

LEARNING EXPERIENCE THREE

Guiding Question: What are indicators of sustainable farming?

This **Learning Source** and accompanying **Build Competencies** activities provide students with examples of sustainable crop farming practices and a focus on soil ecosystems and nutrients. Students consider the range of practices included in Environmental Farm Plans; then explore why and how plant processes and farming practices affect and protect soil ecosystems – including the carbon cycle. This **Learning Source** and **Build Competencies** activity can also be used with **LEARNING EXPERIENCE TWO** on **pages 40 to 43** to explore different aspects of sustainable agricultural ecosystems.

This Learning Source provides starting points and information to investigate: • Sustainable farm ecosystems • Environmental farm plans • Agriculture ecosystems and nutrients • The soil ecosystem • Why the carbon cycle matters to agriculture Introduce this Learning Source by discussing the concept of “indicators” with students. Share a definition such as the following, or guide students in constructing their own definition. <i>An indicator is a characteristic that is specific and can be observed and measured. Indicators are identified and compared to show change or progress.</i> The Build Competencies handout provides a series of experiments that can be assigned to different groups of students. As students explore the Learning Source, and complete the experiments, have them collect what they consider to be facts related to – and indicators of – sustainable farming. Work collaboratively to identify areas of agreement on what sustainable practices include, and use the facts and indicators to create a digital bulletin board display, infographic or poster to display them.	Build Competencies: Finding Sustainable Practices Students find examples of sustainable farming practices, select an experiment that investigates characteristics and qualities of soil, make conclusions that connect soil health to sustainable farming practices. This handout includes activities that support competencies, literacy and numeracy, and weblinks to online resources that can support student learning. 	 Assess Look for evidence of understanding of the following concepts: • Agricultural ecosystem sustainability • Soil ecosystem • Soil erosion, porosity, texture, water retention • Nutrients • Carbon cycle • Environmental risks For a formative assessment, look for evidence of understanding of the role of soil in agricultural ecosystems and food webs, as well as students’ ability to analyze qualitative and quantitative data and develop explanations in the soil labs they complete in the Build Competencies lab activities.
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Lab Preparation

This learning source provides instructions for a series of four labs to explore soil characteristics. Remind students to think about how understandings of soil are connected to agricultural ecosystems.

These labs are adapted from Soil Experiments for Children. Food and Agriculture Organization of the United Nations: Online. www.fao.org/3/i7957e/i7957e.pdf. The lab design was created and contributed by Matt Gunderson.

Preview the labs and gather the following lab supplies. Note that quantities of each of these supplies can vary across the four different labs in the **Build Competencies** handout.

- ◆ Empty 1 L soft drink bottle
- ◆ 250 ml beaker
- ◆ 500 ml beaker
- ◆ 1000 ml beaker
- ◆ Balance scale
- ◆ Water
- ◆ Scissors
- ◆ Ramp (a binder can work)
- ◆ Soil samples - 3 samples of 1 kg each
 - Ground soil (from a garden or field)
 - Potting soil
 - Sandy soil (can make your own soil mixture)
- ◆ Spray bottle
- ◆ 500 g jam jar with lid
- ◆ Water softener
- ◆ 50 ml graduated cylinder
- ◆ Coffee filters
- ◆ Funnel
- ◆ Soil samples and potting compost to test organic matter - 5 samples of 50 g each:
 - Sand
 - Loam
 - Clay
 - Gravel
 - Potting compost



Additional Research or Background Sources

Consult teacher or student background sources such as the examples that follow to further explore, enrich or expand activities for this guiding question. Student research sources are also provided in **Build Competencies** handouts.

The Barilla Center for Food & Nutrition Foundation is a think tank that analyzes the complexity of current agri-food systems and fosters change towards healthier and more sustainable lifestyles in order to achieve the Goals set by the United Nations 2030 Agenda for Sustainable Development. The Food Sustainability Index is one of their initiatives. The resources on their website, found at <https://foodsustainability.eiu.com/>, can provide teacher background on global issues related to food sustainability.

An infographic focused on sustainable agriculture can provide a “global sustainability” model or example for students as they collect and organize indicators they think represent sustainable farming practices. A Barilla Center infographic can be accessed at <https://impact.economist.com/projects/foodsustainability/blogs/sustainable-agriculture/>.

Statistics Canada provides an Accounting for Ecosystem Change (2022) infographic that can be accessed at www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2021073-eng.htm.

The Battle River Watershed Alliance provides programs and resources focused on sustainability and stewardship on their website at www.battleriverwatershed.ca. Find links to several types of resources at www.battleriverwatershed.ca/resources/.

Explore the use of water in more depth with the Alberta Water Nexus: Energy, Food and People from the Alberta Water Portal Society at <https://albertawater.com/nexus>. This website provides a range of resources that can be used to investigate and consider connections between water, soil health and agriculture.



Additional information and discussion questions are provided in the carousel slide for this guiding question in the **sustainable PRACTICES** section of the **LEARN** webpage.

Click on the carousel slide to open and explore the following content.

- ◆ Farm environments
- ◆ Sustainable wheat practices
- ◆ Why pulses are naturally sustainable
- ◆ What canola farmers do for sustainability

These infographics could be used to compare global issues related to sustainable agriculture to the indicators of change in Canadian environments from human activities.



Find **Science 7** learning outcomes supported by this learning experience on the following page.

Use this activity to reinforce the flow of energy and materials within an ecosystem, using the examples from agricultural ecosystems, and identifying criteria for sustainability. Revisit the role of producers, consumers and decomposers to discuss their role in soil ecosystems. Encourage students to reflect on the human activities that can support soil ecosystems or pose environmental risks.



Look on the **MEET A FARMER** webpage for video interviews with Alberta farmers. As students watch the videos, ask them to identify perspectives about soil health and ecosystems shared by farmers.

If student interest or questions expand the content of this learning experience to connections between sustainability, climate change and greenhouse gas emissions, the Biological Carbon Canada website at www.biologicalcarbon.ca/assessing-greenhouse-gas-sources-and-sinks-in-the-crop-sector-alberta-manitoba/ provides teacher background statistics and graphs focused on farm level greenhouse gas emissions. From this research, Alberta farms are net neutral or net negative emissions. Transportation emissions and nitrous oxide emissions are up while carbon sequestration has reduced overall farm emissions. The report is available at www.biologicalcarbon.ca/wp-content/uploads/2020/01/BCC_AssessingGHGSourcesSinks.pdf.

The Canadian Roundtable for Sustainable Crops provides information on Soil Quality & Production: Environmental Sustainability at <http://metrics.sustainablecrops.ca/home/criterion/8>. This website provides a number of statistics, charts and graphs that provide indicators of soil quality – including soil erosion, soil organic carbon, conservation tillage practices and land and crop management practices.

The Farm Sustainability website – a website that provides farmers with information and resources to support decision making at the farm level regarding sustainability – can be accessed at <https://www.farmsustainability.ca/en>. Access the Resource Library to find information and indicators related to economic, environmental and social sustainability. This website can provide teacher background or areas may be selected to guide students through.

Bayer provides a webpage focused on Shaping the Future of Sustainable Agriculture, including a video that discusses sustainability goals for agriculture at www.cropscience.bayer.com/who-we-are/sustainable-agriculture. Crop Life Canada provides a webpage on Supporting Sustainable Agriculture at <https://croplife.ca/supporting-sustainable-agriculture/>. Ensure that students identify the perspective this information is presented from, identifying any bias that may be part of the messages in the information and video. Students can be asked to assess the extent to which their findings from their labs support the assertions that companies such as Bayer or Crop Life make on their websites.

> ACCOMMODATE AND/OR EXTEND LEARNING

As an alternative activity, adapt the make-a-mini-ecosystem-in-a-bottle activity provided at www.agclassroom.org/matrix/lesson/500/. Have students use crop seeds – wheat, barley, canola or a pulse – for their bottle ecosystems. Create an observation chart to track plant growth and use their observations to make connections to the water cycle and how nutrient cycles are represented in the mini ecosystem (Creative Commons).

Contact the First Nations Technical Services Advisory Group to arrange a classroom visit and source water presentation. Find information at <https://tsag.net/youth-initiatives/>.



LEARNING EXPERIENCE THREE: LEARNING OUTCOMES AND COMPETENCY MAP

project AGRICULTURE Activity	GRADE 7 SCIENCE	
	CONCEPTUAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
LEARNING SOURCES What are indicators of sustainable farming? BUILD COMPETENCIES Finding Sustainable Practices	Grade 7 Science Unit A: Interactions and Ecosystems 1. Investigate and describe relationships between humans and their environments, and identify related issues and scientific questions - illustrate how life-supporting environments meet the needs of living things for nutrients, energy sources, moisture, suitable habitat, and exchange of gases - identify examples of human impacts on ecosystems, and investigate and analyze the link between these impacts and the human wants and needs that give rise to them (e.g., identify impacts of the use of plants and animals as sources of food, fibre and other materials; identify potential impacts of waste products on environments) 2. Trace and interpret the flow of energy and materials within an ecosystem - analyze ecosystems to identify producers, consumers and decomposers; and describe how energy is supplied to and flows through a food web, by: - describe the process of cycling carbon and water through an ecosystem - identify mechanisms by which pollutants enter and move through the environment, and can become concentrated in some organisms (e.g., acid rain, mercury, PCBs, DDT) 4. Describe the relationships among knowledge, decisions and actions in maintaining life-supporting environments - identify intended and unintended consequences of human activities within local and global environments (e.g., changes resulting from habitat loss, pest control or from introduction of new species; changes leading to species extinction) - analyze a local environmental issue or problem based on evidence from a variety of sources, and identify possible actions and consequences (e.g., analyze a local issue on the control of the beaver population in a nearby wetland, and identify possible consequences)	Grade 7 Science Unit A: Interactions and Ecosystems Ask questions about the relationships between and among observable variables, and plan investigations to address those - identify questions to investigate arising from practical problems and issues (e.g., identify questions, such as: "What effects would an urban or industrial development have on a nearby forest or farming community?") - state a prediction and a hypothesis based on background information or an observed pattern of events (e.g., predict changes in the population of an organism if factor X were increased, or if a species were introduced or removed from the ecosystem; propose factors that will affect the population of a given animal species) Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data - research information relevant to a given problem or issue - use tools and apparatus effectively and accurately for collecting data (e.g., measure factors, such as temperature, moisture, light, shelter and potential sources of food, that might affect the survival and distribution of different organisms within a local environment) Analyze qualitative and quantitative data, and develop and assess possible explanations - 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., illustrate a food web, based on observations made within a given environment) 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., present findings from an analysis of a local issue, such as the control of the beaver population in a nearby wetland)



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project AGRICULTURE Activity	GRADE 7 SCIENCE	
	CONCEPTUAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
LEARNING SOURCES What are indicators of sustainable farming? BUILD COMPETENCIES Finding Sustainable Practices	Grade 7 Science Unit B: Plants for Food and Fibre 3. Analyze plant environments, and identify impacts of specific factors and controls - investigate and describe characteristics of different soils and their major component (e.g., distinguish among clayey soils, sandy soils and soils rich in organic content; investigate and describe particle sizes, compaction and moisture content of soil samples) - identify practices that may enhance or degrade soils in particular applications	Grade 7 Science Unit B: Plants for Food and Fibre Ask questions about the relationships between and among observable variables, and plan investigations to address those questions - 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?) - 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) Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data - 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) - estimate measurements (e.g., estimate plant populations; estimate the surface area of a leaf) Analyze qualitative and quantitative data, and develop and assess possible explanations - 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 charts its development in terms of height, leaf development, flowering and seed production) 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)