

LEARNING EXPERIENCE FIVE

Guiding Question: How does plant science affect food diversity?

This **Learning Source** and accompanying **Build Competencies** activities focus on examples of plant science – from breeding practices that include artificial selection, selective breeding and a brief overview of genetic modification, to the structure and function of crop plant seeds, cells, organs and tissues.

This Learning Source provides starting points and information to investigate: - Plant science - Selective breeding - Biotechnology and genetics - Using genetic science - Plant systems, structures and functions Ask students to start with the image in the Learning Source that illustrates varieties of Brassica plants. Challenge them to brainstorm the shared characteristics of each of these vegetables. If possible, bring in a bottle of canola oil; tell students that canola also comes from the Brassica family. Find examples of canola plants and challenge them to identify characteristics that are similar to or different from the other Brassica plants. Students can also be challenged to find images of today's corn plant and the original Teosinte plant from which it was bred. Pose a question that asks students to reflect on the role that science plays in their food. For example: - How has scientific ideas and research influenced the variety of food products I use? - Why is selective breeding a science? Why do scientists and farmers require a knowledge of plant cells, organs and systems to increase food diversity?	Build Competencies: Exploring Plant Diversity Students assess the reliability and scientific evidence of sources about the use of genetically modified plants in food products and apply information about plant systems to a crop plant. 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: - Artificial selection - Selective breeding - Biotechnology - Genetically modified organisms (GMOs) - Plant seeds - Plant structures and functions - Vascular plants - Plant cells, organs, tissues For a formative assessment, ask students to apply the research and fact-checking they complete in the Build Competencies activities to an exploration of food labelling. Challenge them to investigate why GMO food products are not labelled differently than other foods. Students can alternatively be asked to create a lab report or display that illustrates crop diversity, focusing on the cells, tissues and organs of at least three different crop plants.
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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.

The Alberta Government provides a Consumer Corner article on Genetically Modified Foods and Consumer Concerns, which can be accessed at <https://open.alberta.ca/dataset/b5d936eb-2127-424e-b1b8-818c486d12aa/resource/3917915e-c108-43d6-a24b-40a3ca091017/download/consumer-corner-gmo.pdf>.





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

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

- Starting with seeds
- Crop seed examples
- Case in point: Canola
- Finding evidence in the seeds

Agriculture and Agri-Food Canada's Fields of Science webpage 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.

- A profile of a scientist who is studying stress-resistant genes in the DNA of wild wheats to produce varieties that are more resistant to disease can be found at <https://agriculture.canada.ca/en/canadas-agriculture-sectors/fields-science/dr-sylvie-cloutier>.
- Another profile of a research scientist based in Lacombe who studies weed control and weed biology can be found at <https://profils-profiles.science.gc.ca/en/profile/dr-breanne-tidemann>.

The Real Farm Lives website provides a discussion of plant breeding at <https://realfarmlives.ca/a-guide-to-plant-science-canada/>. This website also provide an article called Five Common GMO Myths Debunked at <https://realfarmlives.ca/five-common-gmo-myths-debunked/>. A Guide to GMO Canola is provided at <https://realfarmlives.ca/guide-to-gmo-canola/>. A Guide to Barley, found at <https://realfarmlives.ca/guide-to-canadian-barley/>, also provides a section on the implications of plant science.

The Story of Beans at www.youtube.com/watch?v=rb8wfbLZfqs provides a research-focused look at how new bean varieties are developed.

The Real Farm Lives website also provides a number of videos that feature Canadian farmers at <https://realfarmlives.ca/episodes/>.

Find a summary report on Canadian Canola Biotechnology from the Canola Council at www.canolacouncil.org/biotech/files/Canola-Biotech-Report.pdf.

A teacher background article from the University of Calgary – UCalgary scientists produce new canola type for potentially higher crop yield – focuses on the use of gene editing to produce a shorter canola plant with more branches and leaves as well as its potential with other crops such as pulses – can be accessed at <https://science.ucalgary.ca/news/ucalgary-scientists-produce-new-canola-type-potentially-higher-crop-yield>.

A teacher background source that discusses the context for selective breeding and then the use, benefits and drawbacks of GMOs can be found in It's in My Genes: GMOs, Biodiversity and Farming in Saskatchewan on the University of British Columbia's website at <https://environment.geog.ubc.ca/its-in-my-genes-gmos-biodiversity-and-farming-in-saskatchewan/>.

Understanding Ag Biotechnology on the Grains West website focuses on emerging agricultural science and can be accessed at <https://grainswest.com/2018/10/understanding-ag-biotechnology/>. Grains West also provides Genetic Advances Multiply, focused on research projects that are developing new wheat and barley varieties at <https://grainswest.com/2021/03/genetic-advances-multiply/>.

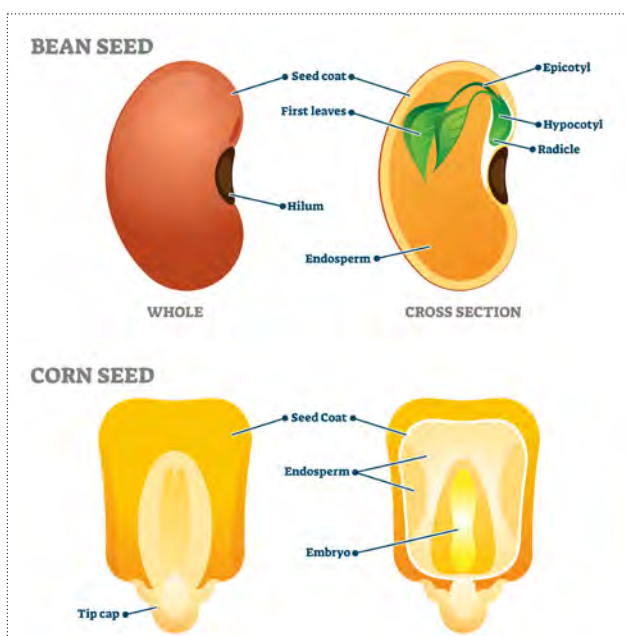
> ACCOMMODATE AND/OR EXTEND LEARNING

Have students work with a partner to dissect a crop plant seed. Use larger seed varieties like faba or lima beans and soak them to soften the seed coat before gently pulling them apart. Have student review the parts of a seed. Record the dissection with photos or sketches:

- ◆ Identify the embryo and cotyledons
- ◆ Examine under a microscope and describe what is observed

Use two different seeds – a dicot and a monocot – to compare similarities and differences.

Extend this activity by growing the plant before dissecting its seed. Alternatively, students can dissect and examine cross sections of the stem, leaf or root tissues and organs.



Find **Science 7 and 8** learning outcomes supported by this learning experience on the following page.

Use this activity to emphasize how research and science informs the development of crop varieties and how this science depends on knowledge of plant structures, cells, tissues and organs. Encourage students to assess and differentiate between evidence-based facts in the information they use to investigate selective breeding and scientific advancements in food and farming.

Look on the **MEET A FARMER** webpage for video interviews with Alberta farmers. As students watch the videos, ask them to listen for insights about biotechnologies shared by Alberta farmers.



LEARNING EXPERIENCE FIVE: LEARNING OUTCOMES AND COMPETENCY MAP

project AGRICULTURE Activity	GRADE 7 AND 8 SCIENCE	
	CONCEPTUAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
LEARNING SOURCES How does plant science affect food diversity? BUILD COMPETENCIES Exploring Plant Diversity 	Grade 7 Unit B: Plants for Food and Fibre 2. Investigate life processes and structures of plants, and interpret related characteristics and needs of plants in a local environment - describe the general structure and functions of seed plants (e.g., describe the roots, stem, leaves and flower of a common local plant) - investigate and interpret variations in plant structure, and relate these to different ways that plants are adapted to their environment (e.g., distinguish between plants with shallow spreading roots and those with deep taproots; describe and interpret differences in flower form and in the timing of flower production) - describe the processes of diffusion, osmosis, conduction of fluids, transpiration, photosynthesis and gas exchange in plants [Note: This item requires a general understanding of the processes; it does not require knowledge of the specific biochemistry of these processes.] - describe life cycles of seed plants, and identify example methods used to ensure their germination, growth and reproduction (e.g., describe propagation of plants from seeds and vegetative techniques, such as cuttings; conduct a germination study; describe the use of beehives to support pollination) 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)	Grade 7 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?) - 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) - formulate operational definitions (e.g., define the health of a plant in terms of its colour and growth pattern) Analyze qualitative and quantitative data, and develop and assess possible explanations - identify strengths and weaknesses of different methods of collecting and displaying data (e.g., compare two different ways to measure the amount of moisture in soil; evaluate different ways of presenting data on the health and growth of plants) 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)



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LEARNING SOURCES How does plant science affect food diversity? BUILD COMPETENCIES Exploring Plant Diversity	Grade 8 Science Unit B: Cells and Systems 1. Investigate living things; and identify and apply scientific ideas used to interpret their general structure, function and organization - investigate and describe example scientific studies of the characteristics of living things (e.g., investigate and describe an ongoing scientific study of a locally-found organism) - apply the concept of system in describing familiar organisms and analyzing their general structure and function 2. Investigate and describe the role of cells within living things - examine plant and animal structures; and identify contributing roles of cells, tissues and organs 4. Describe areas of scientific investigation leading to new knowledge about body systems and to new medical applications - describe ways in which research about cells, organs and systems has brought about improvements in human health and nutrition (e.g., development of medicines; immunization procedures; diets based on the needs of organs, such as the heart)	Grade 8 Science Unit B: Cells and Systems Ask questions about the relationships between and among observable variables, and plan investigations to address those questions - identify questions to investigate (e.g., identify questions that arise from their own observations of plant and animal diversity) - rephrase questions in a testable form (e.g., rephrase a question, such as: "Why this structure?" to become questions, such as: "How is this structure used by the organism?", "How would the organism be affected if this structure were absent or did not function?" or "What similar structures do we find in other organisms?") Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data - observe and record data, and produce simple line drawings (e.g., draw cells and organisms) - organize data, using a format that is appropriate to the task or experiment (e.g., compare the structure and function of two or more organisms, using charts and drawings) 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 charts that compare structures of different organisms) Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (e.g., consider a wide variety of possible interpretations of their observations of animal structures and functions; critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion)