

LEARNING EXPERIENCE TWO

Guiding Question: How do plant science technologies contribute to sustainable farming practices?

This **Learning Source** and accompanying **Build Competencies** activities ask students to focus on the impact of science and research on sustainable agriculture. Examples of current research projects and studies looking at practices used to grow wheat and barley, canola and pulse crops provide a perspective on the use of pesticides – including herbicides, fungicides and insecticides. An example of an Indigenous research project focusing on ways that invasive species affect crop production provides a different orientation to farming practices that support sustainability.

This Learning Source provides starting points and information to investigate: • Plant science • Why plant science matters • Traditional knowledge and plant science • More research on bugs in ecosystems Encourage students to share what they have learned and know about scientific methods. What does it mean to “do” research? What types of understandings do experiments in either lab settings or field settings provide? Explore the information and examples of agricultural research projects in the Learning Source – use these examples to describe the extent to which each example can illustrate advancements toward greater sustainability. Students can be asked to relate the idea of advancements in sustainability to the United Nations Sustainable Development goals, found at https://sdgs.un.org/goals. Discuss the general purposes of Goal 2 and Goal 15, highlighting the concepts of sustainability and ecosystems: • End hunger, achieve food security and improved nutrition and promote sustainable agriculture • Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss (focus students’ attention on sustainable ecosystems and touch on the meaning of terms in this goal)	Build Competencies: Following the Science Students investigate the work and research of scientists, assess ecosystem interactions and explore the influence of traditional knowledge and practices. This handout includes activities that support competencies and weblinks to online resources that students can explore. 	 Assess  Look for evidence of understanding of the following concepts: • Plant science • Innovations • Interactions • Pesticides: herbicides, fungicides and insecticides • Tillage • Traditional plant knowledge and science For a formative assessment, use the cause and effect charts that students complete in the Build Competencies handout to assess their understanding of the interactions and change that occurs in agricultural ecosystems. Extend this assessment by comparing interactions and change to those occurring in a traditional agricultural ecosystem, such as a food forest.
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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.

Crop Life Canada provides information on plant science in Plant Science 101, including infographics and a timeline of innovation and research at <https://croplife.ca/plant-science-101/>.

Agriculture and Agri-Food Canada's Fields of Science webpage, used by students in the **Build Competencies** activity, provides information about scientific research around agriculture and the food system. Access it at www.agr.gc.ca/eng/canadas-agriculture-sectors/fields-of-science/?id=1411999466585.

Agriculture and Agri-Food Canada's (AAFC) research activities are focused around nine science strategies. These strategies can be shared with students at <https://agriculture.canada.ca/en/news-agriculture-and-agri-food-canada/scientific-achievements-agriculture/science-strategies-agriculture>.

AAFC's latest agricultural science achievements can also be explored by accessing a table with links to various scientific and research-based articles or notes. This table can be found at <https://agriculture.canada.ca/en/news-agriculture-and-agri-food-canada/scientific-achievements-agriculture#dataset-filter>.

The Value of Plant Science Innovations to Canadians (2015) can be used as teacher background. This publication was created for Crop Life Canada. Find it at https://croplife.ca/wp-content/uploads/The-Value-of-Plant-Science-Innovations-to-Canadians_RIAS-Inc.pdf.

An infographic with some basic facts about canola production from Agriculture and Agri-Food Canada can be accessed at <https://learncanola.com/wp-content/uploads/2020/03/Agri-Can-Canola-stats-2.jpg>.

The Grains West – Connecting Farmers, Food and Ideas online publication provides an article titled Cultivating Research: Scientist Alicja Ziemienowicz Pursues a Revolution in Cereal Production, focused on her research on nitrogen fixing in crop plants at <https://grainswest.com/2020/09/cultivating-research/>. Encourage students to make comparisons to the nitrogen fixing ability of pulse crops.

Another article titled A Win for Fertilizer: Canadian Soil Scientist Awarded for Work on Nitrous Oxide Emission Reduction focuses on a project that is designed to help farmers optimize nitrogen management at <https://grainswest.com/2021/03/a-win-for-fertilizer/>.

A short article on the historical context of strip farming – alternating cropped and summerfallow strips – can also be found in the Grains West publication in Strip Farming Helped Keep Alberta's Soil in Place at <https://grainswest.com/2021/01/strip-farming-helped-keep-albertas-soil-in-place/>.

Resources on the Alberta Water Portal Society can support students in making the connection between the characteristics of a healthy ecosystem and the science that is applied to make decisions about water use; find them at <https://albertawater.com/resources/>.



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.

- Growing crop plants with science
- Plant pest science (insecticides: herbicides, fungicides, pesticides)
- Seeding and harvesting



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

Use this activity to focus on the concepts of interactions within ecosystems, including farm and traditional food production ecosystems. After completing activities in this learning experience, encourage students to reflect on the sustainability of the practices that farmers use to produce food.

Students may be interested in learning more about the history of irrigation in Alberta, focusing on ways that irrigation technologies have advanced. Find this information at <https://discoverapega.ca/stories/irrigation-transforms-southern-alberta/>.

There are a multitude of additional resources provided on the Empowering the Spirit website, at www.empoweringthespirit.ca.

The Indigenous Food Systems Network at www.indigenousfoodsystems.org provides information, stories and legends, recipes and resources that can be previewed and used as background or with students.

> ACCOMMODATE AND/OR EXTEND LEARNING

Provide students with opportunities to collaboratively - in small groups or as a whole class guided activity - explore farming and soil simulations as part of their research.

Journey 2050 is based on real-life challenges and opportunities. Using an inquiry-based approach, this gamified, virtual program encourages students to make decisions and adjust them as they see their impact on the pillars of sustainability - social, environment, and economic - on a local and global scale. Students can also independently download an app version of the game, Farmers 2050, to play from anywhere in the world.

Find the links to access or download these simulations on the Agriculture in the Classroom Canada website at <https://aitc-canada.ca/en-ca/resources-programs/journey-2050>.

Encourage students to discuss and make comparisons to their own research in this learning experience.



LEARNING EXPERIENCE TWO: LEARNING OUTCOMES AND COMPETENCY MAP

project AGRICULTURE Activity	GRADE 7 SCIENCE	
	CONCEPTUAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
LEARNING SOURCES How do plant science technologies contribute to sustainable farm practices? BUILD COMPETENCIES Following the Science  	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 - describe examples of interaction and interdependency within an ecosystem (e.g., identify examples of dependency between species, and describe adaptations involved; identify changing relationships between humans and their environments, over time and in different cultures—as, for example, in aboriginal cultures) - analyze personal and public decisions that involve consideration of environmental impacts, and identify needs for scientific knowledge that can inform those decisions 2. Trace and interpret the flow of energy and materials within an ecosystem - analyze ecosystems to identify producers, and decomposers; and describe how energy is supplied to and flows through a food web, by: - 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) - describe and interpret examples of scientific investigations that serve to inform environmental decision making - illustrate, through examples, the limits of scientific and technological knowledge in making decisions about life-supporting environments (e.g., identify limits in scientific knowledge of the impact of changing land use on individual species; describe examples in which aboriginal knowledge—based on long-term observation—provides an alternative source of understanding)	Grade 7 Science Unit A: Interactions and Ecosystems 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 - select and integrate information from various print and electronic sources or from several parts of the same source (e.g., compile information on a global environmental issue from books, magazines, pamphlets and Internet sites, as well as from conversations with experts) 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)