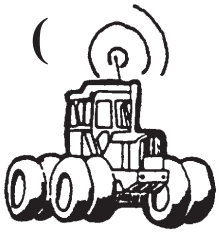
Activity 10

Dirty Business



Activity: Students will learn how soil texture affects plant growth by performing settling tests, porosity tests, and seed growth tests.

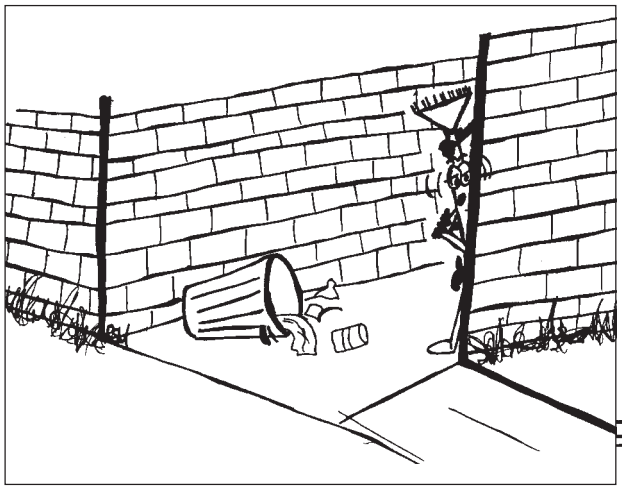
Curriculum Fit: **Grade Eight - Science**
- Growing Plants
- Study of soil characteristics

Agriculture Concepts: Importance of soil and water

Cognitive Level: Analysis

Materials Required:
- soil samples collected from different locations (a shovelful of each sample)
- 100 ml graduated cylinders
- water
- paper towels
- large waste basket (water proof)
- transparent, plastic, cling wrap
- plastic 1 litre bottles
- cloth 1 m2 for use as filters
- rubber bands
- scissors
- 500 ml beakers
- hacksaw
- fast growing seeds (grain seeds, cucumbers, peas or beans)
- 3-inch plant pots

Time Required: 2 - 3 periods



Background — For the Teacher

Soil consists of two parts: solid part and pore space. Mineral particles and organic matter make up the solid part of the soil, while air and water occupy the pore space. Soils vary in their proportions of these components, and the proportions affect the quality of the soil for agricultural use.

For ideal plant growth, an agricultural soil needs to provide:

- at least 15 cm of topsoil, composed of 45%
  mineral particles, 5% organic matter and 50% pore space
- a loamy texture and aggregated structure
- living microbes and invertebrates
- a balanced supply of nutrients, and
- correct acidity (pH).

In such a soil, with adequate rainfall and good management, crops should flourish.

Water and air are essential for plant growth and the activity of soil micro-organisms. The pore space allows for the exchange of gases between the soil and the atmosphere above the soil. The pore spaces also hold water under varying amounts of tension.

Mineral particles are grouped by size into three categories - sand, silt and clay. The proportion of these particles determines the soil texture. Texture has an important influence on many soil properties including size of pore space, water holding capacity, structure and tilth (the condition of soil as a result of cultivation), consistency (the feel of a soil at varying moisture contents) and bulk density (dry mass per unit volume of soil).

In this lesson, students will test soil samples with different textures in order to see how texture affects the properties mentioned above. One test will determine the mineral component of several soils; another will demonstrate the ability of different soils to absorb and hold moisture; and a third will demonstrate the ability of different soils to support plant growth.

NOTE
Test 1 has two parts which must be separated by a 30 minute settling time. Test 2 can be run and test 3 can be set up during this time. Test 3 must be monitored for one or two minutes a day for a week.

Procedure

Preparation

1. Gather a shovelful of soil from several different locations. If some of your students are from farms they may be able to bring samples. You can test any soil types that are available so long as you have several different ones. If forced by circumstances, you can make soils of different types by mixing potting soil, sand or perlite, and peat in different combinations. If possible, obtain samples that are definitely sandy, silty and clayey. Use these as a comparison or control.
2. Set up the testing apparatus for your students.

Introduction

3. Explain that soils differ in their constituents and that these differences change a soil's value to plants.
4. Show your students the sample soils and divide them into as many groups as there are samples.
5. Give each group a soil sample and two 100 ml graduated cylinders.

The Soil Test
Test 1, Part A

6. To determine the mineral composition of the soil, your students should:
   a) crush their soil and clear it of sticks, litter and large lumps.
   b) fill one cylinder to the 15 ml mark with loose soil.
   c) add enough water to fill the cylinder to the 45 ml mark.
   d) cover the cylinder opening with plastic wrap and shake it vigorously for at least three minutes. They must ensure that nothing spills and that large soil particles break up.
   e) set the cylinder down and let the contents settle for <u>exactly 30 seconds</u>.
   f) pour the water and suspended particles into the second cylinder to stand for 30 minutes, taking care not to pour out the settled layer.
   g) record the volume of settled solid in the first cylinder.
   h) take out the settled material.
   i) rub it between their fingers and record the consistency.

gritty	-	sand
slippery	-	silt
sticky	-	clay

Test 2

7. To test their sample for water holding capacity, your students should:
   a) saw the top and bottom off of a plastic bottle, keeping the cylindrical centre portion.
   b) fasten a filter cloth over one end with rubber bands.
   c) add 500 ml of their crushed and screened soil sample to the filter container.
   d) mount the container on a funnel above a graduated cylinder.
   e) quickly pour 200 ml of water into the top of the container, marking the start of the pour as time 0.
   f) record
      1. how long it takes for water to begin to drip through the filter.
      2. the total volume of water that drains out.

Test 3

8. To see how well the soil supports plant growth, each group should:
   a) fill a small plant pot with their soil.
   b) plant a few seeds in the pot, following package directions.

> **NOTE**
> All groups should use the same kinds of seed and grow them under the same conditions.

   c) put their test pot in a well lit place.
   d) add 25 ml of water daily.
   e) record the time until the seeds sprout, the daily increase in height for one week after sprouting and any other apparent changes in the plants as they grow.

Test 1, Part B

9. Once graduated cylinder 2 has settled for 30 minutes students should
   a) record the amount of settled material in the bottom of cylinder 2.
   b) pour off the water and suspended particles, without disturbing the settled layer.
   c) test the settled layer between their fingers and categorize it as previously done (step i of Part A).

Conclusion

10. Have the students compare results and ask them to briefly state how the mineral particle composition of soil affects its water holding capacity and its usefulness to plants.

Discussion Questions

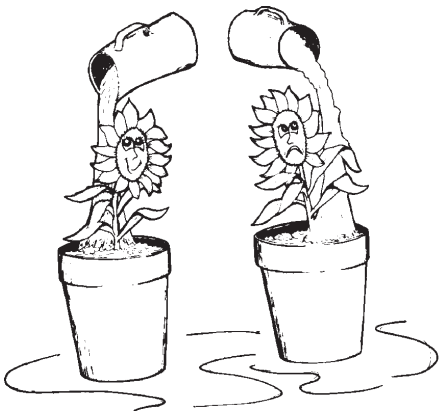
1. Why did the sand settle first?
2. Why do you not wait for the clay to settle?
3. The best soils, called loams, are even-textured. How does your soil compare?
4. Which soil type held water the best? Why?
5. What is the relationship between size/number of pores and adhesion/cohesion forces?
6. What is humus and what role does it play in plant growth?
7. Which soil type yielded the fastest sprouting seeds?
8. Which soil type yielded the fastest growing sprouts? Why?

Related Activities

1. Take your students on a field trip to various locations comparing soil horizons (topsoil, subsoil, parent material) by obtaining soil profiles with a shovel. Observe the vegetation on topsoils of different thicknesses or in moist versus dry locations.

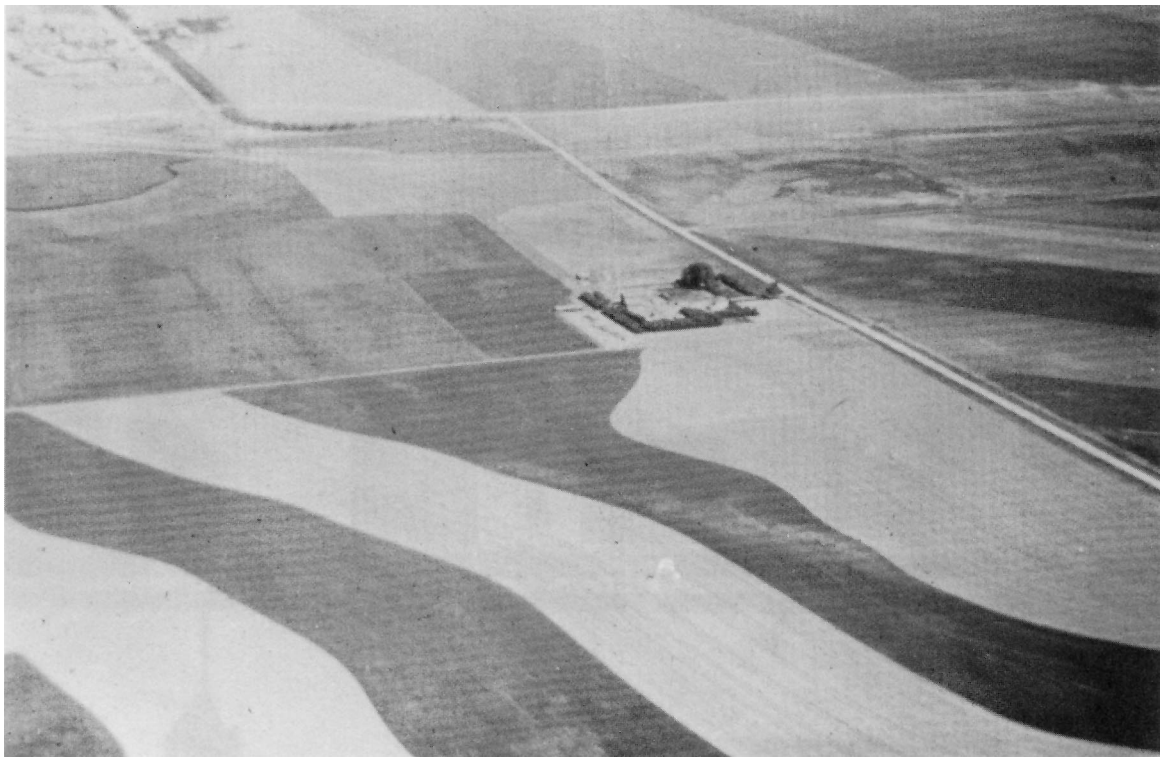
Outside Resources

1. A Matter of Soil (Alberta Agriculture film).

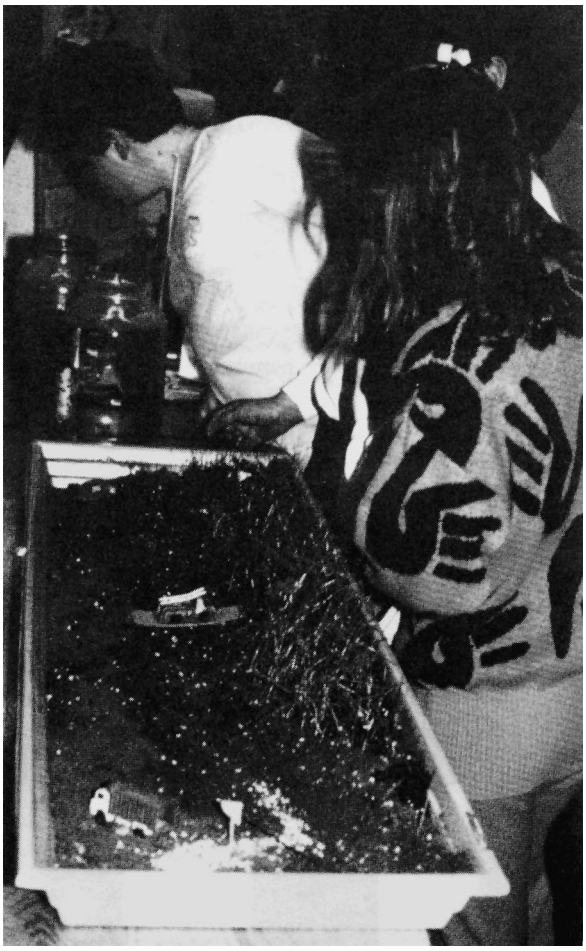


Soil ready to do its work.

Preparing the soil for planting.



Above - Strip farming to conserve soil.



Left- A student project on soil conservation.