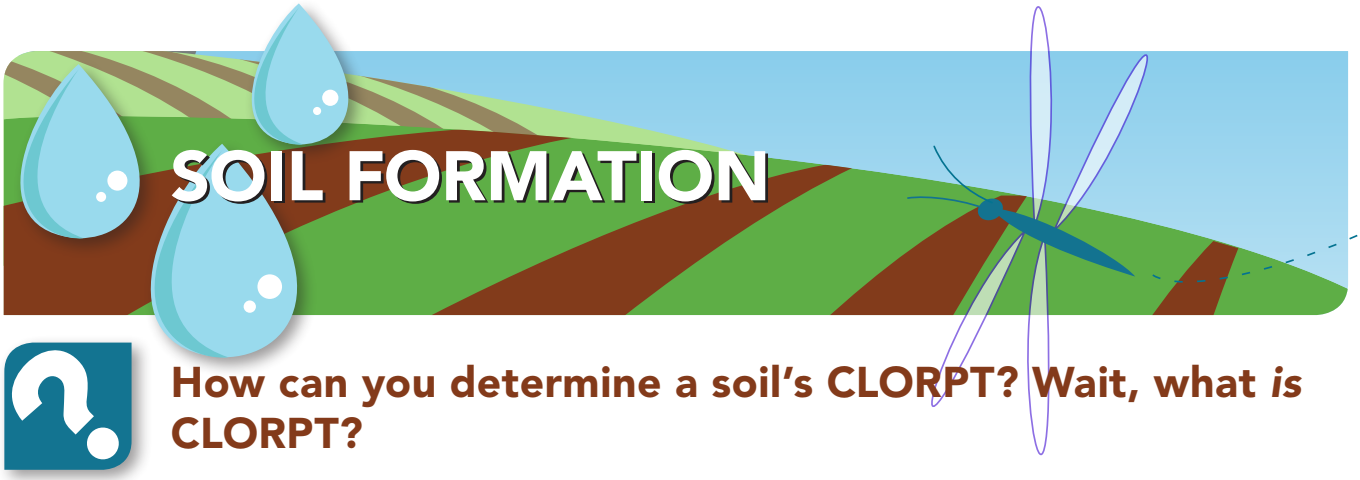



## How can you determine a soil's CLORPT? Wait, what *is* CLORPT?

### INTRODUCTION

CLORPT is an acronym for the five **factors of soil formation**. The letters stand for:

- CL – **CL**imate
  Climate describes weather **characteristics** over a long period of time, including temperatures and rainfall. Soils that formed with 35 inches of rain per year are much different from soils that formed in a desert climate with only 6 inches of rain per year!
- O – **O**rganisms
  Organisms are the kinds of plants and animals that influence the way soils are formed. For example, many years of falling pine needles can make a soil slightly acidic (low pH). Similarly, earthworms have long been associated with healthy, productive soils.
- R – **R**elief (topography)
  Relief describes the shape of the earth's surface, such as mountains, hills, and plains. Have you ever noticed how soils in low-lying areas are wetter than soils on ridges? Soils on north-facing slopes tend to be cooler because the sun doesn't shine on them as much as on south-facing slopes. That's the "topography factor" in action.
- P – **P**arent material
  Parent material describes the kinds of rocks or transported sediments that the soil formed in. Examples include **alluvial**, **colluviums**, **eolian**, glacial, **residual**, and **organic** soils.
- T – **T**ime
  Older soils usually have more differences in color, structure, and texture as you go down from the soil surface. Reddish colors might be caused by **iron oxides** and certain kinds of clay that have been washed down and concentrated at a lower level (**soil horizon**). Younger soils such as a big deposit of windblown dune sand or **floodplain** might have similar characteristics throughout the **soil profile**.

Studying the **landscape** and soil profile and soil properties reveals clues to help determine the factors that helped create the soil in your area. In this activity you will read about the five CLORPT factors that help form soil.

### TOOL KIT

- ☐ Pen or pencil
- ☐ Soil Formation worksheet

### DO IT

- Read and respond to the questions in the worksheet.
- Complete the Chat questions with your adult helper.

### LIFE SKILLS

- Acquiring knowledge
- Critical thinking
- Processing information


**Share What Happened:** Do you remember what the acronym CLORPT stands for?

**Apply:** What can you tell about a soil's formation by looking at it?

**Generalize to Your Life:** How does soil formation affect how a soil should be used?


Courtesy USDA NRCS

## DIG DEEPER

- "Indiana Soils: Evaluation and Conservation," by Dr. Gary C. Steinhardt, Department of Agronomy, Purdue University

  ID-72, www.agry.purdue.edu/soils_judging/

  Read chapters 1 and 2.

  Download the Ag & Environment scorecard and the Homesite scorecard from the homepage to see what is included.

- Read the NRCS information: Soils – Fundamental Concepts – NRCS,Soil, Info.pdf

- Follow the instructions in How to Make Miniature Soil Monoliths (AY-234-W) to make a soil monolith showing a soil profile.

  The publication is available at Purdue Extension's Education Store, www.edustore.purdue.edu; search monolith or AY-234-W.

## NOTES:

# SOIL FORMATION WORKSHEET

**INSTRUCTIONS: Read the text and answer the questions that follow.**

### Introduction

Soil formation (creation) takes many years, and many things affect a soil as it forms. The major factors that affect soil formation are the climate under which it forms; the organisms that are present; the relief, or topography, of the area where the soil forms; the parent material that the soil is created from; and the length of time involved, usually hundreds or thousands of years. Parent material and topography are present when the soil starts to develop. Climate and plant and animal life then act on these initial conditions to cause formation of **soil horizons**. Older soils — those that have existed for a longer time — have more developed layers, or horizons.

### Questions

- Which two factors of soil formation are present when the soil starts to develop?

A. _____

B. _____

- Which two factors then act on these initial conditions to cause formation of soil horizons?

A. _____

B. _____

### Climate

Climate is important in the formation of soils. It determines the kinds of plant and animal life on and in the soil, and the amount of water available for weathering minerals and transporting materials. Temperature, a climate factor, determines the rate of chemical soil weathering. Freezing and thawing cause physical soil weathering. During soil formation, many plant nutrients are **leached** (washed out) from the surface and subsoil horizons by water moving down through the soil. This is why gardeners and farmers fertilize many garden and agricultural soils to achieve good yields. Many soil parent materials in Indiana contained ground-up limestone, but this material has been dissolved and leached from the top several inches in younger soils and from the top several feet in older soils. As a result, many Indiana soils are acidic and need lime added to them.

### Climate questions

- Climate determines the kinds of _____ and _____ life on and in the soil.

- How does the amount of water in a particular climate affect soil formation?

- Why is it often necessary to fertilize gardens and agricultural fields?

### Organisms

The organisms that influence soils in Indiana the most are plants. Bacteria, fungi, earthworms, and human activities are also important to soil formation. Plants and animals add **organic matter**, an important component of garden and agricultural soils. Plant roots and earthworm tunnels also provide channels for water to move through the soil.

Soils are affected greatly by the type of vegetation under which they were formed. The distribution of organic matter in a soil depends on the kinds of plants that grew on it. Soil bacteria and fungi break down dead plant material. Some of it remains in the soil as **humus**, but some is broken down further into nutrients that plants can use.

Indiana's native vegetation of consisted mainly of deciduous hardwood forests, prairie grasses, and water-tolerant grasses and sedges. Grasses have a large, fibrous root system that adds large amounts of organic matter to the upper layers of soil each year. Thus soils formed under grasses have a thick, dark-colored surface horizon. In contrast, in the forest, leaves fall on the soil surface and add organic matter on top of the mineral soil. This results in a thin, dark-colored surface layer of organic material over a lighter-colored layer.

### Organisms questions

- Which has more influence on Indiana soil formation? (circle one)

  plants ☐ animals ☐

- Match the organisms to its chief contribution to soil formation.

| Letter | Organism | Contribution to Soil Formation |
|---|---|---|
| | plant and animal life | A. Break down dead plant material |
| | plant roots and earthworm | B. Add organic material |
| | soil bacteria and fungi | C. Provide channels for water movement |

- Describe the difference in the profiles of soils developed under grasses on prairies and those under forests.

### Relief

Relief, also called topography, describes the shape of the land surface. Relief influences the natural drainage, movement of water in the landscape, **erosion**, plant cover, and soil temperature. Landform and natural soil drainage are related, because the slope and shape of the soil surface affects which areas will lose or gain water. Soils on steep slopes lose water, and soils in depressions gain water. As a result, soils on steep slopes are usually well drained, regardless of the parent material. Soils in depressions are usually poorly drained. Flat or gently sloping soils might be well drained if they are **permeable** and the **water table** is deep. However, if slowly permeable material holds up the water table, the soils are wetter.

## SOIL FORMATION WORKSHEET continued

Relief is categorized as uplands, lowlands, terraces, or floodplains. Uplands are the highest parts of the **landscape**. They lie above the lowlands, which are associated with rivers and streams. Beneath uplands are unstratified materials, meaning they do not have layers, such as weathered bedrock, till, or **loess**. Terraces are at intermediate levels in the landscape, between uplands and floodplains, and are associated with a river or stream. Most terraces are on soil that running water deposited thousands of years ago. **Floodplains**, found in lowlands near rivers and streams, are subject to flooding. Most are nearly level. Floodplains are made of **alluvium**; running water deposited their parent materials.

### Relief questions

- What does relief mean?

- What does relief influence?

- Where do you think the best soil is found? (circle one):

  uplands ☐ lowlands ☐

### Parent material

Parent material is the starting point in soil formation. Soils form from rocks that are igneous, sedimentary, or metamorphic. The parent material is the main factor that determines soil texture resulting from the percentages of **sand**, **silt**, and **clay**. The parent material's chemical and mineralogical properties affect the natural fertility of the soil formed from it.

Indiana soils have many kinds of parent materials. They include material that weathered from bedrock and mainly stayed in place, and material that ice, water, or wind carried some distance. Glaciers transported the parent materials of many Indiana soils. Before the glacial period, the entire state's topography was rough and rolling, much like the current topography in southern Indiana, which ice never covered. Glaciers — ice sheets that were hundreds of miles long and hundreds to a few thousand feet thick — covered much of the state during at least three different ice ages. From the oldest to the youngest, these glacial ice ages were the Kansan, the Illinoian, and the Wisconsinan Ages. As the ice moved south, it destroyed old hills and made new ones. The material the ice carried buried old valleys. A layer of rock, sand, silt, and clay was left when the ice melted and receded. This material, called glacial drift, is partly till and partly outwash.

Till is a homogeneous mixture of sand, silt, and clay, and usually gravel and boulders, that was deposited directly from the glacier ice. Running water from melting glaciers deposited outwash. The size of the particles that make up outwash varies according to the speed of the water that carried them. When fast-moving water slowed down, coarser particles were deposited as outwash; the slower-moving water continued to carry the finer particles such as fine sand, silt, and clay. Outwash deposits generally consist of layers of sandy and gravelly material. In soils formed

from outwash, typically the substratum, or C horizon, consists of coarse sand and gravel. The subsoil, or B horizon, has a finer texture. Lacustrine (lake bed) materials were deposited from slowly moving or ponded glacial meltwater. Because the coarser particles dropped out of moving water as outwash, only the finer particles, such as fine sand, silt, and clay, remained to settle out of still water.

As the glaciers began to melt, they receded. During some periods the flood plains of the glacial meltwater rivers became dry, and wind picked up silt and sand particles from the floodplains and carried them toward the upland. Fine and medium sand particles were carried only a short distance, then deposited in sand dunes close to the flood plain.

**Eolian** (windblown) sand is an important soil parent material along the major rivers of southern Indiana, near Lake Michigan and in the Kankakee Valley. Silt that the wind carried a greater distance from the floodplain settled out of the air as loess. Loess was blown mainly from the Wabash and White River Valleys in central and southern Indiana. Glacial ice never covered south central and southeastern Indiana. The parent material in this area is weathered bedrock.

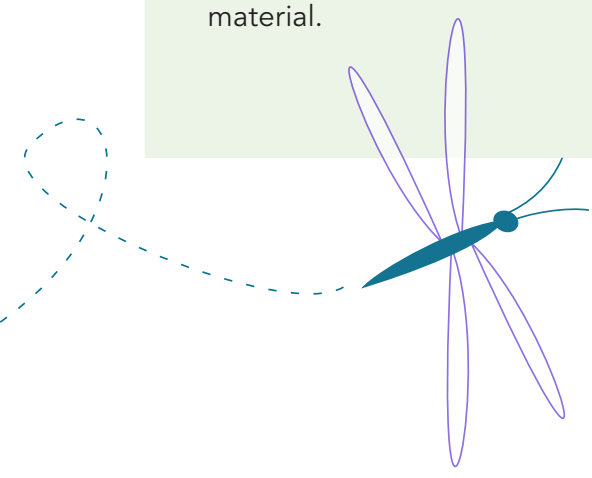
Alluvium, sediment that water recently deposited, is the parent material of soil on floodplains. These materials are usually stratified, or arranged in layers.

Some soils formed in organic materials. After the glaciers melted, water was left standing in depressions in outwash, lake, and till plains. Grasses and sedges growing around the edges of these lakes died. These plant residues were preserved in the water and accumulated around the edges of the lakes. Later, white cedar and other water-tolerant trees grew on the areas. As these trees died, their residues also became a part of the organic accumulation. The lakes were eventually filled with an organic material called peat. In peat, specific plant remains can be identified. Most peat has decomposed to muck, a black humus material in which the source plants cannot be identified.

**Parent Material questions**

- What is soil parent material?

- Study the pictures below. Read the descriptions and match the soil profiles to their parent material.



## SOIL FORMATION WORKSHEET continued

| Parent material | Profile and description |
|---|---|
| _____ A. Alluvium | |
| _____ B. Eolian sand | |
| _____ C. Glacial outwash | |
| _____ D. Glacial till | |
| _____ E. Loess | |
| _____ F. Weathered bedrock | |

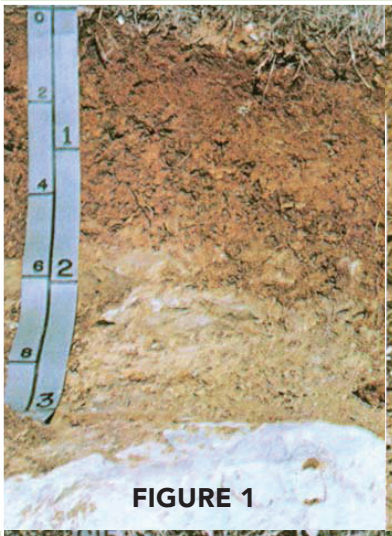


FIGURE 1


FIGURE 2

**FIGURE 1. Contains rock fragments that are angular or flat**

**FIGURE 2. Contains stratified materials or layers of coarse sands and/or rounded pebbles with strong soil development**

**FIGURE 3. Two or more layers that differ in color or texture with weak soil development**

**FIGURE 4. Fine sandy texture that is not stratified and has few or no pebbles**

**FIGURE 5. Silt loam or silt texture with few or no pebbles; not stratified, dense, or chalky**

**FIGURE 6. Chalky with rounded igneous pebbles; not stratified**


FIGURE 3


FIGURE 4


FIGURE 5


FIGURE 6

**Soil graphics courtesy**
**G. Steinhardt, Purdue University**

## SOIL FORMATION WORKSHEET continued

### Time

It usually takes hundreds or thousands of years for soils to form from parent materials. The longer a soil surface has been exposed to soil-forming agents like rain and growing plants, the greater the development of the soil, and with more horizons. Some soils in Indiana are on young surfaces, less than a few thousand years old. Most of these surfaces were created when water or wind deposited new material. Other young surfaces were created when erosion removed upper soil layers, such as on very steep slopes. Soils on young surfaces show few horizons.

Glaciers never covered much of south central and southeastern Indiana, so the soils might be a few hundreds of thousands years old. Some of these soils, however, were eroded a long time ago and then were covered with loess around 20,000 years ago.

### Time questions

- How long does it take to form distinct layers or horizons in the profile?

- How can you distinguish between young and old soils?

## NOTES: