presentation on it:
 - Use of building materials
 - Fuel for heating an cooking
 - Fertilizer
 - Use in digesters to produce methane
- Students could research the methods by which bio-fuels are used in different parts of the world.

Resources/Notes

<http://www.ed.gov.nl.ca/edu/k12/curriculum/documents/science/highschool.html>

ST p. 362

ST pp. 361-362

ST pp. 400-402

