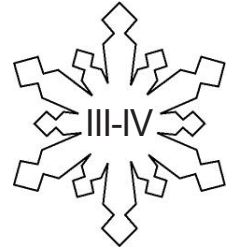


Layering the Soil

Levels



Grades 5-8

Overview:

Soils are divided into layers called horizons. The active layer of permafrost is typically composed of the first few horizons. The active layer thaws and re-freezes each year, insulating the permafrost from the atmosphere. In this lesson, students review soil horizons and the active layer, classify soil by texture, and create a model of local soil horizons. (NOTE: Students should have a basic understanding of the rock cycle and soil formation before this lesson.)

Objectives:

The student will:

- classify soil by texture and particle size;
- identify soil horizons;
- identify the active layer in permafrost; and
- create a model of local soil layers.

GLEs Addressed:

Science

[5-8] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SD2.1 The student demonstrates an understanding of the forces that shape Earth by describing the formation and composition (i.e., sand, silt, clay, organics) of soils.

[6] SD3.2 The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by identifying that energy transfer is affected by surface conditions (e.g., snow cover, asphalt, vegetation) and that this affects weather.

Whole Picture:

In a soil pit or on a roadside cut, various layers in the soil are visible. These layers are called soil horizons. The arrangement of these horizons in a soil is known as a soil profile. Soil scientists, called pedologists, observe and describe soil profiles and soil horizons to classify and interpret the soil for various uses.

Soil is divided up into horizons named O, A, B, and C. O is the top horizon. It is typically about one inch thick and composed mostly of dead plant and animal material. The A horizon contains a lot of roots from plants, as well as bacteria and fungi that help decompose animals and plants. The O and A horizons combined are called topsoil. B and C horizons are harder, so plants and animals have a hard time getting through; C is almost completely inorganic.

Texture class can often determine soil type. Texture class is one of the first things determined when a soil is examined. Soil type is often a direct result of physical weathering. The parent material, or original material (before weathering), often determines the characteristics of the soil horizons. Texture class can be determined fairly well in the field by feeling the sand particles and estimating silt and clay content by flexibility and stickiness.

Vocabulary:

organic - material derived from living organisms (plants and animals)

inorganic - material composed of nonliving material (rocks and minerals)

soil - the upper layer (or surface soil) of earth in which plants grow; a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles

subsoil - the soil lying immediately under the upper layer (or surface soil)

stratum - an underlying layer or substance, in particular a layer of rock or soil beneath the surface of the ground

Materials:

- Double-sided tape, with backing
- Water
- Card stock or index cards
- Disposable cups
- Markers (to label the soil samples)
- Soil samples (see Activity Preparation steps 1A and 1B)
- TEMPLATE: "Soil Horizon Cards"
- OVERHEAD: "Soil Horizons"
- STUDENT INFORMATION SHEET: "Soil Classification by Texture"
- STUDENT WORKSHEET: "Soil Horizons"

Activity Preparation:

1. In disposable cups, collect two sets of local soil samples (the number of samples in each set will depend on class size; students may complete the activity in pairs or small groups):
 - A) A set of samples collected from various locations and depths around the local community. Use a marker to note the location and depth from which each sample was taken. Be sure to collect enough soil in each sample for all students to perform the Classification of Soil by Texture activity, described below.
 - B) A set of samples from a roadside cut or soil pit. Collect a sample for each visible soil horizon. Use a marker to note the horizon and the depth of the horizon on each sample. Be sure to collect enough soil in each sample for all students to perform the Soil Profile Cards activity, described below.
2. Dry the soil samples in a microwave for 10 minutes or in a conventional oven at 220°F for 24 hours.
3. Copy and cut out soil horizon cards from the TEMPLATE, so that there is one card per student. Cards can be copied onto cardstock or glued onto 3-inch x 5-inch index cards.

Activity Procedure:

Classification of Soil by Texture

1. Ask students if soil looks the same on the surface as several feet under ground and why they think so. If there is a soil pit, roadside cut, or other exposed area in a safe and easily accessible location, take the class to the site to explore. Alternatively, photographs can be taken and shown to the class.
2. Show OVERHEAD: "Soil Horizons." Explain soil exists in layers. These layers are called soil horizons. Scientists use the letters O, A, B, and C to identify the horizons. Some soils (but not all) have an organic horizon, O, which includes plants. A is the surface horizon below any plants, B the subsoil, and C the substratum.
3. The A horizon contains a lot of roots from plants, as well as bacteria and fungi that help decompose the animals and plants. The O and A horizons combined are called topsoil. B and C horizons are harder, so plants and animals have a hard time getting through; C is almost completely inorganic.
4. Soil itself is classified into various categories by particle size. Each soil has a distinct look and feel. Scientists have a method for determining soil type by feel. Distribute a copy of the rubric to each student and discuss. Divide students into small groups or pairs. Distribute a soil sample (see Activity

Preparation step 1A, above), water, and STUDENT INFORMATION SHEET: "Soil Classification by Texture" to each group. Guide students through the procedure on the information sheet. Provide students with time to sort and classify their soil. (NOTE: Not all soil types will be present.)

5. Discuss group findings. Did all groups find the same soil types? Why or why not?

Soil Profile Cards

6. Distribute a soil horizon card, double-sided tape, and soil horizon samples (see Activity Preparation step 1B, above) to each student. Instruct students to place a strip of double-sided tape on the vertical box on their soil horizon card. Next, students should pull the backing strip off the tape they have just affixed to the card to the line marking the depth of the first soil horizon. Ask them to sprinkle the soil sample over the sticky part of the tape that was exposed when they removed the backing. Students should repeat this process with the other horizons. Finally, students should label the horizons O, A, B, and C.
7. Explain permafrost can extend hundreds of meters down into the soil. The active layer is the top layer of soil above the permafrost that thaws in summer and refreezes in winter. The active layer is typically about one meter in depth, but it can vary widely depending upon the local conditions. Ask students to note this on their cards.

Critical Thinking Question: The 3-minute Rule. Ask students which soil horizon has the best insulating value, and why. Wait three minutes before providing an answer. (*O, it is composed of organic material, is more porous*) This allows students to think through their replies and provides an opportunity for several students to answer and expand upon the question. Studies show that teachers often answer their own questions within 5 seconds when students do not respond immediately. If necessary, explain the active layer is the top meter or so of the soil; just as soil horizons vary in depth, so does the active layer.

8. Ask students how they can estimate the depth of the active layer without measuring. Explain plants cannot grow in the frozen permafrost; the presence of roots and living organisms indicates the active layer in an area known to have permafrost.
9. Distribute the STUDENT WORKSHEET: "Soil Horizons." Ask students to complete the worksheet individually. Discuss as a class.

Extension Idea: Repeat the soil profile activity with soil from another location to demonstrate how soil horizons vary by location.

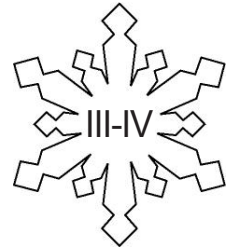
Answers:

1. O = organic horizon, the top horizon, contains mostly dead plant and animal material
A = surface horizon, contains roots, bacteria and fungi
B = subsoil, harder material, contains very little organic material
C = substratum, harder material, almost completely inorganic
2. O, A, and B
3. C. insulates the permafrost
4. False

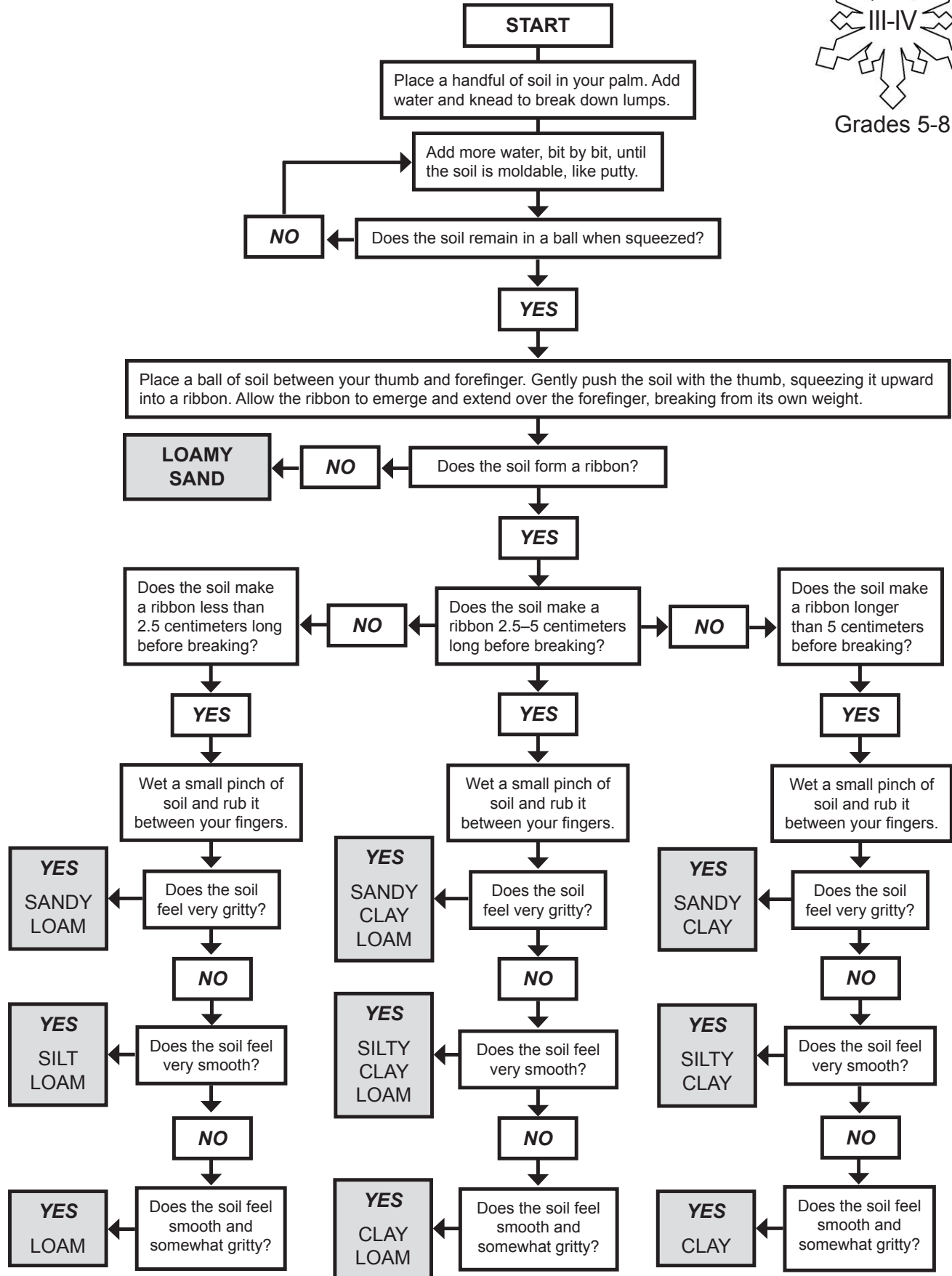
Soil Classification by Texture

Student Information Sheet

Levels



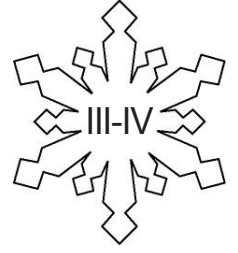
Grades 5-8



Soil Horizon Cards

Template

Levels

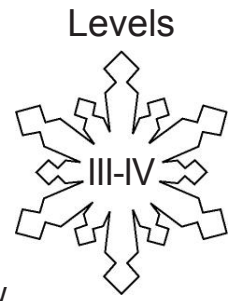


<p>Soil Horizons</p> <p>Depth of active layer of permafrost: _____ cm</p> <p>0 cm 30 cm 60 cm 90 cm 120 cm 150 cm</p>	<p>Soil Horizons</p> <p>Depth of active layer of permafrost: _____ cm</p> <p>0 cm 30 cm 60 cm 90 cm 120 cm 150 cm</p>	<p>Soil Horizons</p> <p>Depth of active layer of permafrost: _____ cm</p> <p>0 cm 30 cm 60 cm 90 cm 120 cm 150 cm</p>
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Name: _____

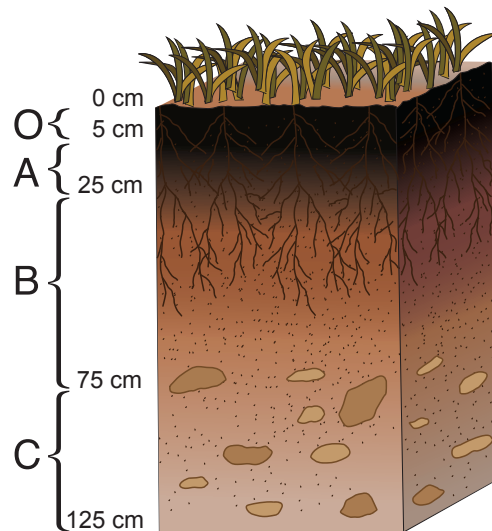
Soil Horizons

Student Worksheet



Directions: Name and describe the soil horizons shown on the diagram below. Answer the questions.

1. O = _____
A = _____
B = _____
C = _____



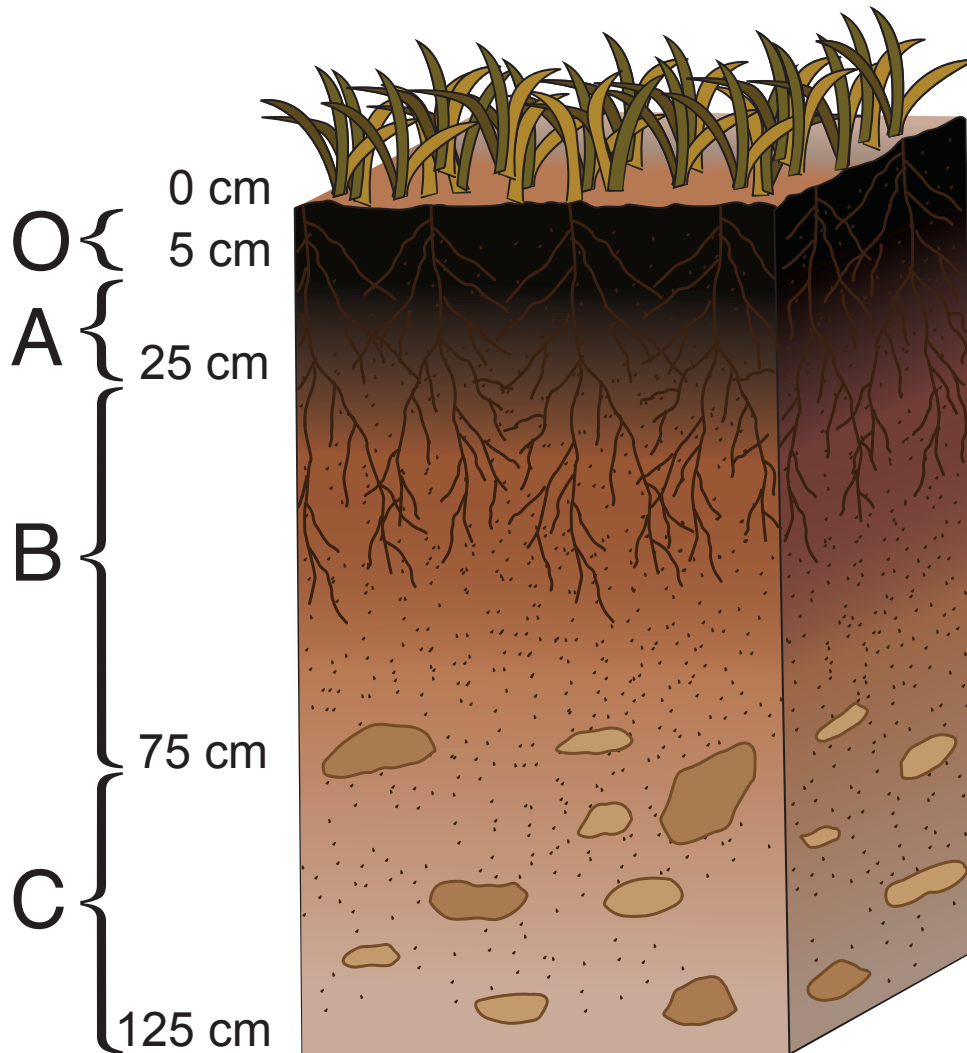
2. Which horizons shown on the diagram make up the active layer? _____
3. The active layer
 - A. is the O horizon.
 - B. is where no ice forms.
 - C. insulates the permafrost.
4. True or False: Soil horizons are always the same depth in all locations. _____

RUBRIC

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student creates a model of local soil layers.	[5-8] SA1.1	The student incorrectly models the local soil layers and/or incorrectly labels the soil horizons on his or her model.	The student creates a model of local soil layers and correctly labels the soil horizons on his or her model.	The student creates a model of local soil layers and correctly labels the soil horizons and active layer on his or her model.
The student classifies soil by texture and particle size.	[5-8] SA1.1 [6] SD2.1	The student correctly classifies soil by identifying less than three soil types by texture and particle size.	The student correctly classifies soil by identifying three soil types by texture and particle size.	The student correctly classifies soil by identifying more than three soil types by texture and particle size.
The student identifies soil horizons.	[6] SD2.1	The student incorrectly identifies soil horizons on a worksheet.	The student correctly identifies soil horizons on a worksheet.	The student correctly identifies soil horizons and correctly explains the difference between the layers on a worksheet.
The student identifies the active layer in permafrost.	[6] SD3.2	The student does not or incorrectly identifies the active layer in permafrost on a worksheet.	The student correctly identifies the active layer in permafrost on a worksheet.	On a worksheet, the student correctly identifies the active layer and identifies that the active layer in permafrost is not always the same depth.

Soil Horizons

Overhead



O = organic horizon

A = surface horizon

B = subsoil

C = substratum