## Resources

Information for this overview was gathered from *Soil! Get the Inside Scoop* book, a publication of the Soil Science Society of America, designed for the middle-school level and available at **www.societystore.org**

### Ask a Soil Scientist | www.soils4teachers.org/ask

If you have any question on soils, soil science, and careers in soil science, this is the place to get answers. And, if you'd like to arrange for a soil scientist to visit your classroom, this is the place to make a request. Your question(s) will be sent to a Soil Science Society of America member, in your region.

**Additional teacher resources are available at:**
**www.soils4teachers.org**
**www.soils.org/IYS**



**Books from the Society Store.**
**www.societystore.org**

Soil Science Society of America
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Images: Istock, *Soil! Get the Inside Scoop,* USDA

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# Soils Overview

Provided by the Soil Science Society of America

Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms that are the decaying remains of once-living things. It forms at the surface of land – it is the "skin of the earth." Soil is capable of supporting plant life and is vital to life on earth.

Soil, as formally defined in the Soil Science Society of America Glossary of Soil Science Terms, is:

1. The unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

2. The unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time.

**So then, what is dirt?** Dirt is what gets on our clothes or under our fingernails. It is soil that is out of place in our world – whether tracked inside by shoes or on our clothes. Dirt is also soil that has lost the characteristics that give it the ability to support life – it is "dead."

Soil performs many critical functions in almost any ecosystem (whether a farm, forest, prairie, marsh, or suburban watershed). There are seven general roles that soils play:

1. Soils serve as media for growth of all kinds of plants.
2. Soils modify the atmosphere by emitting and absorbing gases (carbon dioxide, methane, water vapor, and the like) and dust.
3. Soils provide habitat for animals that live in the soil (such as groundhogs and mice) to organisms (such as bacteria and fungi), that account for most of the living things on Earth.
4. Soils absorb, hold, release, alter, and purify most of the water in terrestrial systems.
5. Soils process recycled nutrients, including carbon, so that living things can use them over and over again.
6. Soils serve as engineering media for construction of foundations, roadbeds, dams and buildings, and preserve or destroy artifacts of human endeavors.
7. Soils act as a living filter to clean water before it moves into an aquifer.

## Soil Formation – CLORPT – for short!

Soils differ from one part of the world to another, even from one part of a backyard to another. They differ because of where and how they formed. Five major factors interact to create different types of soils:

**Cl**imate—Temperature and moisture influence the speed of chemical reactions, which in turn help control how fast rocks weather and dead organisms decompose. Soils develop faster in warm, moist climates and slowest in cold or arid ones.

**O**rganisms—Plants root, animals burrow, and bacteria eat – these and other organisms speed up the breakdown of large soil particles into smaller ones. For instance, roots produce carbon dioxide that mixes with water and forms an acid that wears away rock.

**R**elief (landscape)—The shape of the land and the direction it faces make a difference in how much sunlight the soils gets and how much water it keeps. Deeper soils form at the bottom of a hill because gravity and water move soil particles down the slope.

**P**arent material—Every soil "inherits" traits from the parent material from which it formed. For example, soils that form from limestone are rich in calcium and soils that form from materials at the bottom of lakes are high in clay. Every soil formed from parent material deposited at the Earth's surface. The material could have been bedrock that weathered in place or smaller materials carried by flooding rivers, moving glaciers, or blowing winds. Parent material is changed through biological, chemical and environmental processes, such as weathering and erosion.

**T**ime—All of these factors work together over time. Older soils differ from younger soils because they have had longer to develop. As soil ages, it starts to look different from its parent material. That is because soil is dynamic. Its components—minerals, water, air, organic matter, and organisms—constantly change. Components are added and lost. Some move from place to place within the soil. And some components are totally changed, or transformed.

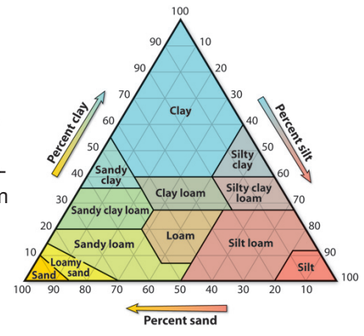
## What is Soil?

There are many soil properties that help us describe and manage soils. Some of the important physical properties are described below.

### Soil Texture

The particles that make up soil are categorized into three groups by size – **sand, silt,** and **clay**. Sand particles are the largest and clay particles the smallest. Most soils are a combination of the three. The relative percentages of sand, silt, and clay are what give soil its texture. A clay loam texture soil, for example, has nearly equal parts of sand, slit, and clay.

**Sand** – 2.0 to 0.05 mm
**Silt** – 0.05 to 0.002 mm
**Clay** – less than 0.002 mm




There are 12 soil textural classes represented on the soil texture triangle on the right. This triangle is used so that terms like "clay" or "loam" always have the same meaning. Each texture corresponds to specific percentages of sand, silt, or clay. Knowing the texture helps us manage the soil.

### Soil Structure

Soil structure is the arrangement of soil particles into small clumps, called **peds** or **aggregates**. Soil particles (sand, silt, clay and even organic matter) bind together to form peds. Depending on the composition and on the conditions in which the peds formed (getting wet and drying out, or freezing and thawing, foot traffic, farming, etc.), the ped has a specific shape. They could be granular (like gardening soil), blocky, columnar, platy, massive (like modeling clay) or single-grained (like beach sand). Structure correlates to the pore space in the soil which influences root growth and air and water movement.

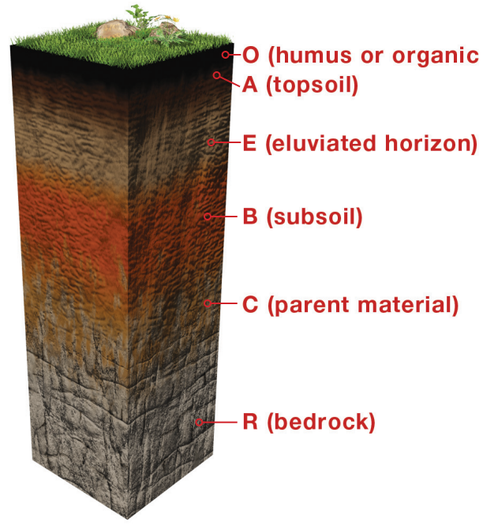
### Soil Color

Soil color is influenced primarily by soil mineralogy – telling us what is in a specific soil. Soils high in iron are deep orange-brown to yellowish-brown. Those soils that are high in organic matter are dark brown or black. Color can also tell us how a soil "behaves" – a soil that drains well is brightly colored and one that is often wet and soggy will have a mottled pattern of grays, reds, and yellows.

### Soil Profile

There are different types of soil, each with its own set of characteristics. Dig down deep into any soil, and you'll see that it is made of layers, or horizons (O, A, E, B, C, R). Put the horizons together, and they form a soil profile. Like a biography, each profile tells a story about the life of a soil. Most soils have three major horizons (A, B, C) and some have an organic horizon (O). The horizons are:

**O –** (humus or 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 –** (subsoil) 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.




### Soil Degradation

Soil degradation is a human-induced or natural process which impairs the capacity of soil to function. As an example, in 3000 BC, the Sumerians built large cities in the deserts of Southern Mesopotamia. Using irrigation, they farmed the desert soils and created large food surpluses that made their civilization possible. But around 2200 BC, the civilization collapsed. Scientists debate why, but one reason may be tied to the soil. Irrigating in dry climates can cause a buildup of salt, a process called salinization. Few crops can tolerate salt. The soil in this region still remains too salty to grow crops.

Other activities that degrade the soil include contamination, desertification, and erosion.

### Soil is Inter-Disciplinary

Soil has been a defining component of cultures since the beginning of civilization. Some of the first written words were recorded on clay tablets and water was carried in clay pitchers. It provides the base for all buildings (although some may be able to support a skyscraper and some others may not be able to support your weight), it holds the clues of past cultures (to be revealed by archeologists or erosion), it supports the web of life (connecting all ecosystems), provides materials to build houses, is a source of nutraceuticals (definite in the American Heritage Dictionary as a food or naturally occurring food supplement thought to have a beneficial effect on human health), and of course, provides the base for our food, fiber, feed, and even some biofuels.