Agri-Environmental Resources

Agriculture Education
Prince Edward Island

High School

www.edu.pe.ca/agriculture/index.html
ACKNOWLEDGEMENTS

The first edition *Agri-Environmental Resources* was designed to give Atlantic Canadian teachers up-to-date information on environmental issues facing the agricultural industry.

The Prince Edward Island Agricultural Human Resources Development Council Inc. would like to thank the Canadian Heritage, PEI Translation Services and the Atlantic Farm Business Management Programs for their partnership in developing this resource.

We thank the following organizations for their generous permission to use their material:


Thanks to the many people and organizations who donated time and skills to develop this resource.

PEI Soil and Crop Improvement Association - Tyler Wright
PEI Department of Education - Clayton Coe
PEI Department of Education - Joan Moore
PEI Department of Agriculture - Rachel Cheverie
PEI Department of Agriculture - Thane Clark
Bluefield High School - Sandy Arsenault
Charlottetown Rural High School - Bonnie Rogerson
Colonel Gray High School - Rosemary Flemming
Atlantic Farmers Council - Edison Heaney
Westisle Composite High School - Marilyn Hudson
Environment Canada - Steve Szabo

© 1999
Prince Edward Island Agricultural Human Resources Development Council Inc.

Photocopies may be made for classroom use only.
# TABLE OF CONTENTS

## Introduction

## Articles

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digging Deeper</td>
<td>2</td>
</tr>
<tr>
<td>Keep it Flowing</td>
<td>17</td>
</tr>
<tr>
<td>Don’t Let it go to Waste!</td>
<td>29</td>
</tr>
<tr>
<td>Pesky Pests</td>
<td>42</td>
</tr>
<tr>
<td>Climate Change</td>
<td>49</td>
</tr>
</tbody>
</table>

## Resources

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>62</td>
</tr>
</tbody>
</table>

## Web Sites

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65</td>
</tr>
</tbody>
</table>

## Industry Contacts

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66</td>
</tr>
</tbody>
</table>

## Teacher Evaluation

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>67</td>
</tr>
</tbody>
</table>

## References

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68</td>
</tr>
</tbody>
</table>

## Glossary

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
</tr>
</tbody>
</table>

## Partnerships


INTRODUCTION

Environmental awareness is happening all over the world. Everyday, people are becoming increasingly interested in the well being of the world around them. Agriculture is no exception. Farmers are implementing many sustainable agricultural practices in their operations. This resource addresses a number of environmental issues that are facing the agricultural industry. It is meant to allow students and teachers to expand their knowledge on these issues, explore topics that they hear about in the media on a regular basis and develop opinions on these topics.

The concept of sustainable agriculture is outlined in the Atlantic Canada Environmental Farm Plan. This program was prepared by the Atlantic Farmers Council and is supported by various Agricultural organizations throughout Atlantic Canada.

Each module in this resource sets out a description, objectives and curriculum links. More specific curriculum connections are included for topics in the Atlantic Canada Science Curriculum.

This unit concentrates on one general expectation - that students will gain awareness and appreciation of the interdependence between the environment and agriculture. Within the context of both agriculture and environmental issues students will:

- obtain information from various sources and make decisions based on information.
- form their own opinions about what they see and hear.
- communicate these opinions using bias-free language and conflict management skills.
- assess environmental problems in school or community and prepare an action plan to address them.

The modules are presented in a lesson format with teacher information, student learning activities and extension possibilities. The activities are not defined by time. Some may take a few minutes whereas others may take two or more classes. The amount of time devoted to each activity will depend on the extent to which it is explored.
There are a number of links to various topics in the Atlantic Provinces Education Foundation science program. These links are shown below. There are also fits within other curriculum area and these are noted at the beginning of each module.

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Gr. 7</th>
<th>Gr. 8</th>
<th>Gr. 9</th>
<th>Gr. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>-Interaction within Ecosystems</td>
<td>-Water Systems on Earth</td>
<td>n/a</td>
<td>-Sustainability of Ecosystems</td>
</tr>
<tr>
<td></td>
<td>-Earth’s Crust</td>
<td></td>
<td></td>
<td>-Weather Dynamics</td>
</tr>
<tr>
<td></td>
<td>-Mixtures &amp; Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Gr. 7</th>
<th>Gr. 8</th>
<th>Gr. 9</th>
<th>Gr. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>-Interaction within Ecosystems</td>
<td>-Water Systems on Earth</td>
<td>n/a</td>
<td>-Sustainability of Ecosystems</td>
</tr>
<tr>
<td></td>
<td>-Earth’s Crust</td>
<td></td>
<td></td>
<td>-Weather Dynamics</td>
</tr>
<tr>
<td></td>
<td>-Mixtures &amp; Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Gr. 7</th>
<th>Gr. 8</th>
<th>Gr. 9</th>
<th>Gr. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure</td>
<td>-Interaction within Ecosystems</td>
<td>-Water Systems on Earth</td>
<td>-Atoms &amp; Elements</td>
<td>-Sustainability of Ecosystems</td>
</tr>
<tr>
<td></td>
<td>-Earth’s Crust</td>
<td></td>
<td></td>
<td>-Weather Dynamics</td>
</tr>
<tr>
<td></td>
<td>-Mixtures &amp; Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>Gr. 7</th>
<th>Gr. 8</th>
<th>Gr. 9</th>
<th>Gr. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pests</td>
<td>-Interaction within Ecosystems</td>
<td>-Water Systems on Earth</td>
<td>-Diversity of Life</td>
<td>-Sustainability of Ecosystems</td>
</tr>
<tr>
<td></td>
<td>-Cells, Tissues, Organs &amp; Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>Gr. 7</th>
<th>Gr. 8</th>
<th>Gr. 9</th>
<th>Gr. 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Plan</td>
<td>-Interaction within Ecosystems</td>
<td>-Water Systems on Earth</td>
<td>n/a</td>
<td>-Sustainability of Ecosystems</td>
</tr>
<tr>
<td></td>
<td>-Earth’s Crust</td>
<td></td>
<td></td>
<td>-Weather Dynamics</td>
</tr>
<tr>
<td></td>
<td>-Mixtures &amp; Solutions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Soil erosion is one of the most important environmental issue in Atlantic Canada. Students in this region need to be familiar with soil conservation practices.

**OBJECTIVES**

- to develop an understanding of the importance of soil.
- to compare and contrast soil conservation techniques.
- to evaluate soil conservation practices of farmers in this region.

**CURRICULUM CONNECTIONS**

Biology  Chemistry  Earth Science
SUSTAINABILITY

Most crops need soil in order to grow. Therefore, soil preservation and conservation is of utmost importance in our region. Much of the future of agriculture in Atlantic Canada depends upon the top few centimetres of its soil. In order for farming to remain sustainable, farmers must adopt soil conservation practices and look after this precious resource.

WHAT IS SOIL?

Soil is the basic material in nature from which plants derive the nutrients necessary for their growth. There are three layers of soil: top soil, subsoil and parent matter. Soil is made up of four main parts - minerals, organic matter, air and water. A well structured soil consists of approximately 45% mineral matter, 25% water, 25% air and 5% organic matter. In well-structured soil, clumps, known as soil aggregates (clumping of mineral and organic particles), stay together when wet, resisting erosion. The clumps vary in size with pores between them. This allows for root growth and air circulation.

**Mineral Matter**

Mineral matter is the part of the soil that you can see and feel. Texture refers to the mixture of different-sized mineral particles in a soil. Soil texture is a combination of sand (largest), silt (smaller) and clay (smallest) particles.

**Air and Water**

An ideal soil should contain the same amount of air and water space. The amount of air and water in soil refers to soil porosity. Two things affect porosity: soil texture and soil structure. Large particles such as sand create larger pores than smaller particles such as clay. A balance of water and air in the soil is necessary for healthy plant growth.
Organic Matter

Organic matter is that part of the soil composed of anything that once was living. It accounts for less than 5% of top soils. It acts as a “glue” that holds soil aggregates together and consequently reduces erosion.

WHY ARE THERE PROBLEMS WITH SOIL?

Erosion of agricultural land is one of the biggest challenges facing farmers in the Atlantic Region. Erosion can occur by wind, water or tillage. Resources valuable to plant production, such as soil particles, organic matter, plant nutrients and pesticides are transported off fields when erosion occurs. These sediments get deposited at off-farm locations.

Soil erosion by water is probably one of the most significant forms of erosion in this region. It is a major problem in several areas of New Brunswick, Prince Edward Island and the Annapolis Valley of Nova Scotia. This is due to intensity of rain received and slope of land being farmed. Raindrops break up the soil and it is then carried away by running water. The water not only carries away precious topsoil, it also transports agricultural chemicals, nutrients and where manure has been applied, bacteria.

Erosion by wind occurs when the soil is dry and has been loosened by cultivation or when bare land is exposed to wind due to lack of snow or vegetative cover. Erosion due to wind tends to be most visible in winter when you can see snow drifts covered with soil.

Tillage erosion occurs when equipment used to break up the land moves the soil downhill. When plowing downhill, the plow and gravity work together to move soil downwards. Overtime, topsoil at the top of the field will be removed and will sit at the bottom of the field. This causes exposure of subsoil on hilltop areas.
WHY IS EROSION A PROBLEM?

Erosion is a problem for a number of reasons. Through water runoff, soil can deposit in waterways and cause rivers and streams to become narrow. This causes a major problem for fish and wildlife habitat. Another concern is the fact that all of the organic matter in soil is found in the topsoil. With the removal of the topsoil, crops will need the addition of more agri-chemicals and fertilizers in order to make up for the organic matter loss. This results in higher input costs for the farmer and loss in productivity while being damaging to the environment.

WHAT CAN BE DONE?

In order to save our soil, there are a number of practices which could be implemented on a farm to reduce soil erosion rates. It is important that all farmers implement some or all of these practices to decrease current rates of soil erosion.

Crop Rotation

Crop rotation is the foundation on which other conservation practices are based. Crop rotation involves alternating cereal crops (e.g. oats, barley) with forage (e.g. clover, alfalfa) and row crops (potatoes, corn).
What are the benefits of crop rotation?

1. Improved soil organic matter levels:
   Forage and cereal crops have root systems that improve soil structure. They also return organic matter to the soil. If they are left over the winter months, soil is not exposed to wind, rain and snow thereby cutting down on erosion (cover crops). Row crops deplete soil of valuable nutrients and provide little cover or organic matter. By using a three year crop rotation (example, year 1 - grain, year 2 - alfalfa, year three - potatoes), the soil has a chance to be replenished.

2. Reduced incidence of disease, insects and fungi:
   Crop rotation can break the cycle of pests, reducing the need for costly alternative control.

3. Increasing rooting depth:
   Soil compaction is the process of increasing soil density by packing soil particles closer together. This compaction makes a soil prone to stress and as a result contributes to shallow root depth. Crop rotation tends to decrease soil compaction, thereby improving soil structure. As a result of improved soil structure, root depth in increased. This provides plants with a greater supply of nutrients and moisture.

4. Improved soil fertility and weed control:
   Rotations with legumes such as clover can reduce the nitrogen-fertilizer requirements as they have the ability to fix nitrogen from the air. Nitrogen fixation occurs because legumes have nodules on their roots which contain bacteria. The bacteria convert nitrogen (N₂) into available nitrogen that the plant can use. The living plants absorb this nitrogen and when they die and decompose, release the nitrogen back into the soil as ammonium (NH₄⁺).
Digging Deeper
Soil in Atlantic Canada

Cover Crops

Cover crops can be grown to protect soil when a field is not in use. Late summer to early fall is a prime time for farmers to establish cover crops before winter sets in. Fields should be covered from November to April. This is when the majority of precipitation in Atlantic Canada is received. Cover crops help reduce soil erosion rates, maintain soil structure and add organic matter. Common cover crops include winter wheat, clover and alfalfa.

Mulching

Mulching is a good alternative to a cover crop. While not as effective as a cover crop, it still does much to control erosion by reducing the impact of raindrops hitting the soil surface and by reducing runoff. Mulch consists of chopped straw or hay spread evenly over a recently harvested field. Studies have shown that erosion rates can be as much as 40 times lower on mulched versus bare fields.

Buffer Zones

A buffer zone is a strip of undisturbed or uncultivated land that borders a watercourse (river, stream, lake or wetland. Buffer zones are permanent borders along waterways in both rural and urban areas that help to reduce the amount of soil ending up in streams. Trees, shrubs and grasses in a buffer zone act as a natural filter to reduce the amount of pollutants reaching surface water resources. They also help to maintain soil structure in areas where there is a lot of traffic due to farm vehicles. Another advantage is that wildlife habitat is protected in a buffer zone area.
Strip Cropping

Strip cropping is the practice of establishing alternating strips of row crops, forages and cereal across the slope of a field. This practice allows farmers to divide a field into smaller sections and grow different crops in one field. Strip cropping helps to decrease erosion by preventing runoff and also helps to replenish nutrients and moisture levels.

Grassed Waterways

A grassed waterway is a permanent saucer-shaped channel designed to carry surface runoff across land without causing erosion. The grass slows the flow of water and protects the soil from erosion. The water is carried to a stable outlet such as a ditch.
Digging Deeper
Soil in Atlantic Canada

WHAT IS BEING DONE?

Soil conservation is being promoted by various government agencies, programs and policies as well as by universities, farm organizations and environmental organizations, groups and clubs. These agencies are sponsoring numerous programs to help farmers control soil erosion, sustain crop productivity and protect water and land resources. Each province is responsible for the protection of natural resources within its boundaries, except for National Parks, which are under the jurisdiction of Parks Canada.

One agricultural organization which is promoting sustainable farming practices is the Atlantic Farmers Council. They are encouraging farmers to develop an Environmental Farm Plan. This plan is designed to help a farmer manage his/her land in ways that will improve the natural environment. Farmers are required to evaluate the quality of their farm environment and make commitments to improve problem areas.

Some people are still not using soil conservation methods. Reasons for this include:
• people fail to see the soil as a natural and living environment
• many farmers require financial assistance to implement soil conservation techniques
• many people do not see the seriousness of soil degradation
Digging Deeper
Soil in Atlantic Canada

TEACHER DEMONSTRATION:
Use the following demonstration to introduce Soil Conservation. See diagram for setup.

MATERIALS
4 cardboard boxes 60 cm x 40 cm x 5 cm deep
4 garbage bags
scissors
masking tape
watering cans
soil (enough to fill boxes)
mulch (dead leaves, straw, wood chips)
4 wide mouth jars
10 or 12 books of equal width
table
4 chairs
piece of grass sod to fill one box

PROCEDURE
1. Cut a notch 3 cm deep and 10 cm wide at one end of each box.
2. Make spouts 10 cm long to fit into the notches. Secure the spouts with masking tape.
3. Line the boxes with garbage bags and label boxes A through D.
4. Pour enough soil into box A so that it is even with the top edge of the box.
5. Fill box B to within 1.5 cm of the top. Add mulch to make it even with the top. Pat it down firmly with your hand.
6. Fill box C half full of soil. Place the grass sod on top of the soil in box C. Make sure that the sod comes to the top of the box.
7. Fill box D with soil and even out the surface. Using your fingers, make even groves across the width of the box. This is to simulate contouring.
8. Place the boxes next to each other on the table. Elevate the unnotched ends with books.
9. Place jars on chairs in front of the spouts. Arrange jars to make sure that all of the runoff is obtained.
10. Ask students which soil surface will erode when water is poured on it? Have them rate them from 1 to 4.

RESULTS
11. Hold the watering cans the same distance above each box. What happens? (Expected outcome: A will lose the most, followed by D, B and finally C.)

12. Have students examine jar contents - were their predictions right?
1. Using the Soil Texture Triangle on page 12, determine the texture of the following soils.

   a. 40% sand, 40% silt, 20% clay
   b. 40% sand, 50% clay, 10% silt
   c. 78% silt, 5% sand, 17% clay
   e. 40% clay, 30% silt, ___% sand

2. Use the **How Does it Feel?** worksheet to determine soil texture by touch. Students will need to use at least two different soil types.

3. Have students take pictures of soil degradation in the community. Allow them to present solutions to soil degradation problems using soil conservation practices discussed in this article.

4. If the school is located near a farming community, encourage students to find out what local farmers are doing to conserve soil. Using the soil questionnaire and score sheet on page ?, have students interview a farmer to rate their conservation practices.

5. **Adopt-a-Soil Project.** This can be an opportunity to take ownership and make a difference. Find a location on school property or within the community that is experiencing soil degradation. Look along streambanks, roadsides, fields, etc. If the site is not on school property, find out who owns it. Make sure you have the owner’s permission before going onto land. Prepare a written plan to rehabilitate the site. Include a description of the problem, location, what you would like to improve, who will be involved, how it will benefit the ecosystem. You will probably want to contact the Department of Environment for advice and expertise. Submit your plan to the appropriate individuals to request permission to carry out the project. Take before and after pictures and keep a detailed progress report. Publicize your project by contacting the local media.
Soil Texture Triangle
How Does it Feel?

Soil has three types of textures: sand, silt and clay. Most soils are a combination of the three. Using the samples that your teacher has provided, discover what texture each soil has. Read the directions below to determine what kind of soil you have.

1. Test two of the soil types provided using the following method.
   a. Place a small amount of soil in the palm of your hand.
   b. Slowly add water until the soil stays together.
   c. When the soil stays together, it is ready to be identified.

2. Roll, squeeze and flatten the soil in your hand what texture does it have?
   a. **Sand** if it: - feels gritty
      - has grains (or particles) that can be seen
      - will not remain in a ball when squeezed
   
   b. **Silt** if it: - feels slippery like flour
      - is not really sticky
   
   c. **Clay** if it: - feels sticky
      - can be squeezed gently upward in a ribbon when placed between the thumb and fore finger

3. Fill in the following table.

<table>
<thead>
<tr>
<th></th>
<th>Soil Type A</th>
<th>Soil Type B</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does it feel like?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does it stay together when squeezed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does it form a ribbon?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our soil texture is mostly...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Compare your results to that of the rest of the class. How do they compare?

5. Estimate the content (% clay, % sand, % silt) of the soil sample. Using the Soil Texture Triangle, determine the texture of each soil.
Soil Conservation Survey

General Information
Farmer’s Name (optional)
__________________________________

Interviewer’s Name
__________________________________

Date of Interview ____________________

1a. What are your biggest challenges in soil conservation?
1b. What actions are you taking to deal with these challenges?

Cropping Practices
2. How many hectares (or acres) of land are farmed? (There are 2.47 acres in a hectare)

3. What crops do you grow? (please indicate the number of hectares or acres of each crop)
- none
- seed
- forage
- grain or silage corn
- soy beans or white beans
- potatoes
- oil seed
- vegetables
- fruits
- pasture
- hay
- other
- not applicable

4. Do you rotate your crops from year to year?
- row crops only
- row crops and cereal
- row crops, cereal, forage
- row crops and forage

5. What type of soil do you have?
- mostly clay
- mostly sand

6. What problems are associated with this soil type? Explain.

7. What type of tillage system do you use?
- no-till
- conservation tillage
- conventional tillage

8. What type of equipment do you use?
- cultivator
- mouldboard plough
- disc
- other

9. Explain reasoning for using equipment from number 8.

10. When do you till? Explain.
- Oct - Dec
- Mar - Apr
- May - Sept
- not applicable

11. To what depth do you till?
- 2.5 - 10 cm (1 - 4 inches)
- 10 - 15 cm (4 - 6 inches)
- 15 - 25 cm (7 - 10 inches)
- greater than 25 cm (10 inches)

- up and down the slope
- across the major slope
- other (please explain)

13. Do you use any plough down crops? Explain why or why not.
14. Do you practise strip cropping? Explain why or why not.

15. Do you have any watercourses running through your land? (If not, go to question 18)
   - yes
   - no
   - not applicable

16. Are watercourses bordered by vegetation?
   - yes
   - to be established, explain
   - other

17. What width are the borders? (in metres or feet) ______

18. Have you changed cropping practices in the last 5 years or do you plan to in the near future? (if no go to question 20)
   - yes
   - no

19. If you have already changed practices or plan to, why?
   - improve yields
   - economic reasons
   - reduce erosion
   - poor soil structure
   - other (please explain)

**Fertilizer Use**

20. Do you apply manure to your land?
   - yes
   - no
   - not applicable

21. How soon do you work the manure into the soil? Explain.
   - same day
   - within 2 or 3 days
   - after 3 days
   - spread on forage
   - other (please explain)

22. Do you apply nitrogen or phosphorus fertilizers?
   - yes (based on experience)
   - yes (based on a soil test)
   - no
   - not applicable

**Land Management**

23. Do you have any of the following on your land. Are you planning to include any of the following in the future?

<table>
<thead>
<tr>
<th>Now</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>water erosion control structures</td>
<td>□</td>
</tr>
<tr>
<td>fences to control livestock access to natural watercourses</td>
<td>□</td>
</tr>
<tr>
<td>ditch or streambank stabilization</td>
<td>□</td>
</tr>
<tr>
<td>permanently vegetated ditches or stream banks</td>
<td>□</td>
</tr>
<tr>
<td>tree windbreaks</td>
<td>□</td>
</tr>
<tr>
<td>reforestation</td>
<td>□</td>
</tr>
</tbody>
</table>

24. Erosion/conservation information from:
   - meetings
   - government
   - farm magazines
   - radio/television
   - books
   - research institution/university
   - other

25. Have you completed the Environmental Farm Plan for your farm?
   - yes
   - no
   - in future
Soil Conservation Survey
Scoring

Not all the questions can be scored. The points for those that can are given below. Mostly, two points are given if the farmer is using the best soil conservation practices. Zero points are given if no soil conservation practices are being implemented. One point is assigned for anything in between. Points are only scored for work already done, not for good intentions.

Questions

3. The highest erosion potential exists on land planted in row crops (potatoes, beans, corn), score 0. Erosion will be least on land planted in woodlot, cereals, forages (score 2).

4. The most potential for erosion exists on land rotated in row crops only (score 0), the least for forage/pasture rotation (score 2).

7. Score 4 points - no till, 3 conservation tillage, 1 conventional.

8. Score 0 for mouldboard plough and 1 for anything else.

10. Score 2 - May - Sept, 0 for Oct - Dec (unless the farmer answered mostly clay in question 12, then give one point), and 1 for Mar - Apr.

11. Shallow tillage is better: 2 for 2.5 cm - 10 cm, 0 for greater than 25 cm and 1 for anything in between.

12. Across slope - 2 points, down slope - 0 points.

13. A plough down crop is a legume (usually clover or alfalfa) that is grown and then ploughed into the soil to add nitrogen and organic matter (score 2 for yes, 0 for no).

14. Score 2 for yes, 0 for no.

17. Score 2 for yes, 1 for some, 0 for no.

18. Score 0 for 2 m or less; 1 for 2.1 to 4.9 m; and 2 for more than 5 m.

20. Yes - 2 points, no - 0 points

21. Same day - 2 points, after three days - 0, 1 point for in between

22. Soil test - 2 points, 0 experience

23. Score 1 point for each type of erosion control

25. Yes - 4 points

Interpreting the Score

22 and up - soil conservation farmer
13 - 21 - practising some soil conservation practices
0 - 12 - should develop some soil conservation practices
DESCRIPTION
Water is a precious resource. It is essential that students understand that they are able to help in water conservation.

OBJECTIVES
- to explain the pathway of the water cycle.
- to calculate water balance.
- to determine water use in a school environment.
- to describe the water filtration process

CURRICULUM CONNECTIONS
Biology    Chemistry    Earth Science
WATER CONSERVATION

Water brings our planet to life and is essential for every living thing in the world. Approximately three quarters of the earth’s surface is covered by oceans or ice fields. This might make water seem like an unlimited resource, however, less than one-hundredth of one percent of the earth’s water (less than one cup out of every ten thousand cups) falls as fresh water in the form of precipitation each year. Water good enough to drink, to farm with, to use in factories or to replenish lakes and rivers is a rare and precious resource. It is our responsibility to keep water free of contaminants so that we can continue to have a clean source for humans and animals. Contamination does occur, however, and in agriculture this is normally due to manure, pesticides, fertilizers and topsoil.

The Water Cycle

Water is never created or destroyed, it is always in constant motion. Water is recycled through the environment in a number of pathways called the water cycle. This cycle is balanced over every hectare of land or every kilometre of river, stream or ocean. We all affect this cycle every time we turn on a faucet or flush a toilet. Below is an outline of the water cycle.
Here’s how it works. Gravity pulls rain, snow, sleet and hail down from clouds to the earth. This is called *precipitation*. A lot of precipitation returns directly to the air. This happens in two ways. The first process is called *evaporation*. Energy from the sun heats water from the earth’s surface, rivers and oceans and changes it into water vapour. The second process is called *transpiration*. In this process, the sun’s energy is used by plants that release water into the air as they take up food and water from the soil.

**WATER BALANCE**

Movement of water through the water cycle can be measured. As water flows back to streams and rivers, it flows over land. This land is called a *watershed*. All land can be broken up into different watersheds. Scientists have developed an equation to determine the breakdown of water on a particular watershed. This equation is referred to as *Water Balance*. The water balance equation shows that water is never created or destroyed, it just moves from place to place. This equation is basically addition or subtraction depending on how much water is in the watershed.
WATERSHEDS ON PRINCE EDWARD ISLAND (260)
WATER BALANCE EQUATION

\[ P = ET + Q +/- \text{change in } S \]

where:
- \( P \) = Precipitation
- \( ET \) = Evaporation and transpiration
- \( Q \) = Stream flow
  \[ = (Q_r + Q_g), \quad Q_r: \text{surface runoff} \]
  \[ Q_g: \text{groundwater discharge to streams} \]
- \( S \) = Stored water

Example:
In one year, on an average Prince Edward Island watershed, 400 millimetres of rain returns to the air through evaporation and transpiration, 310 mm becomes surface runoff and 340 mm soaks into ground water. What is the total amount of rainfall on PEI in one year? (note: stored water is 0 mm)

\[ P = ET + Q +/- \text{change in } S \]
\[ P = ET + (Q_r + Q_g) +/- 0 \text{ mm} \]
\[ P = 400 \text{ mm} + (310\text{mm} + 340\text{mm}) \]
\[ P = 1050 \text{ mm of rain in one year} \]

AROUND THE HOME

Everyone can help to conserve water whether they are two or ninety-two. Wise management of water in the home will help to ensure ample supply and safe use for everyone. There is a direct link between the wastewater created in the home and that which comes out of the tap. Every time water goes down the drain, it enters another part of the water cycle as it travels with ground water and becomes purified.
**Surface Water**

Surface water comes from lakes and rivers. Many urban and rural water supplies come from treated surface water. Water runoff from lawns, fields, etc. helps replenish lakes and rivers with surface water. Pesticides, fertilizers, manure and soil are all sources of contamination for surface water.

**Wells**

Wells are drilled, dug or bored into the ground. Most rural homes have a well. Ground water is found beneath the ground and is formed by rain and snowmelt that filter down through the soil. As water seeps down into the ground, soil and organisms help to purify the water. The water stockpiles in an area referred to as the water table.

**Water Use**

Canadians use over 350 litres of water per household a day. Canada and the United States use twice as much water as Europeans. We have to increase our water use efficiency and help prevent contamination so that future water use will be clean and clear of pollutants. Decreasing the amount of contaminants that are put into water at home can help to cut down on the risk of polluting well water, lakes and rivers.
AROUND THE FARM

The water used around farm buildings can directly affect the quality and amount of water available to use. The majority of uses for water on a farm include: watering livestock, washing barns and milking equipment, chemical mixing and irrigation. Much like home, keeping farm water use to a minimum is important.

Pesticides

Pesticides are chemicals used to protect crops from certain insects, fungi, plants and disease. Pesticides allow farmers to produce high quality and high yielding crops to continue to supply people with enough food to eat. Pesticides are toxic, however, and while helpful, can also be harmful if handled incorrectly. Pesticides have rarely been detected in surface water in Atlantic Canada. Proper care must be taken when applying chemicals to prevent the chance of pesticide escaping the field where it was applied and entering a stream. It is also important to reduce soil erosion as pesticides can be washed away with soil particles.

Fertilizers

Agricultural fertilizers usually consist of three components: potassium, nitrogen and phosphorus. As water flows through a watershed, it will pick up and dissolve some amount of almost anything it meets. If it comes into contact with hazardous materials, it can dissolve chemicals from those materials and carry them into the groundwater. Wherever there is agricultural land, there is potential for high levels of nitrates in the groundwater. Due to this fact, farmers are conscientious of when and how much fertilizer is applied. If it is applied only when needed, crops will use the fertilizer supplied so that very little, if any seeps into the groundwater supply.
Irrigation

Irrigation is the managed application of water to soil to assist in plant growth. Irrigation has helped farmers to produce high quality food, fibre and foliage. There are three main types of irrigation: surface gravity flow, pressurized sprinkler and micro-irrigation. Surface irrigation includes methods where water flows on top of the soil. Sprinkler irrigation includes the use of a mechanical device which sprinkles water over the crops to simulate rain. Micro-irrigation techniques such as drip, spray and subsurface drip, deliver a measured amount of water through an emitter located near each plant. Micro-irrigation techniques can be located above or below ground. The method of irrigation depends on many factors which include: soil type, topography of the land, climate, fertilization methods, cost of water, geographical location, availability of water and economics.

WASTEWATER TREATMENT

Wastewater carries pollutants. Wastewater is produced when water comes in contact with contaminants such as milkhouse rinse water or manure runoff. Household wastewater contains many undesirable substances such as human waste, food scraps, oils, soaps, chemicals and bacteria. Agricultural wastewater contains pesticide residues, soil, rinse water, manure and fertilizers. It is important to prevent these pollutants from reaching ground and surface water sources. Wastewater treatment cleans the water so it is safe to return to the environment. There are three levels of waste water treatment in this region: primary, secondary and tertiary.

Primary Treatment Systems

In these systems, the focus is on removing solid waste. Screens are used to remove solid materials, such as rock and wood from the wastewater. It is then pumped into settling tanks where light material floats on the surface and the organic sludge settles to the bottom. The effluent in the middle of the tank is disinfected to kill bacteria.
Secondary Treatment Systems

These systems focus on reducing the waste material that is dissolved in primary effluent. Bacteria do the work in these systems. Bacteria are encouraged to grow in the wastewater. As they grow, they feed on organic material and reproduce. As the bacteria multiply, the organic matter is removed from tank. The bacteria tend to clump together, becoming a solid mass so that can easily be removed from the tanks.

Tertiary Treatment Systems

Tertiary systems are used in situations where high volumes of effluent would otherwise overwhelm the ability of the receiving water to assimilate the waste. Tertiary treatment removes nutrients from secondary effluent. The goal is to limit algae growth in receiving waters. A variety of physical, chemical and biological processes can be used in tertiary treatment plants.

WETLANDS

Freshwater wetlands are made up of marshes, swamps, bogs or a combination of these. Salt marshes are coastal wetlands found in protected bays and estuaries. Wetlands are found where land meets water. They contain a number of water-tolerant plants and are covered by shallow water. Wetlands give food and shelter to many species of plants and animals. Every drop of water contains microscopic organisms that are a vital part of the food chain. Both the water’s surface and the wetland bottom are covered with insect eggs, larvae, worms, plants, bacteria and protozoa. Wetlands act as filters, protecting the quality of water downstream. They trap chemicals such as nitrogen and phosphorus that can be harmful to wildlife and humans. Some farmers have been draining wetlands on their property in order to increase area for crop production. Others are trying to maintain and protect their wetlands for wildlife. Often the best way to preserve a wetland is to leave it alone. Wetlands also provide water to recharge the ground water supply.
CALCULATIONS

1. In one year, near Petitcodiac, New Brunswick, 600 millimetres of rain returns to the air through evaporation and transpiration, 250 mm becomes surface runoff and 460 mm soaks into ground water. What is the total amount of rainfall in Petitcodiac, NB in one year? (note: stored water is 0 mm)

2. On a watershed in St. Shots, Newfoundland, 1354 millimetres of rain fell in one year. If the rain returning to air through evaporation and transpiration was 535 mm and 235 mm of water was soaked into ground water. How much rain became surface runoff?
CONSERVATION AWARENESS ACTIVITY

1. Classroom Project: School Water Audit. Determine how much water is used at your school and make suggestions for conserving water at school.

   A. Divide the class into six or seven groups. Explain that each group will be responsible for collecting data about a certain aspect of the school’s water use. Inform the appropriate school personnel of the student’s upcoming research. Obtain a copy of the school’s water bill.

Class Groups:

Classroom sinks (including science labs, art room, shop class, etc)
This group will examine the water use in classroom sinks and estimate the total sink use in an average month. They might measure the flow rate (how many litres of water flow in a minute) and take an average. They might time the average length teachers and students keep the water running. Students may devise ways that they will measure water use in their groups.

Rest room sinks (don’t forget teachers)
This group will examine the water use in Rest room sinks and estimate the total sink water used in an average month. They might determine the flow rate similar to the classroom sinks group.

Water Fountain
This group will examine the water use in water fountains and estimate the amount of water used in a month. The might measure a flow rate of a fountain and count the number of students that take a drink in a typical day. Next determine how long the fountain is kept running per drink and calculate an average.

Cafeteria
This group will estimate how much water is used in the cafeteria. Determine how much water is used for food preparation and clean-up in a month. They might measure the flow rate of cafeteria sinks. They might look for information about how much water the dishwashers use per cycle and how many cycles there are in a day.

Shower/locker rooms
This group will estimate the amount of water used in a the showers and locker rooms. The group must be willing to conduct this investigation in a way that won’t embarrass themselves or other group members. Group members might time their own showers, determine a flow rate, ask gym teachers for the number of students showering in a typical day, etc.

Rest room toilets (don’t forget teachers)
This group will estimate the amount of water used in the school toilets. This group must be willing to conduct this investigation in a non-embarrassing fashion. Each group member must tally the number of time he or she flushed the toilet at school in a typical day and take a group average. They could then multiply this average by the number of students at the school to estimate the number of flushes. Find out from school personnel how many litres of water are used per flush.

Landscaping/General Up-Keep group
This group will investigate how much water is used in the up-keep of the school. Determine how much water is used by custodial staff for cleaning as well as water used in water lawns, flower beds or other plants.

B. Upon collection of data, have each group present what they have found. Make a class chart or graph showing the estimated monthly average water used. Compare the class estimate with the school’s water bill. What might account for any differences?

C. Have students suggest ways in which to conserve water in the area they researched. They may want to try to implement some of these suggestions.
Don’t Let it go to Waste!
Manure Management

DESCRIPTION
Manure is a valuable natural resource. With proper handling and management, it is a source of nutrients for soil and crops.

OBJECTIVES
• to develop an understanding of the importance of manure.
• to develop opinions on manure management issues.
• to calculate land base required for manure application.

CURRICULUM CONNECTIONS
Biology       Chemistry       Earth Science
MANURE MANAGEMENT

When people think of manure, they may think of pigs, cows, odour and mess. However, manure is extremely important to farmers and with proper management, it can be a great “natural” resource. Manure can supply nutrient requirements for crops and add organic matter to the soil.

Livestock and poultry manure is essential to Atlantic agriculture. A large portion of cereals and forages grown in Atlantic Canada is fed to livestock and poultry. In this way, the sun’s energy is converted into animal products for people to eat. Manure is spread on crops grown to feed both animals and humans. Animals can then be used for our consumption.

When manure is added to fields, it helps to maintain soil structure, aeration and water-holding properties through the addition of organic matter. It also replenishes many of the nutrients taken out of the soil during the growing season. In order to get the maximum benefits and reduce environmental risks from manure, it must be handled in such a way that the nutrients are preserved until it is ready to be spread on the land.

COMPOSITION OF LIVESTOCK AND POULTRY MANURES

What is manure made of and why is it good for the soil? Manure is composed of water, macro-nutrients (such as nitrogen, phosphorus and potassium), micro-nutrients, microorganisms and undigested materials such as weed seeds. Up to 90% of solid manure is organic matter which is why it is so good for the soil. When applied to the soil, it is broken down quickly by microorganisms to allow plants to use the nutrients right away.
MACRO-NUTRIENTS

Macro-nutrients are the main nutrients that all plants require. Nitrogen, phosphorus and potassium are the most important.

**Nitrogen**

Nitrogen (N) occurs in manure in two forms: ammonium nitrogen and organic nitrogen. The ammonia form is easily converted to a gas and lost to the air if not managed properly. Organic nitrogen has different challenges. It must be converted into a soluble inorganic form before plants can use it.

**Phosphorus**

Most of the phosphorus (P) found in manure is in the solid portion. It exists in organic and inorganic forms, but unlike nitrogen, it is not lost to the atmosphere. Runoff away from manure storage areas can reduce the amount of phosphorus available in manure as well as contaminate waterways. About half of the phosphorus from manure is available as fertilizer. The other half remains tied up in organic forms and is attached to soil particles.

**Potassium**

Approximately 75% of potassium (K) is found in the liquid manure portion. It is available to plants as soon as it is worked into the soil.
MICRO-NUTRIENTS

Manure is high in other minerals such as boron, chlorine, copper, iron, molybdenum and zinc. It also contains elements that are important for animal health such as selenium, chromium, iodine and cobalt.

MANURE STORAGE

Storing manure properly is key to getting the most value out of it. However, it can be quite expensive to install a proper manure storage facility. Liquid manure has different storage requirements than solid manure due to the fact that it is a liquid material. A properly designed manure storage will reduce the risk of contaminants escaping into the environment. Governments provide guidelines on how these storage facilities must be constructed.

Liquid Manure

There are two types of liquid manure storage: open and covered. These storages are usually made of concrete. An open system needs to be larger due to the fact that rain and snow will be getting into it. Covered storage is much more expensive than the open type, but can be smaller in size.

Solid Manure

Solid manure can be stored in a number of ways. It can be removed from where it is produced to a covered storage area. A covered solid manure storage keeps manure much dryer by preventing direct rainfall. Secondly, it can be stored on a open concrete pad that collects runoff. An uncovered pad must be built larger to contain all of the rainwater and runoff from the manure. A third option is to keep it in the barn, where it is produced, until spreading.
There are challenges to preserving the manure in all of these systems. There needs to be prevention of runoff to eliminate the chance of contamination of waterways, wells and ponds. It is also essential to reduce the loss of nitrogen (in all forms) from the manure.

**APPLICATION**

Spreading manure on land can be a beneficial method of recycling a natural organic by-product of livestock production. However, there can be too much manure spread on a field. Soil tests should be done when using manure so that farmers can determine the amount of manure needed. Different crops require varying amounts of nutrients, so nutrient levels for specific crops should be observed. Finally, after spreading, the manure must be worked into the soil quickly to reduce nitrogen loss and odour production. Farmers should try to incorporate the manure the same day it is spread, unless applied to hay or pasture land.

**How is it applied?**

Manure can be spread or injected by manure application equipment. Manure application equipment differs depending on whether liquid or solid is being handled. The injection type deposits the liquid manure directly beneath the surface of the ground. The spreader type of application deposits solid or liquid manure directly on the soil surface.

The application rate of manure should not exceed the amount necessary to meet the crop nitrogen requirements. There are two ways to calculate application rates:

- estimated land base area using nutrient production rates; and
- detailed method using specific manure and soil test results.
Don’t Let it go to Waste!
Manure Management

Using the following calculation, farmers can estimate the amount of manure required on their farm. This method can be very useful in many situations in which manure and soil test results are not available. Below is an example of how a farmer would estimate the land required for the amount of manure being produced by his/her livestock. Use Worksheet #1 and the information in Tables 1, 2 & 3 (used with permission from Guidelines for Manure Management for Prince Edward Island Prince Edward Island Department of Fisheries and Environment & Prince Edward Island Department of Agriculture and Forestry) to calculate the manure application rate.

**EXAMPLE OF WORKSHEET 1**
**ESTIMATE THE LAND BASE REQUIRED**

**STEP 1:** Enter the number of livestock places or barn capacity \( L = \)__________

**STEP 2:** Determine the annual nitrogen production for one animal \( P = \)_______

(Table 1)

**STEP 3:** Enter the fraction of nitrogen retained after storage and \( R = \)_______

application (Table 2)

**STEP 4:** Determine the nitrogen utilization for the crop (corn, hay) \( U = \)_______

under consideration (Table 3)

**STEP 5:** Calculate the land base required. \( C \times P \times R \div U \)
EXAMPLE

Farmer Brown has 275 beef cows. She has an open lot manure handling facility. When spreading, she normally incorporates the manure within 24 hours. Farmer Brown will be growing sweet corn. Calculate the land base required.

**STEP 1:** $C = 275$ beef cows  
**STEP 2:** $P = 87$ kg  
**STEP 3:** $R = 0.40$  
**STEP 4:** $U = 130$ kg/ha  
**STEP 5:** $C \times P \times R \div U; 
\quad 275 \times 87 \times 0.40 \div 130 = 74$ ha of land is required for this amount of manure

**Environmental Concerns**

Although manure is a wonderful resource, if not managed properly, it can pose a number of environmental problems. Odour from manure can evoke complaints from community members living close to livestock farms. Farmers have been able to reduce odours, but there is no way to completely eliminate them.

The major area of concern, however, is surface and ground water contamination. If not stored, managed and applied properly, phosphorus and nitrogen can pollute water, pose a threat to our families and communities and harm fish and wildlife. Phosphorus tends to pollute surface water through runoff, while nitrogen tends to leach into ground water. Implementation of manure management systems that reduce or prevent water contamination are very important for our environment and farmers, but they can also be quite costly.
Composting of Manure

Composting is a biological process in which microorganisms convert organic matter, such as manure, into compost under aerobic conditions. Composting controls conditions so that materials decompose faster. The composting process produces heat, which decreases moisture content and destroys pathogens (harmful micro-organisms) and weed seeds. Composting can reduce the volume of waste up to 50% and decrease odours.

When composting, an adequate supply of oxygen is required. To achieve this, farmers mix the pile on a regular basis. Proper management of composted manure will ensure that the manure is undergoing an aerobic process and will have a non-offensive earthly odour. The site should be located a minimum of 90 metres away from a watercourse or well and all surface water should be diverted away from the compost site.
Don’t Let it go to Waste!
Manure Management

CLASSROOM ACTIVITIES

1. Using the Internet sites provided -pg 65 (or by searching manure management), discover what types of manure management problems are facing both farmers and environment. What is being done to solve some of these?

2. Using the worksheet in the article and Tables 1, 2 and 3, calculate the land base required for the following situations.

   a) The Cliffords milk 50 cows. They store their manure in a completely enclosed system and apply it by injection. They are trying to maintain a legume pasture to rotate their cattle on during the summer months. Calculate the land base required to spread this amount of manure.

   b) Mr. Sweet raises 700 broilers. He is growing mixed grains to feed to his chickens. All manure is stored in a manure pack, but when spread is not incorporated for 2 days. Calculate the land base required.

3. Case Study

   Allow students to work in groups of three and read the following case study on the next page. Have groups develop alternatives. Share the results with the class as a large group. Note: There are no correct answers, however, ensure that students have solid reasoning to support their argument.
Don’t Let it go to Waste!
Manure Management Case Study

The Situation
During 1996, Lisa Barnes, a Newfoundland dairy farmer expanded her herd from 35 to 50 cows in a tie-stall barn. In a tie-stall barn, cows are tied up and have a mechanical stable cleaner behind them. This moves the manure out of the barn into a pile located outside the barn. She spreads the manure when the weather permits, but with the increase in cattle Lisa finds that she sometimes gets behind. Neighbours have been complaining of an increase in odour and have noticed that there has been an increase in growth of plants in and around the river below the farm. The neighbours are upset with this situation and have called a community meeting to discuss the problem.

Lisa’s Perspective
Lisa realized that the manure pile was affecting the environment and decided that when she expanded her operation in 1996 she would make changes. Due to cost, she was unable to make changes at the time of the expansion. Lisa is concerned about the river, however, she is planning to add another 10 cows to her herd this year. If she buys these cows, she’ll be unable to afford to implement a new manure handling system until next year.

The Neighbours Perspective
People in the community are tired of the odour that the manure pile is emitting. Many of them say that they can’t even open the windows of their houses. They also attribute the unusual plant growth in the river to runoff from the manure pile and are concerned that further problems will occur with the fish and wildlife.

Alternatives
Pretend that you are the experts at the community meeting. What suggestions would you offer to help solve these problems?
**TABLE 1: ANNUAL LIVESTOCK NITROGEN PRODUCTION**

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Annual Nitrogen Production (kg) by one animal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dairy</strong></td>
<td></td>
</tr>
<tr>
<td>Milking cows and associated livestock</td>
<td>145 kg</td>
</tr>
<tr>
<td><strong>Beef</strong></td>
<td></td>
</tr>
<tr>
<td>Beef cows and associated livestock</td>
<td>87</td>
</tr>
<tr>
<td>Feeders:</td>
<td></td>
</tr>
<tr>
<td>100 day backgrounder</td>
<td>33</td>
</tr>
<tr>
<td>200 day backgrounder</td>
<td>36</td>
</tr>
<tr>
<td>Summer pasture</td>
<td>44</td>
</tr>
<tr>
<td>Short keep</td>
<td>58</td>
</tr>
<tr>
<td>Long keep</td>
<td>51</td>
</tr>
<tr>
<td><strong>Hogs</strong></td>
<td></td>
</tr>
<tr>
<td>Sows, farrow to finish</td>
<td>91</td>
</tr>
<tr>
<td>Sows, farrow to weanling</td>
<td>24</td>
</tr>
<tr>
<td>Sows, farrow to nursery</td>
<td>18</td>
</tr>
<tr>
<td>Weanlings</td>
<td>1</td>
</tr>
<tr>
<td>Feeders</td>
<td>10</td>
</tr>
<tr>
<td><strong>Chickens</strong></td>
<td></td>
</tr>
<tr>
<td>Broilers</td>
<td>0.43</td>
</tr>
<tr>
<td>Roasters</td>
<td>0.66</td>
</tr>
<tr>
<td>Layers</td>
<td>0.73</td>
</tr>
<tr>
<td>Pullets</td>
<td>0.24</td>
</tr>
<tr>
<td>Broiler Breeder Pullets</td>
<td>0.24</td>
</tr>
<tr>
<td>Broiler Breeder Hens</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Turkeys</strong></td>
<td></td>
</tr>
<tr>
<td>Broilers</td>
<td>0.60</td>
</tr>
<tr>
<td>Heavy Toms</td>
<td>1.04</td>
</tr>
<tr>
<td>Heavy Hens</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Sheep</strong></td>
<td></td>
</tr>
<tr>
<td>Ewes and associated livestock</td>
<td>15</td>
</tr>
<tr>
<td>Feeder lambs</td>
<td>7</td>
</tr>
<tr>
<td><strong>Horses</strong></td>
<td></td>
</tr>
<tr>
<td>Mares and associated livestock</td>
<td>97</td>
</tr>
</tbody>
</table>
Don’t Let it go to Waste!
Manure Management

<table>
<thead>
<tr>
<th>Storage Method</th>
<th>Injection</th>
<th>Broadcast &amp; Incorporation within 24 hrs</th>
<th>Broadcast &amp; Not Incorporated</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Liquid Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enclosed</td>
<td>0.83</td>
<td>0.68</td>
<td>0.43</td>
</tr>
<tr>
<td>Open</td>
<td>0.78</td>
<td>0.64</td>
<td>0.4</td>
</tr>
<tr>
<td>Earthen</td>
<td>0.59</td>
<td>0.48</td>
<td>0.3</td>
</tr>
<tr>
<td>II. Solid Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily Scrape</td>
<td></td>
<td>0.60</td>
<td>0.38</td>
</tr>
<tr>
<td>Manure Pack</td>
<td></td>
<td>0.56</td>
<td>0.35</td>
</tr>
<tr>
<td>Open Lot</td>
<td></td>
<td>0.40</td>
<td>0.25</td>
</tr>
</tbody>
</table>
# Don’t Let it go to Waste!
## Manure Management

## TABLE 3: FERTILIZER RECOMMENDATIONS FOR CROPS (ACTUAL kg/ha)

<table>
<thead>
<tr>
<th>Crop with Soil Test Groups</th>
<th>Nitrogen (N)</th>
<th>Phosphate (P$_2$O$_5$)</th>
<th>Potash (K$_2$O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>50</td>
<td>50 - 25</td>
<td>50 - 25</td>
</tr>
<tr>
<td>Carrots</td>
<td>100</td>
<td>150 - 100</td>
<td>150 - 100</td>
</tr>
<tr>
<td>Cole Crops</td>
<td>150</td>
<td>200 - 150</td>
<td>150 - 100</td>
</tr>
<tr>
<td>Corn</td>
<td>60</td>
<td>45 - 0</td>
<td>75 - 50</td>
</tr>
<tr>
<td>Corn - Sweet</td>
<td>130</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>Fall Rye</td>
<td>20</td>
<td>45 - 30</td>
<td>45 - 30</td>
</tr>
<tr>
<td>Field Peas</td>
<td>20</td>
<td>60 - 40</td>
<td>40 - 25</td>
</tr>
<tr>
<td>Grass - Hay/Pasture</td>
<td>75</td>
<td>40 - 15</td>
<td>75 - 40</td>
</tr>
<tr>
<td>Legume/Hay</td>
<td>20</td>
<td>70 - 40</td>
<td>140 - 75</td>
</tr>
<tr>
<td>Legume/Pasture</td>
<td>20</td>
<td>40 - 15</td>
<td>140 - 75</td>
</tr>
<tr>
<td>Mixed Grain</td>
<td>40</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Mixed Hay</td>
<td>50</td>
<td>40 - 15</td>
<td>75 - 40</td>
</tr>
<tr>
<td>Potatoes (Kennebec)</td>
<td>100</td>
<td>200 - 135</td>
<td>135</td>
</tr>
<tr>
<td>Potatoes (Russet Burbank)</td>
<td>180</td>
<td>200 - 135</td>
<td>135</td>
</tr>
<tr>
<td>Potatoes (Shepody)</td>
<td>160</td>
<td>200 - 135</td>
<td>135</td>
</tr>
<tr>
<td>Potatoes (Yukon)</td>
<td>155</td>
<td>150 - 90</td>
<td>135</td>
</tr>
<tr>
<td>Rutabaga</td>
<td>45</td>
<td>60 - 40</td>
<td>90 - 45</td>
</tr>
<tr>
<td>Soy Beans</td>
<td>20</td>
<td>45 - 30</td>
<td>40 - 25</td>
</tr>
<tr>
<td>Wheat</td>
<td>60</td>
<td>45 - 30</td>
<td>60 - 30</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>20</td>
<td>45 - 30</td>
<td>30</td>
</tr>
</tbody>
</table>
DESCRIPTION
Pesticides and agricultural chemicals are often at the forefront of news stories. Students need to hear both sides to develop informed decisions and opinions.

OBJECTIVES
- to define the term pest
- to compare types of crop protection methods
- to examine the difference between organic and conventional farming methods

CURRICULUM CONNECTIONS
Biology  Chemistry  Earth Science
PESTICIDE USE

The use of pesticides on crops is a controversial issue throughout the world. Health risk questions and food safety top the lists of concerns in relation to pesticide use. Whether we realize it or not, everyone relies on effective pest management techniques to ensure adequate food supplies. We compete with insects, diseases and weeds for our share of food. It has been estimated that without pest management, crop losses would average 40%. This section gives an overview of different types of management techniques. Provide students with all information so that they are able to form opinions based on factual information.

WHAT ARE PESTS?

Pests are different things to different people. A pest is anything that is in a place where it is not wanted or can cause harm. Farmers consider insects, fungi, disease and weeds to be pests as all of these will affect product quality and decrease yields.

WHAT ARE PESTICIDES AND WHY ARE THEY USED?

Pesticides are chemicals which are used to protect crops from pests. Pesticides are used to control weeds, diseases and insects. Many people wonder why farmers use agricultural chemicals when it has been shown that almost all crops can be produced using organic crop protection methods. Plants do have some natural defence against pests, but like people, sometimes medication is needed to fight off disease. Crops could not be grown on such a large scale if pesticides were not used. Pesticides allow farmers to produce high quality and high yielding crops to continue to supply people with enough food to eat. Also with an increase in the world population, farmers must continue to produce food sustainably with little effects from pests. Agricultural chemicals are vital to the industry’s effort to control pests. If no pesticides were used, the agricultural land base would dramatically increase, thus natural wildlife areas would be converted to agricultural land. Even so, pesticide use must be kept to a minimum. With proper education and alternative methods, use of agricultural chemicals will decrease.
Pesky Pests  
Pesticide Use in Atlantic Canada

RISKS?

Careless application or storage of pesticides can pose a significant threat to human health and the environment. Presently, there is legislation that require farmers to complete a Pesticide Certification Course in order to purchase or apply agriculture chemicals. Pesticides that are not handled properly can contaminate the water supply. Anyone who is applying pesticides should wear protective clothing, safety goggles and respirators to prevent illness.

ORGANIC AGRICULTURE

The Canadian organic agriculture movement emerged in the 1950s. It was inspired in part by visits from foreign experts such as Dr. Einfried Pfeiffer and through the distribution of literature from Europe, the United Kingdom and the United States. Today, there are a number of certified organic growers across the country.

The term organic refers not to the food itself, but to how it is produced. Organic food production is based on a system of farming that maintains and replenishes the fertility of the soil. Throughout Canada, food produced by organic means is in increasing demand by consumers. Organic farming is a combination of agricultural practices and biological processes. Organic farmers manage their crops without the use of synthetic chemicals (pesticides and fertilizers). In organic crop production, pests are managed by extended crop rotations, biological controls, disease-resistant varieties and varying planting dates. Biological controls are natural pesticides that are used to reduce pests. An organic farmer’s primary strategy is prevention. Healthy soils and plants are better able to resist disease and insects.
Certified Organic

Certified organic food is different from other organic food. Certified means that the food has been grown according to strict uniform standards put in place by provincial and national organizations. Certification includes inspections of farm fields and processing facilities, detailed record keeping and periodic testing of soil and water to ensure that growers and handlers are meeting the standard which have been set. Organic farming is often more labour intensive due to the strict regulations that organic farmers must meet. Due to this fact, organic produce is often more expensive. It also requires a much larger land base to obtain the same amount of saleable produce that would be produced under conventional farming methods.

INTEGRATED PEST MANAGEMENT (IPM)

Integrated Pest Management (IPM) is a system for managing pests that involves more than one control method. It combines chemical, cultural and biological methods. This proves to be both environmentally and economically sound.

IPM has many benefits. It allows for efficient use of pesticides only when necessary. There is less reliance on only one management method, thus reducing development of pest resistance to control methods. Most importantly for farmers, crop yield and quality is preserved.

IPM requires farmers to have a greater understanding of the interactions among the species involved. It requires monitoring of crops by taking samples of weeds, insects and plants. Farmers set traps in fields to catch insects so that they can be counted and identified. Weeds are also identified and removed by hand, cultivation and/or mulching. Chemicals are then applied to kill pests during the vulnerable part of their life cycle so that they cannot cause damage to crops. Many companies are starting research on reduced risk compounds that are more environmentally friendly for pest control and safer for people to use.
Monitoring Using IPM techniques

Recognizing the pest is the first step in determining how to deal with it. There are two types of pests **direct** and **indirect**. A direct pest is one that injures the portion of the crop that is sold. An indirect pest is one that injures part of the crop plant, but not the part that is sold or consumed. There are also beneficial predators, parasites, diseases or insects that are natural enemies of crop pests. These beneficial things help control pests and keep populations in balance.

Monitoring begins by taking samples of plants, insects and weeds. Sampling tells you whether the pest is direct or indirect, natural enemies present, if pest controls have been successful, and has the pest changed. Sampling methods vary according to the pest and its stage of development. Each field is mapped and sampled at various locations by a crop scout.

**Visual Counts**

A visual count technique lets you estimate numbers of pests and beneficial species per plant or unit area. Leafhoppers and potato beetles are commonly monitored this way. A hand lens or microscope can be used to see insects and diseases on leaves. Traps can also be used to catch insects and then count them. There are several kinds of traps:

**Pheromone Traps** - sticky cardboard traps with a capsule containing synthetic sex attractants specific to the pest being monitored.

**Sticky Traps** - The colour is specific to the pest being monitored. Insect species have colour preferences, these are usually yellow, orange, blue, white or red.

**Pitfall or Interception Traps** - trenches or holes are constructed in the ground to catch insects as they walk.
Back Light Traps - contain a UV light to which many insects are attracted. Useful for monitoring insects that are not attracted by pheromones.

Bait Traps - made of the crop itself

Spore Traps - used to monitor plant diseases by catching spores that cause infections

From the catches in the traps, crop scouts are able to track seasonal development of pests and determine when best to spray crops. Trap counts reveal activity patterns of a pest population.

Sweep Nets
A sweep net is a cloth net on a frame. It is used in the field to determine the presence and the numbers of many insects.

BIOTECHNOLOGY

Advancements in research, especially in the area of biotechnology, have decreased the need for pesticides for some crops. Scientists are developing insect, disease and viral resistant varieties of plants which benefit both the farmer, the consumer and the environment. Biological forms of pest control continues to aid farmers in their commitment to sustainable agriculture.

RESIDUES ON FOOD?

Many people are concerned about the amount of residues on food left by agricultural chemicals. The Canadian Government, under the Food and Drug Act, has regulations in place to monitor the amount of residue that is permitted without endangering human health. Keep in mind that while traces of natural or synthetic pesticide residues may be present, they are only on the surface of a product. They are not absorbed into fruits and vegetables. The best way to prevent sickness due to pesticide residues is to wash and prepare all fruits and vegetables carefully before eating them.
Interview home owners to determine if they are using pesticides on lawns and/or gardens. What kinds are they using? What type of protective clothing do they wear? What kind of knowledge do they have of the products they are using? Have they ever completed a pesticide application course?
The climate in Atlantic Canada is changing. Unlike the rest of Canada, this region is undergoing a slight cooling trend. This article discusses the relationship between agriculture and climate change.

**DESCRIPTION**

**OBJECTIVES**

- to define climate change
- to describe the relationship between climate change and agriculture
- to compare and contrast the various greenhouse gases

**CURRICULUM CONNECTIONS**

Biology  Chemistry  Earth Science
Climate Change
In Atlantic Canada

WHAT IS CLIMATE CHANGE?

Climate change is a change in the average weather a given region experiences over a period of time. It is a natural occurrence, however over the last 200 years, human actions have been influencing the rate of change of the climate system. This has caused climate change to become one of the most serious environmental issues that we face today. Climate change may cause warming in some areas, cooling in others and general climate instability.

THE KYOTO PROTOCOL

In December 1997, officials from 160 countries met in Kyoto, Japan to discuss climate change. From this meeting, a number of countries signed the Kyoto Protocol. Under this agreement, industrialized countries must reduce their collective emissions of greenhouse gases (GHG) by 5.2% by the period of 2008 to 2012. Canada signed the Kyoto Protocol on Climate Change on April 29, 1998. Upon signing, Canada agreed to reduce its greenhouse gas emissions by approximately 25% by the year 2010.

Agriculture holds a unique position with respect to its effect on GHG. Although the agricultural industry is a contributor of GHG, it is also able to decrease the amount of emissions by storing carbon dioxide in the soil. Most of the emissions in Canadian agriculture are from agricultural machinery, ruminant livestock (cows, goats, sheep, deer), manure management, nitrogen fertilizers, farming practices, transportation and impact of land use.
WHAT ARE THE GREENHOUSE GASES (GHG) AND WHERE DO THEY COME FROM?

Water vapour - comes from natural and human-induced transpiration and evaporation. Water vapour released from evaporation increases as the Earth’s surface temperature rises.

Carbon dioxide (CO$_2$) - Carbon dioxide comes from the decay of materials, respiration of plant and animal life and combustion of materials and fuels. It is removed from the atmosphere through photosynthesis and ocean absorption.

Methane (CH$_4$) - Although there is less methane than carbon dioxide in the atmosphere, methane is a more potent greenhouse gas. It comes from the decay of matter without the presence of oxygen. Primary sources include wetlands, rice paddies, animal digestive processes, fossil fuel extraction and decaying garbage in landfills.

Nitrous oxide (N$_2$O) - Soils and oceans are the primary natural sources of nitrous oxide. Humans contribute to N$_2$O emissions through soil cultivation, use of nitrogen fertilizers, nylon production and burning of fossil fuels. Nitrous oxide is the most potent greenhouse gas emitted by agricultural means.

Ozone (O$_3$) - Ozone exists naturally in the atmosphere in small quantities. It is also produced in the lower atmosphere from a reaction involving pollutants and sunlight.

Halocarbons - These are human-produced chemicals containing member of the halogen family (bromine, chlorine, and fluorine) and carbon. They are some of the most potent greenhouse gases of all. Chlorofluorocarbons (CFC’s) are a familiar example.

The GHG associated with Canadian agriculture are methane, carbon dioxide and nitrous oxide.
Climate Change
In Atlantic Canada

HOW DO GREENHOUSE GASES MAKE IT WARMER?

There are natural trace gases in the atmosphere which help to maintain the Earth’s temperature. These trace gases are referred to as greenhouse gases. Radiation coming from the sun in the form of visible light penetrates the atmosphere and reaches Earth’s surface. Some of the light is absorbed and radiates back to space. Travelling with the visible light waves are also infrared light waves. These light waves are much longer than visible light. The greenhouse gases allow the visible light to come in to the atmosphere, but stop some of the infrared waves that are trying to get out. The trapped infrared energy heats both the atmosphere and the Earth’s surface. If the concentration of greenhouse gases in the atmosphere is increased, more infrared light will be trapped, thereby increasing the mean global temperature.

In recent years, Global Warming Potential (GWP) indices have been developed to account for the direct effects of carbon dioxide, methane, nitrous oxide and other gases. The concept of GWP compares the potency of various greenhouse gases. The heat-trapping potential of a gas depends on both its capacity to absorb and re-emit radiation and how long the effect lasts. Scientists have determined that methane is twenty-one times more potent than carbon dioxide. Whereas nitrous oxide is 310 times more potent than carbon dioxide.

Effects of climate change globally

Using models of the world’s climate, scientists have calculated the Earth’s average temperature to have risen between 0.45°C and 1.35°C over the last 100 years. The Intergovernmental Panel on Climate Change (IPCC) concluded that if human activities contributing to the greenhouse effect are not slowed, global mean temperatures could rise as much as 3.5°C. This may seem insignificant, but keep in mind that this is a world average. This change would have an impact on all of Earth’s ecosystems. Earth’s warmest years since 1881 have been in the last twenty years with 1998 being the warmest on record.
CONTRIBUTORS TO CANADA’S GREENHOUSE GAS PROBLEM

Industries dealing with fossil fuels have the biggest impact on the GHG production. The chart below shows the distribution of greenhouse gases throughout the industries. Electric utilities, manufacturing and energy are at the top of the list. Agriculture is close at 10%. It is important to keep in mind that this is only primary agriculture. Other factors are found in different industries. For example, fossil fuels burned by agricultural machinery are found under transportation.
EFFECTS OF CLIMATE CHANGE ON ATLANTIC CANADA

The Atlantic Region has not followed the national warming trend of the past century. Although Canada as a whole experienced an increase in temperature, Atlantic Canada underwent slight cooling during the last fifty years. One of the reasons for this is that the mean earth temperature has been increasing, causing ice caps in Greenland and Northern Canada to melt. The cooler air and water temperatures associated with the melted ice has been flowing downward through the Atlantic Ocean causing a cooling effect on Atlantic Canada. The continuing increase in GHG emissions is expected to result in a changing and more varied climate, the extent of which is not know at this time. In general, this could mean a higher frequency in weather extremes such as unusually severe storms, drought and less winter snow cover. It could also see an accelerated rise in sea-levels which would increase the risk of floods, coastal erosion and sedimentation around coast lines. Since the Atlantic Region is very dependant on the sustainability of natural resources and the environment, it is important that researchers discover the relationships that link the climate with this region.

WHAT IS THE RELATIONSHIP BETWEEN AGRICULTURE AND CLIMATE CHANGE?

A warming trend could actually be beneficial to agriculture (except for crops requiring reliable snow cover for survival). However, as stated before, Atlantic Canada is not following the national warming trend. Variations in climate that would affect agriculture include: excess moisture (in certain areas), unusually late springs or early frosts, drought, severe storms and an exceptionally cool growing season. The agricultural industry will have to reduce its emissions to assist Canada in meeting its commitment to the Kyoto Protocol, but it must also adapt to the changing climate. Agriculture is highly dependent upon weather and climate in order to produce food and fibre necessary to sustain human life. Canadian agriculture provides over 80% of the food consumed by over 30 million Canadians. Therefore, it is important that farmers learn to adjust to climate change so they are able to continue producing food to feed Canadians.
HOW IS AGRICULTURE CONTRIBUTING TO CLIMATE CHANGE?

The chart below gives a description of what sectors of agriculture are contributing to climate change. The main areas where emissions are a problem are enteric fermentation or digestive capabilities of ruminant animals, fertilizers, manure and crops.

Environment Canada, 1996
AGRICULTURAL SOIL MANAGEMENT

Agricultural soil management activities such as fertilizer application and other cropping practices were Canada’s largest source of nitrous oxide emissions accounting for approximately 49% of the total Canadian N₂O emissions. Excessive application of fertilizers and manure can add to N₂O emissions.

Soils can either release or absorb CH₄ depending on moisture content. When organic materials decompose in soils under water, large amounts of CH₄ are released (due to low oxygen supply). Most agricultural soils are well aerated so that they do not produce CH₄, instead, the soils convert CH₄ to CO₂.

Crop Residues

Most of the methane emitted from agriculture is produced by the microbial break down of plant material. Normally, under aerobic conditions, in the presence of oxygen, most of the carbon in decomposing plant material is converted to CO₂. Under anaerobic conditions, without the presence of oxygen, decomposition is incomplete and the carbon is released as CH₄.

Large amounts of N are returned to the soil in the form of crop residues (straw, roots) and other plant materials. The amount of N₂O produced depends on the rate of N release. An important tool in dealing with crop residue is tillage. Tillage practices alter residue placement and influence soil moisture, temperature and aeration which affect N₂O production.
Livestock

Methane is produced by all animals when they digest feed. Emission of CH$_4$ is especially high in ruminant animals such as cattle, sheep and goats. These animals have a fore-stomach or rumen that is used to pre-digest feed by microbial fermentation under restricted oxygen supply. This process allows these animals to digest coarse feeds like forages. Other animals, such as pigs and horses also emit some methane, but the amounts are very small when compared with that of sheep and cows.

Manure

Methane is also emitted from the carbon excreted in manure. Manure is decomposed by microorganisms. If there is little oxygen present, a lot of methane may be produced. The ratio of CO$_2$ and CH$_4$ produced depends on how the manure is managed. If aeration is adequate inside of the pile, little CH$_4$ will be emitted.

Fertilizers

Various commercial fertilizers are used to supplement soil nutrients. Nitrogen is one of the main nutrients added. It is often added as urea or anhydrous ammonia (pressurized ammonia gas). The physical form and application of fertilizers may influence N$_2$O emissions, however, the effect of fertilizer formulation and placement has on N$_2$O emissions has not been fully determined.

SOIL SINKS

A sink is the opposite of an emission. Soil becomes a carbon sink, when emissions from soils decline and becomes negative. That is, soils gain or absorb carbon. Canada is arguing for the inclusion of soil sinks as a way to decrease total GHG emissions, but no ruling has been made as yet.
REDUCING GHG EMISSIONS IN AGRICULTURE

Some of the methods that can be used to decrease emissions of CH$_4$ and CO$_2$ are:

**Reduce Tillage**
A growing number of farmers have eliminated tillage entirely using no-till or direct seeding practices. These practices protect soil C by shielding it inside aggregates and keeping crop residues on the surface.

**Nutrient Management**
Application of fertilizers, animal manure or green manure improve the physical condition of the soil. This can lead to increasing yields and residue additions.

**Eliminate summer fallow**
Fallow is land left unplanted. Leaving land unplanted can help to control weeds and replenish soil moisture, however it leaves it open to erosion and soil carbon loss. Summer fallowing is common practice in Western Canada, but is not common in Atlantic Canada.

**Cover Crops**
The use of cover crops can add more residues to the soil and prevent erosion.

**Manure handling**
Apply manure to land as soon as possible and work into soil within 24 hours of application. Solid manure storage produces less methane than liquid storages, thereby reducing emissions. It is also important to aerate manure during composting. The aeration encourage complete decomposition to CO$_2$ rather than the release of C as CH$_4$. 

Agri-Environmental Resources  ➤  58
Climate Change
In Atlantic Canada

There are also ways to reduce nitrous oxides from being emitted.

**Limited Application of Fertilizers**
Match fertilizer application to plant needs. Apply just enough N so that crops can reach maximum yield without leaving any available N behind. Regular soil testing can help to achieve this although a perfect match is hard to achieve.

**Improve Soil Aeration**
Emission can be reduced by careful management of soil water. Avoid over application of irrigation water and use of conservation tillage practices can help to decrease N$_2$O emissions.
1. There is an international meeting where delegates will discuss whether countries should reduce emission of carbon dioxide in the atmosphere. You are to prepare a paper or make a speech advocating whether or not Canada or another country of your choice should do this. Write/give this paper, taking whatever position you believe.

2. Science Reporting on Greenhouse Gases

You are the newspaper science reporter for the Atlantic Area News. Your assignment is to go out to the Nova Brunswick Found Island Observatory and report on their research on the greenhouse effect. As usual, you have the challenge of explaining science to non-scientists. Your report must include the following:

- An explanation of the suspected greenhouse effect.
- A description of the types of research being done.
- The types of gases involved and their sources.
- The trends of the gas levels over the past 250 years.
- The trends of the temperatures over the past 250 years.
- Quote two scientists you meet at Nova Brunswick. You can make up their names if you like. Interview them about their opinions of the data being collected. Their theories on the relationship of CO2 and climate warming can differ. The quotes should be at least three sentences.
- Your personal prediction about global warming and gases levels.
- Some type of graphic to enhance the article. You may not copy from the Greenhouse Gases reading, however, you can get ideas. Try to combine carbon dioxide levels, temperatures changes, and years on the same graph.
- Anything else you believe is relevant.
Climate Change
In Atlantic Canada

CLASSROOM ACTIVITIES

3. A. Using the worksheet located at: http://www.ns.ec.gc.ca/co2/worksheet.html calculate your personal CO₂ inventory. If this sheet is unavailable, do a web search for carbon dioxide worksheets. Students may have to consult with their parents to get some values required for the form.

B. Have students compare their values and discuss ways in which to decrease personal CO₂ emissions.
Individuals may obtain up to 5 free publications per year. Most groups and associations may obtain up to 100 free publications per year.

---

**FILM AND VIDEO RESOURCES**

**National Film Board**

The following videos may be available from your local or provincial libraries.

**Protecting Our Planet Series**  -  193C 9192 090/EC005
A global education series of seven 15-minute programs featuring young people from different countries taking action to effect positive changes in their local environment. Teacher’s notes included. Ages 10-14.

**Perspectives in Science: The Complete Series**  -  193C 0197 110/EC005
Students will see how science affects their daily lives and will develop the skills necessary to make moral and ethical choices in a technology driven world. Topics include soil, air, forestry, biotechnology, water and toxic waste. Six 1-hour videos.

**Sustainable Development and the Ecosystem Approach**  -  C0193 070/EC005
A compilation of two videos produces by Environment Canada to encourage group discussions about environmental, economic and ecological concerns. Ages 13 and up. 17 min
RESOURCES

Government of Newfoundland and Labrador
For more information on borrowing these videos call (709) 729-3843

Our Soil - 13:45 min

Toxicology - An Environmental Education Unit for Secondary Schools and Communities - 12:15 min

Farm Drainage

Soil Conservation - A Practical Guide - 39 minutes

Soil Erosion Control - Maintaining the Balance - 12:35 minutes

Prince Edward Island Department of Agriculture & Forestry
Call Client Information Services at (902) 368-5663 for more information on these videos.

Erosion Control Structures and Machinery Practices
Produced in Grand Falls NB.

Gully and Rill Erosion Control

Conservation Tillage: Making the Switch
A 24 minute video produced by the University of Guelph.

Squeezing Resources to Their Maximum
Produced by the PEI Soil and Crop Improvement Association

Protecting Water Quality
An 18 minute video produced by CIBA-GEIGY.

Agri-Environmental Resources
RESOURCES

PEI Agricultural Human Resources Council
To borrow the following videos call (902) 892-1091

Natural Resource Management
A compilation of segments on the Focus on Resources television series.
   Land Management: Strip Cropping - 5:25 minutes
   Environmental Farm Plan - 6:10 minutes
   Land Management: Constructed Wetlands - 6:55 minutes
   Land Management: Land Clearing Practices - 5:20 minutes
   Land Management: Drip Irrigation - 5:08

Soils and Soil Conservation
A compilation of video segments from the Focus on Resources television show.
   Soil and Feed Lab - 4:33 minutes
   Land Management: Soil Survey Mapping - 7:00 minutes
   Land Management: Precision Farming - 6:23 minutes
   Land Management: Residue Management - 7:10 minutes

PUBLICATIONS

Additional Soil Resources (call: 902-892-1091)

WEB SITES

Water
» http://www.water-ed.org/ - A great web site developed by the Water Education Foundation.
» http://www.dep.state.pa.us/earthdaycentral/96/project_wet/project_wet.htm - Project Wet, water lesson plans for teachers.

Soil
» http://www.bib.wau.nl/agralin/ss-lsw.html - Land, Soil and Water Internet Resources
» http://homepages.which.net/~fred.moor/soil/links/l0104.htm - Links to other soils pages.

Pests
» http://www.virtuo.com/farmsafety/pesticide/define.html - Pesticide safety page. It also contains information on why pesticides are used.
» http://ianrwww.unl.edu/ianr/pat/ephhome.htm - A site devoted to pesticide education.
» http://www.cropro.org - A site developed by the Crop Protection Institute.

Manure
» http://www.manure.mb.ca/ - Manitoba Livestock Manure Management Initiative
» http://res.agr.ca/manurenet/ - A Canadian Website dedicated to manure management.
» http://www.ae.iastate.edu/waste.htm - Agriculture Waste Management

Environment/ Sustainable Agriculture
» http://www.ns.ec.gc.ca/ - Environment Canada - Atlantic Region
» http://www.dnr.state.wi.us/org/caer/ce/eek/teacher/tpages.htm - Teacher lesson plans
and Environmental Education for kids.
INDUSTRY CONTACTS

Eastern Canada Soil & Water Conservation Centre
RR 4, St-Andre
Grand Falls, NB
E0J 1M0
ph: 506-475-4040

Fédération des Agriculteurs et Agricultrices
Franophones du Nouveau Brunswick
18 rue de l’École
Edmunston, NB
E3V 1X6
ph: 506-735-7013

New Brunswick Department of Agriculture and Rural Development
P.O. Box 6000
Fredericton, NB
E3B 5H1
ph: 506-453-2666
http://www.gov.nb.ca

New Brunswick Federation of Agriculture
1115 Regent St.
Fredericton, NB
E3B 3Z2
ph: 506-452-8101

Newfoundland & Labrador Department of Forest Resources and Agrifoods
Provincial Agriculture Building
P.O. Box 8700
St. John’s, NF
A1B 4J6
ph: 709-729-3843
http://public.gov.nl.ca/agric/default.htm

Newfoundland Federation of Agriculture
P.O. Box 1045
Mount Pearl, NF
A1N 3C9
ph: 709-747-4874

Nova Scotia Agricultural College
Box 550, Truro, NS
B2N 5E3
ph: (902) 893-6600
http://www.nsac.ns.ca

Nova Scotia Department of Agriculture & Marketing
Box 550, Truro, NS
B2N 5E3
ph: (902) 893-6600
http://agri.gov.ns.ca/

Nova Scotia Federation of Agriculture
339 Willow Street, Truro, NS
B2N 5A6
ph: 902-893-2293

PEI Client Information Services
440 University Ave.
Charlottetown, PE
ph: 902-368-5663

Prince Edward Island Department of Agriculture and Forestry
P.O. Box 2000
Charlottetown, PE
C1A 7N8

PEI Federation of Agriculture
420 University Ave.
Charlottetown, PEI
C1A 7Z5
ph: (902) 368-7289

PEI Soil & Crop Improvement Association
P.O. Box 21012
Charlottetown, PE
C1A 9H6
ph: 902-887-2535
EVALUATION FOR TEACHERS

We would really appreciate your feedback on this unit. Any suggestions or comments that you have can help us to make future resources easier for you to use.

Completed forms can be sent to: Agriculture Education Coordinator, PEI Agricultural Human Resources Development Council, 420 University Ave., Charlottetown, PEI C1A 7Z5
Fax: 902-892-1091.

Please rate the following on the scale of 1 to 5 (1 being poor, 5 being excellent)

1. This resource was easy to follow and use. _______
   Comments: ____________________________________________________
   ________________________________________________________________
   ________________________________________________________________

2. The background information was useful. ______
   Comments: ____________________________________________________
   ________________________________________________________________
   ________________________________________________________________

3. Students found the unit interesting and challenging. ______
   Comments: ____________________________________________________
   ________________________________________________________________
   ________________________________________________________________

4. Agri-Environmental Resources helped meet curriculum objectives. ______
   Comments: ____________________________________________________
   ________________________________________________________________
   ________________________________________________________________

5. How, if at all, could this unit be improved? _______________________
   ________________________________________________________________
   ________________________________________________________________

6. I would be interested in receiving Agriculture Education resources in future.
   ☐ Yes    ☐ No

If yes, please fill in the information requested below

Name ___________________________  School ________________  Grade ________

Mailing Address __________________________________________________________
REFERENCES


Environment Canada. 1998. *What is Climate Change?*  


REFERENCES


Prince Edward Island. 1997. *Cultivating Island Solutions. Round Table on Resource Land Use and Stewardship*. Queen’s Printer, Charlottetown, PEI.


Prince Edward Island Department of Fisheries and Environment & Prince Edward Island Department of Agriculture and Forestry. 1999. *Guidelines for Manure Management for Prince Edward Island*. Queen’s Printer, Charlottetown, PEI.


GLOSSARY

Biotechnology: A science that uses our knowledge of plant and animal systems to create a variety of new products, improve products, plants and animals that already exist or develop micro-organisms for specific uses.

Buffer zone: a permanent strip of vegetation along side a watercourse. It helps prevent erosion by directing surface water to a safe outlet.

Conservation Tillage: Tillage which reduces the amount of crop residue incorporated into the soil.

Cover Crops: A crop grown in rotation with regular crops which is grown for ground cover rather than harvest.

Cow Mattress: A product made from ground up tire pieces that is used to prevent incidence of disease in cattle.

Crop Rotation: Using a different crop in the same field for new planting. Crop rotation improves crop yields and makes it easier to control insects and weeds.

Erosion: The movement of soil particles from one place to another because of wind, water or tillage.

Grassed Waterways: A channel covered with perennial vegetation established to direct the flow of water and prevent it from eroding the soil.

Green Manure: A forage crop plowed down into the soil late in the fall or early in the spring.

Groundwater: Water found in the soil beneath the water table.

Integrated Pest Management (IPM): A method of pest control that requires farmers to monitor pests in order to know when to apply pesticides.

Leaching: The movement of contaminants through the soil into the groundwater.

Milkhouse wash water: Mixture of water, milk and chemicals used to clean and sanitize the milking system and bulk tank.

Mulching: Spreading straw or hay on the ground after harvest of crops such as potatoes to protect against water erosion and to help retain moisture.
Nitrates: A form of nitrogen in the soil that is absorbed by plants

Organic Farming: A combination of agricultural practices and biological processes. Crops and animals are managed without the use of synthetic products.

Organic Matter: The humus within the soil that consists of plant residues and soil life.

Pest: A plant, animal, bacteria or fungus that is unwanted or can cause harm.

Pesticides: Chemicals used to protect crops from insects, fungi, disease and weeds.

pH: A measure of a soil’s acidity or alkalinity.

Runoff: The loss of water from an area when excess water flows over the surface instead of being absorbed by the soil.

Soil Structure: Soil particles stick together into clumps called aggregates. A soil that has lots of small aggregates, lots of pore space and does not crust has good soil structure.

Soil Texture: The amount of clay, sand and silt in a soil.

Topography: Description of the hills and valley of the land.

Water Table: The upper level of a soil zone where all the spaces between the soil particles are filled with water.

Watercourse: Any channel which holds water. Includes ditches, streams, brooks.

Water Cycle: Water is never created or destroyed, but is in constant motion due to processes such as evaporation, transpiration, condensation and precipitation.

Waterway: A flow path where surface water collects and flows.

Wetlands: Where land meets water and is made up of marshes, bogs and swamps.
PARTNERSHIPS

Prince Edward Island Agricultural Human Resources Development Council Inc.

Department of Agriculture & Rural Development
Agriculture et Aménagement rural

Government of Newfoundland & Labrador
Department of Forest Resources and Agrifoods

Canadian Heritage Patrimoine canadien

Department of Technology and Environment

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

Department of Education

Human Resources Development Canada

Développement des ressources humaines Canada

Prince Edward Island ADAPT Council