Alberta Canola Producers Critical Issues Guides
Sustainability and Agriculture:
Making Wise Decisions
Exploring Critical Issues Series
Agriculture in Education
Teaching and Learning Resource

The roots of most Canadian rural communities are in agriculture. Today, Canada is no longer an agrarian nation. And in this change, we are losing the connection to the food that we eat – where it comes from, what is required to provide our 'daily bread', and the independence that our forefathers knew came with being able to grow enough to feed one's self.

But more importantly, we are losing the resources that allow Canada to produce its food, and the citizenship that values regional cuisine made from foods that are produced in the areas where they live. These resources are meant to 're-connect' a population pulled to the city with the industrial revolution, with an appreciation for the resources that agriculture needs, if 'made in Canada' food is to continue to be a reality.

The websites in this resource were current as of the printing date of this publication. It is, however, beneficial to preview all websites before asking students to use them.
Every effort has been made to acknowledge sources used in this resource. Should any question arise from the use of any material, we will be pleased to make the necessary corrections in future printings.

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Sustainability and Agriculture: Making Wise Decisions Teaching and Learning Resource for Grade 7 Science

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Introduction and Overview

Evolving agricultural practices have always influenced the sustainability of both agriculture and the environment. This resource helps students explore sustainability through topics such as selective breeding and the consequences of monocultural land use. It develops and builds on key concepts that include the needs and uses of plants, chemical and biological controls, plant varieties, selective breeding, monocultures and sustainability. Technology also affects management practices in agriculture, including genetic technology and its impacts. Students will also explore how changes in technology affect the agricultural environment and agricultural production.

A Critical Issues Approach

Issues that are relevant and meaningful to students support a constructivist, inquiry-based approach to learning. Critical issues frame learning around key questions that pose problems that intrigue and interest students, and set a focus for motivated learning. Posed effectively, critical issues ask students to develop and apply critical thinking skills and look at multiple perspectives, consider alternatives, and recognize that challenges can

often involve many different solutions.
This teaching and learning resource is developed around a critical issues approach and promotes inquiry-based learning and critical thinking. The exploration of issues is framed around inquiry questions that are relevant and meaningful to students, engage them in deliberative research and promote social participation skills.

Curriculum Support
This resource supports Alberta's Grade 7 Science program of studies. Unit B in the program, Plants for Food and Fibre - Science and Technology, encourages an exploration of issues related to sustainability in an agricultural context. This resource develops concepts relating to fertilizers and soil nutrients, plant varieties, selective breeding, resource management and sustainability. It also develops skills and attitudes that emphasize problem solving and stewardship. A curriculum correlation chart follows. Specific charts are provided with each lesson in this resource, indicating those outcomes on which each lesson focuses.

Making Wise Decisions: Grade 7 Science Curriculum Connections
Critical Issue
How should decisions about environmental and agricultural sustainability be balanced?

Related Inquiries and Issues

- Where does our food supply come from and why should we care?
- To what extent does agriculture change natural environments?
- What short- and long-term effects can agricultural innovations have?
- How can management practices and agricultural decisions ensure Sustainability?

Knowledge Outcomes
1. Investigate plant uses; and identify links among needs, technologies, products and impacts

- describe human uses of plants as sources of food and raw materials, and give examples of other uses (e.g., identify uses of plants as herbs or medicines; describe plant products, and identify plant sources on which they depend)
- investigate the extent of natural and managed living resources in agricultural, horticultural, forest and grassland environments; and identify examples of local and global change (e.g., describe changes in the size of forested areas; describe changes in the characteristics of forested areas)
- investigate practical problems and issues in maintaining productive plants within sustainable environments, and identify questions for further study (e.g., investigate the long term effects of irrigation practices or fertilizer use)

3. Analyze plant environments, and identify impacts of specific factors and controls

- identify practices that may enhance or degrade soils in particular applications
- describe and interpret the consequences of using herbicides, pesticides and biological controls in agriculture and forestry

4. Identify and interpret relationships among human needs technologies, environments, and the culture and use of living things as sources of food and fibre

- investigate and describe the development of plant varieties through selective breeding, and identify related needs and problems (e.g., identify needs leading to the development of new grain varieties; identify problems arising from the development of new plant varieties that require extensive fertilization)
- investigate and identify intended and unintended consequences of environmental management practices (e.g., identify problems arising from monocultural land use in agricultural and forestry practices, such as susceptibility to insect infestation or loss of diversity)
- identify the effects of different practices on the sustainability of agriculture and environmental resources (e.g., identify positive and negative effects of using chemical fertilizers and pesticides and of using organic farming practices)

Skill Outcomes

Initiating and Planning

- ask questions about the relationships between and among observable variables, and plan investigations to address those questions
- define practical problems (e.g., identify problems in growing plants under dry conditions)
- identify questions to investigate arising from practical problems and issues (e.g., What methods will help limit moisture loss from plants and soil? What reduction in the loss of soil moisture can be achieved through the use of a plastic ground sheet or through the use of a plastic canopy?)
- rephrase questions in a testable form, and clearly define practical problems (e.g., rephrase a broad question, such as: "What amount of fertilizer is best?" to become "What effect will the application of different quantities of fertilizer X have on the growth of plant Y and its environment?")
- state a prediction and a hypothesis based on background information or an observed pattern of events (e.g., predict the effect of a particular plant treatment)

Performing and Recording

- conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data
- research information relevant to a given problem
- observe and record data, and create simple line drawings (e.g., describe plant growth, using qualitative and quantitative observations; draw and describe plant changes resulting from an experimental procedure)

Analyzing and Interpreting

- analyze qualitative and quantitative data, and develop and assess possible explanations
- use and/or construct a classification key (e.g., distinguish among several grain varieties, using a classification guide or key)
- compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs and line graphs (e.g., prepare a record of a plant's growth that chart its development in terms of height, leaf development,

flowering and seed production)

- identify new questions and problems that arise from what was learned

Communication and Teamwork

- work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., show the growth of a group of plants over time through a data table and diagrams)
- evaluate individual and group processes used in planning, problem solving, decision making and completing a task

Attitude Outcomes

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider the nutrient content of food they eat and the potential presence of residues; consider observations and ideas from a number of sources, during investigations and before drawing conclusions)
- work collaboratively in carrying out investigations and in generating and evaluating ideas (e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)
- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., voluntarily care for plants in a school or home environment; assume personal responsibility for their impact on the environment; recognize that their consumption habits have environmental consequences)

The Critical Issue

How should decisions about environmental and agricultural sustainability be balanced?

Related Inquiries

Where does our food supply come from and why should we care? (Lesson One)
To what extent does agriculture change natural environments? (Lesson Two)
What short- and long-term effects can agricultural innovations have? (Lesson Three)
How can management practices and agricultural decisions ensure sustainability? (Lesson Four)

In their inquiry into this critical issue, students explore agricultural management strategies and their effects within the context of the issue of sustainability. They examine the choices that agricultural producers make and the impact of these choices on agricultural production and the environment. Students also examine the issue of genetic engineering through the example of canola.

The Process

This resource is structured around inquiry questions that form the basis for exploring the critical issue. Each inquiry question provides a focus for a lesson and for deliberative research. Each lesson also contains "I can..." statements that set a context for researching the essential learnings of the lesson, provide criteria for assessment and help students focus their learning. These statements can be shared with students at the beginning of each lesson.
Each of the lessons in this resource provides activities that introduce and explore topics in a 50- to 60-minute class period. Additional activity suggestions provide opportunities to extend the lesson and further develop research and inquiry skills. An overview of instructional strategies is provided with each activity. These instructional strategies include cooperative learning and inquiry.
Each of the lessons is self-contained and provides the instructional process, activity ideas, briefing notes and other handouts. Therefore, teachers may choose lessons they are interested in to support the Grade 7 Science program, and select any of the activities from the lessons.

Briefing Notes
Each of the lessons centres on a topic introduced through a Briefing Notes handout. Each briefing note provides students with an opportunity to connect their prior knowledge and understandings to the topic through Predict questions. Many of the briefing notes also provide research questions and web links that encourage research and the exploration of multiple viewpoints and opinions on issues relating to agriculture.
The briefing notes format provides an opportunity for students to take on a variety of research roles. Each lesson contributes to research that students gather to explore the critical issue. Students should be encouraged to come back to the critical issue when the lessons have been completed.

At-a-Glance
The following provides an overview of the sequence of the lessons, inquiry focus, instructional strategies, curriculum connections, and assessment focus in this resource.

Lesson One: The Importance of Agriculture
In Lesson One, students explore the important uses of plants in agricultural food production and are introduced to the concept of sustainability in agriculture.

Inquiry Focus:
Where does our food supply come from and why should we care?

Instructional Strategies:
- Cooperative Learning Board Share
- Read and Summarize
- KWHL Chart
- Flow Chart

Curriculum Connections:

Knowledge Outcomes

1. Investigate plant uses; and identify links among needs, technologies, products and impacts
   - describe human uses of plants as sources of food and raw materials, and give examples of other uses (e.g., identify uses of plants as herbs or medicines; describe plant products, and identify plant sources on which they depend)

Skill Outcomes

Initiating and Planning

- state a prediction and a hypothesis based on background information or an observed pattern of events (e.g., predict the effect of a particular plant treatment)

Performing and Recording

- conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data
- research information relevant to a given problem

Analyzing and Interpreting

- analyze qualitative and quantitative data, and develop and assess possible explanations
- use and/or construct a classification key (e.g., distinguish among several grain varieties, using a classification guide or key)

Communication and Teamwork

- work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., show the growth of a group of plants over time through a data table and diagrams)

Attitude Outcomes

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider the nutrient content of food they eat and the potential presence of residues; consider observations and ideas from a number of sources, during investigations and before drawing conclusions)
- work collaboratively in carrying out investigations and in generating and evaluating ideas (e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)
- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., voluntarily care for plants in a school or home environment; assume personal responsibility for their impact on the environment; recognize that their consumption

Assessment Focus: (I Can... Statements)

Lesson One encourages students to demonstrate their learning by developing understandings such as the following:

- I can describe how plants are an important source of food and raw materials.
- I can identify and discuss the connections between agricultural decisions, production and human activities.

Lesson Two: Change and Decisions

In Lesson Two, students examine different land management approaches in agriculture. They examine the extent of agricultural land use in Canada, and explore the benefits and risks of strategies such as pesticide use, irrigation, fertilizer, monoculture, and organic farming.

Inquiry Focus:

To what extent does agriculture change natural environments?

Instructional Strategies:

- Cause and Effect Bubble Chart
- Issues and Decisions
- Cooperative Learning Carousel
- Comparison Chart

Curriculum Connections:

Knowledge Outcomes

1. Investigate plant uses; and identify links among needs, technologies, products and impacts
    - investigate the extent of natural and managed living resources in agricultural, horticultural, forest and grassland environments; and identify examples of local and global change (e.g., describe changes in the size of forested areas; describe changes in the characteristics of forested areas)

3. Analyze plant environments, and identify impacts of specific factors and controls
    - identify practices that may enhance or degrade soils in particular applications
    - describe and interpret the consequences of using herbicides, pesticides and biological controls in agriculture and forestry

4. Identify and interpret relationships among human needs, technologies, environments, and the culture and use of living things as sources of food and fibre
    - investigate and identify intended and unintended consequences of environmental management practices (e.g., identify problems arising from monocultural land use in agricultural and forestry practices, such as susceptibility to insect infestation or loss of diversity)
    - identify the effects of different practices on the sustainability of agriculture and environmental resources (e.g., identify positive and negative effects of using chemical fertilizers and pesticides and of using organic farming practices)

Skill Outcomes

Initiating and Planning

- ask questions about the relationships between and among observable variables, and plan investigations to address those question
- define practical problems (e.g., identify problems in growing plants under dry conditions)
- identify questions to investigate arising from practical problems and issues (e.g., What methods will help limit moisture loss from plants and soil? What reduction in the loss of soil moisture can be achieved through the use of a plastic ground sheet or through the use of a plastic canopy?)
- rephrase questions in a testable form, and clearly define practical problems (e.g., rephrase a broad question, such as: "What amount of fertilizer is best?" to become "What effect will the application of different quantities of fertilizer X have on the growth of plant Y and its environment?")
- state a prediction and a hypothesis based on background information or an observed pattern of events (e.g., predict the effect of a particular plant treatment)

Performing and Recording
- research information relevant to a given problem

Analyzing and Interpreting
- identify new questions and problems that arise from what was learned

Communication and Teamwork
- work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., show the growth of a group of plants over time through a data table and diagrams)
- evaluate individual and group processes used in planning, problem solving, decision making and completing a task

Attitude Outcomes
- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider the nutrient content of food they eat and the potential presence of residues; consider observations and ideas from a number of sources, during investigations and before drawing conclusions)
- work collaboratively in carrying out investigations and in generating and evaluating ideas (e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)
- demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (e.g., voluntarily care for plants in a school or home environment; assume personal responsibility for their impact on the environment; recognize that their consumption habits have environmental consequences)

Assessment Focus: (I Can... Statements)

Lesson Two encourages students to demonstrate their learning by developing understandings such as the following:

- I can describe the changes and effects that managing land and resources has on natural environments.
- I can compare different consequences of agricultural practices to develop my own opinions about their impact on natural environments

Lesson Three: Needs and Innovations

In Lesson Three, students explore the impact of agricultural innovations on crop production and the environment. They examine the impact that selective breeding and genetic engineering has had on crop production. Students also explore the example of canola, and consider the intentional and unintentional impact of genetic technology on crops like canola. Lesson Three encourages students to build understandings that help inform their perspective on the balance between increased crop production technologies and economic and environmental sustainability.

Inquiry Focus:

What short- and long-term effects can agricultural innovations have?

Instructional Strategies:

- Predictive Timeline
- Retrieval Chart
- Cooperative Learning Stand and Share
- Community Participation

Curriculum Connections:

Knowledge Outcomes

3. Analyze plant environments, and identify impacts of specific factors and controls
    - identify practices that may enhance or degrade soils in particular applications
4. Identify and interpret relationships among human needs, technologies, environments, and the culture and use of living things as sources of food and fibre
    - investigate and describe the development of plant varieties through selective breeding, and identify related needs and problems (e.g., identify needs leading to the development of new grain varieties; identify problems arising from the development of new plant varieties that require extensive fertilization)

Skill Outcomes

Initiating and Planning

- ask questions about the relationships between and among observable variables, and plan investigations to address those questions

Performing and Recording

- observe and record data, and create simple line drawings (e.g., describe plant growth, using qualitative and quantitative observations; draw and describe plant changes resulting from an experimental procedure)

Analyzing and Interpreting
- analyze qualitative and quantitative data, and develop and assess possible explanations

Communication and Teamwork
- work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., show the growth of a group of plants over time through a data table and diagrams)

Attitude Outcomes
- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider the nutrient content of food they eat and the potential presence of residues; consider observations and ideas from a number of sources, during investigations and before drawing conclusions)
- work collaboratively in carrying out investigations and in generating and evaluating ideas (e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)

Assessment Focus: (I Can... Statements)
Lesson Three encourages students to demonstrate their learning by developing understandings such as the following:
- I can identify the short- and long-term effects of technology on agricultural production and ways of life.
- I can use evidence and data to compare and analyze the consequences of technology based innovations on agricultural practices.

Lesson Four: Influences and Sustainability
In Lesson Four, students revisit their understanding of sustainability and explore the issue of balanced decision making. They examine the impact that environmental and economic decision making has on the implementation of sustainable agricultural practices, and research some different points of view on sustainability. Lesson Four encourages students to deepen their understanding of sustainability and start to develop their own opinions.

Inquiry Focus:
How can management practices and agricultural decisions ensure sustainability?

Instructional Strategies:
- Brainstorming with a Venn Diagram
- Tip Sheet or Top Ten List
- Comic Strip
- Illustrated Map

Curriculum Connections:

Knowledge Outcomes

1. Investigate plant uses; and identify links among needs, technologies, products and impacts
    - investigate practical problems and issues in maintaining productive plants within sustainable environments, and identify questions for further study (e.g., investigate the long-term effects of irrigation practices or fertilizer use)

4. Identify and interpret relationships among human needs, technologies, environments, and the culture and use of living things as sources of food and fibre
    - identify the effects of different practices on the sustainability of agriculture and environmental resources (e.g., identify positive and negative effects of using chemical fertilizers and pesticides and of using organic farming practices)

Skill Outcomes

Initiating and Planning

- ask questions about the relationships between and among observable variables, and plan investigations to address those questions

Performing and Recording

- conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data
- research information relevant to a given problem

Communication and Teamwork

- work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results
- communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means (e.g., show the growth of a group of plants over time through a data table and diagrams)

Attitude Outcomes

- seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider the nutrient content of food they eat and the potential presence of residues; consider observations and ideas from a number of sources, during investigations and before drawing conclusions)
- work collaboratively in carrying out investigations and in generating and evaluating ideas (e.g., assume responsibility for their share of work in preparing for investigations and in gathering and recording evidence; consider alternative ideas and approaches suggested by members of the group; share the responsibility for difficulties encountered in an activity)

Assessment Focus: (I Can... Statements)

Lesson Four encourages students to demonstrate their learning by developing understandings such as the following:

- I can identify practices that have positive and negative effects on sustainable

environments.

- I can describe different dimensions of and perspectives on sustainability.
- I can take and support a position on practices that support sustainable development.

Rubrics

The assessment rubrics that follow can be applied to many of the products that students develop in the activities in this resource. These rubrics can be adapted and developed with students. A template is provided for the creation of customized rubrics.

Visual organizers

Excellent 4	Demonstrates an understanding of the topic, its relationships and related concepts and ideas; provides appropriate labels and organizers; provides information that reflects the topic; links are made appropriately; visual organizer is used appropriately
Proficient 3	Displays understanding of the topic and relationships to concepts and ideas; provides appropriate labels and organizers; provides information that relates to the topic; attempts to make links; uses the visual organizer appropriately
Acceptable 2	Identifies concepts and ideas that relate to the topic; provides labels and organizers; includes information that relates to the topic; uses the format of the visual organizer
Limited 1	Provides information related to the topic; uses parts of the visual organizer to present information
No work completed 0	

Group activities

Excellent 4	Articulates clear understanding of the group task and the individual contribution to the group; listens to group members; expresses opinions and ideas; contributes information and research; works with the group to fulfil group responsibilities
Proficient 3	Articulates understanding of the group task the role each individual plays with the group; listens to group members; contributes ideas and information; fulfils individual responsibilities for the group
Acceptable 2	Describes the group task; describes individual role; listens to group members; contributes information to group task
Limited 1	Describes individual role within the group setting; listens to others in the group; contributes ideas
No work completed 0	

Research

Excellent 4	Develops a strategy for conducting research; develops and identifies research and inquiry questions; analyzes and assesses sources of information selected for the research task; records information using an appropriate format; applies research to inquiry question; makes effective use of research time
Proficient	Identifies a strategy for conducting research; identifies research

3	and inquiry questions; selects and assesses sources of information; records information using an appropriate format; identifies links between research collected and inquiry question; makes effective use of research time
Acceptable 2	Uses an identifies strategy for conducting research; records research and inquiry questions; selects and reads sources of information; records information using an appropriate format; uses information from sources to answer inquiry questions
Limited 1	Selects and reads sources of information; records identifies research and inquiry questions; records information using an identified format; identifies information from sources that relates to inquiry questions
No work completed 0	

Timelines

Excellent 4	Develops timeline to accurately reflect the passage of time; creates organizational structure and presentation of timeline; selects appropriate information and details to the time period and purpose of the timeline; timeline shows an understanding of the topics, events, people or concepts being depicted; uses visuals to expand on the presentation of information
Proficient 3	Develops timeline to accurately reflect the passage of time; uses an identified format for the structure and presentation of timeline; selects appropriate information for the time period and purpose of the timeline; selects topics, events, people or concepts that relate to the time period depicted; uses visuals to enhance the presentation of information
Acceptable	Develops timeline in a chronological order; uses an identified

2	format for the structure and presentation of timeline; selects topics, events, people or concepts that relate to the time period and purpose of the timeline; uses visuals to present information
Limited 1	Displays topics, events, people or concepts on timeline; uses and identifies format to record information for timeline
No work completed 0	

Projects

Excellent 4	Develops a project planning strategy and process; identifies goals and purpose of project; demonstrates understanding of topics and concepts represented in the project; selects an appropriate method of constructing and creating project; uses research and information gathered appropriately and effectively in the project; demonstrates ability to summarize and synthesize information within the project; displays learning with pride in final presentation of project
Proficient 3	Identifies a project planning strategy and process; identifies purpose of project; selects information relating to topics and concepts under study for the project; selects an appropriate method of constructing and creating the project; uses research and information gathered appropriately and effectively in the project; demonstrates ability to summarize information within the project; displays learning with pride in final presentation of project
Acceptable 2	Uses an identified project planning strategy and process; selects information relating to topics and concepts under study for the project; selects a method for constructing and creating the project; uses research and information gathered throughout the project; displays learning with pride in final presentation of project

Limited 1	Selects information relating to topics and concepts under study for the project; constructs and creates the project using an identified approach; uses information gathered for the project
No work completed 0	

Template

Excellent 4	
Proficient 3	
Acceptable 2	
Limited 1	
No work completed 0	

Lesson One: The Importance of Agriculture
Overview
In Lesson One, students explore connections to agriculture in the context of daily life. Students share examples of the agricultural products we depend upon to meet our needs and consider where those products come from. Lesson One provides students with an overview of the importance of agriculture in order to understand the inquiries introduced in the other lessons.

Rationale
Students should understand how our daily lives are strongly connected to agriculture and the decisions that agricultural producers must make. Presenting students with “I can...”

statements can help focus their learning and provide a context for assessment with this lesson's activities.

Inquiry
Where does our food supply come from and why should we care?

Preparation
The following handouts, materials, and resources are used in this lesson:
• Handouts
  • Briefing Notes 1A: The Importance of Agriculture
  • Student Resource 1B: KWHL Chart
 • Chart paper
• Poster paper
• Classroom and Internet resources about agricultural products and different types of crops

"I CAN"
Lesson One encourages students to demonstrate their learning by developing understandings such as the following:
• I can describe how plants are an important source of food and raw materials.
• I can identify and discuss the connections between agricultural decisions, production, and human activities.

Lesson One: Teaching and Learning Strategies
In Lesson One, students explore the important uses of plants in agricultural food production and are introduced to the concept of sustainability in agriculture.

Introductory Activity
Students begin the lesson with a brainstorming session in which they brainstorm and think about the extent to which plants affect their daily lives.
Instructional Strategy: Cooperative Learning Board Share
A Board Share strategy asks students to work in small groups and brainstorm responses to a question. While the group brainstorms, an appointed recorder records the group's ideas on the board. The recorder is responsible for ensuring that all of the group's ideas are recorded.

Process
1. Ask students to think about ways that plants are an integral part of our daily lives. Consider specific goods and products we use every day that come from plants. Have students work with small groups to brainstorm their ideas, using a group share strategy such as a Board Share.
2. Record brainstormed ideas in the form of a brainstorming web on the whiteboard, blackboard, or chart paper.
3. Extend: Ask students to investigate what types of plants are used in some of the products they've brainstormed and explore where these plants have come from. Create a poster list and display the poster in the classroom.

Briefing Notes Activity
Students read and discuss the briefing notes with a partner. They explore the concept of sustainability as it relates to agriculture.

Instructional Strategy: Concept Web
Reading for meaning and summarizing main points by using a visual organizer, such as a concept web, requires students to synthesize information and critically evaluate relationships and connections to their prior knowledge and understandings.

Process
1. Provide each student with a copy of the Briefing Notes 1A: The Importance of Ask students to discuss or respond in writing to the Predict questions at the beginning of the handout.
2. Have students work with a small group to respond to the research questions in the handout. Use classroom and Internet resources to explore the agricultural products we need on a daily basis and the different types of crops that are grown to supply those needs.
3. Extend: Set up research stations in the classroom or computer room. Have each group of students rotate through computer or resource based stations to collect information.
4. Have students respond to the questions at the end of the handout.
Why do agricultural decisions affect people living in both urban and rural communities? In what ways? Why are these effects similar? What effects do you think may be different?
What do you think the differences are between environmental, economic and social sustainability?
5. Extend: Find, or have students bring, samples of different grain varieties – either seeds or actual plants. Can students distinguish between the varieties based on their physical appearance?

Closing Activity
Students complete a KWHL chart that introduces them to, and focuses on, the issue of sustainability.

Instructional Strategy: KWHL Chart
Group discussion, analysis, and synthesis of information encourages students to draw conclusions and ask questions that lead to further research. Using a visual organizer, such as a KWHL chart, encourages students to link their prior knowledge and understandings to ideas for further research.

Process
1. Introduce the critical issue to students by writing the issue question on the board. How should decisions about environmental and agricultural sustainability be balanced?
2. Have each student complete Student Resource 1B: KWHL Chart. Trade the chart with another student and discuss ideas that are similar and different.

3. Have students, in their small groups, discuss and record their response to the question. Share perspectives, responses, and ideas with the class.

Extension Activity
Students work with a small group to create a flowchart that shows the production process.

Instructional Strategy: Flow Chart
Visual representations and compilations of student research provide an opportunity to explore other viewpoints and opinions around a particular topic. A flowchart provides an alternate method of asking students to collect and organize research that emphasizes process and relationships between events. Students should be asked to not only collect and organize information in the flowchart, but also to examine and analyze the flowchart. They should be asked to identify the sequences of events and the effects of the process.

Process
- Have students work in small groups to create a flowchart, showing the various foods that result from different crops. Have each group select a crop on which to focus, and describe the process that takes a product from crop to table.

Briefing Notes 1A The Importance of Agriculture
Where does our food supply come from and why shouldwe care?

Predict
What roles do plants have in our society? Make a list of these roles. How have we used plants to help us meet our needs?

Extend
Where do most of the foods we eat come from? Plan a trip to a grocery store, check the labels on foods, and make a list of the places our foods come from.

Plants are Essential to Human Life
Plants are necessary for all life on Earth. Plants provide many things for the sustainability of life on our planet and are part of all ecosystems. They provide oxygen for all other living things to survive. They can help reduce the pollution by using carbon dioxide and provide food in natural food chains. They also can provide shelter, contribute to water quality, and prevent soil erosion. Plant vegetation in Canada can be grouped into four main categories: forest, tundra, barren, and agriculture.

Agriculture Provides the World's Food Supply
What does it take to feed people all over the world? As the world's population grows, we have become increasingly concerned with ways to increase our food supply. What has this meant?
Most of the food supply in the world is based on a few major crops. These crops provide a variety of foods that are necessary for sustaining life. Most of our food supply comes from crops like wheat, rice, corn or maize, potatoes, barley, cassava and sorghum. Canada grows 5% of the world's wheat. We also grow cereal crops, such as oats, barley,

rye and corn, and other major crops like canola and potatoes. Canada produces between 10 and 15 percent of the world's canola supply, depending on the year.
Nearly 75 percent of the world's food supply is based on seven major crops: wheat, rice, maize (corn), potatoes, barley, cassava, and sorghum. These crops are considered to be managed resources. This means that selected crops are grown in specific areas, depending on the needs and the best growing conditions of each crop. These managed resources are dependent on natural resources, like water and soil. Therefore, the choices we make about the ways we use both natural and managed resources are interrelated.

Find Information: Web Links
Start with these web links for future research about where food comes from: What's In Your Grocery Cart? www.statcan.ca/english/research/96-328-MIE/2004009/96-328-MIE2004009.pdf
Canadian Canola in Texas www.ntxe-news.com/artman/publish/article_33643.shtml

Explore
Select four different crops to research. Use a chart such as the one below to record your research.

- Identify each crop in the first row of the chart.
- Use the second row to identify and describe products that come from each crop.
- What different oilseed or grain varieties are available for one of the crops you selected? Use classroom or Internet resources to find out. In the third row of the chart, identify three to five available seed or grain varieties of the crop you selected.
- Work with another group that selected the same crop and combine your information. Work together to create a classification key that distinguishes between the different seed or grain varieties that you identified.
- Share your research on different seed or grain varieties with the rest of the class. Create a poster with images and descriptions of each seed or grain variety and identify the characteristics that can help differentiate between each. Identify the main adaptation for which each variety is recognized.

Crop				
Products (Consider both direct and indirect products)				

Oilseed or Grain Varieties				

Why are our choices so important?
Many people recognize that we need to make better decisions about managed and natural resources. The desire to protect resources while finding better ways to produce and use them is called sustainability.
Three different perspectives influence decisions and actions that support sustainability.

- Environmental sustainability perspectives recognize the impact that human activity has on the natural environment.
- Economic sustainability refers to the balance between the economic benefits of agriculture and effective production methods. This means that farmers want to be able to make a good living from their agricultural activities. Farming activities should provide a living for farmers from year to year.
- Social sustainability involves the quality of life in communities and areas associated with agriculture.

Breaking News
What is sustainable agriculture? 1 (1 Strang, Niki (2004). What is "sustainable" agriculture? Statistics Canada. www.statcan.ca/english/research/96-328-MIE/2004017/96-328-MIE2004017.pdf (July 5, 2006).)
When we talk about sustainability, there are three recognized components. While environmental sustainability gets the headlines, economic and social sustainability are also important. All affect and are affected by each other, and some balance among them is necessary for agriculture to be truly sustainable.
The idea of environmentally sustainable agriculture is not new, although the term may be. In 1987, the Brundtland Commission, established by the United Nations, characterized sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Environmental sustainability
In order to respond to a growing world population, farmers and researchers have found methods that continue to increase food production levels. Chemical fertilizers that increase soil fertility and pesticides to reduce pest problems have resulted in benefits, but they can also leave residues in soil and water. Some farming practices also continue to cause erosion and result in the loss of organic matter in the soil. There are other options to these practices, and the knowledge and technology exist to ensure that agriculture supports and sustains the environment. However, people must consider whether consumers or producers should be willing to pay more for agricultural products and production.

Economic sustainability

Economic sustainability involves questions of pricing for food and fibre products as well as costs of production. To be economically sustainable, agricultural production must cover costs and help farmers make a living. This can involves practices such as subsidies that support farmers when the supply of a product is more than the demand for it, and farmers sell the product for less than it costs to produce it.

Social sustainability

Social sustainability refers to the idea that agriculture should support and improve the quality of life of farmers and all people in society. What does this mean? Many believe that farming families should be able to earn a good living and live in a rural community that is stable and provides job and business options. Increasing urbanization has meant that populations in rural communities are decreasing, and goods and services are not always available. Some smaller farms have also been at risk, even through technology has enabled them to increase their production. This means that fewer and fewer family farms are thriving and less young people are attracted to agriculture as a way to make a living.

How do we know when agriculture is successful and sustainable? Production levels, efficient practices and profits often determine success in agriculture. Most industries and businesses are measured by these factors. It is increasingly important that farming operations are stable and able to support themselves.

Explore

Talk or write about the following questions.

- Why do agricultural decisions affect people living in both urban and rural communities? In what ways? Why are these effects similar? What effects do you think may be different?
- What do you think the differences are between environmental, economic and social sustainability?

Find Information: Web Links

Start with this web link for further research: The Pembina Institute: Agricultural Sustainability www.pembina.org/pdf/publications/38.%20Agriculture.pdf

Student Resource 1B KWHL Chart

How should decisions about environmental and agricultural sustainability be balanced? Agricultural producers make choices that affect our lives, because we use agricultural products daily. Producers must always balance their practices and base their decisions on the sustainability of agriculture and their effects on the environment. They must make decisions about how best to use technology and to what extent possible risks and consequences should be considered in the decisions they make. How should production and environmental protection be balanced?

What I Know	What I Want to Know More About	How I Will Find This Out	What I Learned

Defining Terms Write your definition for each term:
Sustainability:
Agricultural resources:
Environment:

Lesson Two: Change and Decisions

Overview
In Lesson Two, students examine different land management approaches in agriculture. They examine the extent of agricultural land use in Canada, and explore the benefits and risks of strategies such as pesticide use, irrigation, fertilizer, monoculture, and organic farming.

Rationale
Students build their understanding of the effects of agricultural activities on the environment and on crop production. Presenting students with “I can...” statements can help focus their learning and provide a context for assessment with this lesson’s activities.

Inquiry
To what extent does agriculture change natural environments?

Preparation
The following handouts, materials, and resources are used in this lesson:
- Handouts
  - Briefing Notes 2A: Change and Decisions
  - Student Resource 2B: Explore Opinions
- Chart paper
- Poster paper
- Classroom and Internet resources about agricultural products and different types of crops
- Atlases

Lesson Two: Teaching and Learning Strategies
In Lesson Two, students explore the causes and effects of land management strategies used in agriculture.

Introductory Activity
Students begin Lesson Two by considering the effects of human agricultural activities. They create a bubble chart and brainstorm questions for research and inquiry.

Instructional Strategy: Cause and Effect Bubble Chart
A cause-and-effect bubble chart is a visual organizer that encourages students to consider relationships between concepts. The cause-and-effect chart focuses on the relationship between needs and agricultural activities, and between agricultural activities and their effects.

Process
1. Have students use a visual organizer, such as the bubble chart below, to examine causes and effects of human agricultural activities. Have students start by brainstorming needs. Then, use the chart to:
- Identify human needs that are met by agricultural activities
- Identify the activities that meet those needs
- Describe the effects of these activities on ecosystems and the environment.

2. Have students create a bubble chart for each need identified.
3. Use the bubble charts to discuss the issues that are associated with each effect.
4. Extend: Have students add the following to their bubble charts:
- The benefits and costs of agricultural activities
- Any practical alternatives methods that could result in the same results.

Briefing Notes Activity
Students read and discuss the briefing notes with a small group. They focus on the choices that agricultural producers make and the consequences of these choices for crop production and the environment.

Instructional Strategy: Issues and Decisions
Research and inquiry processes that are centered on issues and decisions should address:
• The concepts related to the issue question: What does this mean? How should this be defined?
• The information connected with the issue: What are the facts? How can these facts be tested?
• The values and attitudes reflected in positions that people take: What points of view do people have? What are their opinions based on? 2 (2 Canadian Parks and Wilderness Society. Teaching controversial issues. www.cpawscalgary.org/education/action-challenge/teaching-controversial-issues.html (July 5, 2006).)

Pesticides are governed by regulations and laws both federally and provincially. These regulations can be accessed at: http://strategis.ic.gc.ca/canadian_industry_statistics/cis.nsf/IDE/cis3253defe.html and www.qp.gov.ab.ca/documents/Regs/1997_043.cfm?frm_isbn=0779723864

Process
1. Provide each student with a copy of the Briefing Notes 2A: Change and Decisions. Ask students to discuss or respond in writing to the Predict questions at the beginning of the handout.
2. Have students work with a small group to explore the extent of land management in Canada, and methods that agricultural producers use.
3. Assign each group an environmental condition to investigate. Have groups use classroom resources, the Internet and other research sources to identify the challenges or problems associated with each condition and the possible actions farmers can take. Then, have each group develop questions that could be used to test the effectiveness of each action. How would we know if the action was effective for crop production? How would we know what effect it would have on the environment?
4. Ask students to use the format provided in the briefing notes and contribute their research to a class chart.
5. Provide each group with Student Handout 2B: Explore Opinions. Have groups use classroom and Internet resources to find out how others view the land management decisions made about the condition they are focusing on. Have groups discuss and record their opinions and provide evidence and research to support it.

Closing Activity
Students share their research evidence with others in the class in a cooperative learning carousel.

Instructional Strategy: Cooperative Learning Carousel
A carousel allows students to share research and learning with other students or groups in the class. Each group organizes a display of their research results on their group table. Place a comment sheet on each group table. Groups rotate through the displays at timed intervals. One group member can remain with their displays to present group research

and ask visiting groups to record questions or comments. Alternatively, groups can stay together and be asked to record their comments or questions on the comment sheet on each table. The carousel strategy encourages students to develop presentation and communication skills in a small group setting instead of in front of the entire class.

Process

1. Have each group organize and display the research on the condition they investigated. Share research results with the class using a carousel sharing strategy.
2. Discuss the effectiveness and processes used to complete the research in a group setting. Ask each group to reflect on the group processes they used to work together.
3. Extend: Have students work with a partner to develop a concept web, such as the one below, showing the different results from composting and mulches compared to fertilizer use. Have students consider the reasons for using each method, and the pros and cons involved. Students create a poster advertisement related to a current issue in agricultural ways of life.
4. Extend: Have students consider which of these methods would work more effectively in small and large scale farming operations.

Extension Activity

Students apply their research to an exploration of different ecosystems.

Instructional Strategy: Comparison Charts

Comparison charts are an effective way for students to develop research skills in both collecting and organizing research data. Comparison charts can encourage the collection of information from multiple sources and the consideration of multiple perspectives.

Process

1. Have students work with a partner to identify other resources that they can use to research different types of ecosystems in which agricultural activities take place:
    - Wetlands
    - Grassland
    - Forest
2. Have students use these resources to collect data using a comparison chart using a format such as the one below. Have students consider which agricultural activities are best suited to different ecosystems.

Changes in Canola Production in Alberta

This website provides information on the increases or decreases in canola production for different ecosystem regions.

www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag3416

Type of ecosystem	Characteristics of the ecosystem	Examples of human agricultural activities in the ecosystem	What human needs are met through these activities

Wetlands			
Grasslands			
Boreal Forests			

3. Have students use their comparison charts to compare the characteristics, uses, and effects of human activity for of each type of ecosystem. Have students identify intended and unintended consequences of human agricultural activities in these ecosystems.
4. Have students use the information they collect to create a model of their own test field. Have them research processes and methods used to increase yields, through modifying the environment and by creating artificial environments (e.g., processes used in raising bedding plants or in vegetable production through hydroponics). Have groups create models of what a "test field" would look like to implement these processes and methods.

Briefing Notes 2A Change and Decisions
To what extent does agriculture change natural environments?

Predict
In what ways do agricultural activities affect the way people view and use the land? What are the positive and negative effects of this land use?
Canada's Agricultural Land
Canada has a rich land base. There are over 68 million hectares of farmland, in which different varieties of crops are grown. When decisions are made to clear land for crops, original ecosystems and environments are affected.

Explore
Compare a map of Canada's agricultural land use with a map that shows Canada's ecological regions. Talk or write about the following questions.
• What regions are affected by agriculture?
• In what ways do you think agricultural activities have changed them?

A map of Canada's agricultural land can be found in the article, First you take an ecumene.... This article is available from Statistics Canada on the website : www.statcan.ca/english/research/ 96-328-MIE/2004002/96-328-MIE2004002.pdf

Managing the Environment
What choices have farmers made to adapt to the environment in Canadian farming? In order to deal with challenges that the natural environment brings to crop production, farmers have made decisions to try to increase their crop yields and health.

Pesticides

What is a pesticide? Pesticides are chemicals that kill pests such as harmful insects, weeds, and fungi. They can be natural or synthetic and include chemical pesticides, fungicides, herbicides, insecticides, and antibiotics. Some pesticides are natural. For example, ladybugs have been used as a type of pesticide in greenhouses, where they are released to control aphids. Farmers use pesticides to maintain their crops or increase their yields. Pesticides can help farmers grow more food using less land, and decrease crop loss to insects, diseases, and weeds.
The application of natural pesticides or herbicides is one method that has been used to decrease harmful weeds. Sometimes, they are used with other methods like direct seeding and increasing the number of seeds per hectare to try to increase the number of plants and decrease the opportunity for weeds to grow. All of these methods can reduce the need to plough fields extensively. Less ploughing has helped to reduce the loss of topsoil and soil erosion. However, some pesticides can be harmful to the animal life, useful insects, and can contaminate the water supply.

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Types of Pesticides 3 (3 U.S. Environmental Protection Agency. Types of pesticides. www.epa.gov/pesticides/about/types.htm (July 7, 2006).)
The Environmental Protection Agency in the United States categorizes pesticides based on the types of pests they are designed to eliminate:

- algicides: control algae in lakes, canals, swimming pools, water tanks, and other sites.
- antifouling agents: kill or repel organisms that attach to underwater surfaces, such as boat bottoms.
- antimicrobials: kill microorganisms (such as bacteria and viruses).
- attractants: attract pests (for example, to lure an insect or rodent to a trap. however, food is not considered a pesticide when used as an attractant.)
- biopesticides: biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.
- biocides: kill microorganisms.
- disinfectants and sanitizers: kill or inactivate disease-producing microorganisms

on
inanimate objects.
- fungicides: kill fungi (including blights, mildews, moulds, and rusts).
- fumigants: produce gas or vapour intended to destroy pests in building or soil.
- herbicides: kill weeds and other plants that grow where they are not wanted.
- insecticides: kill insects and other arthropods.
- miticides (also called acaricides): kill mites that feed on plants and animals.
- microbial pesticides: microorganisms that kill, inhibit, or out-compete pests, including insects or other microorganisms.
- molluscicides: kill snails and slugs.
- nematicides: kill nematodes (microscopic, worm-like organisms that feed on plant roots).
- ovicides: kill eggs of insects and mites.
- pheromones: biochemicals used to disrupt the mating behaviour of insects.
- repellents: repel pests, including insects (such as mosquitoes) and birds.
- rodenticides: control mice and other rodents.

The term pesticide also includes these substances:
- defoliants: cause leaves or other foliage to drop from a plant, usually to facilitate harvest.
- desiccants: promote drying of living tissues, such as unwanted plant tops.
- insect growth regulators: disrupt the moulting, maturity from pupal stage to adult or other life processes of insects.
- plant growth regulators: substances (excluding fertilizers or other plant nutrients) that alter the expected growth, flowering, or reproduction rate of plants.

Irrigation

In some areas, farmers need to use irrigation. Irrigation brings ground water that is not available from natural precipitation up to the surface. Although irrigation can be essential to good crop yields and health, it can also bring negative effects. Intensive irrigation can increase the salinity, or the concentration of mineral salts in the topsoil. This can damage soil by making it infertile; it can also jeopardize animal habitats. The process of irrigation of ground water can also reduce the natural underground water reserves. When surface water is used for irrigation, it can carry contamination along with it.

Fertilizers

The use of fertilizers helps to increase crop yields and enhance crop health. Farmers use commercial fertilizers, meals (bone, canola, etc.), and manure. Fertilizers help enrich the soil by adding nutrients beneficial to crop growth. However, too much fertilizer or the wrong type of fertilizer can cause environmental problems.

Opinions on the Use of Fertilizer

Farmers commit to using fertilizers responsibly. Fertilizer is expensive and farmers cannot afford to use more than is necessary to benefit their crops. They say that fertilizers can be used in ways that reduce the risk of pollution to the soil and the groundwater, as well as to minimize the odours associated with the use of manure.

Scientists recognize that fertilizer use is linked to issues of water quality, soil health, and the application of nutrients, both on farms and in urban gardens. Nitrogen is an important nutrient for crops. The presence of nitrogen is what makes manure a good fertilizer for crops. The ability to determine the nitrogen content of manure helps farmers make sure they do not apply too much. Scientists believe that as the size of farms increase, efforts must be made to find more effective ways to use fertilizer to benefit crop yields and minimize risks to the environment.

Some governments have introduced bylaws to control the size and location of barns and the use of manure. There are not always consistent bylaws and/or enforcement in different communities. Many farm groups have worked with governments to develop guidelines for the responsible use and storage of manure on farms.

Monoculture

Many farmers plant only one type of crop in a field. This is called monoculture. This practice can benefit the farmer because crops are easier to manage and less expensive to harvest and care for. However, monoculture can result in increased insect populations that are attracted to a specific type of crop. This means that farmers have to find ways to control insects, which often requires increased use of pesticides. Crops that are planted too many times in a row in the same field can rob the soils of their nutrients. This means that farmers may have to use more fertilizer each successive year. However, these nutrients can often be replaced naturally when crops are grown in rotation. Farmers need to consider the potential for crop rotation as a natural method of enhancing soil nutrients as they plan from year to year.

Another unintended consequence of monoculture is its potential to reduce the natural diversity of the environment. This occurs when only one habitat is available for plant and animal life for an extended period of time.

Organic Food Production

Some farmers use alternatives to pesticides and chemical fertilizers. Organic food, by definition, is grown without chemical fertilizers and chemical pesticides by using a variety of alternative methods. Many of these methods are similar to traditional farming methods used for centuries, before technology allowed us to introduce chemical pesticides and fertilizers. Organic farmers add nutrients to the soil by using manure, high quality protein meals, and compost. To reduce pests, they rely on rotating crops and tilling the soil. Mulch is added to increase the vitality of the crops and reduce weaknesses. Insects and weeds are removed by hand. Other plants that repel insects are planted with the main crops.

Organic farming can increase the taste quality of the crop and reduce potentially harmful effects of pesticides on the environment and people. However, it can be more expensive for the farmer because the yields are often lower and the cost of labour is higher. This raises concerns over the ability to produce enough food to adequately feed the population that is economically affordable, both for the producer and the consumer.

What challenges do farmers deal with?
Farmers face the challenge of trying to increase their crop yields and minimize their cost base while making sure they protect the land and animals upon which their future production ability depends. They must balance the use of pesticides to increase crop yields and health with concerns over the possible harmful effects of these pesticides. They must also decide when to plant crops and how to minimize the need for fuel and fertilizer. Some of the methods that farmers can use to protect the environment are more costly to implement. This can mean that farmers do not make enough profit on their crops to earn a good living.

Explore
Create a class chart such as the one below, that outlines the process you would follow to investigate the causes and effects of actions agricultural producers take once they decide which crop to plant. Work in a small group to select one condition and develop a plan to research:
• The challenges associated with growing this crop under this condition
• The possible actions that farmers can take to improve the condition
• The specific questions that would test whether each action would be effective
• The most effective action
• The effect this action would have on crops and the environment

Conditions	Problems or Challenges of this Condition	Possible Actions	Specific Questions that Would Test Which Action is Most Effective	Our Prediction – Effect on the Crop and Environment
Dry conditions				
Insect infestations				
Soil with insufficient nutrients				
Diseased crops				

Find Information: Web Links
Start with these web links for further research: Watering our Prairie farms
www.statcan.ca/english/research/96-328-MIE/2004010/96-328-MIE2004010.pdf
It's waste and a valuable resource too www.statcan.ca/english/research/96-328-MIE/2004006/96-328-MIE2004006.pdf
Protecting crops from pests www.statcan.ca/english/research/96-328-MIE/2004011/96-328-MIE2004011.pdf
There's more to organic farming than being pesticide-free
www.statcan.ca/english/research/96-328-MIE/2004018/96-328-MIE2004018.pdf
Harvest Race http://science.gc.ca/default.asp?Lang=En&n=65B968F8-1
Alberta Agriculture, Food and Rural Development – Diseases, Insects, Pests
www.agric.gov.ab.ca/app21/seltopcat?cat1=Diseases%2FInsects%2FPests
Soil conservation management in Prince Edward Island
http://gov.pe.ca/af/agweb/index.php3?number=71764

Student Resource 2B Explore Opinions
Land Management Options
Opinion 1
Opinion 2
Opinion 3
Our Opinion and Supporting Evidence

Lesson Three: Needs and Innovations

Overview
In Lesson Three, students explore the impact of agricultural innovations on crop production and the environment. They examine the impact that selective breeding and genetic engineering has had on crop production. Students also explore the example of canola, and consider the intentional and unintentional impact of genetic technology on crops like canola. Lesson Three encourages students to build understandings that help inform their perspective on the balance between increased crop production technologies and economic and environmental sustainability.

Rationale
Students develop their understanding of selective breeding and genetic technologies as well as their intentional and unintentional effects. Presenting students with "I can..." statements can help focus their learning and provide a context for assessment with this lesson's activities.

Inquiry
What short- and long-term effects can agricultural innovations have?

Preparation
The following handouts, materials, and resources are used in this lesson:
- Handouts
  - Briefing Notes 3A: Needs and Innovations
- Sources of information on what the local community might have looked like before it was inhabited and built up by people

"I CAN"
Lesson Three encourages students to demonstrate their learning by developing understandings such as the following:
- I can identify the short- and long-term effects of technology on agricultural production and ways of life.
- I can I can use evidence and data to compare and analyze the consequences of technology based innovations on agricultural practices.

Lesson Three: Teaching and Learning Strategies

In Lesson Three, students examine selective breeding and genetic technology and explore different perspectives on the balance between increased crop production technologies and economic and environmental sustainability.

Introductory Activity
Students create a predictive timeline to explore their understandings of how technology influenced agriculture in the past, the impact of technology today, and where it may lead agriculture in the future. Students then have the opportunity to ask questions about what effects technology and innovation have on agricultural production and how this impacts our lives today and to predict how it may affect our lives in the future.

Instructional Strategy: Predictive Timeline
Asking students to predict and make inferences develops critical thinking skills. Timelines can emphasize these skills and encourage students to consider how change and innovation affects daily living and scientific knowledge. Applied to agricultural innovations, a predictive timeline can encourage students to ask questions about where technology was in the past, analyze how it is applied today, and predict where it may lead us. A predictive timeline can be completed by having students brainstorm what they think agricultural technology and innovations looked like 100 years ago, what is used today, and what changes the future may bring.

Process
1. Introduce the inquiry question to students: What effects do agricultural innovations have on ways of life? Ask students to brainstorm the types of technology that agriculture uses today. Use the discussion to have students consider the broad applications of technology in agriculture: machinery, research and scientific technology, and information technology.

2. Have students work with a partner to create a predictive timeline. Ask them to describe technology they think was used in agriculture 100 years ago, technology used today, and what they think agricultural technology might look like in 100 years. Have students use a simple 3-box timeline such as the one below to record their ideas.
3. Extend: Students can research technology used in agriculture 100 years ago and today to support their predictions and add to their timelines.

Agricultural Technology 100 Years Ago
Agricultural Technology Today
Agricultural Technology 100 Years from Now

Briefing Notes Activity
Students read and discuss the briefing notes with a small group. They are introduced to trends and issues associated with agricultural technology and innovations, such as selective breeding and genetic engineering, as well as some intended and unintentional consequences of these innovations.

Instructional Strategy: Retrieval Charts Retrieval charts are an effective way for students to develop research skills in both collecting and organizing research data. Retrieval charts can encourage the collection of information from multiple sources and the consideration of multiple perspectives. The data and information collected in a retrieval chart provide the basis for an essay that identifies and supports a personal stance on an issue.

Process
1. Provide each student with Briefing Notes 3A: Needs and Innovations. Ask students to discuss or respond in writing to the Predict questions at the beginning of the handout.
2. Have students work with a small group to investigate and identify the needs leading to the development of new crop varieties through selective breeding and genetic engineering, and identify related needs and problems in developing new plant varieties. Students will also consider the benefits and some unintentional consequences of genetic technology, using canola as an example.
3. Have students complete the following retrieval chart, including one or two other examples of crops developed through selective breeding or genetic technology.
4. Have students work individually to write a short argumentative essay taking a position on the issue: "Should there be unlimited ways in which crop varieties are developed?"

A teaching resource on the topic of biotechnology is available from the Alberta Canola Producers Commission, or at www.canolalearningcentre.com

Type of crop	Intended Benefits	Unintentional consequences and challenges

Canola		

Closing Activity
Students present different perspectives on the effects of agricultural innovations and technology.

Instructional Strategy: Cooperative Learning Stand and Share
Spencer Kagen's Stand and Share cooperative learning structure provides a quick opportunity for students to share learning and perspectives orally with classmates. In Stand and Share, all students stand by their desks. They are asked to volunteer to share an insight, learning, or perspective on a topic. Once one student has presented an idea, others who have the same idea can sit down. The sharing continues until all students are sitting down.

Process
1. Have each student share an insight or perspective from their research on innovation and the application of genetic technology in agriculture, using the Stand and Share strategy.
2. As ideas are presented, encourage students to consider alternate perspectives. Continue presenting and discussing ideas until all students are seated. The following questions can help generate class discussion:
• What kinds of decisions about genetic technology can affect ecosystems? How do these decisions result in positive and negative effects?
• What factors should be considered before deciding about the use of genetic technology and genetically modified agricultural products?
• To what extent should farmers and the agricultural industry be consulted in decision making about the use of genetic technology?
• Genetic technology can be very expensive. Who should bear the costs involved?
• If farmers' costs increase because of the use of genetic technology, the result could be further decline for family farming. How would this affect you and the people around you?

Extension Activity

Students explore how changes that occur in a community over time can result in improvements and challenges to the environment and to ways of life.

Instructional Strategy: Community Participation
Community participation provides an opportunity for students to engage as citizens in and contribute to their communities. Applying learning and engaging in research that is connected to the local community extends the inquiry process and develops values and attitudes associated with active and responsible citizenship.

Process
1. Have students work with a small group to create a view of what their community might have looked like before it was inhabited and built up by people. Ask groups to research the natural vegetation, landforms, and environmental conditions of the area to create a drawing of the community before habitation.
2. Have students identify what has changed over time as a result of human activities. They may identify urban development, agricultural development, changes to soil, vegetation, water resources, and climate, and changes in available products and technology, depending on the community resources that may be available for them to use in their research.
3. Have each group consider and discuss what has improved over time, and has deteriorated.
4. Ask the class to consider how people can address the concerns identified by each group. What changes in technology help us improve environmental and of life conditions? What changes in ways of life may be necessary to make improvements?

Briefing Notes 3A Needs and Innovations
What short- and long-term effects can agricultural innovations have?

Predict
What is an innovation?
What agricultural innovations can you describe?
To what extent do you think these innovations improve our quality of life?
What risks do you think innovations can bring?

Agriculture's history is full of innovations. Farmers, scientists, and researchers continually look for new ways to improve crop yields and the health of plants and animals. Innovation has often involved the application of science and technology.

Developing Better Crops
Plants depend on environmental conditions for healthy growth; some plants are more suited to specific environments than are others. Early settlers, who brought varieties of wheat they formerly grew in Europe to Canada, found this out. Plants that could withstand colder temperatures and shorter growing seasons are needed to grow successful crops in Canada.

Farmers select plants with the characteristics that work best in their environments. They select plants for characteristics such as:
• the ability to grow in different environmental conditions
• how much food is produced (i.e., crop yield)
• resistance to disease
• appearance

The selection and reproduction of plants with specific characteristics is called selective breeding. What advantages do you think the practice of selective breeding brings? What risks do you think might come with selective breeding?
As populations increase and conditions change, new and improved varieties of plants are always needed. For example, new diseases can attack plants that were previously resistant to known forms of disease. As plants evolve and change, the pests and diseases that affect those plants will also evolve and change. And farmers are always looking to increase their crop yields. Over the years, scientists have continued to research and create new varieties of plants.

Explore
Talk or write about the following questions.
• What needs have led to innovations in crops and agricultural techniques?
• In what ways have people made changes to their environments to meet these needs?
• What role do you think changing weather patterns have in crop innovations?
• What are some examples of agricultural innovations?
• What benefits and risks have resulted from these innovations?

Find Information: Web Links
Start with these web links for further research: Prairie farmers have always found a way to adapt www.statcan.ca/english/research/96-328-MIE/2004012/96-328-MIE2004012.pdf
The rise and fall of fall rye www.statcan.ca/english/research/96-328-MIE/2004014/96-328-MIE2004014.pdf
A Science Fiction Harvest www.statcan.ca/english/research/96-328-MIE/2004026/96-328-MIE2004026.pdf

Breaking News
Genetic Technology
In the last few years, scientists have developed the technology to take a gene from one organism and move it to another. This form of gene technology is called genetic engineering. It allows scientists to blend the characteristics of one plant with another by combining genes. Gene technology lets scientists select specific characteristics of one or more organisms to blend with another organism. It also lets scientists take genes from one species and use them in another species. For example, insecticide-producing genes can be added to a plant to make it resistant to insects. This blending of genes, particularly between species, has led to many controversial issues and questions.
The new crop varieties that are developed through genetic technology can result in many benefits. Crop yield can be increased if the plants are designed to be resistant to disease, insects, and specific pesticides. Plants can also be designed to be more tolerant of drought

conditions and short growing seasons. However, the introduction of new crop varieties may also present new challenges and some unexpected and unintended consequences. Genetically modified plants may require more fertilizer or different pesticides. These modifications can increase the farmer's costs, both in the initial purchase of genetically engineered seed and during a growing phase that requires care that is potentially more expensive. Genetic modifications can also cause unintended harm to the environment.

What is genetic engineering? 4 (4 Canola Information Service. Canola & Biotechnology; Citizen's Conference Website:
FAQs - www.acs.ucalgary.ca/~pubconf/whatis.html.
www.canolainfo.org/resources/faq.html July 7, 2006).)
The term genetic engineering is often used interchangeably with biotechnology. It is another term that is used to describe genetic technology. Products developed by biotechnology are sometimes described as "genetically engineered" or "genetically modified."

What is biotechnology?
Biotechnology, as defined in the Canadian Environmental Protection Act, is the application of science and engineering in the use of living organisms, or parts or products of living organisms, in their natural or modified forms. Examples of biotechnology include the production of products like yogurt or cheese. These products are made by applying bacteria to other food products. Genetic engineering is another type of biotechnology.
What are the benefits of biotechnology? 5 (5 Saskatchewan Agricultural Biotechnology Information Center (SABIC), Ag-West Biotech Inc. Crop biotechnology: Harvesting the benefits. www.canolainfo.org/resources/faq.html (July 7, 2006).)
Biotechnology lets us change food products to taste different or better. Many people believe that genetically engineered plant varieties can provide benefits to farmers with crops that are less vulnerable to pests and weather conditions. Some examples include potato beetle resistant potatoes, virus resistant squash, insect-resistant corn, herbicide tolerant canola and soybean, or tomatoes that ripen more slowly. These genetically modified foods have been created through genetic technology.

What are some examples of genetically modified products? 6 (6 Ibid.)
Crops that have been approved for use in Canada include:

- corn – herbicide resistant, insect resistant and insect resistant and herbicide tolerant, hybridized corn system
- canola – herbicide tolerant canola, specialty oil canola, hybridized canola system
- tomato (approved but not grown in Canada) – delayed ripening tomato, reduced pectin degradation tomato
- potato – potato beetle resistant potato
- soybean – herbicide tolerant soybean
- cotton (approved for import into Canada) – insect resistant cotton, herbicide resistant cotton
- flax (approved but not grown commercially) – herbicide tolerant flax
- squash - virus resistant squash

How can I be sure genetically engineered products are safe? 7 (7 The Consumers Association of Canada. A growing appetite for information. www.canolainfo.org/resources/faq.html (July 7, 2006).)
Some people have raised questions about the safety of genetically engineered food products. These questions are ongoing and have led to different opinions and perspectives on the ethics and safety of genetically modified foods. Scientists and farmers both continue to deal with issues surrounding the safety of foods.
The government passes safety regulations to make sure that the products created by both genetically engineering and traditional growing methods are safe:
• Health Canada is responsible for the regulation of "novel foods." Novel foods include those that have not previously been used as food, food resulting from genetic modification and foods modified from traditional products using new processes or microorganisms.
• Health Canada and the Canadian Food Inspection Agency share responsibilities for the safety of novel foods developed using agricultural biotechnology.
• The Canadian Food Inspection Agency conducts safety assessments on fertilizers, seeds, plants, animals, animal vaccines or diagnostics and feeds. The Agency also establishes food labelling policies with respect to non-health and safety matters.
• Each biotech product is assessed on a case-by-case basis. Only products that meet standards set by these agencies and that are considered safe for humans, plants, animals and the environment will be approved.

How do we know if a food has come from a genetically engineered product? 8 (8 Ibid.)
• Labelling is voluntary. Since the application of biotechnology is generally regarded as an extension of existing breeding techniques, the rules and laws applied to traditional food products is deemed suitable for biotechnology products.
• Whenever the genetic engineering of a product involves a health or safety issue, it must be labelled. The issues of concern could include whether or not people with allergies may be at risk, or a change in nutritional value, i.e. a tomato modified to contain higher levels of lycopene.
Food manufacturers may choose to use labels promoting the fact that the products have or have not been modified through genetic engineering.

Explore
Talk or write about the following questions.
• What are some conflicting points of view about the use of genetic engineering? What do you think the merits of each point of view are? What points and facts would you use to argue for or against the use of genetic engineering in food production?

Find Information: Web Links
Start with these web links for further research: Concerns about the ethics of genetic modification www.plant.uoguelph.ca/research/homepages/eclark/lehman.htm

Genetics provides opportunity to feed world, experts say
http://usinfo.state.gov/xarchives/display.html?p=washfile-english&y=2005&m=October&x=200510 27134033SAikceinawz0.7631189&t=livefeeds/wf-latest.html

A Case in Point: Canola 9 (9 Case Study adapted from Canola Council of Canada. Canada's canola book.
www.canolainfo.org/newsite/resources/faq.html (July 7, 2006).)
Canola is an oilseed crop that was developed using selective breeding and genetic technology. Canola originated from a plant called rapeseed. Rapeseed did not produce edible oils; only oils that could be used in machinery. Canola was developed to produce seeds that created a healthier, lighter oil. Canola crops are now more resistant to diseases, drought, and even certain chemicals. An example of a risk, however, is that canola might also cross-pollinate with natural vegetation or weeds. What do you think could result from this?
Most of Canada's canola is grown in the west. Canola's history goes back to the rapeseed plant, but canola and rapeseed are not the same. Canola and rapeseed are different; therefore, the names cannot be used interchangeably. In 1970s, Canadian plant breeders produced canola through traditional plant breeding techniques. The major differences are reduced levels of both glucosinolates (which contribute to the sharp taste in mustard and rapeseed) and licosenic and erucic acids (two fatty acids not essential for human growth) in canola. "Canola" refers to varieties with two percent or less erucic acid in the oil and 30 micromoles per gram or less of the normally measured glucosinolates in the meal. In Canada, rapeseed is now grown only under special contract and is used for industrial purposes.

What decisions do canola producers make?
When agricultural producers make decisions about which crop to grow, they look at many factors. They evaluate the potential crop price, determine their production cost, their anticipated yield, and grow the crop that will provide the highest net return per hectare. Producers also evaluate the cost of growing genetically modified varieties versus conventional varieties of canola to determine the most cost-effective crop to produce on their farm. Genetically modified crops can sometimes result in higher canola yields, especially under high weed pressure. Higher yields versus production costs must be evaluated to determine crop profitability.
In the future, there can be many potential consumer benefits from the use of biotechnology and genetically modified organisms. The canola plant can be modified to use in the production of pharmaceutical products. A number of different canola types could be developed which would have different fatty acid profiles for specific markets. Developing these products can result in improving the nutritional quality of canola to benefit consumers. Biotechnology can improve the development of different canola types to meet different specialty needs such as frying, salad oils, or specialty uses.
Consumers have to be satisfied with current products at the grocery stores for producers to maintain the economic viability of canola production in Canada. Canola producers would like to ensure consumers receive accurate and factual scientific information that is available to make an assessment on the utilization of genetically modified or non-genetically modified products.

The nutritional qualities of canola oil include a low level of saturated fat compared to other edible oils. Working with private industry, agricultural scientists have developed a canola additive that can be added to diesel fuel. The addition of low saturated fat content to diesel fuel, such as that provided by canola, is linked to improved performance in cold weather. This addition improves diesel's lubricity (slipperiness) and reduces engine wear at very low temperatures. Not only that... adding 160 million kilograms of canola oil lubricant could save 1.1 billion kilograms of diesel fuel and prevent the emission of 3 billion kilograms of carbon dioxide into the atmosphere!

Did you know?
Canada, like many other countries, is developing standards and regulations that will permit the development of a vegetable oil biodiesel industry. Find out more on these websites:
www.canola-council.org/biodiesel/
www.fleetchallenge.ca/en/library/index.html#biodieselcalc

What does canola look like?
Each canola plant grows anywhere from two-thirds of a meter to two meters tall and produces groups of yellow flowers which, in turn, produce seed pods about five centimetres long. Each pod turns brown as it ripens and contains twenty or more tiny round black or brownish-yellow seeds. Each seed contains at least 40 percent oil and therefore, canola is classed as an oilseed.

How is canola produced?
Canola is a cool-season crop that grows particularly well on the prairies where cool night temperatures allow it to recover from hot days and limited amounts of rainfall. Growing and harvesting canola requires the same machinery used in growing cereal crops (wheat, oats and barley). This allows farmers to switch to canola production without large cash expenditures.
There are two main types of canola grown, the short growing season Polish type (Brassica rapa, a brown/yellow seed) and the longer season Argentine type (Brassica napus, a black seed). Fields are cultivated, seeded, fertilized, and herbicides/pesticides may be applied to control insects, weeds, and diseases.
Growing canola requires careful management on the part of the farmer as the crop has to be closely monitored in order to make sure it doesn't become diseased. Seedlings emerge four to ten days after planting. From a taproot, bottom leaves form a rosette, which send up a flower stalk as the plant grows. The flowering stage lasts 14 to 21 days and prairie fields at this time are a sea of brilliant yellow flowers. The flowers of the Polish type canola are fertilized by the wind and the Argentine type is self-fertilized. Bees, visiting the flowers for nectar pollinate the flowers by carrying pollen. Once the flowers are fertilized, pods form, which take 35 to 45 days to fill. The field is swathed when about one-half of the seedpods have turned color from green to yellow or brown. The swathed crop dries for approximately ten days and is then harvested.

Explore

• What does the life cycle of the canola plant look like? Use a diagram such as the one below to illustrate the life cycle.
• What are the characteristics of a healthy canola plant?

What challenges does canola present to the farmer?
Canola seed is very fine (about the size of a radish or turnip seed) and it must be planted shallow in a moist seedbed so the seed can germinate. Since canola is subject to attack by several diseases and insects, canola is grown only one year in four on the same field. Seed treatment is used to reduce seedling disease and early flea beetle attacks. Herbicides are used to control weed growth.

Where does canola go when it leaves the farm?
Approximately 45 percent of canola production is trucked to the nearest processor where it is crushed for oil. Plants are located across Manitoba, Saskatchewan, and Alberta. Seed delivered to a processing plant is graded according to a strict grading standard established and maintained by the Canadian Grain Commission. Payment to the farmer is based on grades that range from Canada No. 1 Canola to sample grade. Graded seed is then cleaned to remove plant stalks, grain seeds, and other materials. Processing canola involves heating and crushing the seeds to release the oil. Once the oil is extracted, it is mixed and processed according to meet end product requirements. Different treatments are used to process salad oils, margarines, and shortenings. The leftover meal is processed into pellets or mash. The United States is our largest importer of canola oil and meal. Approximately 40 percent of Canada's canola seed is directly exported to Japan for processing by Japanese crushers. Some canola seed is exported to Mexico, China, and Europe. Canola meal is exported to Indonesia, South Korea, Pakistan, and Pacific Rim countries.

Who uses canola oil and canola products?
Canola oil is recognized for its nutritional qualities. It contains the lowest level of saturated fat of any fat or oil on the market. It is high in both monounsaturated fat (which may lower LDL cholesterol levels) and polyunsaturated fats, which are essential in human diets. Canadians are the largest per capita consumers of canola oil foodstuffs in the world. Canola is used in 80 percent of the salad oil market, 56 percent of the shortening market, and 42 percent of the margarine market. Besides being used in cooking oil and sprays, salad dressings, margarines and shortenings, canola oil is also used in deep frying, baking, sandwich spreads, coffee whiteners, and creamers. Consumer products containing canola carry the canola flower logo. Canola oil is also utilized in inedible products such as cosmetics, printing inks, suntan oils, oiled fabrics, plasticizers, plastic wraps, pesticides, and industrial lubricants. Research is underway to discover other uses such as plastic tubing and industrial oils. Canola meal is used as fertilizer and as high protein feed for livestock, poultry, fish and pets.

Who is involved in producing and marketing canola?
Canola production provides jobs for many people:
• canola farmers
• canola seed growers

• plant breeders
• farm implement dealers and mechanics
• agricultural products sales personnel
• chemists at crushing plants and the Canadian grain commission
• transporters/truckers/railway workers
• grain inspectors
• agronomists
• oil processors and refiners
• food manufacturers
• ship crew/dock workers
• nutrition researchers (animal and human)
• chefs

What soil types are required? How often should the crop be rotated?

Canola is a cool season crop that requires more available moisture than wheat, as well as cool night temperatures to recover from extreme heat or dry weather. Although canola grows well in most soil types, it is best suited to loamy soils that do not crust severely and hamper seedling emergence. Good yields can also be obtained when the crop is grown in peat and heavy clay soils. Canola can be grown on summer fallow fields or it may be incorporated into a continuous cropping system with cereals, legumes or other break crops. A firm, moist seedbed is critical for the small seeds of this crop. Canola yields can be severely reduced by diseases such as blackleg, Scleotinia wilt, and Rhizoctonia root rot. Good crop management, including adequate rotation with other crops, can substantially reduce the impact of these and other diseases. Canola should be grown on land that is relatively weed free. Canola should be grown one in four years on the same field.

Explore

Talk or write about the following questions.

How does canola provide an example of a plant affected by both selective breeding and the use of genetic technology?

What advantages has the selective and genetic breeding of canola provided to agricultural production?

Have there been any unintentional consequences to the breeding of canola? What are they?

What challenges do canola producers face? What choices do you think canola producers have in meeting these challenges?

Find Information: Web Links

Start with this web link for further research:

The Impact of Canola-Based Biodiesel Industry in Canada www.canola-council.org/biodiesel/16993newsletterfinal.pdf

Lesson Four: Influences and Sustainability

Overview In Lesson Four, students revisit their understanding of sustainability and explore the issue of balanced decision making. They examine the impact that

environmental and economic decision making has on the implementation of sustainable agricultural practices, and research some different points of view on sustainability. Lesson Four encourages students to deepen their understanding of sustainability and start to develop their own opinions.

Rationale
Students deepen their understanding of the decisions and consequences involved in developing sustainable agricultural practices. Presenting students with "I can..." statements can help focus their learning and provide a context for assessment with this lesson's activities.

Inquiry
How can management practices and agricultural decisions ensure sustainability?

Preparation
The following handouts, materials, and resources are used in this lesson:
• Handouts
  • Briefing Notes 4A: Influences and Sustainability
  • Student Resource 1B: KWHL Chart (from Lesson One)
• Oranges or apples; small paring knife or section cutter for small groups

"I CAN"
Lesson Four encourages students to demonstrate their learning by developing understandings such as the following:
• I can identify practices that have positive and negative effects on sustainable environments.
• I can describe different dimensions of and perspectives on sustainability.
• I can take and support a position on practices that support sustainable development.

Lesson Four Teaching and Learning Strategies
In Lesson Four, students develop further understandings of what sustainability means, and explore the decisions and consequences that are involved in implementing sustainable agricultural practices. They research alternate points of view regarding agricultural sustainability.

Introductory Activity
Students use a triple Venn diagram to explore practices that support environmental, economic, and social sustainability.

Instructional Strategy: Brainstorming with a Venn Diagram
Brainstorming ideas and prior knowledge and understandings by using a visual organizer, such as a Venn diagram, requires students to synthesize information and critically evaluate relationships and connections.

Process
1. Review the definition of sustainability from Lesson One. Ask students to consider

what practices would improve or ensure environmental, economic, and social sustainability in agriculture.
2. Ask students to use a triple Venn diagram to consider practices that support these three types of sustainability. Brainstorm practices for each type of sustainability in each circle of the Venn. Then, look for common practices in each of the three areas to record in the areas in which the circles overlap.
3. Share and discuss Venn diagrams with a partner, small group or the class.
4. Extend: An example of a Venn diagram that explores connections between environmental, economic, and social aspects of sustainability can be found on the Government of Manitoba's Agriculture, Food and Rural Initiatives website at www.gov.mb.ca/agriculture/research/susag.html. Have students compare their Venn diagrams to the one on this website and discuss similarities and differences. Use this discussion to create a list of questions for further inquiries.

Briefing Notes Activity
Students read and discuss the briefing notes with a partner. They focus on perspectives and issues associated with sustainability and agriculture.

Instructional Strategy: Tip Sheet or Top Ten List
Student products provide an opportunity to summarize, synthesize and communicate learning and display research results. Students can be engaged in creating a "real world" product such as a tip sheet or top ten list.

Process
1. Provide each student with a copy of the Briefing Notes 4A: Influences and Sustainability. Ask students work with a partner to discuss or respond in writing to the Predict questions at the beginning of the handout.
2. Ask the class to brainstorm and list as many ways as possible to plan crops to maximize crop yield and minimize soil erosion.
3. Have students use the research activities on the briefing notes to gather information and explore different points of view regarding sustainable agricultural practices.
4. Extend: Have students try the online simulations, one from Green Alberta on Alberta Land Use Planning and one from Crop Life Canada on farming and crop production. Students can work with a small group to explore one simulation and share their insights with a group that has explored the other.
5. Ask students to work with their partners and use their research to create a tip sheet that outlines methods for increasing crop yields in sustainable ways. Encourage each pair to consider different approaches to fertilization as well as alternative methods.
6. Extend: Have students do additional research on methods used to increase crop yields, including modifying the farm field environment and creating new methods of farming.

Closing Activity
Students use what they have learned to create a comic strip to illustrate effective practices for sustainable land use and management.

Instructional Strategy: Comic Strip

Comic strips require students to synthesize and summarize key points of information in order to communicate them in a comic strip format. Comic strips also provide an opportunity for students to present alternate or conflicting points of view on a topic or issue, or demonstrate their understanding of cause and effect or sequence of events.

Process

1. Have students work with a small group to develop a comic strip that illustrates points of view on ways to approach sustainable land use and management. Ask each group to identify one point of view around which to develop their comic strip, or conflicting points of view around a specific topic such as Integrated Pest Management programs, the use of fertilizer, or different crop planting techniques.
2. Use the comic strips to discuss the extent to which environmental impacts of human activities should be considered in setting guidelines and regulations for land use decisions, as well as the effect of such guidelines and regulations on farming activities and the ability to use the land to meet human needs.
3. Have students revisit the KWHL chart they completed on Day One. Ask them to fill in the last column and share observations about their learning with a partner or small group.

Extension Activity

Students develop an illustrated map of Canada that describes information relating to human activity and agricultural practices in different regions.

Instructional Strategy: Illustrated Map

The development of an illustrated map provides the opportunity for students to connect research on human activity, scientific knowledge, and agricultural practices to geographic factors and regions.

Process

1. Have students research examples of agricultural use of the environment in different regions of Canada. Have students focus on:

• The use of the environment in each region for agricultural activities
• The effects of using the environment
• Examples of resources and products
• Examples of environmental limitations and environmental emergencies that result from use of the environment through agriculture

2. Ask students to display and illustrate their research on a map of Canada, using pullout boxes or simple illustrations to describe the agricultural practices, resources, and products that are used in each region.

How can management practices and agricultural decisions ensure sustainability?

Predict
What choices do you make that promote sustainable ways of life? Why do you think the link between agriculture and sustainability is such a strong one?
Today, people are becoming increasingly concerned with practicing sustainable land management. What do we mean by sustainability? Sustainability means meeting the needs of people today without damaging the ability of future generations to meet their needs. It means using natural resources wisely.

Explore
- How has sustainability become an increasing concern and priority over time?

Did you know?
Thousands of years ago, large cities existed in the ancient world. The people who lived in these cities were supported and fed by thousands of hectares of cropland. Crops were irrigated from nearby rivers. As the land was continually farmed, the soils lost their nutrients. Salt built up and the soils eroded. As the land became unusable, people deserted the cities and moved to other areas that could support them.

Find Information: Web Links
Start with this web link for further research:
An Environment and Sustainability Chronology
www.sustreport.org/resource/es_timeline.htm

Try the experiment on this page with a small group and talk or write about the following questions.
• What if the topsoil that people depend upon should suddenly disappear?
• What will happen if the world's population continues to grow while our earth's topsoil remains the same?
• What ways can you and your family help conserve soil in your own backyard?

Experiment
What you need: a large apple OR a large orange and a section cutter or paring knife
One of the most important natural resources that covers much of the earth's land surface is soil. All living things depend on it as a source of food, either directly or indirectly. Our food producing land remains the same and yet the world population continues to grow. Consequently, each person's food portion becomes smaller and smaller. It is the responsibility of this generation to use the soil wisely to ensure the future. What does this demonstration tell you about the amount of the earth's surface that is actually used for food production as compared to our growing population?
1. Cut the orange or apple into four equal parts. Three parts represent the oceans of the world. The fourth part represents the land area.

2. Cut the land section in half lengthwise. Now you have two 1/8 pieces. One section represents land such as deserts, swamps, Antarctic, Arctic and mountain regions. The other one-eighth section represents land where people can live but may not grow food. (People can grow gardens, but gardens won't feed the entire world.)
3. Slice this one-eighth section lengthwise into four equal parts. Three of these 1/32 sections represent the areas of the world which are too rocky, too wet, too hot, or where soils are too poor for production, as well as areas developed by people.
4. Carefully peel the last 1/32 section. This small bit of peeling represents the soil of our earth on which mankind depends on for food production.

Sustainable Practices

What are sustainable practices based on? If soil and water are used faster then they can be replaced, then the agricultural activities that cause this are unsustainable. Sustainability also depends on biodiversity. Natural ecosystems must be kept in balance. The diversity of organisms in soil maintains nutrients and prevents disease and pests. Some agricultural practices, such as monoculture, overuse of pesticides, removal of wetlands, lack of crop rotation, and over tilling the soil, can affect the biodiversity of ecosystems.
Sustainability also involves the quality of life of agricultural producers. Farmers must be able to make a living and communities must be able to support themselves. Therefore, sustainability involves economic and social decision-making. Farmers must be able to make good decisions about what they are going to produce and what practices they will use, and be able to balance their quality of life with the costs of implementing these practices.
Sustainable practices in agriculture help protect the environment. Practices such as crop rotation can result in benefits that:

- prevent insect and disease attacks
- improve soil health
- control problem weeds
- improve crop yields
- prevent the depletion of nutrients in the soil
- are economically sustainable.

Find Information: Web Links

Try this…
Farmer Frank www.croplife.ca/foodforthought/farmer_frank/farmerFrank_content.html

Clearing the Land

The twentieth century has seen major changes in farming practices. From farmers guiding a plough and horse at the turn of the century, to the advent of tractors and other motorized farm implements, to the introduction of computer technology, the fields in the prairies have been cultivated for over one hundred years. Unfortunately, farming practices both now and in the past have led to damage to large areas of soil. What practices have caused soil damage? Continuous field cultivation can damage or destroy natural vegetation. Without vegetation to soak up water, the water simply runs off or drains directly into underground water systems or sloughs. The same thing can happen when soil receives too much water, especially from irrigation systems. When there is too much water or not

enough vegetation to hold the water, the ground is exposed to sunlight and higher temperatures, increasing decomposition rates and topsoil erosion. The practice of regular summer fallow, or not planting a crop to control weeds, has the same effect.
The result of these types of soil damage can be salinization. Salinization refers to the build up of salt in soil, which then runs off the land into water sources. It is easy to spot salinization as it appears as a hard white ring around a slough or lake in the farmer's field. Salinization can have the same effect as a drought. Planting vegetation to hold water can slow the flow of water runoff and give the soil more time to absorb water – this reduces both soil erosion and salinization. Vegetation will also help reduce wind erosion. Erosion is a serious problem because of the loss of topsoil, which has more organic matter and nutrient holding capacity. Losing topsoil decreases soil productivity. Farming practices can either curb or create erosion. Planting more vegetation slows the erosion process as the plants absorb the water and keep the winds from exposed soil. However, erosion is caused not only by the lack of plants, but also the lack of trees in a field. Using trees as a shelterbelt around the perimeter of fields can reduce wind erosion. Tillage is another practice that can be improved – tillage involves turning the surface soil upside down and buries most of the plant residues. Today there is special equipment for tillage that can be used in the fight again erorsion. The Noble blade and drill is an innovative way to plow fields that disturbs less soil and buries less residue. Rotating crops so that the same patterns of plowing and harvesting do not occur year after year also keeps more nutrients in the soil and slows erosion.

Explore
Talk or write about the following questions.

- What are different points of view on agricultural sustainability? Who holds these views?
- Why do you think some believe that practices that encourage sustainability must be a collective process that involves all participants in decision-making?

Find Information: Web Links
Start with these web links for further research:
What is Sustainable Agriculture?
www.sarep.ucdavis.edu/concept.htm
Alberta Environmental Sustainable Agriculture Program
www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/aesa6422
Alberta Environmental Farm Plan
www.albertaefp.com/questions.shtml
Pesticide use
www.agcare.org/uploadattachments/WhyFarmersUsePest.PDF
www.agcare.org/uploadattachments/WhatHappens.pdf
Environmentally Sustainable Agriculture – University of Alberta
www.rr.ualberta.ca/Research/Index.asp?page=EnvSustAgric
Sustainable Agricultural Practices – Alberta Research Council
www.arc.ab.ca/Index.aspx/ARC/3091
Ask the Experts – CropLife Canada
www.croplife.ca/foodforthought/ask_experts/index.php

Find Information: Web Links
Try this…
Alberta Tomorrow: A Land Use Simulator www.albertatomorrow.ca/index2.htm