

How soils form

Soil is the thin layer of material covering the earth's surface and is formed from the weathering of rocks. It is made up mainly of mineral particles, organic materials, air, water and living organisms—all of which interact slowly yet constantly.

Most plants get their nutrients from the soil and they are the main source of food for humans, animals and birds. Therefore, most living things on land depend on soil for their existence.

Soil is a valuable resource that needs to be carefully managed as it is easily damaged, washed or blown away. If we understand soil and manage it properly, we will avoid destroying one of the essential building blocks of our environment and our food security.

Soil profile showing the different layers or horizons.

The soil profile

As soils develop over time, layers (or horizons) form a soil profile.

Most soil profiles cover the earth as 2 main layers—[topsoil](#) and [subsoil](#).

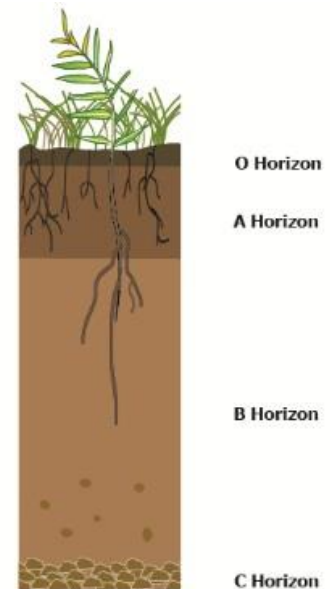
Soil horizons are the layers in the soil as you move down the soil profile. A soil profile may have soil horizons that are easy or difficult to distinguish.

Most soils exhibit 3 main horizons:

- **A horizon**—humus-rich topsoil where nutrient, organic matter and biological activity are highest (i.e. most plant roots, earthworms, insects and micro-organisms are active). The A horizon is usually darker than other horizons because of the organic materials.
- **B horizon**—clay-rich subsoil. This horizon is often less fertile than the topsoil but holds more moisture. It generally has a lighter color and less biological activity than the A horizon. Texture may be heavier than the A horizon too.
- **C horizon**—underlying weathered rock (from which the A and B horizons form).

Some soils also have an **O horizon** mainly consisting of plant litter which has accumulated on the soil surface.

The properties of horizons are used to distinguish between soils and determine land-use potential.



Factors affecting soil formation

Soil forms continuously, but slowly, from the gradual breakdown of rocks through weathering. Weathering can be a physical, chemical or biological process:

- physical weathering—breakdown of rocks from the result of a mechanical action. Temperature changes, abrasion (when rocks collide with each other) or frost can all cause rocks to break down.
- chemical weathering—breakdown of rocks through a change in their chemical makeup. This can happen when the minerals within rocks react with water, air or other chemicals.
- biological weathering—the breakdown of rocks by living things. Burrowing animals help water and air get into rock, and plant roots can grow into cracks in the rock, making it split.

The accumulation of material through the action of water, wind and gravity also contributes to soil formation. These processes can be very slow, taking many tens of thousands of years. Five main interacting factors affect the formation of soil:

- parent material—minerals forming the basis of soil
- living organisms—influencing soil formation
- climate—affecting the rate of weathering and organic decomposition
- topography—grade of slope affecting drainage, erosion and deposition
- time—influencing soil properties.

Interactions between these factors produce an infinite variety of soils across the earth's surface.

Parent materials

Soil minerals form the basis of soil. They are produced from rocks (parent material) through the processes of weathering and natural erosion. Water, wind, temperature change, gravity, chemical interaction, living organisms and pressure differences all help break down parent material.

The types of parent materials and the conditions under which they break down will influence the properties of the soil formed. For example, soils formed from granite are often sandy and infertile whereas basalt under moist conditions breaks down to form fertile, clay soils.

Organisms

Soil formation is influenced by organisms (such as plants), micro-organisms (such as bacteria or fungi), burrowing insects, animals and humans.

As soil forms, plants begin to grow in it. The plants mature, die and new ones take their place. Their leaves and roots are added to the soil. Animals eat plants and their wastes and eventually their bodies are added to the soil.

This begins to change the soil. Bacteria, fungi, worms and other burrowers break down plant litter and animal wastes and remains, to eventually become organic matter. This may take the form of peat, humus or charcoal.

Climate

Temperature affects the rate of weathering and organic decomposition. With a colder and drier climate, these processes can be slow but, with heat and moisture, they are relatively rapid.

Rainfall dissolves some of the soil materials and holds others in suspension. The water carries or leaches these materials down through the soil. Over time this process can change the soil, making it less fertile.

Topography

The shape, length and grade of a slope affects drainage. The aspect of a slope determines the type of vegetation and indicates the amount of rainfall received. These factors change the way soils form.

Soil materials are progressively moved within the natural landscape by the action of water, gravity and wind (for example, heavy rains erode soils from the hills to lower areas, forming deep soils). The soils left on steep hills are usually shallower.

Transported soils include:

- alluvial (water transported)
- colluvial (gravity transported)
- aeolian (wind transported) soils.

Read more about [soil erosion](#).

Time

Soil properties may vary depending on how long the soil has been weathered.

Minerals from rocks are further weathered to form materials such as clays and oxides of iron and aluminum.

Soil Horizons



O (humus or organic)
A (topsoil)

E (eluviated horizon)

B (subsoil)

C (parent material)

R (bedrock)

O HORIZON

Surface litter:
Partially decomposed
organic matter

A HORIZON

Topsoil: Humus, living
creatures, inorganic
minerals

E HORIZON

Zone of leaching, mate-
rials move downward

B HORIZON

Subsoil: iron, aluminium
humic compounds are
accumulated and clay
leached down from A
and E horizons

C HORIZON

Weathered parent
material: Partial break-
down of inorganic
minerals

R HORIZON

Bedrock

Photo source: <https://www.pmfias.com/soil-profile-soil-horizon-soil-types-sandy-clayey-loamy/>