

Instructional Value

Soil Basics

Grade Level: 6-12**Type of Lesson:**

Activity

Materials Needed

Soil profile images for students
(could be laminated copies for
repeated use)

Markers, pencils, pens, dry erase
markers

Time

Teacher Prep: 10 minutes to
gather/print materials

Student Class Time: 30 minutes

Student Learning Objectives:

- Identify and draw the major soil horizons as present (O, A, E, B, C, R) in a soil profile
- Describe observable differences among horizons (color, texture, structure, organic matter, etc.)
- Explain in general terms how soil forming factors and processes lead to horizon formation and how different horizons form in various soil types

Keywords

Soil profile, soil horizon, soil
formation, soil order

Reading the Layers: Soil Horizon Mapping

Overview

Soil is not uniform with depth. As soils “grow up” over time, they develop horizons: relatively horizontal (or gently wavy) layers that differ in color, texture, structure, organic content, and other properties.

Horizon formation results from four major processes:

- **Additions:** organic matter, dust, or sediments are added to the soil surface
- **Losses:** materials are removed by leaching, erosion, or plant uptake.
- **Translocations:** movement of materials within the profile, such as clay, organic matter, or dissolved minerals moving downward or sideways with water or organisms
- **Transformations:** chemical and biological changes including mineral weathering, decomposition of organic matter, and oxidation or reduction of iron

All soil formation is influenced by the CLORPT soil forming factors (Climate, Organisms, Relief, Parent Material, Time, www.soils4teachers.org/formation). Over long periods of time, these horizon formation processes and soil forming factors create distinguishable horizons.

Together all the soil horizons make up the soil profile (www.soils4teachers.org/soil-horizons).

Typical major horizons (from surface downward) include:

- **(organic):** Mostly organic matter such as decomposing leaves. The O horizon is thin in some soils, thick in others, and not present at all in others.
- **A (topsoil):** Mostly minerals from parent material with organic matter incorporated. A good material for plants and other organisms to live.
- **E (eluviated):** Leached of clay, minerals, and organic matter, leaving a concentration of sand and silt particles of quartz or other resistant materials – missing in some soils but often found in older soils and forest soils.
- **B (accumulation):** Rich in minerals that leached (moved down) from the A or E horizons and accumulated here.
- **C (parent material):** The deposit at Earth’s surface from which the soil developed.
- **R (bedrock):** A mass of rock such as granite, basalt, quartzite, limestone or sandstone that forms the parent material for some soils – if the bedrock is close enough to the surface to weather. This is not soil and is located under the C horizon.

Reading the Layers: Soil Horizon Mapping

Soil Science Society of America

Not all horizons are present in every soil. Some soils might have only A-C, others O-A-B-C, others more complex sequences. Horizon development depends on the soil's environment and age. For example, a young soil may not have had enough time yet for strong horizon development. Many very young soils might only show an A horizon or a C horizon, with no B horizon yet formed. Older soils, especially those in humid climates or areas with abundant rainfall, often show many more horizons due to prolonged weathering, leaching, and translocation. These profiles may have very thick B horizons, multiple subhorizons (e.g., Bt, Bh, Bs), or complex sequences of leached and enriched layers. Disturbances such as erosion, deposition, or land use (e.g., plowing a farm field) can also remove or change horizons.

Teacher Notes

Powerpoint Download: <https://www.agronomy.org/files/s4t/lessons/soil-horizons-activity-ppt.pptx>

The first slide of each set is student-facing, and the second gives the horizon designations and some info about how you would identify the different horizons (color vs texture).

Print copies of the slides without the horizon lines for students. Consider laminating them so students can write on them with an erasable marker.

The first profile is done as a class, the next four are completed in pairs, and the final horizon can be used as a formative assessment to check for understanding.

The soil profiles selected represent a range of soil orders and state soils so you may choose to expand on this activity by exploring additional resources including:

www.soils4teachers.org/soil-types and www.soils4teachers.org/state-soils

For more advanced students, you may optionally challenge them to infer which soil-forming processes (additions, leaching, clay illuviation, etc.) likely produced each horizon in each profile, based on appearance and context.

Soil profiles are provided with major and subhorizons (e.g., Bt, Bw, Bh, Bs) labeled for you to use based on student level.

Soil profiles were selected to represent soils from the Spodosol, Ultisol, Mollisol, Andisol, Alfisol, and Inceptisol orders. Soils are also the state soils of Michigan, North Carolina, Kansas, Washington, Arkansas, and Massachusetts.

Each soil profile has 4 slides

1. Soil profile with prompt
2. Answer key with major horizons
3. Answer key with major horizons and text details
4. Answer key with all horizon/subhorizons and text detail

Note About Interpretation

It is completely normal and scientifically acceptable for students (and even professional soil scientists!) to interpret soil horizons slightly differently. Some boundaries are sharp and easy to draw; others are gradual, transitional, or ambiguous. Two trained soil scientists describing the same profile might draw boundaries in slightly different places or assign slightly different labels.

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Students should use their understanding of how soils form and what typical horizons look like to make reasoned decisions. The annotated “answer” photos represent one expert interpretation, but that does not make them the only correct interpretation. Slight variation is expected and encouraged as part of learning.

Discussion Prompts:

1. What clues did you use to decide where one horizon ended and the next began?
(Prompt students to reference color changes, texture, structure, and organic matter.)
2. Did anyone make different decisions about horizon boundaries or labels? Why might that happen?
(Reinforces that interpretation varies and that ambiguity is normal in soil science.)
3. Looking across the different soil profiles, which ones appear to be the “youngest” and which appear to be the “oldest”? What evidence supports your reasoning?
(Encourages noticing horizon thickness, presence/absence of B horizons, degree of weathering.)
4. How do you think climate influenced the thickness and color of the horizons you observed?
(Warm/wet → more leaching, deeper profiles; cold/dry → shallower profiles, organic matter accumulation, etc.)
5. How could parent material influence the textures or colors of these profiles?
(Sandy parent material → sandy horizons; glacial till → mixed textures; volcanic ash → dark A horizons, etc.)

Suggested Formative Assessment question: Choose one soil profile and explain how at least two soil-forming factors contributed to its horizons. Make sure to use evidence from the profile (color, texture, horizon thickness, etc.).

Student Instructions

The pictures of soil profiles are from around the country and represent the different soil orders.

1. Examine the soil profile photograph carefully from top to bottom. Notice color changes, textural/structural differences, roots or stones, and any layering.
2. Identify and draw horizon boundaries as you see them. Look for color, texture, or structure changes.
3. Label each horizon using appropriate master-horizon letters (O, A, E, B, C, R) depending on what you observe. If uncertain or transitional, indicate as “transitional (e.g., AB, BE, etc.).”
4. Write brief notes beside each horizon describing what you see (color, texture, structure, organic matter, roots, stones, etc.).
5. Optional: Based on your observations, propose which soil-forming processes likely contributed to the development of each horizon (e.g., leaching, clay accumulation, organic matter addition).
6. Compare your drawing and labels to the annotated (answer-key) version of the profile.
7. Reflect: Were there horizons you missed or mis-labeled? Why might that have happened? What made some boundaries easy to see and others more subtle?

The soil profile photo set is available here:

<https://www.soils4teachers.org/files/s4t/lessons/soil-horizons-soil-profile-set.pdf>