Soil: It’s not just Dirt.

Essential Standard 2.1

Explain how processes and forces affect the lithosphere.

Learning Objective 2.1.3

Explain how natural actions such as weathering, erosion (wind, water, and gravity), and soil formation affect Earth's surface.

I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can identify various horizons on a soil profile.
- I can list and explain various factors that affect soil formation.
- I can describe various soil characteristics and how they impact plant growth

Natural Resource

Soil is an important natural resource that it is essential to life on Earth.

Plants need soil to grow; animals burrow within the soil; and soil filters pollutants.

Definition

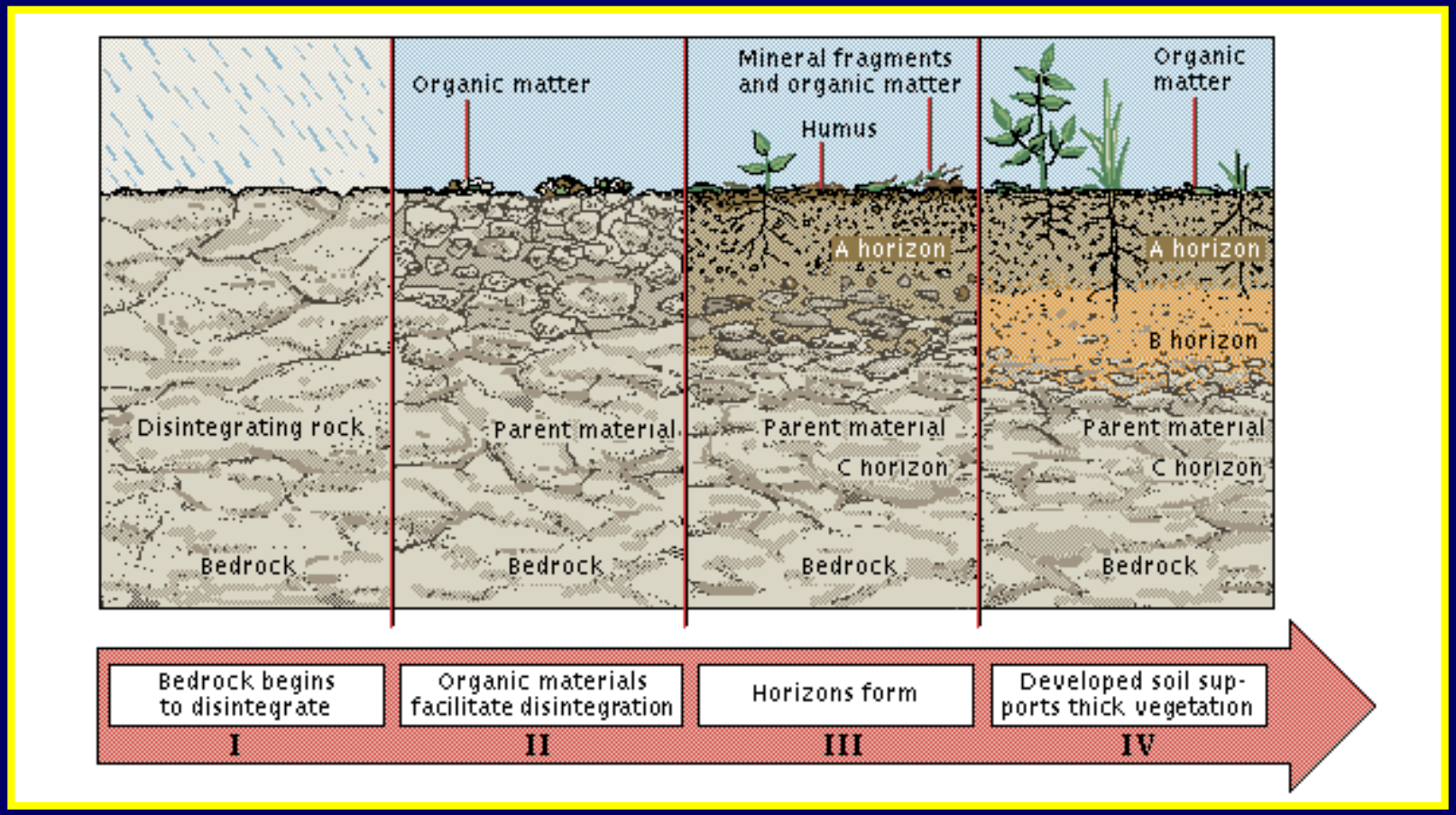
Soil is the loose covering of sediment and decaying organic matter, called humus, overlying the bedrock of Earth's surface.

Humus

hyoo·muhs

Formation of Soil

Soil formation begins with the weathering of rock into smaller pieces.

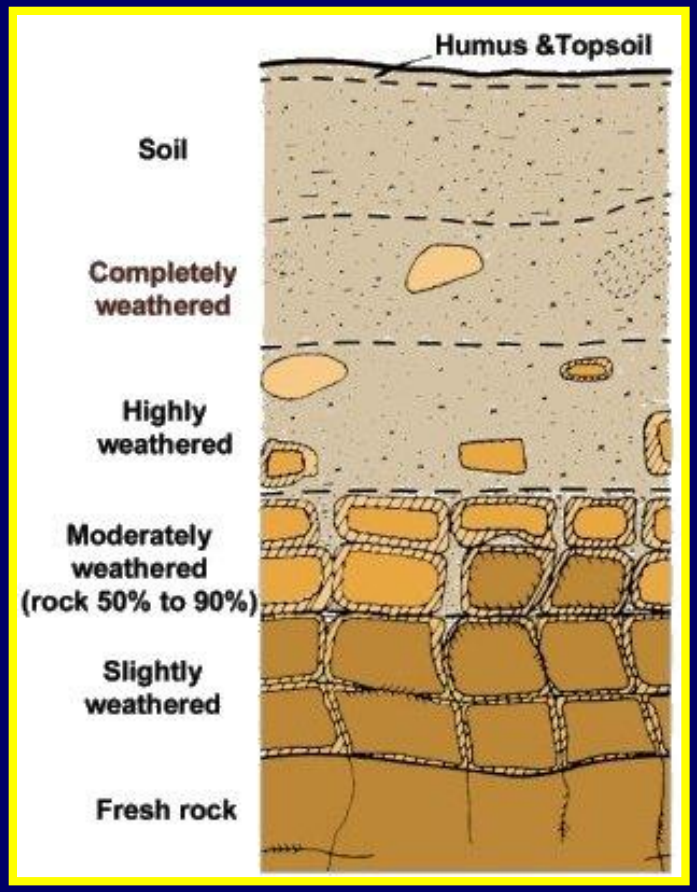


Formation of Soil

When organisms begin living in the weathered material, nutrients are added which improve soil's texture and water holding capacity.

Formation of Soil

During the process of soil development, soil forms in layers.



The bedrock, from which the weathered rock broke off from, is called the parent rock layer.

The broken pieces continue to weather and smaller pieces form layers on larger pieces.

Formation of Soil

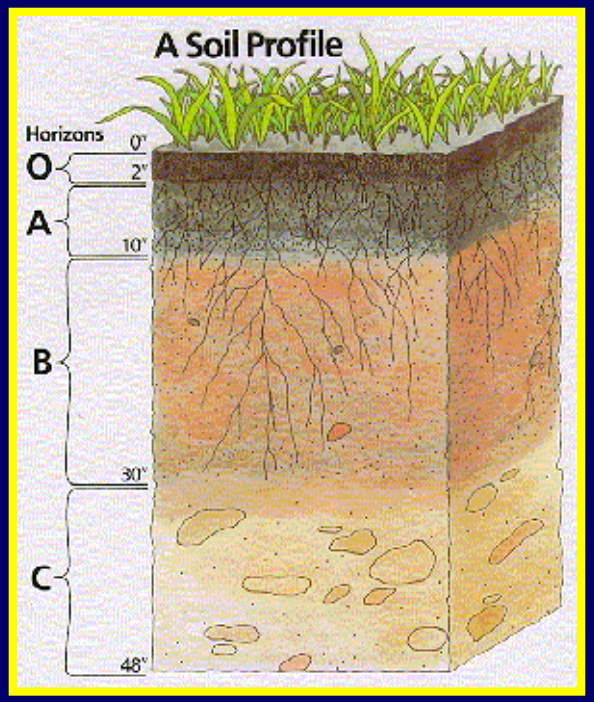
Soil located above its parent rock is called residual soil.

Transported Soil in a Flood Plain

Soil that has been moved, due to erosion, away from its parent rock, is called transported soil.

Soil Profiles and Horizons

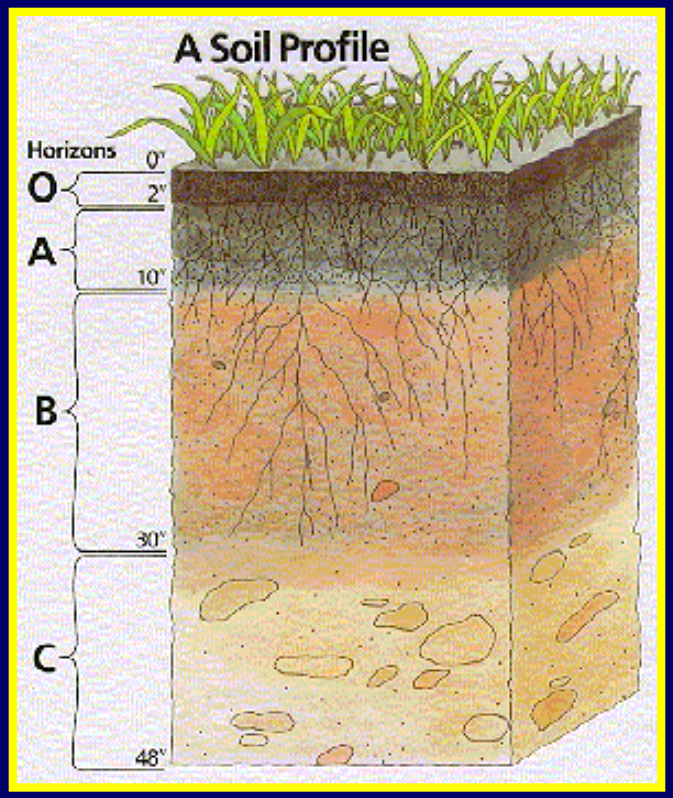
When you dig into soil, you will find defined layers in the soil called a soil profile.



Each distinct layer is called an horizon. There are four major soil horizons: O, A, B, and C.

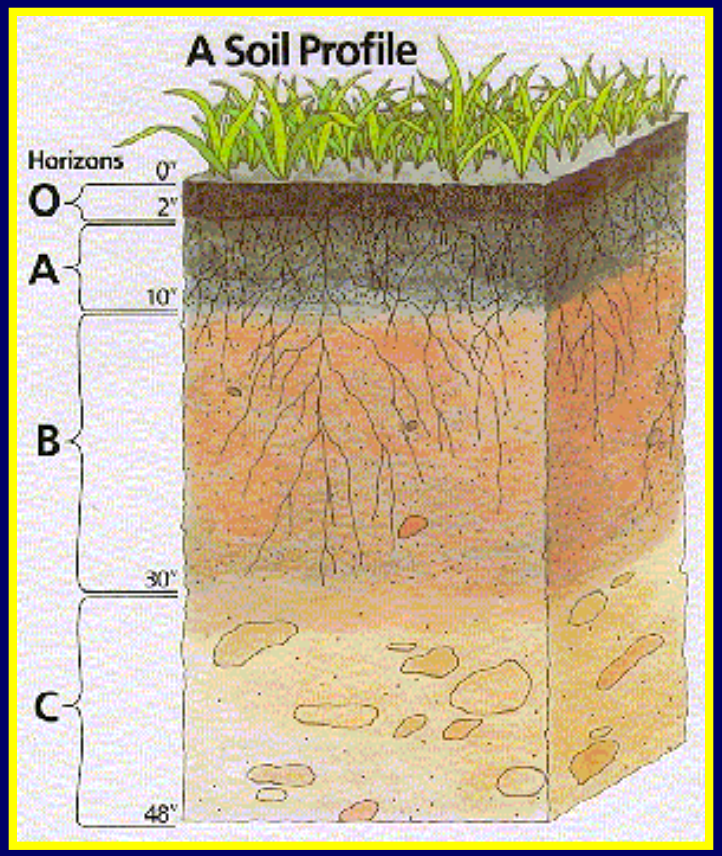
Soil Horizons

Horizon O is the thin, top layer and contains most of the living organisms such as worms.



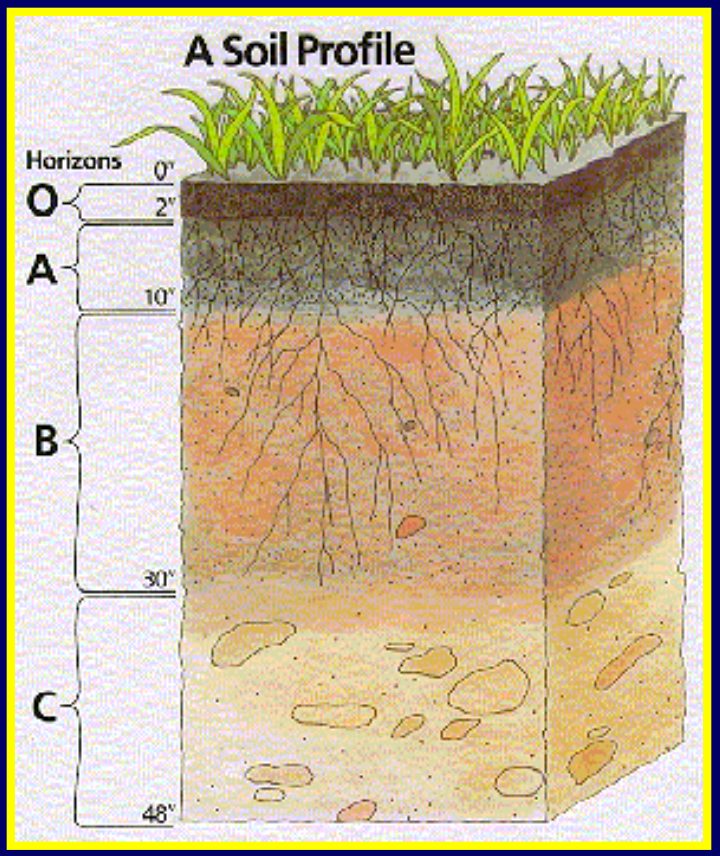
Soil Horizons

Horizon A contains high concentrations of organic material, humus, and so appears darker than lower layers.



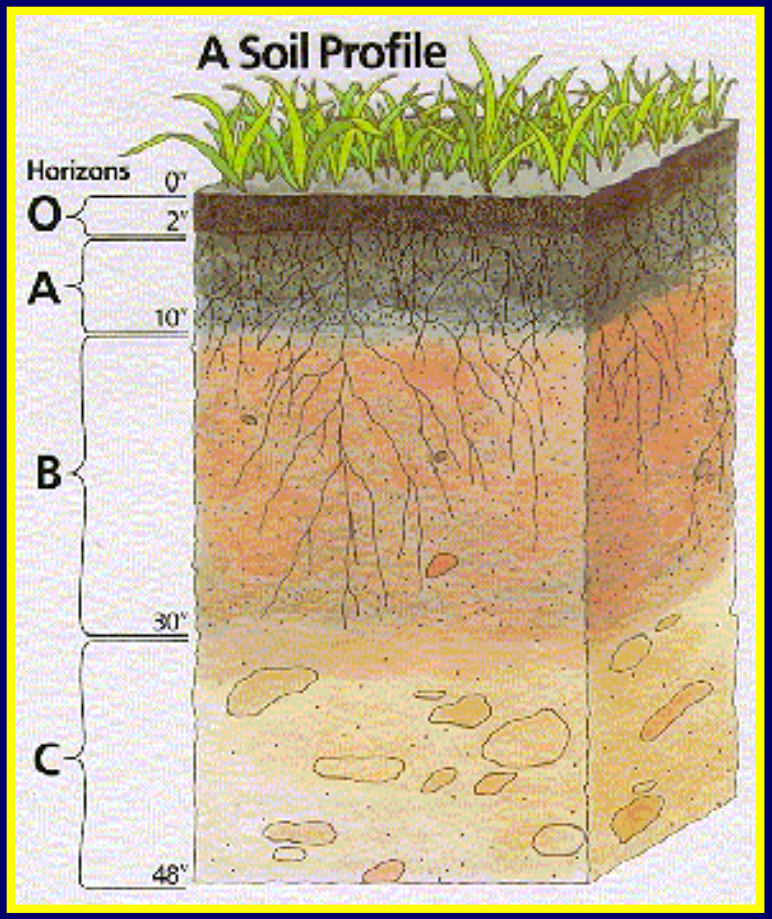
Soil Horizons

Horizon B contains subsoil that is enriched with clay materials and may be red as a result of iron oxides.



Soil Horizons

Horizon C contains partially weathered parent rock material.



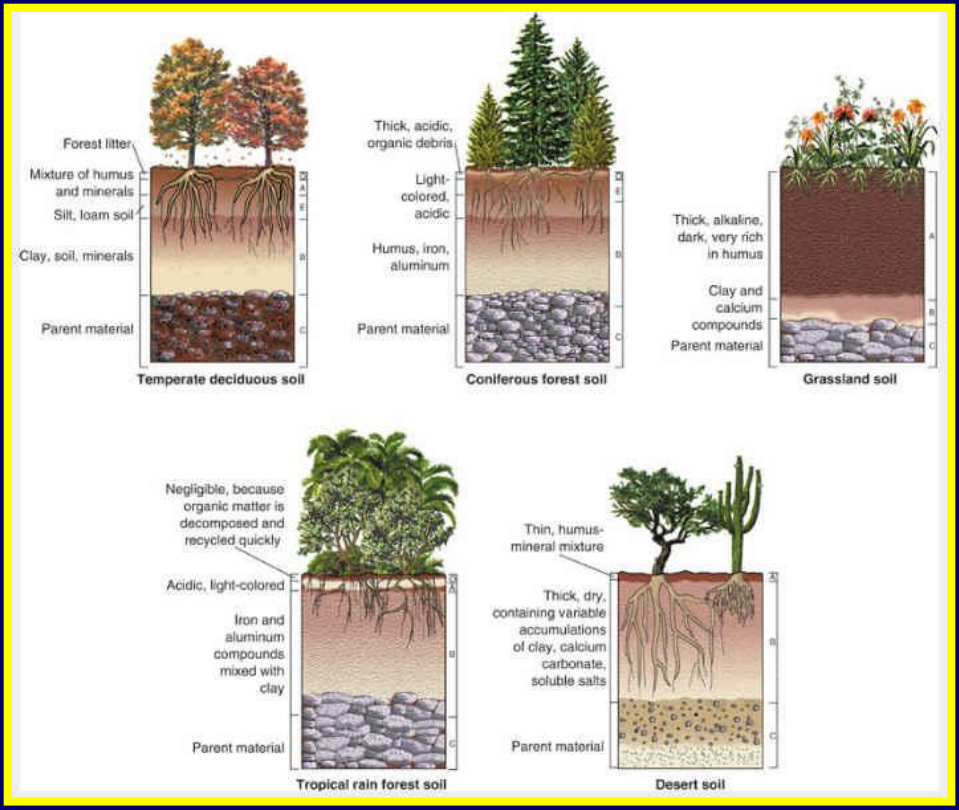
Factors that Affect Soil Formation

The topography of a region affects the thickness of developing soil.

On slopes, where runoff occurs, soils tend to be thin, while soils in valleys tend to be thick and fertile.

Factors that Affect Soil Formation

Climate plays a major role in soil formation due to different water amounts, weathering amounts, and type of plant growth.



Four Types of Soils Based on Climate

Polar

Temperate

Desert

Tropical

Polar Soils

Polar soils form at high latitudes and high elevations such as Greenland, Canada, and Antarctica.

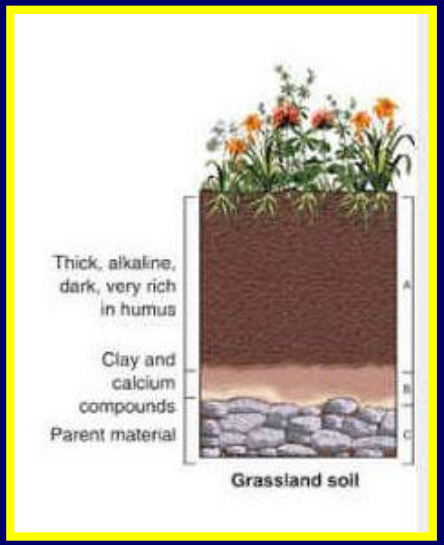
The groundwater in polar soils are permanently frozen, permafrost, so there is little plant growth and little decomposition.

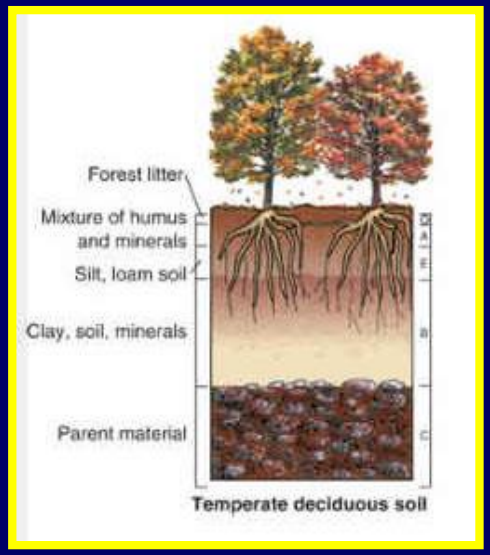
Polar soils tend to be very shallow with little only small amounts of organic matter.

Temperate Soils

Temperate soils vary greatly.

Grasslands have an abundance of humus.

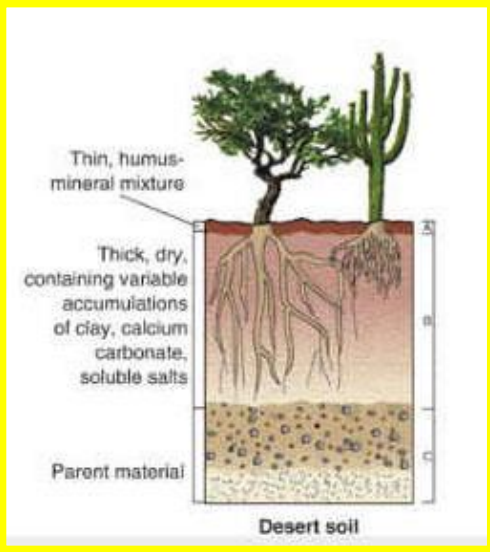




Forests soils are shallow, less fertile, and contain aluminum rich clays.

Desert Soils

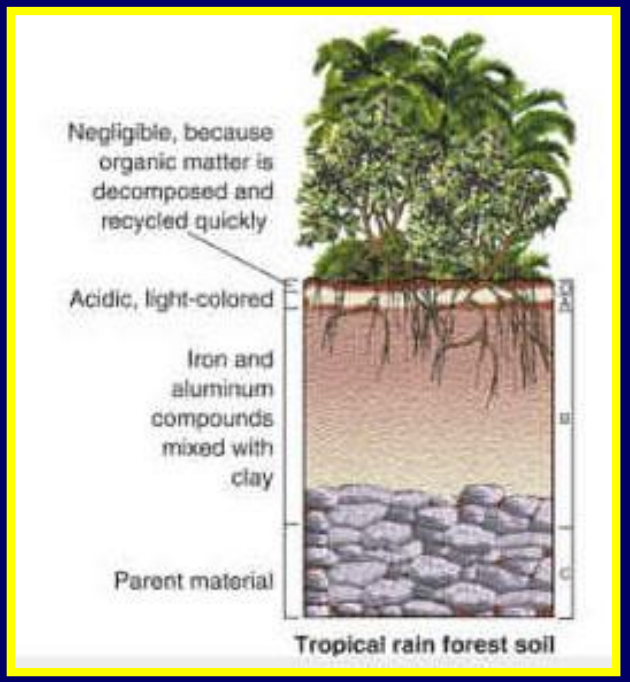
Desert soils have little or no humus and a very thin A horizon.



They also tend to be light colored and may contain a lot salt and gypsum.

Tropical Soils

Tropical soils have very little humus and very few nutrients due to the amount of competition by plant growth.



Most of the soil is composed of concentrations of metals mixed with clay.

Soil Characteristics

Scientists and agriculturalists usually describe soil according to its color, compaction, moisture content, organic content, pH, profile, structure, and texture.

Of these characteristic, texture, organic content, and pH are the most important.

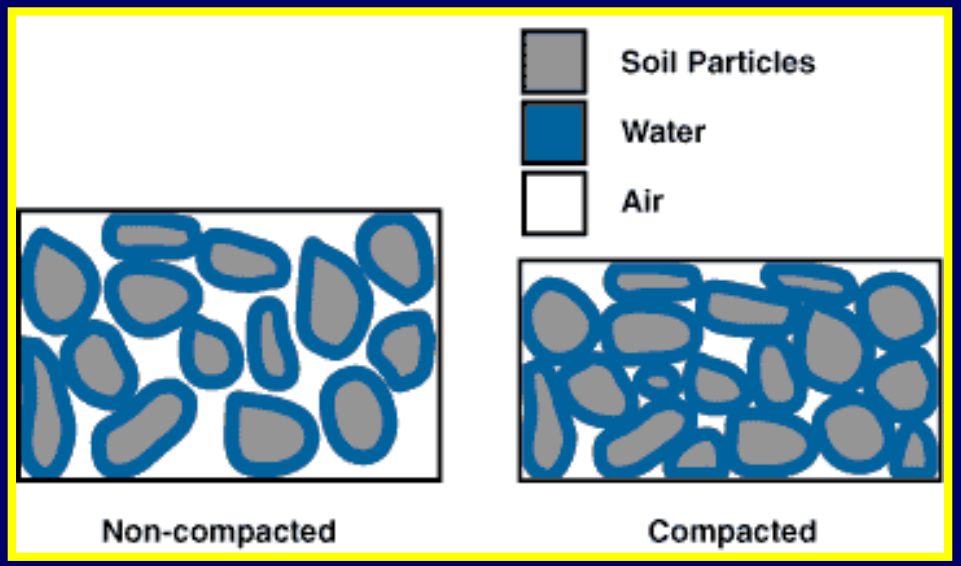
Soil Characteristics

Soil color can provide information about organic matter in the soil, drainage, biotic activity, and fertility.

Condition	Color		
	Dark	Moderately Dark	Light
Organic Matter	High	Medium	Low
Erosion Factor	Low	Medium	High
Aeration	High	Medium	Low
Available Nitrogen	High	Medium	Low
Fertility	High	Medium	Low

Soil Characteristics

To be healthy, a soil needs air and water to be able to move through it easily.

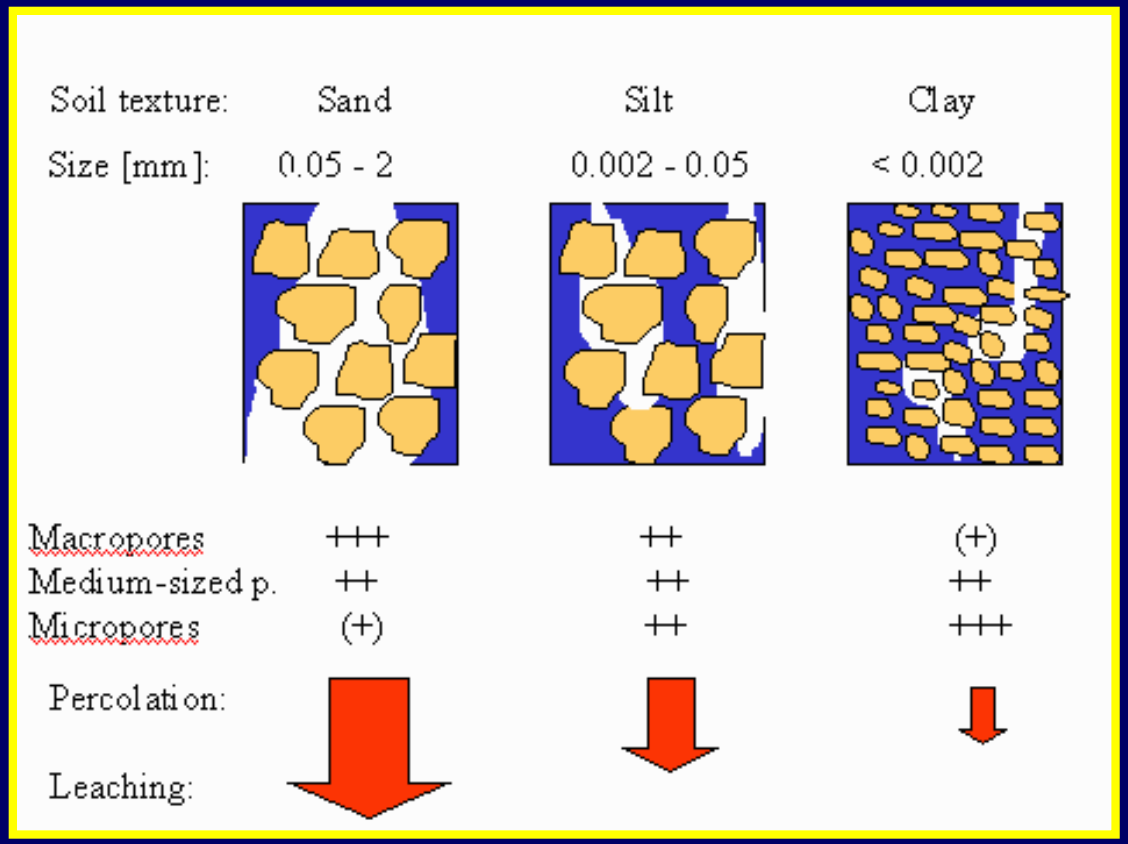


Compacted soils don't allow much air to circulate to the root zone and water (rainfall or irrigation) tends to just run-off.

Higher runoff increases erosion and strips away vegetation and topsoil.

Soil Characteristics

Soil texture refers to the size of the soil particles.



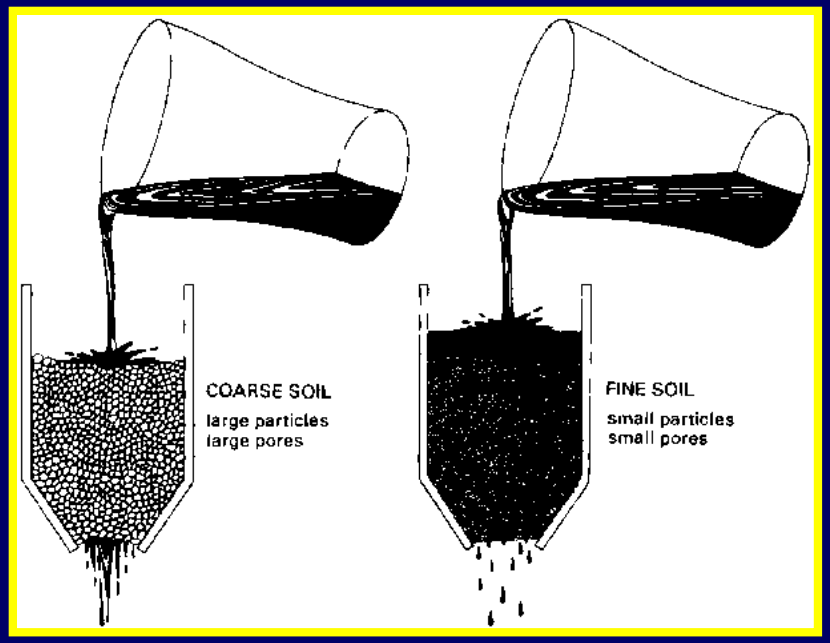
Sand is the largest

Silt

Clay is the smallest

Soil Characteristics

Soil texture determines how easily water will infiltrate the soil and be made available to plants.



Sand

Water infiltrates easily but is not held for plant use

Silt

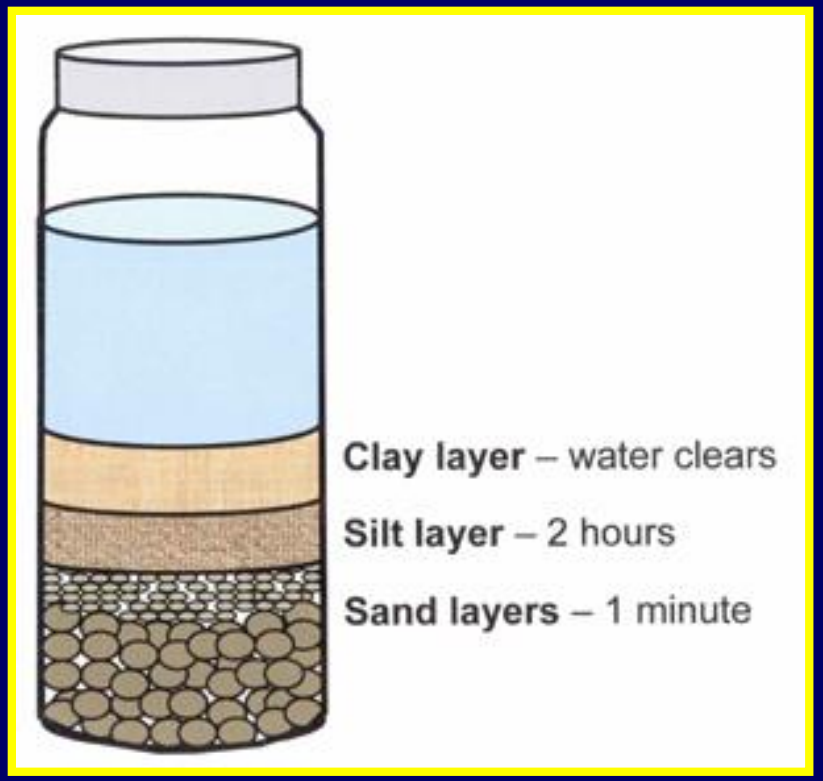
Water infiltrates and is held for plant use (best soil for plants)

Clay

Water barely infiltrates and so is not good for plant growth

Soil Test for Texture

A simple test for soil texture is to place a sample of soil in jar with water and after shaking the jar, allowing the soil to settle out.



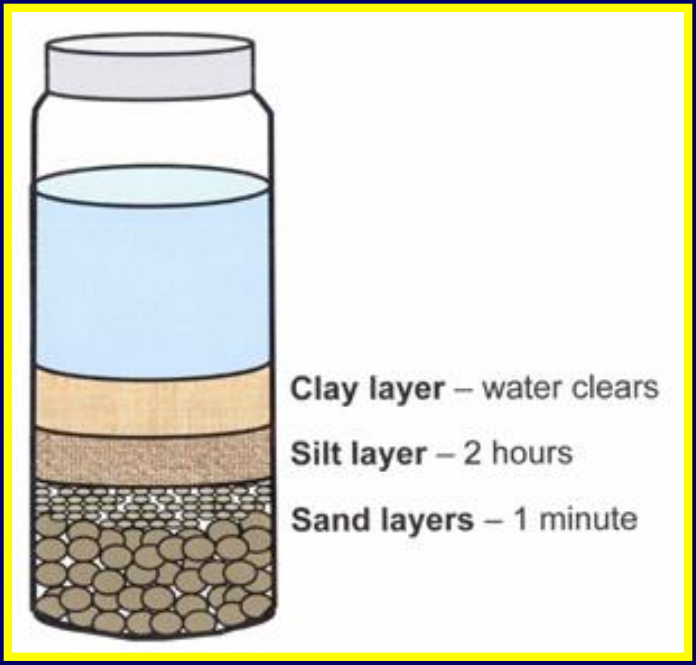
Sand will drop first.

Silt will drop second.

Clay will drop last.

Soil Test for Texture

After all the soil particles have dropped, each layer is measured and the percentages for each type of particle is calculated.



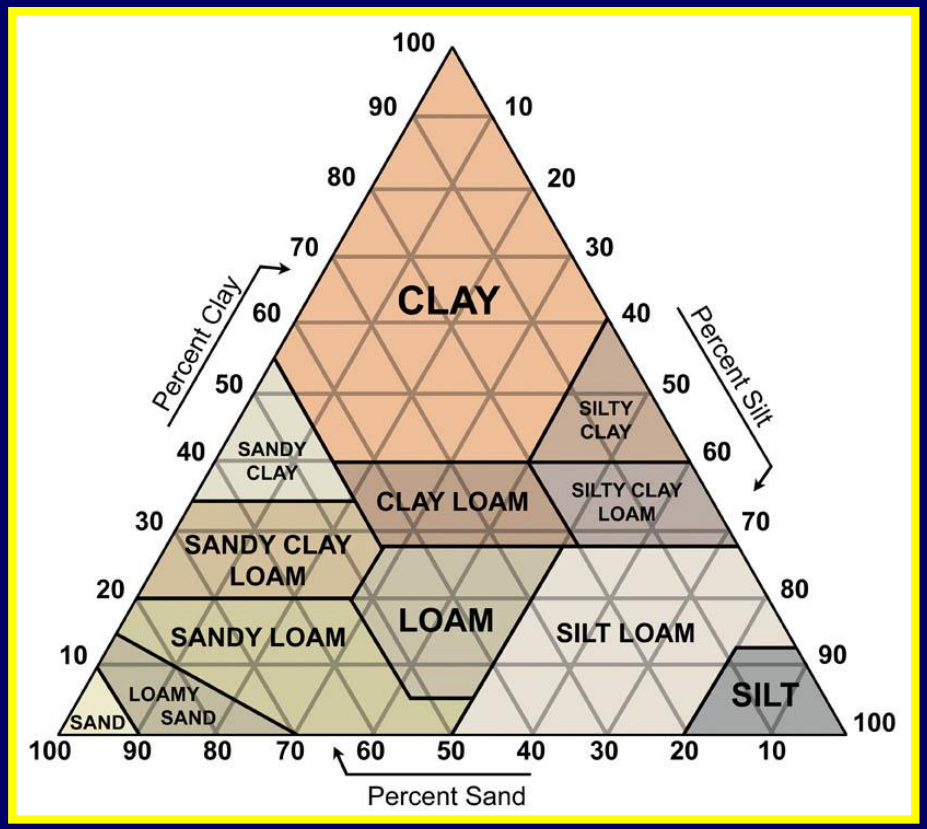
10% Clay

20% Silt

70% Sand

Soil Chart

One the percentages for each type of particle is known, a soil chart is used to determine the type of soil present.

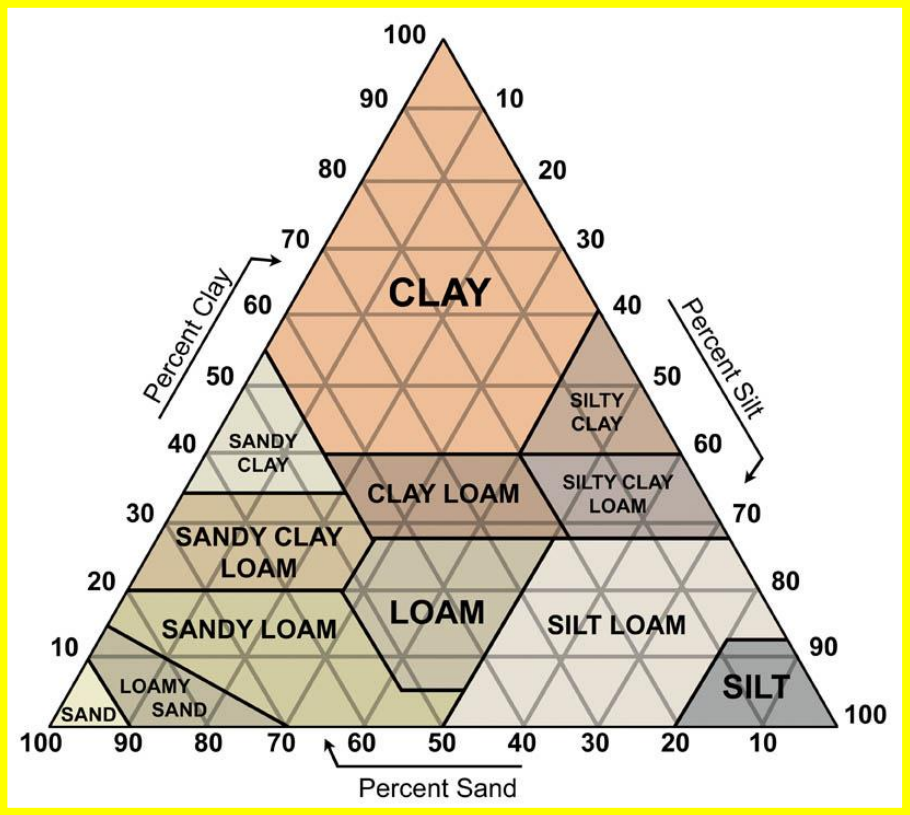


On a soil chart, you locate the percentage of one of the soil particles and follow the line until it meets the percentage of a second soil particle.

Percentage of the 3rd particle should also meet at that point.

Soil Chart

The section on the chart where all the percentages meet will tell you the soil type.

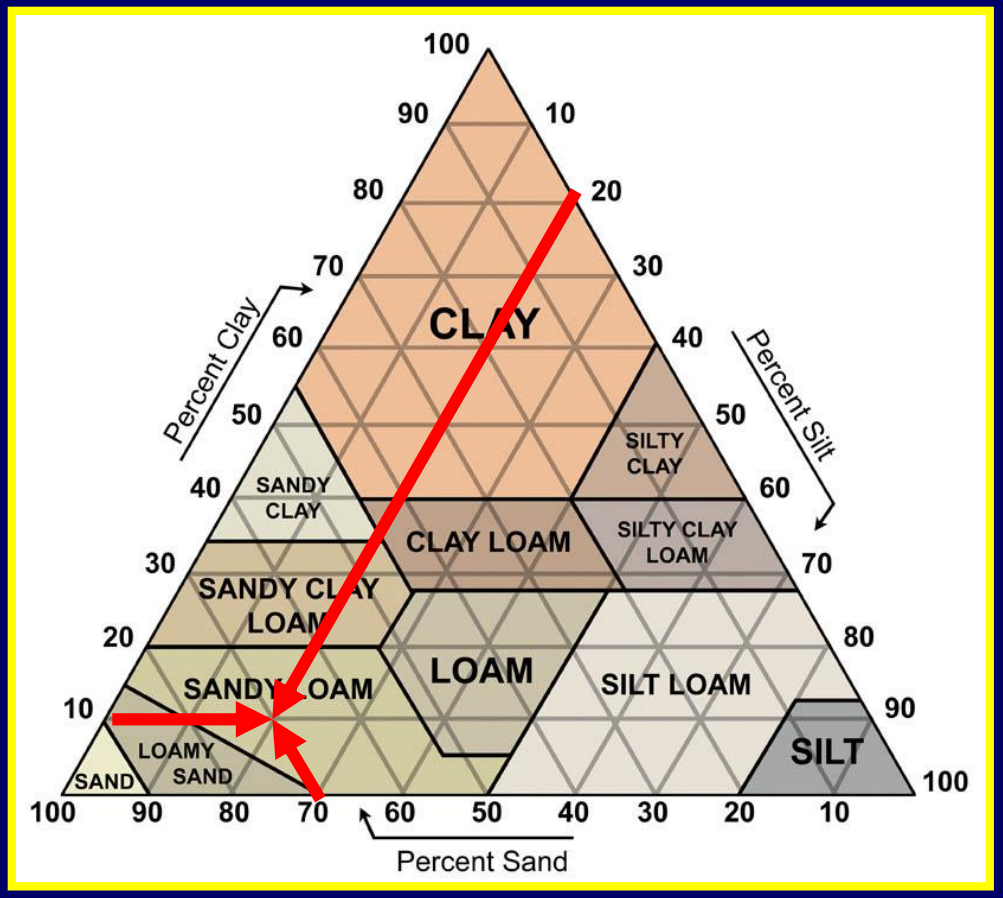


Notice that the arrows indicate the direction for which to follow the line for each particle.

For example, for clay, you go across the chart.

Soil Chart

The example sample, contained 10% clay, 20% silt, and 70% sand.



The sample contains sandy loam.

Loam is the best type of soil for plant growth because it drains easily (sand%) but still retains a lot the water (silt%).

Sandy loam would still need to be watered a lot.

Soil Characteristics

pH is a measurement of how acidic or basic a soil is and is measured on a scale from 0 to 14.

Acidic Soil

Acids have a pH below 7 and become more acidic the closer they are to 0.

Acids

Basic or Alkaline Soil

Bases have a pH above 7 and become more basic the closer they are to 14.

Bases

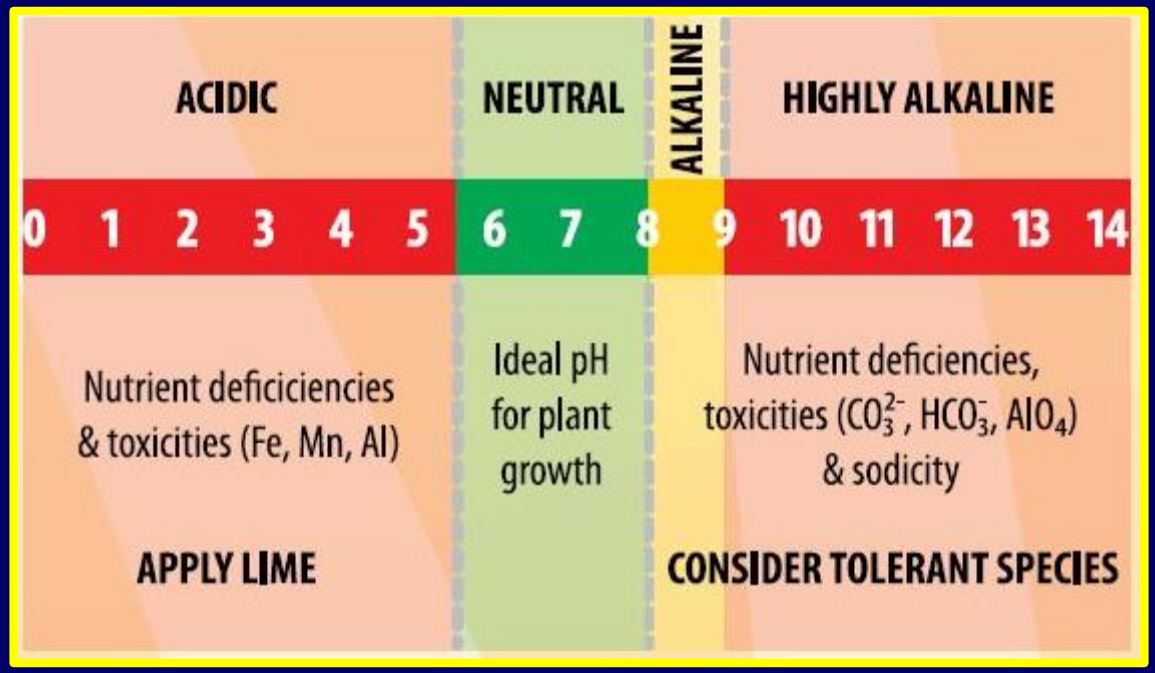
Neutral

A soil with a pH of 7 would not be acidic or basic, but neutral.

Neutral

Effects of pH on Plant Growth

When soils are too acidic or too basic, it can prevent plants from absorbing minerals in soil.



Most plants grow best in soils with a pH between 5.5 and 8.5.

Carbonic Acid

Rainwater (if its not polluted) has a normal pH of about 6 - 6.5, which is slightly acidic.

$H_2O + CO_2 \rightarrow H_2CO_3$

H_2O = Water

CO_2 = Carbon Dioxide

H_2CO_3 = Carbonic Acid

This is due to dissolved carbon dioxide from the air, which reacts with water to form carbonic acid.

However increased levels of CO_2 in the atmosphere is turning some soils more acidic.

Acid Rain

When rainwater can turn acidic when it mixes with pollutants from coal burning plants.

Acid rain has a pH below 4.5 and can interfere with a plant's ability to take up minerals from the soil.

Soil Characteristics

The pH of soil can be easily measured with pH test strips, pH meters, or pH test kits.

If the pH is not ideal, you can treat the soil with various chemicals to adjust the pH.

Soil Characteristics

Adding lime helps make soil less acidic.

Adding sulfur makes soil more acidic.

Soil Characteristics

Different plants grow well in acidic soil, while other plants grow best in basic soil.

Hydrangea plants will produce different colored blooms, based on soil pH.

Acidic soils produce blue blooms.

Basic soils produce pink blooms.

Soil Characteristics

The organic content of soil greatly influences the plant, animal and microorganism populations in that soil.

The darker the soil, the greater amount of organic content present to help support decomposers that live in the soil.

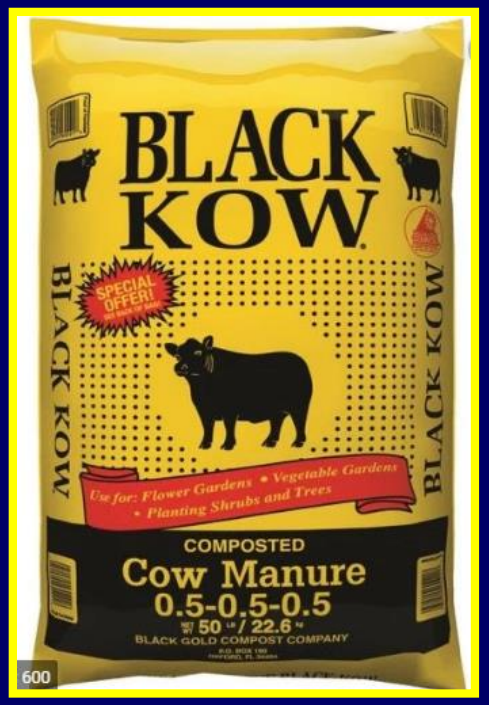
Soil Characteristics

Decomposes provide many necessary nutrients to plants by breaking down and recycling organic matter and minerals.

Decomposers also loosen the soil and provide pore spaces for water and air to flow more easily through the soil to plants.

Organic Fertilizers

Manure, compost, organic mulch, and peat moss can be added to increase the soil's fertility, improve texture, improve water holding capabilities and prevent erosion.



Peat Moss

Peat moss is derived from the Sphagnum moss plant which grows in bogs.

Dead sphagnum moss can hold large quantities of water or air inside their cells making them good soil conditioners.

Inorganic Fertilizers

Gardeners and farmers often use industry created fertilizer to replace minerals and maintain soil fertility.

Fertilizers contain Nitrogen, Phosphorus, and Potassium.

The numbers on the bag indicate the amount of nitrogen, phosphorus, and potassium is present.

Drawbacks of Inorganic Fertilizers

Inorganic fertilizers do no add humus to the soil so it doesn't increase the ability of the soil to retain water and support living organisms.

Supplies only a limited number of nutrients: nitrogen, phosphorus, and potassium.

The over-use of chemical fertilizers can lead to soil acidification because of a decrease in organic matter in the soil.

The End