

LEARNING EXPERIENCE THREE

Guiding Question: Why should agricultural environments be monitored?

This Learning Source provides starting points and information to investigate: • Environmental monitoring indexes • Soil, air and water quality • Biodiversity • Stewardship • Greenhouse gas emissions	Build Competencies: Food identities Students graph trends of environmental indicators over time to determine environmental quality and measure concentrations. 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: • Environmental measures • Concentrations • PPM and pH For a formative assessment, ask students to use a T-Chart to identify challenges and opportunities, related to the environmental indicators, that are posed by agricultural activities.
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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.



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

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

- An introduction to **planning to protect environments**
- Perspectives on **proactive stewardship**
- An introduction and example of **protecting water**

The Agriculture and Agri-Food Canada report, *Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series—Report #4* (2016), presents agri-environmental performance results and trends for the 30-year period from 1981 to 2011. The report provides a snapshot of the health of the Canadian agriculture and agri-food system using data from the 2011 Canadian Census of Agriculture. It can be accessed at www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/environmental-sustainability-of-canadian-agriculture-agri-environmental-indicator-report-series-report-4/?id=1467307820931.

Students can be encouraged to supplement the indicators found in this report - and used in the Learning Source for this guiding question - with updated statistics on environmental sustainability, found in *Environmental Indicators* from the Government of Canada at www.canada.ca/en/environment-climate-change/services/environmental-indicators.html.

The Safe Drinking Water Foundation provides information and additional resources focused on water quality and environmental monitoring in Canada and the United States. A TDS and pH factsheet can be accessed at <https://www.safewater.org/fact-sheets-1/2017/1/23/tds-and-ph>.

Find information on Environmental Farm Plans and related articles, including conservation practices used to monitor and protect environmental factors, from Agriculture in the Classroom Canada at <https://aitc-canada.ca/en-ca/learn-about-agriculture/category/farming-the-environment/environmental-farm-plans>.

The Alberta Environmental Farm Plan website at www.albertaefp.com provides resources that explain how farmers implement environmental farm plans. The Species at Risk webpage provides information on this biodiversity initiative at www.albertaefp.com/species-at-risk.

The Government of Alberta provides information and an assessment of biodiversity risk and agriculture on their Biodiversity Risk webpage at www.alberta.ca/biodiversity-risk.aspx. Data in different formats can also be accessed at <https://open.alberta.ca/opendata/93d539b5-e651-47eb-83f1-eef9eab460a4#summary>.

The Alberta Government provides information on environmental monitoring in Alberta's Environmental Monitoring and Science Program website, found at <http://environmentalmonitoring.alberta.ca/>. Work with students to identify examples of environmental elements that are monitored through research and scientific studies and hypothesize their impact on agriculture.

> EXTEND LEARNING

Provide students with definitions for stewardship and sustainability. **Stewardship** involves the careful and responsible management of something entrusted to one's care. For farmers, stewardship involves the responsible care of the land, soil, water, air and biodiversity. Revisit the definition of **sustainability** as the ability to meet present needs without compromising the ability of future generations to meet their own needs.

Have students identify and examine current agricultural practices that promote environmental responsibility. Start students with practices such as the following:

- 🔥 Environmental farm plans and life cycle assessments
- 🔥 Practices that protect soil quality, such as crop rotation
- 🔥 Practices that promote biodiversity
- 🔥 Manure and nutrient management
- 🔥 Controlling emissions



Use a **Retrieval Chart** to assess the contribution that each of these practices makes to stewardship and sustainability. Record each practice in the first column. Assess how each practice addresses stewardship and sustainability in the second and third columns. In the fourth column, assess whether the practice focuses more on sustainability or stewardship. Find this graphic organizer in **sustainability MATTERS Project Tools**.



Find **Science 9**, **Science 20** and **Biology 20** learning outcomes supported by this learning experience on the following pages.

Use this activity to investigate the role of substances in agricultural environments and the processes used by both scientists and farmers to monitor environmental factors. Reinforce data analysis skills by assessing information provided by environmental indicators.

Encourage students to make connections between natural and agricultural ecosystems, exploring the influence of human activities on biogeochemical cycles and water, air and soil quality.

After completing activities in this learning experience, have students reflect on trends in sustainability and environmental conservation practices in agriculture. What are the implications of these trends for the environment and food production?



Look on the **VIEW** webpage for video interviews with Alberta farmers about sustainable farming practices. As students watch the video, ask them to identify perspectives shared by farmers.



LEARNING EXPERIENCE THREE: LEARNING OUTCOMES AND COMPETENCY MAP

project AGRICULTURE Activity	GRADE 9 SCIENCE	SCIENCE 20	BIOLOGY 20
	CONCEPTUAL KNOWLEDGE	CONCEPTUAL KNOWLEDGE	CONCEPTUAL KNOWLEDGE
LEARNING SOURCE Why should agricultural environments be monitored?	Unit C: Environmental Chemistry 1. Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things - Describe and illustrate processes by which chemicals are introduced to the environment or their concentrations are changed (e.g., dilution in streams, biomagnification through food chains) - Identify questions that may need to be addressed in deciding what substances – in what amounts – can be safely released into the environment (e.g., identify questions and considerations that may be important in determining how much phosphate can be released into river water without significant harm to living things) 2. Identify processes for measuring the quantity of different substances in the environment and for monitoring air and water quality - Identify substrates and nutrient sources for living things within a variety of environments - Describe and illustrate the use of biological monitoring as one method for determining environmental quality (e.g., assess water quality, by observing the relative abundance of various vertebrate and invertebrate species) - Identify chemical factors in an environment that might affect the health and distribution of living things in that environment (e.g., available oxygen, pH, dissolved nutrients in soil) - Apply and interpret measures of chemical concentration in parts per million, billion or trillion - Identify acids, bases and neutral substances, based on measures of their pH (e.g., use indicator solutions or pH meters to measure the pH of water samples) - Describe effects of acids and bases on living things	Unit D: Changes in Living Systems 20-D1.1k Investigate and analyze an aquatic or a terrestrial local ecosystem, distinguish between biotic and abiotic factors, describe how these factors affect population size and - Infer the abiotic effects on life; e.g., light, nutrients, water, temperature 20-D1.2sts Explain that society and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F2-4.8, F3-4.1] - Assess habitat loss and the responsibility of society to protect the environment for future generations 20-D2.2k Describe artificial and natural factors that affect the biogeochemical cycles: - Nitrogen cycle; e.g., automobile, agricultural and industrial contributions to NO_x combining with water to produce nitric acid, nitrogen in manure and fertilizers - Carbon cycle; e.g., emissions of carbon oxides from extraction, distribution and combustion of fossil fuels, releases associated with deforestation and cement industries - Water cycle; e.g., extraction of ground water, dams for hydro-electricity and irrigation 20-D2.1sts Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F2-4.8, F3-4.1] - Assess whether the efforts to reduce human impact on biogeochemical cycles are viable, taking into consideration a variety of perspectives (considerations for deep-well and deep-ocean injection of wastes, for example, include properties of waste, concentration, uncertainty, environmental concerns, risks and benefits to human health and organisms, costs) - Evaluate the influence of society, and the impact of a variety of technologies, on the nitrogen cycle - Discuss the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation, considering such things as manufacturing, the oil industry, agricultural systems, the mining industry and domestic daily water consumption	Unit A: Energy and Matter Exchange in the Biosphere 20-A2.1sts Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1] - Discuss the influence of human activities on the biogeochemical cycling of phosphorus, sulfur, iron and nitrogen: – fertilizer applications – waste and sewage disposal – vehicle and refinery emissions – acid deposition – persistent organic pollutants - Discuss the use of water by society, the impact such use has on water quality and quantity in ecosystems, and the need for water purification and conservation: – agricultural systems – domestic daily water consumption 20-A3.2sts Explain that science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1] - Describe how human activities can have a disrupting influence on the balance in the biosphere of photosynthetic and cellular respiratory activities: – fossil fuel combustion – depletion of stratospheric ozone – forest destruction Unit B: Ecosystems and Population Change 20-B1.3k Identify biotic and abiotic characteristics and explain their influence in an aquatic and a terrestrial ecosystem in the local region; e.g., stream, lake, prairie, boreal forest, vacant lot, sports field 20-B1.1sts Explain how science and technology have both intended and unintended consequences for humans and the environment (SEC3) [ICT F3-4.1] - Evaluate the impact that human activity has had, or could have, on the biodiversity in an ecosystem: – land use

project AGRICULTURE Activity	GRADE 9 SCIENCE	SCIENCE 20	BIOLOGY 20
	PROCEDURAL KNOWLEDGE	PROCEDURAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
BUILD COMPETENCIES Environmental monitors        	Unit C: Environmental Chemistry Ask questions about the relationships between and among observable variables, and plan investigations to address those questions - State a prediction and a hypothesis about the concentration or dispersal of a chemical substance within an environment (e.g., state a hypothesis that relates the amount of oxygen in a local water sample to the presence or absence of dissolved nutrients) - Select appropriate methods and tools for collecting data and information and for solving problems (e.g., design an investigation to compare the chemical characteristics of two soils) Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data - Use instruments and materials effectively and accurately for collecting data (e.g., measure and compare the pH in household products, foods and environments) Analyze qualitative and quantitative data, and develop and assess possible explanations - Identify the line of best fit on a scatterplot, and interpolate or extrapolate based on the line of best fit (e.g., interpret class data on the effects of acidity on mould growth, graph the data, prepare a line of best fit, and predict the amount of growth that might be expected at different acidity values) - Apply given criteria for evaluating evidence and sources of information (e.g., use scatterplot data in evaluating how strong a relationship exists between two variables; evaluate claims of environmental impacts, based on the scope and relevance of supporting evidence) Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results - Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise	Unit D: Changes in Living Systems 20-D1.1s Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues - Design an experiment and identify specific variables to investigate relationships between biotic and abiotic elements of a micro-ecosystem (IP-NS2) 20-D1.2s Conduct investigations into relationships among observable variables and use a broad range of tools and techniques to gather and record data and information - Use library and electronic research tools to collect information on a given topic, such as: – protection of the environment as a priority over economic interest – sustainable development initiatives (PR-NS4) [ICT C1-4.1, C3-4.2] 20-D2.4s work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results - Work cooperatively in a group to investigate the influence of human activities on the biogeochemical cycles and, using appropriate multimedia, present the findings (CT-SEC1, CT-SEC2) [ICT P3-4.1]	Unit A: Energy and Matter Exchange in the Biosphere 20-A2.4s Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results - Work cooperatively in a group to investigate the influence of human activities on the biogeochemical cycles and use appropriate multimedia to present the information to a group (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.2, F2-4.7, P3-4.1] 20-A3.4s Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results - Work cooperatively as a group to investigate, synthesize and present information on the effects of changes to stratospheric ozone levels on society, agriculture, plants and animals (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.4, C7-4.2, F2-4.7] Unit B: Ecosystems and Population Change 20-B1.3s Analyze data and apply mathematical and conceptual models to develop and assess possible solutions - Analyze the interrelationship of biotic and abiotic characteristics that make up the ecosystem studied (AI-NS2, AI-NS3, AI-NS6) 20-B1.4s Work collaboratively in addressing problems and apply the skills and conventions of science in communicating information and ideas and in assessing results - Work cooperatively to make clear and logical arguments to defend a decision on a given issue, such as human impact on ecosystems, land reclamation or wildlife habitat preservation (CT-SEC1, CT-SEC2, CT-SEC3) [ICT C1-4.4]