



## Stage 5 - Soil in the Environment

### Stage Overview:

In this stage, students will learn about the importance of healthy soil for healthy plants. They will explore different soil types using a choice of activity options for both in and outside the classroom.

### Learning Objective:

- Understand the importance of soil and soil health.
- Understand soil composition.
- Assess human impact on soils, ways we can improve the quality of soils, and farmers' role in maintaining soil health.

### Materials Needed:

#### Soil type investigation

- Access to various types of soil (or pre-collected soil in mason jars)
- Spades (one per group, optional)
- *Types of Soil in Ontario* reference sheet (one per group)
- *Investigation Planning Grid* (one per group)

#### Soil compaction investigation

- Tennis ball
- Different sized balls such as ping pong and volleyball
- Wooden board
- Tray
- Sand or soil

#### Fertilizer investigation

- Seeds
- Compost
- Fertilizer pellets
- Measuring cylinder
- Recycled jars or pots to plant in

**Time Frame:** 1 - 3 hours, depending on how many practical activities are completed.

**Curriculum Connections:** These lesson plans are mapped to curriculum objectives. Find all the details on page 5.

### Presentation Notes

**Slide 3 - 7:**  
What is Soil?

- Revisit the conditions plants need to grow and be healthy from stage 3.
- Take students outside to collect their own soil samples from various locations on the school property (works well in dixie cups). Or, hand out pre-collected samples.
- Let students examine soil samples and discuss similarities and differences. Use the *Types of Soil in Ontario* sheet to identify their soil samples.
- Based on this exploration, ask students to discuss what they think soil is. What types of soil make up your school grounds? Take feedback.
- Watch the video to learn about soil:  
<https://www.youtube.com/watch?v=if29mjcd5bc>
- Soil is made up of minerals from broken-down rocks, air containing gases such as carbon dioxide and oxygen, water, and organic matter from decaying plants and animals.



<p><b>Slide 3 - 7:</b> What is Soil?</p>	<ul style="list-style-type: none"> <li>• The well-being of all plants and land-based animals depends on the complex processes that take place in soil. To grow healthy crops, you need healthy soil. What do we mean by that?</li> <li>• Healthy soil has high soil biodiversity, which means the number of living things or organisms in it, such as earthworms, insects, microbes, and plant roots. They all contribute toward the ecosystem in the soil. Did you know soil is home to a quarter of our planet's biodiversity? It is one of nature's most complex ecosystems and one of the most diverse habitats on earth; just one teaspoon of healthy soil can contain more living organisms than there are people living on earth!</li> </ul>
<p><b>Slide 8:</b> Soil and Farming</p>	<ul style="list-style-type: none"> <li>• Farmers work hard to ensure their soils stay healthy and full of nutrients for their plants.</li> <li>• However, they face some challenges when looking after their soil.</li> </ul>
<p><b>Slide 9 - 11:</b> Compacted Soil</p>	<ul style="list-style-type: none"> <li>• Soil is compacted when something presses down on it and soil particles are pushed together, which can make it more difficult for water to drain through the soil, roots to grow through the soil, and even seedlings to emerge from the soil. It can increase the risk of flooding, water erosion, and unnecessary soil movement.</li> <li>• Soil can be compacted by heavy rainfall, driving on it a lot, or even a lack of crop diversity on farms. Different types of soil can be affected differently in the same conditions.</li> <li>• Farmers are changing how they farm to reduce soil compaction. Farmers are planting cover crops to protect soil in winter and driving less on their fields, using technology to do some jobs. Farmers practise conservation tillage (tilling only where seeds will be planted), which protects the soil and has the added benefit of using less fuel – more than 170 million litres per year.</li> </ul>
<p><b>Slide 12 - 15:</b> Innovative Technology</p>	<ul style="list-style-type: none"> <li>• Work is being done to find a solution to soil compaction. Some of it is low tech – finding out how variably inflated tires and track-based agricultural machinery affect soil. Some of it is high tech – using drone mapping to monitor fields, using that digital mapping to spray only where it is needed, and using advanced seeders that can detect seeding depth. Let's watch some videos to learn more! (could be shown at lunch time).</li> <li>• Along with digital mapping, farmers use GPS and auto-steer (self-driving) tractors to spray only where necessary, so they are not driving on every bit of their fields. <a href="https://canadianfoodfocus.org/on-the-farm/gps-helps-farmers-use-less-pesticides/">https://canadianfoodfocus.org/on-the-farm/gps-helps-farmers-use-less-pesticides/</a></li> <li>• The Dino Robot is a weeding machine that has been tested in Canada: <a href="https://www.naio-technologies.com/en/news/large-scale-vegetable-weeding-in-canada-with-dino/">https://www.naio-technologies.com/en/news/large-scale-vegetable-weeding-in-canada-with-dino/</a> (Text is in English and French; videos are in French).</li> <li>• This video shows 10 innovative farm machines. Which ones do you think will help prevent soil compaction? <a href="https://www.youtube.com/watch?v=K-FvYZv785U">https://www.youtube.com/watch?v=K-FvYZv785U</a></li> </ul>



**Slide 16 - 17:**  
Compaction

**Minds on!**

- Let us talk about how soil is affected by different things pressing on it. Imagine being on a beach or in a garden and seeing where rain has pounded down on it. It looks like millions of fingers poked it. You may also see smooth spots where water pooled; water has weight, so a puddle presses down on the surface of the soil.
- You can also see where your footprints have made an impression. That impression is soil compaction.
- Ask:
  - How much pressure does it take to compact the soil?
  - How long does pressure have to be applied to make a mark?
  - How can farmers change things? That's a good question. Farmers are thinking of these things too.

**Extension activity you may want to try to investigate further.**

- Place a tennis ball in a tray of sand. Place a small piece of wood or sturdy cardboard on top as a platform and use it to roll the tennis ball across the tray. Examine the depth of the groove it created.
- Students could repeat this process with different-sized balls or weights on the platform. Observe the effect changing the weight has on the depth of the groove.
- Students could also investigate the effect of using different sized balls to simulate the effect of changing the size of the tire.

**Slide 18 - 19:**  
Erosion

- Erosion is another way soil is affected; it happens when the top layer of soil is worn down and transported by wind or water.
- When top soil is dry, the wind can pick it up and carry it away, taking with it the nutrients plants need to grow.
- In addition to washing the nutrients and top soil away from fields, water erosion can also cause flooding as the soil is washed into nearby rivers.
- This video shows the impact of plants on preventing soil erosion:  
<https://www.youtube.com/watch?v=im4HVXMG168>
- Many farmers help prevent erosion by planting cover crops, such as radishes, clover, or winter wheat. They help keep wind off the soil and their roots help hold the soil together while they absorb water.

**Slide 20:**  
Nutrients

- Different crops need different nutrients to grow.
- As plants grow, they use the nutrients in the soil. If the same plants always grow in one spot, they will use up all the nutrients that type of plant needs and eventually, that type of plant cannot grow there anymore. Farmers have to make sure the nutrients the plants use 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.
- 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.



<p><b>Slide 21 - 23:</b> Investigating Soil Nutrition</p>	<ul style="list-style-type: none"><li>• 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.</li><li>• First, recap the concept of fair testing and remind the children that all variables (e.g., how much water 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.</li><li>• Students should choose which variables they measure (i.e., some may focus on speed of growth, the plants' heights, or number of leaves.)</li><li>• Different groups could grow different seeds to investigate to produce a range of results within the class.</li></ul>
<p><b>Slide 24:</b> Investigating Soil Biodiversity</p>	<ul style="list-style-type: none"><li>• A final investigation for students is a worm survey.</li><li>• The number of worms in a soil sample is an indication of soil health. Students could cut out two equally sized squares of earth from different places (school, home) and count the number of worms.</li><li>• Each group could display their worm counts on a bar graph.</li></ul>
<p><b>Slide 25:</b> Composting</p>	<p>Alternative/extension activities could include:</p> <ul style="list-style-type: none"><li>• Making a mini composter using a 2 L bottle containing soil and organic waste and leaving it in direct sunlight for 8 weeks.</li><li>• Investigate the benefits of composting and design a poster about why it is important to your city and the food you eat.</li></ul>



## Additional Resources:

- Draw with Rob  
<https://GoodinEveryGrain.ca/draw-with-rob-ep-2/>
- Soil Testing  
<https://GoodinEveryGrain.ca/2021/04/19/earth-day-2021-soil-testing/>
- Farming to Protect the Soil  
<https://GoodinEveryGrain.ca/2022/04/07/farming-to-protect-the-soil/>
- Earth Day 2021: soil testing - Good in Every Grain  
<https://goodineverygrain.ca/2021/04/19/earth-day-2021-soil-testing/>
- It isn't just dirt! - Good in Every Grain  
<https://goodineverygrain.ca/2021/12/05/it-isnt-just-dirt/>

## Curricular Connections:



### Science and Technology: 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.
- **E2.3** examine different types of soils found in Ontario and describe how different soils are suited to growing different types of food, including crops.
- **E2.4** explain the process of erosion, including its causes and its impact on soils.
- **E2.5** identify various strategies used to maintain and improve soil health in Ontario.
- **E2.6** describe the process of composting and explain some benefits of composting.

### New Expectations

- **E2.5** identify various strategies used to maintain and improve soil health in Ontario.



## Curricular Connections:



### Social Studies: People and Environments

- **B3.5.** Describe major types of land use (e.g., agriculture, industry, commerce, housing, recreation, transportation, conservation) and how they address human needs and wants (e.g., agricultural lands provide us with food for local consumption and export; land use for recreation lets people enjoy the outdoors and participate in or watch sports and other activities; residential areas have different types of buildings to meet people's housing needs; conservation lands protect ecosystems and habitat for organisms so that biodiversity is preserved for future generations; untouched wetlands help ensure clean water and a healthy habitat)
- **B3.** Describe major landform regions and types of land use in Ontario and some of the ways in which land use in various Ontario municipalities addresses human needs and wants, including the need for jobs.
- **B1.** Demonstrate an understanding of key aspects of the interrelationship between the natural environment, land use, employment opportunities, and the development of municipal regions in Ontario. How do physical features influence the ways in which land is used? How does the way land is used influence local communities and local jobs?
- **B2.** Use the social studies inquiry process to investigate some of the environmental effects of different types of land and/ or resource use in Ontario municipal regions, as well as some of the measures taken to reduce the negative impact of that use.
- **B2.1.** Formulate questions to guide investigations into some of the short-and/or long-term effects on the environment of different types of land and/or resource use in two or more municipal regions of Ontario (e.g., the impact of mining, forestry, agriculture, suburban land development) and measures taken to reduce the negative impact of that use.
- **B2.5.** Evaluate evidence and draw conclusions about some of the short-and long-term effects on the environment of different types of land use in municipal regions of Ontario and about key measures to reduce the negative impact of that use. Sample question: "What did you find out about the environmental impact of some types of agricultural land use?"



# Types of Soil in Ontario

Soils are made of air, water, minerals, and organic matter. The amount of each of those elements determines soil types. There are several soil types in Ontario. Some are better for growing plants than others. The most common types of soil in Ontario's agricultural areas are clay, loamy, and sandy. What kind of soil is in your area?

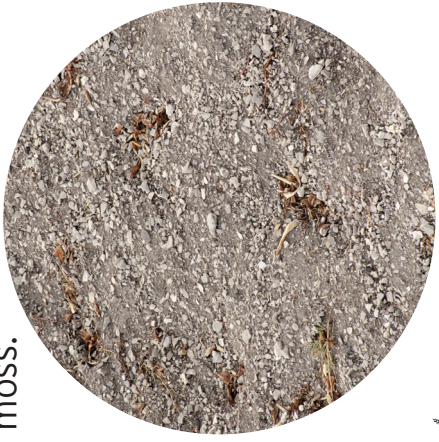


<p><b>Clay</b></p> <p>Clay is heavy! It stores water well but not air. It is smooth when wet but cracks when dry. It holds together if you squeeze it. Clay agricultural soil is not the same as the clay you make pots with.</p> <p>Clay holds plant nutrients but drains slowly. It compacts easily so driving big machines on it when wet can damage it. Clay soil is improved by adding microbes.</p> 	<p><b>Loam</b></p> <p>Loamy soil is the best soil for growing! It is a mix of sand, clay, and silt. It holds water, does not dry out in summer, and stays together if you squeeze it.</p> <p>Loam holds nutrients and drains well so it is good soil for many crops. It may have stones in it, depending how it was formed. That is not ideal. Loamy soil can be made stronger by adding microbes.</p> 	<p><b>Sand</b></p> <p>Sandy soil is mostly sand, which is tiny bits of rock! It is light and feels gritty. Sand is often low in nutrients. It has large particles, so it dries out quickly and nutrients and water can leach away. Plants growing in sandy soil may be dry and need watering and they may need organic fertilizer.</p> <p>Sandy soil warms up quickly in the spring so it is great for early spring planting.</p> 

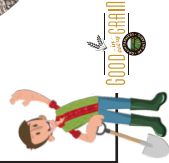




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<p><b>Chalk</b></p> <p>Chalk soil has something in common with sidewalk chalk – both contain the mineral calcium carbonate!</p> <p>Chalk soil does not hold water well, so it is difficult to farm. Chalk is susceptible to water erosion – heavy rain just runs off instead of soaking in. It also does not hold nutrients well.</p> <p>To make chalky soil better, add organic material – compost, manure, or peat moss.</p>	<p><b>Peat</b></p> <p>Peat soil is made from plant material decaying in a wet environment over thousands (!) of years. It holds moisture very well.</p> <p>Peat soil is an excellent material for improving dry types of soil, like sandy soil. It helps make air spaces for roots and it does not contain harmful micro-organisms.</p> <p>Peat is a non-renewable resource. It should be used carefully.</p>	<p><b>Silt</b></p> <p>Silt is like sand but with smaller particles that are bigger than clay particles. When silt is dry, it feels like flour; when wet, it forms a ball.</p> <p>Silty soil is more fertile than sand and easier to farm than clay. It does not filter water well; it compacts and gets hard so farmers avoid driving their heavy equipment on it when it is wet.</p> <p>Compost and microbes improve silty soil.</p>
		





# Investigation Planning



**My research question:**

**Things I will keep the same:**

**One thing I will change:**

**What I will measure:**

**My prediction:**

