STAGE 4: SOIL IN THE ENVIRONMENT

Students will learn about the importance of healthy soil to healthy plants. They will explore soil composition, including the biodiversity of this complex ecosystem, to understand that there are different types of soil. Often soil dictates what can be grown—or not—in a particular area. Students will explore human impact on soil and farmers' role in soil health and the technology they use to mitigate environmental harm. Designing a new farming machine is an optional bonus activity.

Lesson 1: What is Soil?
Lesson 2: Soil Types in Ontario (and Regions)
Lesson 3: Compaction and Erosion
Lesson 4: Soil Nutrients
Lesson 5: STEM and Technology on Farms
Lesson 6: Designing an Innovative Farm Machine

LESSON 4 – Nutrients

Overview:

We need healthy soil to be healthy! That's because healthy soil produces the healthy plants that are the foundation of our lives. Like people, soil needs nutrients to be healthy. The main nutrients soil needs are nitrogen, phosphorous, and potassium, minerals found naturally in soil. It also needs calcium, zinc, and iron—just like us.

Students will learn the importance of soil nutrients, the three essential soil nutrients, and how farmers manage the soil in their fields to keep it healthy.

Learning Goals

- Understand that plants needs nutrients to grow
- Understand how soil has nutrients available, and if not how farmers can add nutrients to the soil for plants to use
- Grow plants and conduct a fair test to track their growth

Materials Needed

- Lesson Slides

ACTION: Investigating Soil Nutrition materials needed:

- Seeds (Check out https://goodineverygrain.ca/good-in-every-classroom/ for seed kits)
- Small plant pots, soil, fertilizer
- Rulers/measuring tapes
- Writing materials, paper for tracking plant growth

Time Frame: 40 min

Curriculum Expectations

Science & Technology Curriculum
Strand A STEM Skills

- A1.2 Use a scientific experimentation process and associated skills to conduct investigations
- A1.5 Communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes

Science & Technology Curriculum
Strand E Soils in the Environment

- E1.1 Assess the importance of soils for society and the environment
- E1.2 Assess the impact of human activity on soils, and describe ways in which humans can improve the quality of soils and/or lessen or prevent harmful effects on soils
- E2.1 Identify the living and non-living components of soil, and describe the characteristics of healthy soil

- E2.2 Identify different substances that are commonly added to, or absorbed by, the soil, and describe their effects on soil health
- E2.5 identify various strategies used to maintain and improve soil health in Ontario
- E2.2 Identify different substances that are commonly added to, or absorbed by, the soil, and describe their effects on soil health

Mathematics Curriculum

- Strand D Data
- D1.2 Collect data through observations, experiments, and interviews to answer questions of interest that focus on qualitative and quantitative data, and organize the data using tables

Agriculture/Agri-Food Themes

- Farmers use a range of practices to protect soil health, such as fertilizing with one of several methods that have been proven to work or rotating crops so plants return nutrients to the soil

Media Links (embedded in the slides)

Earth's Atmosphere Broken Down https://www.britannica.com/video/73156/atmosphere-Earth-oxygen-nitrogen-water-vapour-component

On the Farm – Nitrogen https://www.britannica.com/video/73156/atmosphere-Earth-oxygen-nitrogen-water-vapour-components

Teaching Notes

Slide 6: Minds ON!	What do these items have in common? Kick off your lesson with a mystery bag discussion: Step 1: Place three objects that represents an essential nutrient for the human body in bags, one per bag. Examples: an empty bottle of calcium, another of magnesium, and a bottle of water. Step 2: Place them on a table at the front of the classroom. Have three students each put a hand in the bags and guess what the items are. After each student has guessed, place the items on the table. Step 3: Ask the class what these items have in common. You're looking for the answer – they are all things that the body needs to be healthy. Even better if they use the term nutrient! **Reminder:** The six essential nutrients are vitamins, minerals, protein, fats, water, and carbohydrates. People need to consume these nutrients from dietary sources for proper body function.

Slide 7: Nutrients	• Different plants need different nutrients to grow. • As plants grow, they use the nutrients in the soil. After a plant is done growing in the soil, the nutrients it used needs to be added back into the soil for the next plant to grow. Farmers make sure the nutrients the plants used are put back into the soil for the next crop. • Farmers apply fertilizers to their soil to put back the nutrients the plants have used. Farmers make sure they use only the amount necessary to help the soil and prevent excess fertilizer getting into waterways. They know what they need based on soil sampling tests (From Stage 4, Lesson 2: Soil Types in Ontario (and Regions)) • Fertilizer can be animal waste like manure or a blend of nutrients like nitrogen, phosphorus, or potassium, which are essential minerals found naturally in soil. • Fertilizer can also be naturally occurring organic matter from other plants- the plant debris leftover from the growing season like leaves, pods, stalks, or straw!
Slide 8/9: Nutrients	Ask students to think about what it means when the plants stops growing and are harvested. What's left in the soil? What needs to be happen then?
Slide 10: Essential Nutrients	If plants didn't have these nutrients, they would not grow. There are other nutrients that help plants that do not stop the plant's life cycle.

Slide 11: **Where do Nutrients Come From?**	The common question is where does fertilizer come from? Like the other sources of nutrients, it comes from NATURE! • Fertilizer can be in granular or liquid form of the nutrients Nitrogen, Phosphorus and Potassium. • Manure is from livestock droppings (yes, it's poo!) • Organic sources from leftover plant debris including fallen leaves and dry materials like straw. • Compost is decomposing organic material like food and plants. Sometimes manure is added to compost to make it break down more quickly.
Slide 12: **On the Farm – Fertilizer and Manure**	Fertilizer can be animal waste like manure or a blend of nutrients like nitrogen, phosphorus, and potassium, which are essential minerals found naturally in soil. It can be found in liquid forms and sprayed, or in solid forms and spread.
Slide 13: **On the Farm – Nitrogen**	Check this out! Air is nearly 80% nitrogen! https://www.britannica.com/video/73156/atmosphere-Earth-oxygen-nitrogen-water-vapour-components Nitrogen comes from nature - in the air and in plants. It moves through the environment, cycling through the air, soil, and living organisms. Some plants can draw nitrogen from the air. Other crops need it given to them in a more digestible form, so fertilizer companies mix nitrogen from the air with natural gas to make it something that can be given to plants.

Slide 14: **On the Farm – Crop Rotation**	Crop rotation is when farmers rotate the crops they plant in their fields each year, instead of growing the same crop year after year on the same field. Farmers choose their own rotations; some have 3-year rotations of corn, soybeans, and wheat; others may have a 5-year rotation of corn, soybeans, wheat, barley, and oats. They may also add other crops like hay, canola, or vegetables to their rotation!
Slide 15: **On the Farm – Crop Rotation**	Rotating their crops is a sustainable practice that helps farmers boost their soil health, reduce pests (like weeds, diseases, or insects), and manage their nutrients use. Different grain plants need different nutrients each year, so rotating them each year allows different nutrients to be used or added into the soil.
Slide 16: **ACTION: Investigating Soil Nutrition**	**Tip!** This is best done as a whole class or in business groups. Fertilizer can be purchased in spikes, liquid form or solid form. Ask your garden centre or families if they have some to donate to your class. You will need only a small amount. • Students could conduct an investigation at this stage to determine the effect of fertilizer on plant growth by growing three plants from seeds, giving each one a different amount of fertilizer, and observing differences in how the plants grow. • First, recap the concept of fair testing and remind students that all variables (e.g., how much water is given or location in the classroom) must be kept the same. The only thing they should change is the amount of fertilizer they give each plant. • Students should choose which variables they will measure (i.e., some may focus on speed of growth, the plants' heights, or number of leaves.) • Different groups could grow different seeds to produce a range of results within the class. • Fast-growing seeds include radishes, peas, and beans

Slide 17: **Making a Fair Test**	Reminder: Fair testing was covered in STEMterprise Stage 3, Lesson 4 When we set up a fair test with our other seeds, we learned about variables. To know how a variable changes something, we have to be sure not to changed anything but that one variable.
Slide 18: **Measuring the Plants' Growth**	You may also wish to have your students decide how they will chart their plants' growth: journal, graph, chart.

Assessment Resources. Coming soon!
Please check the STEMterprise webpage at https://goodineverygrain.ca/ontario-farming-stemterprise/