Customize this project process by creating your own **HyperDocs**, using the links from this guide and selecting those activities you think are most appropriate for your students.

SPARK AND ENGAGE

start with a stance

Identify opposite sides of the classroom as "agree" and "disagree" sides; simple posters can also be put up in advance to identify each side.

Select statements such as the following and share those selected orally or display them on the board, one at a time. As each statement is displayed, have students move to the side of the classroom that represents their opinion. Students who are undecided can stand between the two sides.

- Sustainability is only about the environment and measuring our environmental footprints.
- Chemical substances in the environment should be monitored.
- Increasing the world's food supply should be our highest priority.
- Agriculture is the biggest threat to sustainable use of land.

Ask students to volunteer why they agree or disagree. Encourage students to draw on what they have learned and know about ecosystems, agriculture and sustainability to explain their stance.

Alternatively, online apps such as **Google Forms** can be used to set up a simple digital survey or a **Padlet** board to collect students' reasons for their stance.

As a class, discuss how the concept of sustainability involves different perspectives and interpretations but is based on understandings of the relationships between organisms and their environment — and is connected a knowledge of chemistry, nutrients, ecosystems, organic and inorganic materials, environmental monitoring, biogeochemical cycles and food chains and webs. It also involves social and economic issues like the need to address poverty, increase the food supply for the world's growing population and ensure that people have adequate livelihoods and quality of life.

focus on agriculture

Pose the question, Why and how should sustainability matter? and spark student thinking by writing it on a class board or display.

Have students work with a partner or small group to brainstorm words, phrases, images, symbols in response to this question and use these to create a word splash on the board or on a poster.

Use their brainstorming to challenge students to come up with their own definition of sustainability. Ask each pair or small group to write a paragraph or create an illustration that represents the range of concepts that are connected with sustainability.

connect to prior knowledge

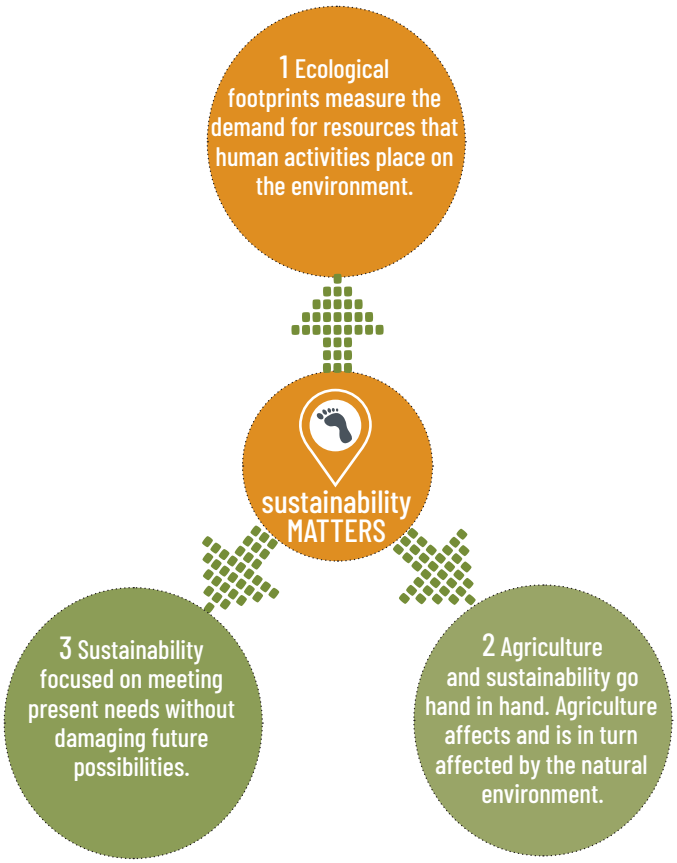
Share the appropriate essential understandings with students — Grade 9 students can focus on statements 1 and 2; Grade 11 students can focus on statement 3.

As you share and discuss the essential understandings with students, use evidence-focused questions such as the following to encourage their thinking about what they already know and how they know it:

- What terms are you familiar with in this statement? What are the important ideas in the statement?
- What do you see when you think about this statement? What do you know?
- What do you see, have you seen or know that makes you say that?

Ask individual students to use a **KWHL Chart** to jot down their resulting ideas in the "What I **Know**" and "What I **Want** to Know" columns. Use the "**How** I will find out" and "What I **Learned**" columns as students investigate and research.

A **KWHL Chart** is provided in **Project Tools**, found on the **sustainability** MATTERS **TEACH** webpage at **www.projectagriculture.ca/teach/sustainability-matters/** and on the **Project GUIDES** webpage at **www.projectagriculture.ca/share/project-guides/**.



> SCAFFOLD AND DIFFERENTIATE

Use this evidence-focused questioning strategy as a whole class first, teaching students how to examine their understandings and conceptions. Students can then discuss these or other statements in small groups, using these questioning strategies with each other.

Keep a chart or ongoing list of students' thoughts and ideas in the classroom as a reference to students' initial thinking and ideas. Invite students to use and add to these lists as they develop their projects.

Consider creating a class version of a KWHL chart, collecting information on what students know, what they want to know, how they think they will find out, and then, completing what they learned after sharing their projects. Monitor class understandings and provide support in areas that students need.

> CONNECT TO PRIOR LEARNING

Ask students to explore what they think agriculture involves — place, activities, practices, issues, values and beliefs. Discuss and create a definition of agriculture on the board before students start brainstorming. **Agriculture** refers to the practices involved in growing crops and feeding and raising livestock for food and other products. Encourage students to make connections between agriculture and the food they eat.

> CONNECT TO EXPERIENCES

Encourage students to share stories about connections to agricultural places, events and activities that they have experienced. Identify and discuss the characteristics of agricultural communities that students live in or have visited. Set up a **Padlet** or other digital bulletin board for students to post word or image snapshots of their experiences connected to agriculture.

reflect on connections

Create a **Mind Map** on the board with the whole class to reflect on connections to what students may have learned about concepts related to farming, ecosystems, food chains and webs, food sources and sustainable practices.

A **Mind Map** is provided in **Project Tools**, found on the **sustainability** MATTERS **TEACH** webpage at **www.projectagriculture.ca/teach/sustainability-matters/** and on the **Project GUIDES** webpage at **www.projectagriculture.ca/share/project-guides/**.

> EXTEND LEARNING

Encourage students to consider what they have previously learned about Indigenous perspectives and beliefs regarding the land and resources. To what extent could these perspectives inform current practices, values and beliefs about sustainable practices, agriculture and food, today and in the past?

spark inquiry with a sustainability MATTERS cafe

Have students further explore perspectives and concepts related to all or some of the three essential understandings in a **world cafe**, using the **Spark Questions about sustainability** MATTERS sources.

Start student exploration by sharing the **project** AGRICULTURE website on an interactive whiteboard. Go to the **sustainability** MATTERS photo banner on the **project** AGRICULTURE website and click on the "spark" icons to access and explore the **Spark Questions** sources.

Preview the information and questions. Then, provide in digital or print form for students to explore individually.

Several starting points for further inquiry are provided as questions throughout the **Spark Questions** sources. These questions are found in **INVESTIGATE MORE** sidebars in each handout and include:

- How can an ecological footprint be used to balance food choices?
- What are the benefits and limitations of the science that the calculations of ecological footprints are based on?
- How does measuring and monitoring carbon footprints support sustainable agriculture?
- How do people monitor environmental conditions? How effective are these practices in promoting sustainability?
- How does measuring and monitoring carbon footprints support sustainable agriculture?
- How can environmental monitoring support sustainability in agriculture?
- How should ecosystems be managed in agricultural environments? How can people intervene in the most sustainable ways?
- How would you describe the cycles involved in a sustainable agricultural ecosystem? What inputs and outputs affect the balance of an agricultural ecosystem?
- How do sustainable agriculture practices benefit the human food chain?
- How is a knowledge of the chemical elements of life essential to the sustainability of food?
- How can chemistry principles be applied to monitor environmental and human health?
- What could or should sustainable agriculture look like in the future?
- How can connections between agriculture, the environment and food be strengthened?
- How do stable ecosystems benefit local food systems?

The three essential understandings from the previous activity are shared with students in the **Spark Questions about sustainability** MATTERS PDF sources.

The **INVESTIGATE MORE** questions in the **Spark Questions** sources are intended as starting points for student investigation and research. They can be used to identify areas for inquiry or as a focus for the development of a project question.

Specific curriculum outcomes for each of the three Spark Questions learning sources in this topic, correlated to each, are provided in the LEARNING OUTCOMES AND COMPETENCY MAP on the following pages.

Click on each guiding question in the map to go directly to the downloadable source on the website.

- What makes agricultural activities sustainable? How do these activities affect natural ecosystems? How are they influenced by natural ecosystems?

Tell students that they will be asked to hold group conversations, focused on one of the **Spark Questions** sources. Organize students into groups of three or four at a table or cluster of desks. Select a leader for each group. The leader will record the major points of the group conversation and be prepared to summarize them.

Share questions such as the following with students as the focus for their group conversations:

- What information and examples can you find in this source to support the essential understanding?
- What more information is needed to better understand the essential understanding?
- What would you most like to find out more about? Why?

Have groups discuss the questions for an established period of time.

Once the time is up, have the leader stay but the other group members rotate to a different table. Ask the leader to summarize the main points of the conversation they had with their former group for their new group members.

Have each new group select a new group leader. Repeat the process to provide multiple students with the opportunity to lead a group.

Consult *Teamwork Skills: Being an Effective Group Member* from the University of Waterloo at **https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/tips-students/being-part-team/teamwork-skills-being-effective-group-member** for group and teamwork skills that can be shared with students.

SPARK QUESTIONS: LEARNING OUTCOMES AND COMPETENCY MAP

project AGRICULTURE Activity	GRADE 9 SCIENCE	SCIENCE 20	BIOLOGY 20
	CONCEPTUAL KNOWLEDGE	**CONCEPTUAL KNOWLEDGE**	**CONCEPTUAL KNOWLEDGE**
SPARK LEARNING SOURCE **What is the environmental footprint of our food sources?** **Ecological footprints measure the demand for resources that human activities place on the environment.**	**Unit C: Environmental Chemistry** 3. Analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment • Investigate and evaluate potential risks resulting from consumer practices and industrial processes, and identify processes used in providing information and setting standards to manage these risks (e.g., interpret and explain the significance of manufacturer's information on how wood preservatives can be safely applied; recognize that some individuals may have greater sensitivity to particular chemical substances than do others in the general population) • Identify and evaluate information and evidence related to an issue in which environmental chemistry plays a major role (e.g., evaluate evidence that the use of insecticides to control mosquitoes has an effect/has no effect on bird populations)	**Unit D: Changes in Living Systems**	**Unit A: Energy and Matter Exchange in the Biosphere** **Unit B: Ecosystems and Population Change**
SPARK LEARNING SOURCE **Why is balance important for sustainable ecosystems?** **Agriculture and sustainability go hand in hand. Agriculture affects and is in turn affected by the natural environment.**	**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 • Identify common organic and inorganic substances that are essential to the health and growth of humans and other living things, and illustrate the roles served by these substances (e.g., identify calcium as an essential material for bones; identify minerals that are known to enhance plant growth but that limit growth if too little or too much is available) • Describe, in general terms, the forms of organic matter synthesized by plants and animals, including carbohydrates, proteins and lipids	**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 • Infer biotic interactions; e.g., predator-prey relationships, competition, symbiotic relationships • Infer the influence of biota on the local environment; e.g., microclimates, soil, nutrients	**Unit A: Energy and Matter Exchange in the Biosphere** 20–A1.1k Explain, in general terms, the one-way flow of energy through the biosphere and how stored energy in the biosphere, as a system, is eventually "lost" as heat; e.g., • Photosynthesis/chemosynthesis • Cellular respiration (muscle-heat generation, decomposition 20–A2.1k Explain and summarize the biogeochemical cycling of carbon, oxygen, nitrogen and phosphorus and relate this to general reuse of all matter in the biosphere **Unit B: Ecosystems and Population Change** 20–B1.1k Define species, population, community and ecosystem and explain the interrelationships among them 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

project AGRICULTURE Activity	GRADE 9 SCIENCE	SCIENCE 20	BIOLOGY 20
	CONCEPTUAL KNOWLEDGE	CONCEPTUAL KNOWLEDGE	CONCEPTUAL KNOWLEDGE
SPARK LEARNING SOURCE How should agriculture be managed to ensure stable ecosystems? Sustainability focused on meeting present needs without damaging future possibilities.	**Unit C: Environmental Chemistry**	**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 • Infer biotic interactions; e.g., predator-prey relationships, competition, symbiotic relationships • Infer the influence of biota on the local environment; e.g., microclimates, soil, nutrients 20–D2.3k Analyze and describe how energy flows in an ecosystem, using the concepts of conservation of energy (second law of thermodynamics); energy input and output through trophic levels, food webs, chains and pyramids; and specific examples of autotrophs and heterotrophs 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)	**Unit A: Energy and Matter Exchange in the Biosphere** 20–A1.3k Explain the structure of ecosystem trophic levels, using models such as food chains and food webs 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–B1.1k Define species, population, community and ecosystem and explain the interrelationships among them 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–B1.4k Explain how limiting factors influence organism distribution and range; e.g., • Abiotic factors: soil, relative humidity, moisture, ambient temperature, sunlight, nutrients, oxygen • Biotic factors: competitors, predators and parasites

project AGRICULTURE Activity	GRADE 9 SCIENCE	SCIENCE 20	BIOLOGY 20
	PROCEDURAL KNOWLEDGE	PROCEDURAL KNOWLEDGE	PROCEDURAL KNOWLEDGE
ALL SPARK LEARNING SOURCES	**Unit C: Environmental Chemistry** Ask questions about the relationships between and among observable variables, and plan investigations to address those questions • Identify science-related issues (e.g., identify issues regarding the use of soil fertilizers) • Identify questions arising from practical problems and issues (e.g., ask questions about the needs of different living things for nutrients and about the mechanisms by which these nutrients are obtained) • 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) Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data • Identify data and information that are relevant to the issue	**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–D1.3s Analyze data and apply mathematical and conceptual models to develop and assess possible solutions • Analyze the information presented by opposing sides on an environmental issue, such as that of an environmental group and that of an industry representative, to determine bias (AI–NS4, AI–SEC1) [ICT C2–4.1, C2–4.2] • Identify new questions that arise from investigations, such as: "Should naturally occurring forest fires be fought?" (AI–NS5) 20–D2.1s Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues • Predict disruptions in the nitrogen cycle that are caused by human activities (IP–NS3)	**Unit A: Energy and Matter Exchange in the Biosphere** 20–A2.1s Formulate questions about observed relationships and plan investigations of questions, ideas, problems and issues • Design an experiment to compare the carbon dioxide production of plants with that of animals (IP–NS1, IP–NS2, IP–NS3, IP–NS4) • Predict disruptions in the nitrogen and phosphorus cycles that are caused by human activities (IP–NS3) [ICT C6–4.1] **Unit B: Ecosystems and Population Change** 20–B1.1s Formulate questions about observed relationships; plan investigations of questions, ideas, problems and issues; and define and delimit problems to facilitate investigation • Hypothesize the role of biotic and abiotic factors in ecosystems; e.g., competition and chinooks (IP–NS3) [ICT C6–4.1]