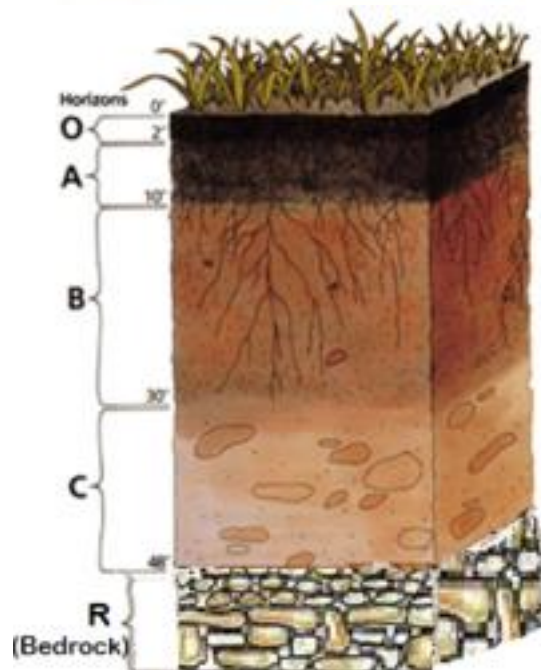
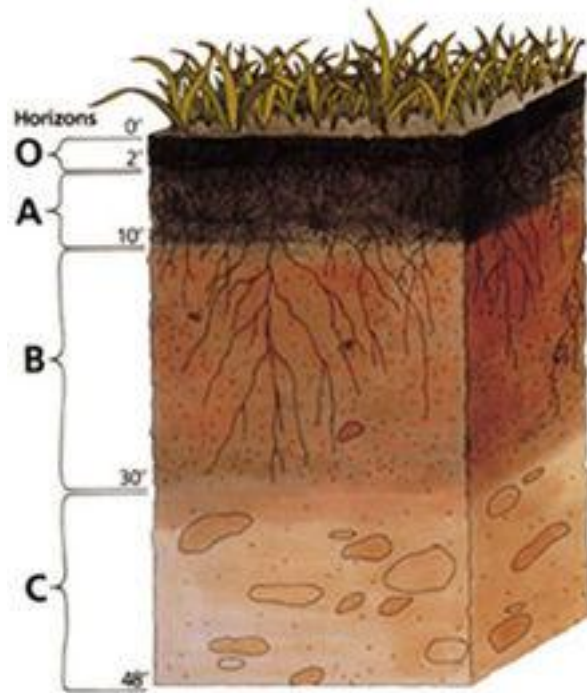


Humus



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This article is about the organic matter in soil. For the band, see [Humus \(band\)](#). For the food, see [Hummus](#). For programming language, see [Humus \(programming language\)](#). Not to be confused with [Hummus](#).

Humus has a characteristic black or dark brown color, due to an accumulation of organic [carbon](#). Soil scientists use the capital letters O, A, B, C, and E to identify the master horizons, and lowercase letters for distinctions of these horizons. Most soils have three major horizons -- the surface horizon (A), the subsoil (B), and the substratum (C). Some soils have an organic horizon (O) on the surface, but this horizon can also be buried. The master horizon, E, is used for subsurface horizons that have a significant loss of minerals (eluviation). **Hard bedrock, which is not soil, uses the letter R.**

In [soil science](#), **humus** (coined 1790–1800; < *Latin*: earth, ground^[1]) refers to any [organic matter](#) that has reached a point of stability, where it will break down no further and might, if conditions do not change, remain as it is for centuries, if not millennia.^[2] Humus significantly influences the texture of soil and contributes to moisture and nutrient retention.

In [agriculture](#), humus is sometimes also used to describe mature, or natural compost extracted from a forest or other spontaneous source for use to [amend soil](#).^[3] It is also used to describe a [topsoil horizon](#) that contains [organic matter](#) (humus type,^[4] humus form,^[5] humus profile).^[6]

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Humification[[edit](#)]

Transformation of organic matter into humus[[edit](#)]

The process of "humification" can occur naturally in [soil](#), or in the production of [compost](#). The importance of chemically stable humus is thought by some to be the [fertility](#) it provides to soils in both a physical and chemical sense,[\[7\]\[8\]\[9\]](#) though some agricultural experts put a greater focus on other features of it, such as its ability to suppress disease.[\[10\]](#) It helps the soil retain [moisture](#)[\[11\]](#) by increasing [microporosity](#),[\[12\]](#) and encourages the formation of good [soil structure](#).[\[13\]\[14\]](#) The incorporation of [oxygen](#) into large organic molecular assemblages generates many active, negatively charged sites that bind to positively charged [ions](#) ([cations](#)) of [plant nutrients](#), making them more available to the plant by way of [ion exchange](#).[\[15\]](#) Humus allows soil organisms to feed and reproduce, and is often described as the "life-force" of the soil.[\[16\]\[17\]](#) Yet, it is difficult to define humus precisely; it is a highly complex substance, which is still not fully understood. Humus should be differentiated from decomposing organic matter in that the latter is rough-looking material,[\[8\]\[9\]](#) with the original plant remains still visible, whereas fully humified organic matter is uniform in appearance (a dark, spongy, jelly-like substance) and amorphous in structure, and may remain such for millennia or more.[\[18\]](#) It has no determinate shape, structure or character. However, humified organic matter, when examined under the microscope may reveal tiny plant, animal or microbial remains that have been mechanically, but not chemically, degraded.[\[19\]](#) This suggests a fuzzy boundary between humus and organic matter. In most literature, humus is considered an integral part of [soil organic matter](#).[\[20\]](#)

[Plant](#) remains (including those that passed through an animal gut and were excreted as feces) contain organic compounds: [sugars](#), [starches](#), [proteins](#), [carbohydrates](#), [lignins](#), [waxes](#), [resins](#), and [organic acids](#). The process of organic matter decay in the soil

begins with the decomposition of sugars and starches from [carbohydrates](#), which break down easily as [detritivores](#) initially invade the dead plant organs, while the remaining [cellulose](#) and [lignin](#) break down more slowly.[21] Simple proteins, organic acids, starches and sugars break down rapidly, while crude proteins, [fats](#), waxes and resins remain relatively unchanged for longer periods of time. [Lignin](#), which is quickly transformed by [white-rot fungi](#),[22] is one of the main precursors of humus,[23] together with by-products of microbial[24] and animal[25] activity. The end-product of this process, the humus, is thus a mixture of compounds and complex life chemicals of plant, animal, or microbial origin that has many functions and benefits in the soil. [Earthworm](#) humus ([vermicompost](#)) is considered by some to be the best organic [manure](#) there is.[26]

Stability of humus[\[edit\]](#)

Compost that is readily capable of further [decomposition](#) is sometimes referred to as effective or active humus, though scientists would say that, if it is not stable, it is not humus at all. This kind of compost, rich in plant remains and [fulvic acids](#), is an excellent source of plant nutrients, but of little value with respect to long-term soil structure and tilth. Stable (or passive) humus consists of [humic acids](#) and [humins](#), which are so highly [insoluble](#), or so tightly bound to [clay](#) particles and [hydroxides](#), that they cannot be penetrated by microbes and are greatly resistant to further decomposition.[8][9] Thus stable humus adds few readily available nutrients to the soil, but plays an essential part in providing its physical structure. Some very stable humus complexes have survived for thousands of years.[18] The most stable humus is that formed from the slow oxidation of black [carbon](#), after the incorporation of finely powdered [charcoal](#) into the topsoil. This process is at the origin of the formation of the fertile Amazonian dark earths or [Terra preta do Indio](#). [8][9][27]

Benefits of soil organic matter and humus[\[edit\]](#)

- The process that converts raw organic matter into humus feeds the soil population of [microorganisms](#) and other creatures, thus maintains high and healthy levels of [soil life](#).[\[17\]\[28\]](#)
- The rate at which raw organic matter is converted into humus promotes (when fast) or limits (when slow) the coexistence of [plants](#), [animals](#), and [microbes](#) in soil.
- Effective humus and stable humus are further sources of nutrients to [microbes](#), the former provides a readily available supply, and the latter acts as a longer-term storage reservoir.
- Decomposition of dead plant material causes complex organic compounds to be slowly oxidized (lignin-like humus) or to break down into simpler forms ([sugars](#) and [amino sugars](#), [aliphatic](#), and [phenolic organic acids](#)), which are further transformed into microbial biomass (microbial humus) or are reorganized, and further oxidized, into humic assemblages (fulvic and [humic acids](#)), which bind to [clay minerals](#) and metal hydroxides. There has been a long debate about the ability of plants to uptake humic substances from their root systems and to [metabolize](#) them. There is now a consensus about how humus plays a [hormonal](#) role rather than simply a [nutritional](#) role in [plant physiology](#).[\[29\]](#)
- Humus is a [colloidal](#) substance, and increases the soil's [cation exchange capacity](#), hence its ability to store nutrients by [chelation](#). While these nutrient [cations](#) are accessible to plants, they are held in the soil safe from being leached by [rain](#) or [irrigation](#).[\[15\]](#)
- Humus can hold the equivalent of 80–90% of its weight in moisture, and therefore increases the soil's capacity to withstand drought conditions.[\[30\]\[31\]](#)
- The biochemical structure of humus enables it to moderate – or buffer – excessive [acid](#) or [alkaline](#) soil conditions.[\[32\]](#)
- During the humification process, microbes secrete sticky gum-like [mucilages](#); these contribute to the crumb structure (tilth) of the soil by holding particles together, and allowing greater [aeration](#) of the soil.[\[33\]](#) Toxic substances

such as [heavy metals](#), as well as excess nutrients, can be chelated (that is, bound to the complex organic molecules of humus) and so prevented from entering the wider [ecosystem](#).^[34]

The dark color of humus (usually black or dark brown) helps to warm up cold soils in the [spring](#).