



## 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 6 – Designing an Innovative Farm Machine

### Overview:

This is a highlight for students and teachers. It's a great activity for consolidating their learning about soils and technology!

The lesson can take multiple blocks. It's up to you how much time you give to this lesson.

### Example:

- Block #1 - Introduce prototypes and review the Engineering Design Process. Learn about farm machines.
- Block #2 - Imagine & Plan
- Block #3 - Create, Test, Improve
- Block #4 - Share



## Learning Goals

- Practise the engineering design process.
- Learn how crops are planted, grown, harvested, and processed.
- Learn about current farming equipment.
- Discuss/review what you've learning about how environment and agriculture affect each other.

## Materials Needed

- Lesson Slides
- Farm Machines Note-Making Template
- Scissors, pencils, tape, masking tape
- Variety of recycled materials for building planter prototype: toilet paper tubes, cardboard, straws, boxes (tissue), skewers, popsicle sticks, jar lids for wheels, beads, marbles, dixie cups

**Time Frame: 40 min**

## Curriculum Expectations

### Science & Technology Curriculum Strand A STEM Skills

- A1.3 Use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems
- A1.5 Communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes
- A3.1 Describe practical applications of science and technology concepts in their home and community, and how these applications address real-world problems
- A3.2 Investigate how science and technology can be used with other subject areas to address real-world problems



### Agriculture/Agri-Foods Themes

- Modern farm machinery is more efficient and less harmful to soil and the environment. More efficient vehicles mean farmers spend less time driving on fields, which means less soil compaction and therefore healthier soil.

### Media Links (embedded in the slides)

#### Embedded in the slides

There's Got to be a Better Way <https://www.youtube.com/watch?v=8KVGDJJzAU>

Tractor prototype <https://www.youtube.com/watch?v=0l-UjCe-NSk>

How do You Plant Ontario Grains? <https://www.youtube.com/watch?v=0ML0x7Cehn8>

Choosing the right cultivator on your farm <https://www.youtube.com/watch?v=7f4GEeqKyik>

Seed Drill <https://www.youtube.com/watch?v=0ML0x7Cehn8>

Crop Sprayer <https://www.youtube.com/watch?v=Pz3XHlbPdXk>  
[https://www.youtube.com/watch?v=noLu\\_xwfgXY](https://www.youtube.com/watch?v=noLu_xwfgXY)

Combine Harvester <https://www.youtube.com/watch?v=w9u0aYlkjKQ>

Future of Farming Robots <https://www.youtube.com/watch?v=uD4mJCgsmdM>

Engineering Inspiration Video <https://www.curiositymachine.org/challenges/121/>

#### In the teaching notes only

Early tractors

<https://www.farmcollector.com/steam-traction/first-steam-tractor-zm0z01sepzraw/>

<https://www.fwi.co.uk/machinery/tractors/machinery-milestones-the-worlds-first-tractors>





## Teaching Notes

<p><b>Slide 6: Minds ON!</b></p>	<p><b>What is a prototype?</b> There's Got to be a Better Way <a href="https://www.youtube.com/watch?v=8KVGDDJJzAU">https://www.youtube.com/watch?v=8KVGDDJJzAU</a></p>
<p><b>Slide 7: Prototypes</b></p>	<p>When you look at a modern piece of equipment, it may not look like the first prototype. Sometimes machines go through a lot of versions as it becomes the most efficient version of itself. For example, one of the first prototypes of farm tractors was powered by steam. That means they used coal to boil water in a boiler to create steam. Eventually they were replaced by the internal combustion engine, which used kerosene or gasoline. Today tractors run on diesel engines.</p> <p>Sources: <a href="https://www.farmcollector.com/steam-traction/first-steam-tractor-zm0z01sepzraw/">https://www.farmcollector.com/steam-traction/first-steam-tractor-zm0z01sepzraw/</a> <a href="https://www.fwi.co.uk/machinery/tractors/machinery-milestones-the-worlds-first-tractors">https://www.fwi.co.uk/machinery/tractors/machinery-milestones-the-worlds-first-tractors</a></p>
<p><b>Slide 8: Engineering Design Process</b></p>	<p>Use the PowerPoint presentation to share the stages of the engineering design process and then work through the stages.</p>
<p><b>Slide 9: Designing an Innovative Farming Machine</b></p>	<p>Tell students - You are going to work in your business groups and apply your STEM skills to engineer innovative farming equipment.</p> <p>Brainstorm - How might this help your granola bar business in the future?</p>





<p><b>Slide 10: Farm Machinery - Ask</b></p>	<ul style="list-style-type: none"> <li>• Explain: we will use the engineering design process to design our own planting machine. Our goal is to overcome challenges faced by farmers.</li> <li>• Ask students to remember some of the challenges farmers face that we learned about in previous stages (e.g., soil compaction, keeping nutrients in the soil, erosion).</li> </ul>
<p><b>Slide 11: Research</b></p>	<ul style="list-style-type: none"> <li>• Allocate one piece of farming machinery to each business group and ask them to research what it does, how it works, and some of its advantages and disadvantages. For example, you could use a cultivator, a seed drill, a crop sprayer, and a combine harvester.</li> <li>• Ask students to make their notes on the Farm Machines Note-Making Template and then present their findings to the class.</li> <li>• The next three slides introduce machinery students could research.</li> </ul>
<p><b>Slide 12: Cultivator/Tillage Machine</b></p>	<ul style="list-style-type: none"> <li>• Watch the video to learn how a cultivator works: Choosing the right cultivator on your farm <a href="https://www.youtube.com/watch?v=7f4GEeqKyik">https://www.youtube.com/watch?v=7f4GEeqKyik</a></li> <li>• Ask students to make their notes on the Farm Machine Note-Making template and then present their findings to the class.</li> </ul>
<p><b>Slide 13: Seed Drill</b></p>	<ul style="list-style-type: none"> <li>• Watch the video to learn how a seed drill works: How Do You Plant Ontario Grains? <a href="https://www.youtube.com/watch?v=OML0x7Cehn8">https://www.youtube.com/watch?v=OML0x7Cehn8</a></li> <li>• Ask students to make their notes on the Farm Machines Note-Making Template and then present their findings to the class.</li> </ul>



<p><b>Slide 14:</b> <b>Crop Sprayer</b></p>	<ul style="list-style-type: none"> <li>• Watch these short videos to learn how a crop sprayer works.  <a href="https://www.youtube.com/watch?v=Pz3XHlPdXk">https://www.youtube.com/watch?v=Pz3XHlPdXk</a>  <a href="https://www.youtube.com/watch?v=noLu_xwfgXY">https://www.youtube.com/watch?v=noLu_xwfgXY</a> </li> <li>• Ask students to make their notes on the Farm Machines Note-Making Template and then present their findings to the class.</li> </ul>
<p><b>Slide 15:</b> <b>Combine Harvester</b></p>	<ul style="list-style-type: none"> <li>• Watch this video for a thorough explanation of how a modern combine works (the video is 6:46 long).  <a href="https://www.youtube.com/watch?v=w9u0aYIkjKQ">https://www.youtube.com/watch?v=w9u0aYIkjKQ</a> </li> <li>• Ask students to make their notes on the Farm Machines Note-Making Template and then present their findings to the class.</li> </ul>
<p><b>Slide 16:</b> <b>Imagine</b></p>	<ul style="list-style-type: none"> <li>• Explore the role of technology on farms.</li> <li>• This video, The Future of Farming Robots, shows how farming technology can use AI mapping, GPS, and robots within the natural environment. Robots can help make farming more efficient, environmentally friendly, and productive.  <a href="https://www.youtube.com/watch?v=uD4mJCgsmdM">https://www.youtube.com/watch?v=uD4mJCgsmdM</a> </li> </ul>



<p><b>Slide 17:</b> <b>Plan</b></p>	<p><b>Plan</b></p> <ul style="list-style-type: none"> <li>• Ask students to start planning their farming machine designs by thinking about how it works, referring to their notes, and creating a labelled sketch.</li> <li>• To simplify this activity, you could use this example as a starting point: <a href="https://www.curiositymachine.org/challenges/121/">https://www.curiositymachine.org/challenges/121/</a></li> <li>• If you opt to use the tutorial in the video, which shows a plan for a seed planter that drops one seed at a time, the activity could be to think about how to adapt and improve the tutorial's planter using what they have learned. For example, real seed drills plant hundreds of seeds at a time. How could students modify the seed planter to plant a larger area of the field at a time, so the farmer could plant a field of grains faster?</li> </ul>
<p><b>Slide 18:</b> <b>Create</b></p>	<p><b>Create</b></p> <ul style="list-style-type: none"> <li>• Working in groups, ask students to build their farming machine using recycled materials. This could be a homework task if you are short of time.</li> </ul>
<p><b>Slide 19:</b> <b>Test and Improve</b></p>	<p><b>Test and Improve</b></p> <ul style="list-style-type: none"> <li>• Give the students an opportunity to test their prototype and make adjustments to it.</li> <li>• Using the evaluation template, ask students to evaluate what has gone well with their machine design and what they would like to improve.</li> </ul>





<b>Slide 20: Share</b>	Ask groups to present their designs to the class and explain the farming challenge they are solving.
<b>Slide 21: Check In</b>	Next up, is Stage 5: Recipe Design and Market Research, Lesson 1: Grains in Our Diet.

**Assessment Resources. Coming soon!**

Please check the STEMterprise webpage at <https://goodineverygrain.ca/ontario-farming-stemterprise/>

# Farm Machines – Note Taking Template



## Cultivator/Tillage Machine

Function:

How does it work?

## Sprayer

Function:

How does it work?

## Seed Drill

Function:

How does it work?

## Combine Harvester

Function:

How does it work?