Calvary Gardening Ministry's Homepage

Properties of the Different Kinds of Soil

by Moira Whitehouse PhD

Remember physical properties are the things we can observe about a substance using our five senses.

For soil, the two main physical properties are color and texture.

Color tells us something about the plant nutrients that are found in the soil.

Texture, determined by the size of particles in the soil, affects the soil's ability to hold water and thereby sustain plant growth.

Soil Color

The most obvious property when looking at soil is its color.

Geologist officially recognize over 170 different soil colors.

But the most common color of soils are shades of black, brown, red and gray.

Brown Soil

Black Soil

Gray Soil

Red soil

Generally speaking, the darker a soil, the more nutrients it contains.

The darker color often indicates an increase in decomposed organic matter known as humus.

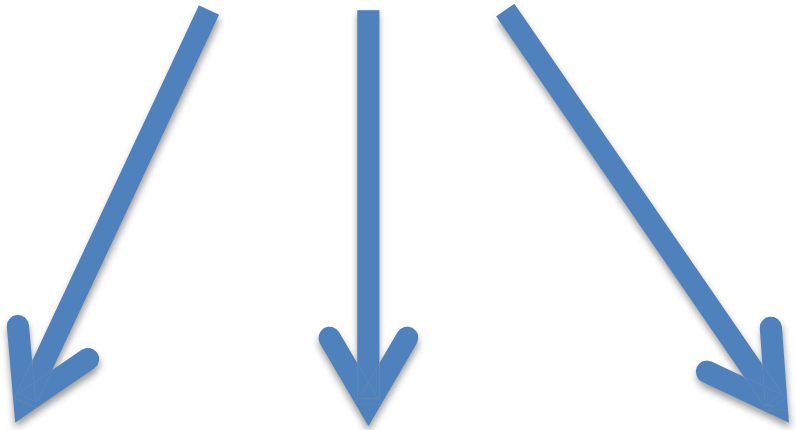
infertile red soil

black fertile soil

Soil texture however, not color, is the single most important physical property of the soil. Knowing the soil texture alone will provide information about:

- 1) how easily water flows through it
- 2) its water holding capacity
- 3) how well plants will grow in it

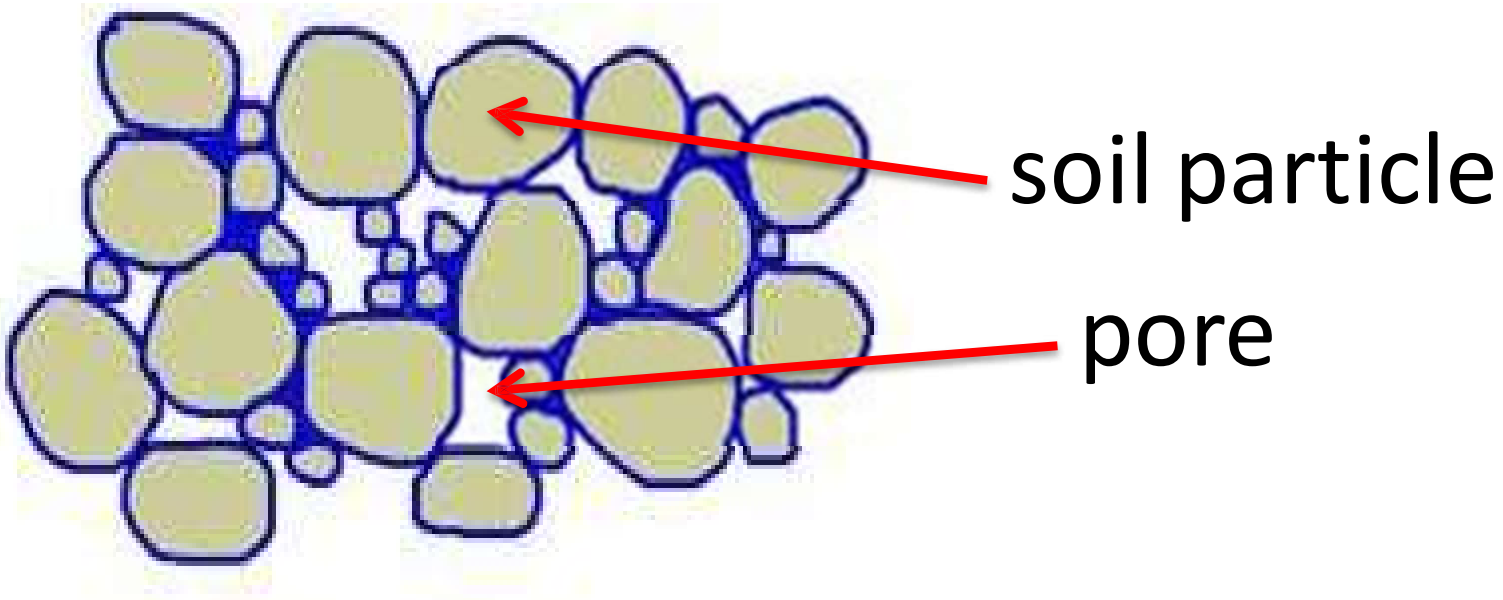
The three types of soil formed from weathered rock



Sand Silt Clay

largest → smallest particles

The size particles that make up each type of soil determines the size of the pores between the particles.



The pores in the soil hold air and water.

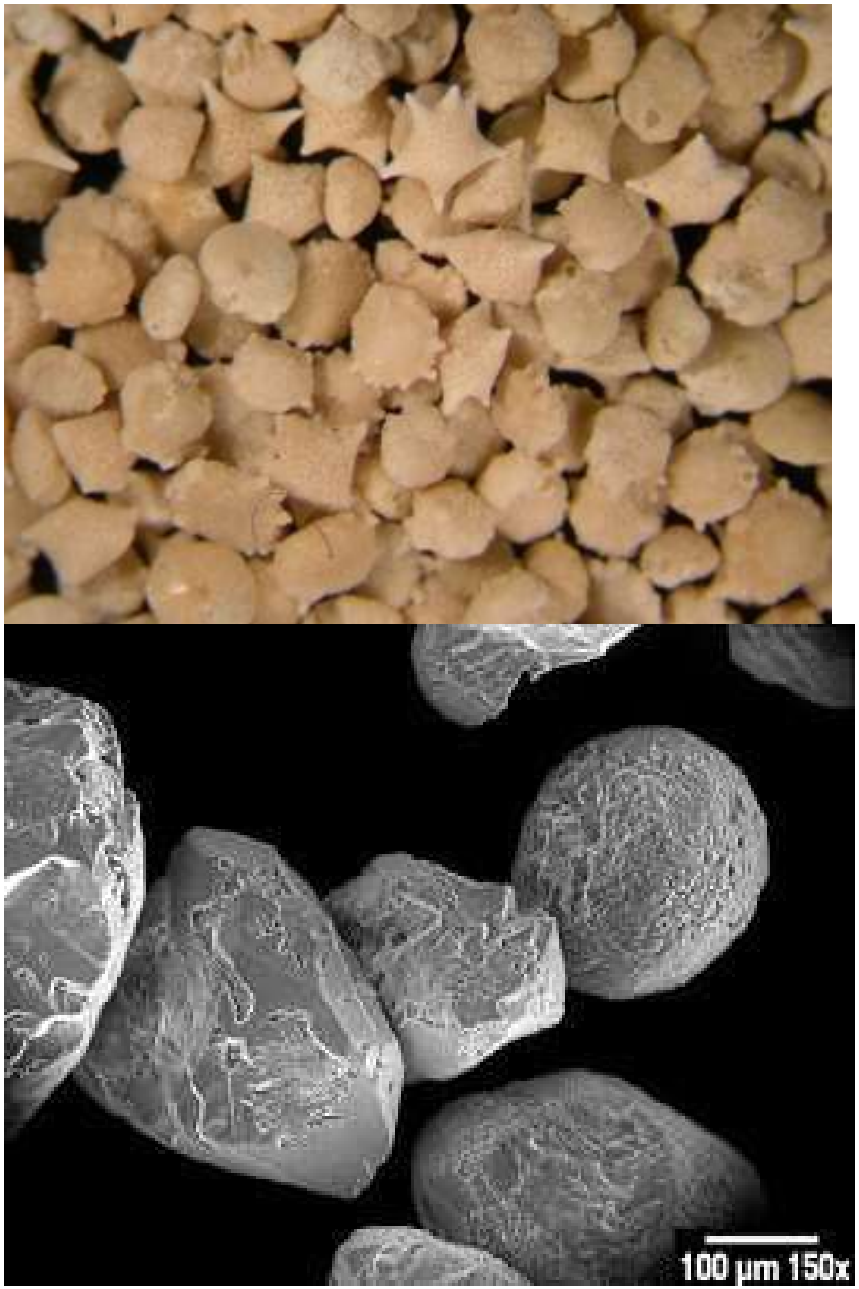
The larger the particles making up the soil, the larger the pores between them.

Let's look at the particles that make up <u>sand.</u>

- < 2 mm to > 0.05 mm

- particles are visible without microscope

- rounded or angular in shape



Images from Wikipedia Commons

Particles under a microscope

Because of the size of the particles, **sand**

- feels gritty
- does not stick together in a mass unless it is very wet.
- has fewer nutrients for plants than silt or clay
- has pores between sand particles that allow free drainage of water and entry of air
- holds little water and is prone to drought

Sandy soil

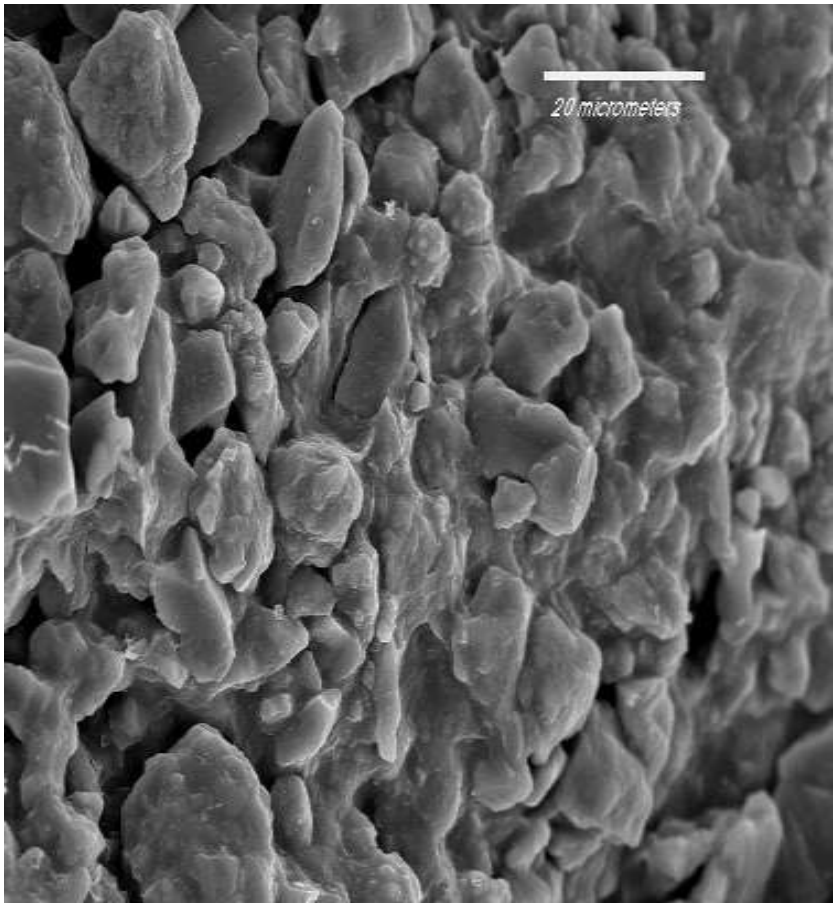
Sandy soil has large particles with large spaces or pores between them.

Therefore, water drains through sandy soil quickly. Sandy soils do not hold or retain water very well. As a result, it is not good for growing most plants.

Humus added to sandy soil acts like a sponge, absorbing and holding moisture and any nutrients dissolved in it.

Silt یمط

- particles < 0.05 mm to > 0.002 mm



- particles not visible without a microscope

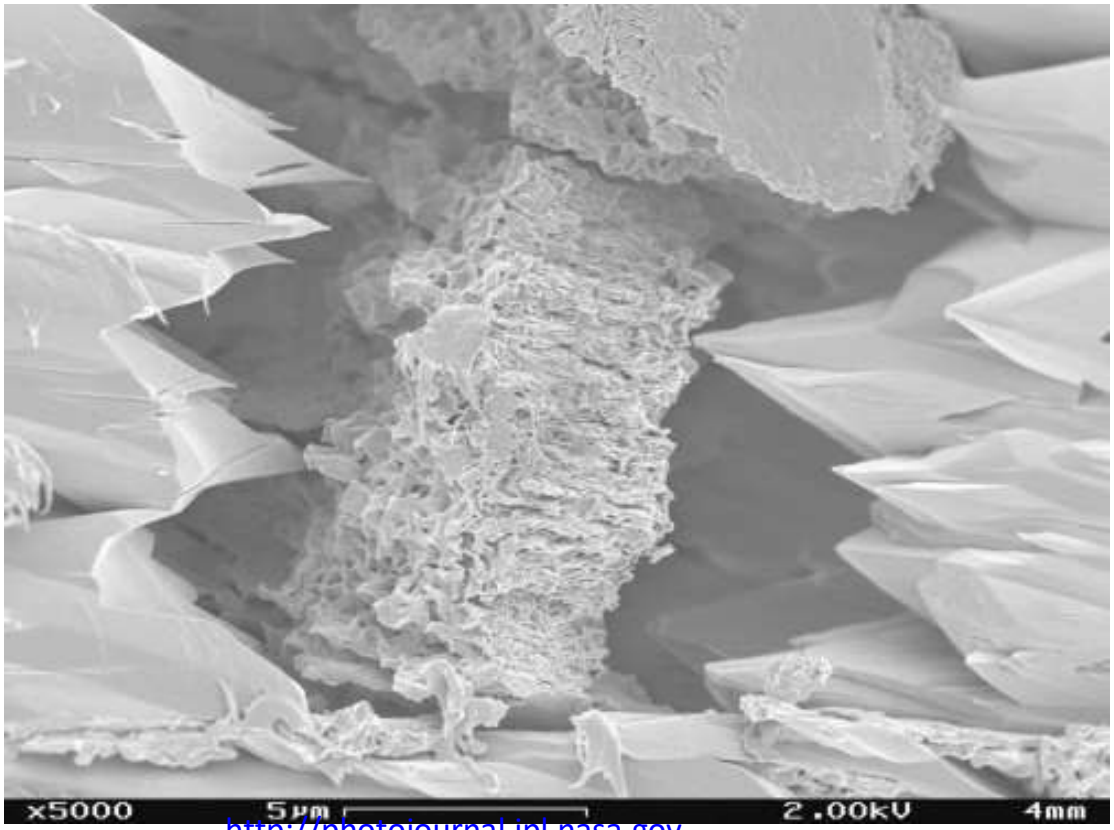
- erosion by glaciers often responsible for formation of silt

- feels floury powdery -- smooth like silly putty when wet.
- wet silt does not stick together and cannot mold it into different shapes.

- smaller particles than sand -- retains more water for plants and have slower drainage than sand.
- easily washed away by flowing water – highly erosive.
- has more plant nutrients than sand.

Clay طين لاصق

- < 0.002 mm
- particles are flat plates or tiny flakes
- when mixed with water the small particles of clay do not settle



http://photojournal.jpl.nasa.gov

Clay particles under a microscope

- clay is very powdery when dry and very sticky and slippery when wet. Wet clay can can be molded readily into any shape or a rod.

- can be easily formed into long ribbons

- swells when you add water and shrinks and become hard when the if water evaporates

- pore spaces between particles are very small.
- water and air move very slowly through clay
- tremendous ability to hold water.

Clay soil

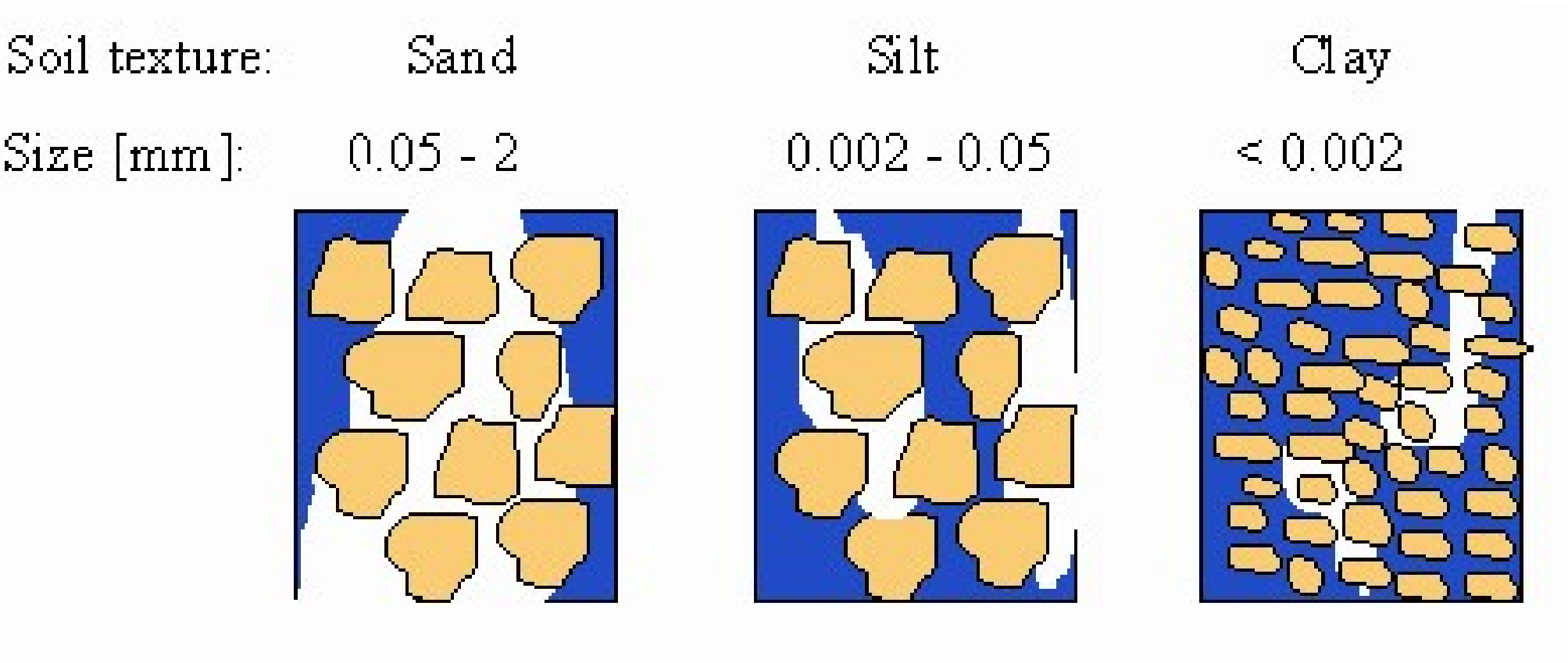
Clay soils has small particles and small spaces or pores between them.

Clay soil tends to stick together causing water to fill up the air spaces.

Since moisture does not drain from this soil well, clay soil is often too wet for plant roots to absorb oxygen. As a result, they rot.

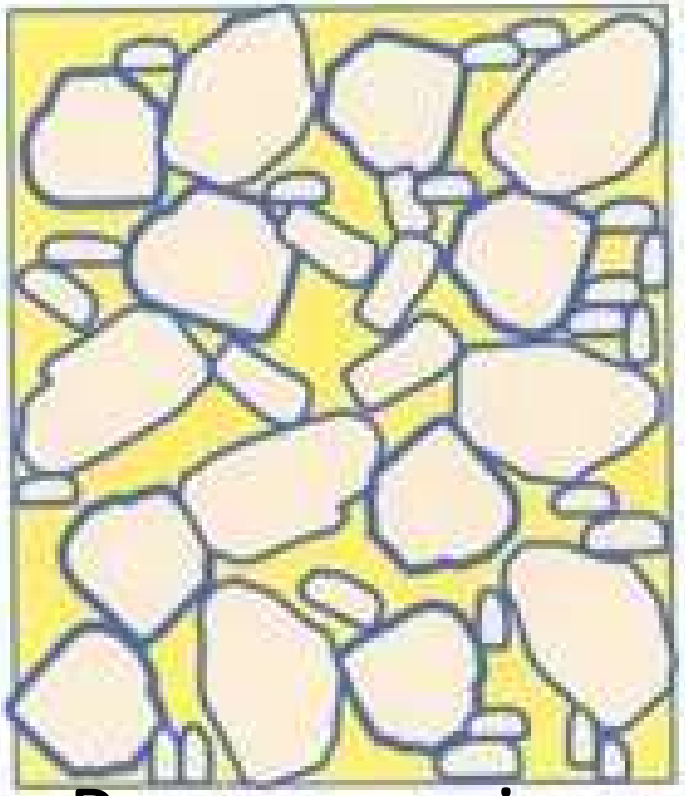
Adding humus to clay soils discourages the small particles from sticking so tightly together, resulting in larger spaces that drain water more easily and hold more air.

The three different kinds of soil formed from weathered rock have different sized particles and pore spaces.

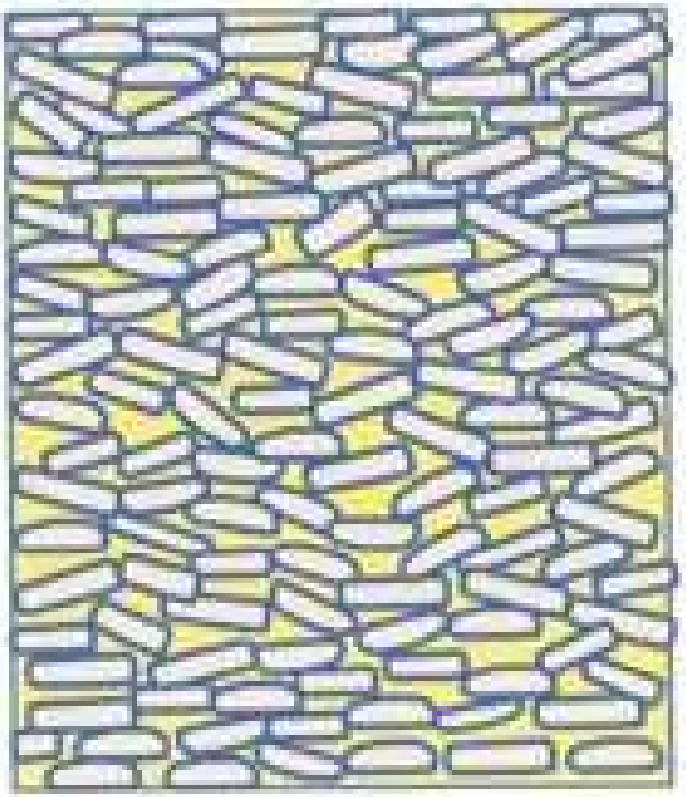


Which kind of soil would water drain through more quickly?

Which kind of soil would retain or hold more water?



Pore space in sandy soils



Pore space in clay soils

Determining Soil Texture - Feel Method

- Wet a sample of the soil in your hand
- Try to roll it into a ribbon.
- If it makes a ribbon, it contains clay.
- The longer the ribbon the more clay in the soil.
- If it does not roll into a ribbon, it is sand or silt
- Gritty feel indicates sand.
- Smooth floury feel indicates silt.

Moving water, as in streams and rivers, carries soil. When the water slows down, it drops or deposits the soil.

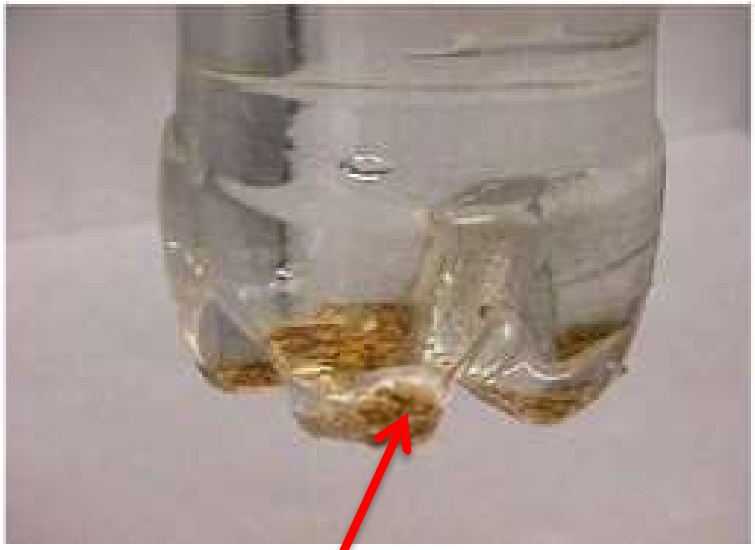
Sand and clay behave differently from one another when mixed with water that is moving and when the water stops moving.

To demonstrate this, you can add sand and clay to water in a plastic water bottle and shake it up.

Add sand or clay to a plastic bottle half full of water, shake up the bottles and observe how long it takes for the particles to settle.

Sand settles rapidly to the bottom of the bottle when you quit shaking it whereas clay settles more slowly. It stays suspended in the water.

Observe the difference in the clarity of the water of the sand and water mixture to the clay and water mixture. Which is clearer?



sand

clay

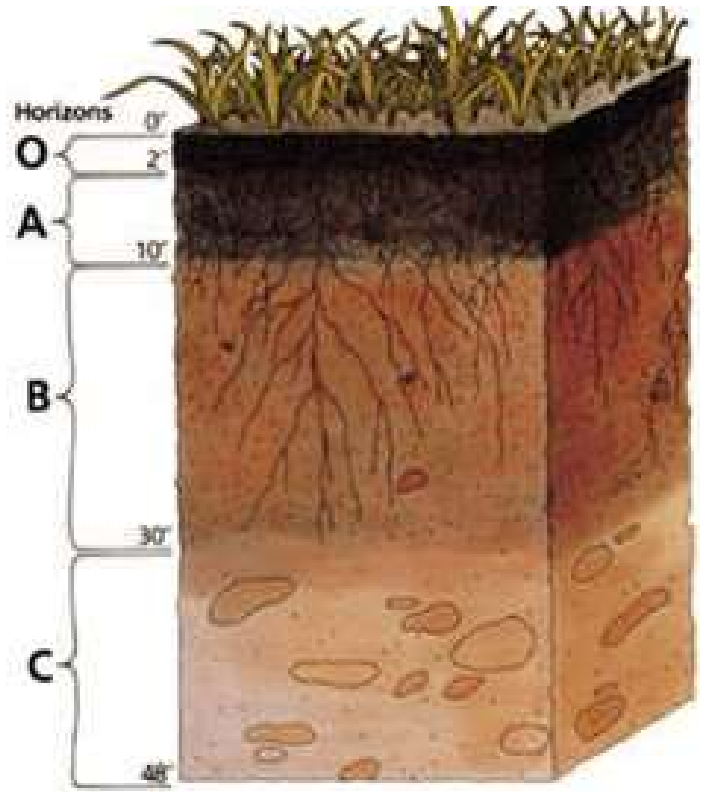
Now what about the properties of humus--the soil formed when dead plants and animals decay.

http://www.edupic.net/sci_gr.htm
Free clip are for educational use

It is a dark brown or black (color).

It feels crumbly and loose when dry and spongy when wet (texture).

When dead plants and animals decay leaving behind the humus, it accumulates in the second layer of soil (A).



Humus holds more water than sand or silt but less than clay.

Water does drain through humus quickly.

Humus contains the minerals that were part of the bodies of the dead plants and animals.

It contains nutrients (minerals such as, nitrates, phosphates, potassium, copper, zinc dissolved in water) that plants need to be healthy. Without these nutrients plants will not flourish.

In short, humus brings soil to life.

Comparing the different soils—sand, silt, clay and humus.

First on their ability to hold water:

Clay soils hold more water than sand, silt or humus.

Humus hold more water than sand or silt.

For growing most things, clay holds too much water whereas sand, silt and humus hold too little water.

Second, compared by the amount of nutrients (minerals), each type of soil holds.

Clay has more nutrients (minerals) than sandy soils.

When water drains through sandy soils, it often dissolves the minerals in the rock and carries them along with it. This condition is called leaching.

When nutrients leach out of the soil, they are no longer available for plants to use.

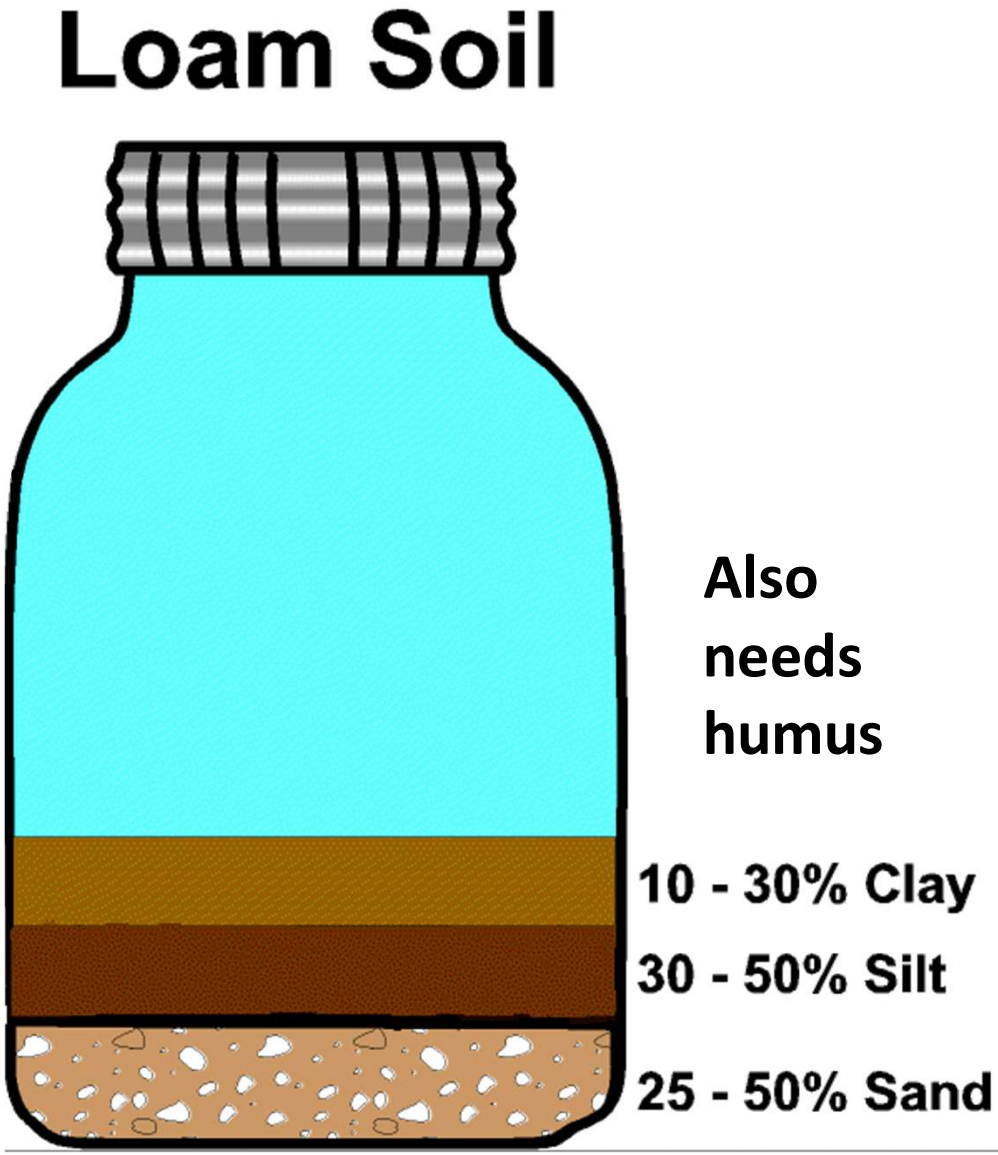
Humus soils have lots of nutrients for plants.

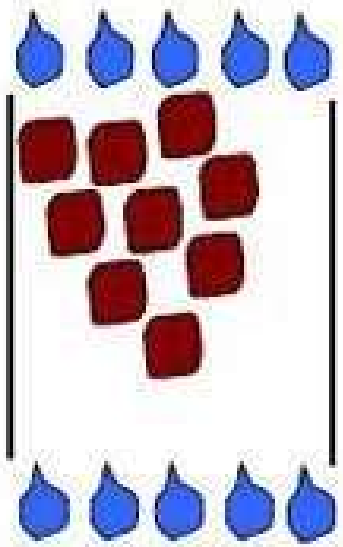
Adding humus to infertile soil increases its fertility.

Loam is a mixture of clay, silt, sand and humus and is the best soil for growing plants.

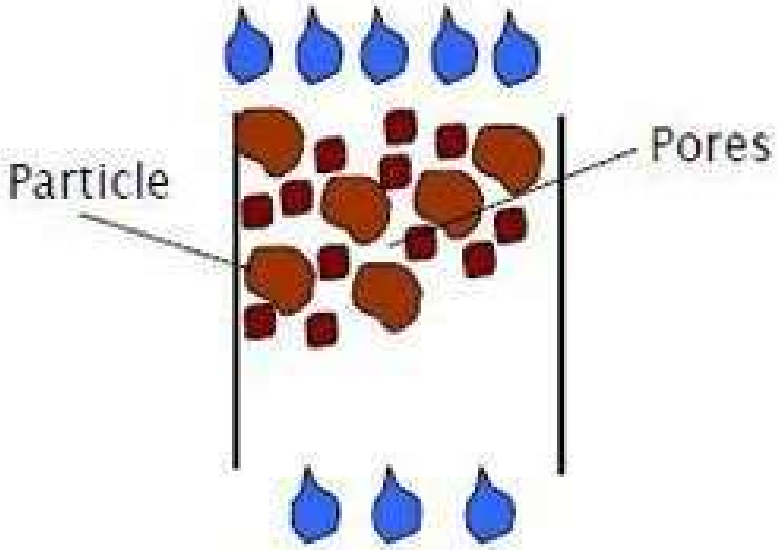
Because loam is a mixture of four kinds of soil, it holds the proper amount of water and provides all the nutrients plants need

Loam is formed in nature when the dead plants and animals are left to rot and mix in clay, sand or silt.

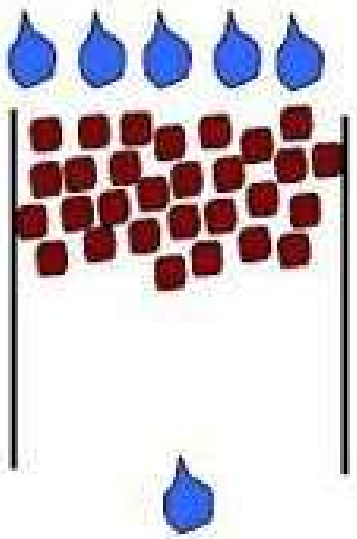




Sandy Soil: Note size of particles and fewer pores but larger pore size. Water can freely drain through this soil.



Loam type soil: Note different sized particles, mixture of sands and clays. There are more pores varying in size than in sandy soil. Drainage is slowed but still well drained.



Clay soil: Soil particles are small size with many small pores. Water tends to get trapped in the pores due to high tension causing drainage to be often poor and slow.

What's in the soil?	Why is it important?
Sand Drains well but cannot hold onto nutrients [Large Particles]	Sand is an important part of the soil because it provides drainage
Silt Can hold water, but can be hard to drain. Can hold limited nutrients. [Medium particles]	Silt is an important part of the soil because it holds onto limited nutrients and holds onto water
Clay Holds water well but can become heavy and waterlogged when wet. Can hold nutrients. [Small particles]	Clay is an important part of the soil because it holds water well and can hold onto nutrients
Air Fills all the gaps in soil and allows plant roots and animals to breathe. 35 to 40% of a good soil is air! [A Gas]	Air is important in the soil because it allows the plant roots and animals to breathe
Water Clings to soil particles and is taken up by the plant roots	Water is important in the soil because without it the plants and animals would die
Organic matter Releases nutrients slowly as it rots and improves water Holding	Organic matter is important in the soil because it improves water holding and helps stick the soil together