# Soil, the Mystery Beneath Our Feet

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What is soil?

Solids: organic and mineral materials
Liquids: water and solutions that are mostly water
Gases: Oxygen, carbon dioxide

The solid part and how it affects plant growth

1. Texture

a. What is texture?
The relative coarseness or fineness of a soil.
Determined by relative amounts of sand, silt and clay.

b. Particle size & characteristics

| **SAND** | **SILT** | **CLAY** |
|---|---|---|
| Largest particle | smaller than sand | smallest particle |
| Rough | smooth, not sticky | smooth, sticky |
| Little surface area | more surface area | most surface area |
| Little water capacity | good water capacity | best water capacity |

c. Soil texture influences

Water movement (Intake & Drainage):
Fine texture = many small pores; slow water movement
Coarse textures = faster water movement

Water storage:
-clay holds the most, due to small pores, but all is not available
-silt is similar to clay
-sand holds the least due to large pores

Root movement: similar to water movement; very coarse soils may slow movement if they stay dry.

Ease of tillage: sand easier than silt; silt easier than clay
-fine soils--if too wet when tilled, structure breaks down

Soil fertility: clay/organic matter store more nutrients due to charge (negative)

2. Structure

a. What is structure?
-refers to the arrangement of soil particles; arranged into aggregates or groups
-Good structure allows for faster water movement and better air capacity

b. Structure modifies the influence of texture
-a soil high in clay may still drain well if structure is good

c. Changing soil structure (adding soil amendments)
-to improve drainage and aeration; reduce compaction
-Sand--avoid it unless you are prepared to add <u>very large</u> quantities
-Gypsum may loosen soils if soil is compacted due to excess sodium. Gypsum replaces the sodium molecule in salt-contaminated soils. But to be effective, gypsum must be put down before the salt and must be incorporated
-Organic matter (compost, manure, leaf mold) is best
-increases available water while improving drainage
-stores nutrients--supplies them to plants
-improves structure of soil
-improves ease of tillage and reduces compaction

Water and air in the soil

1. Water
-water molecules stick to each other through negative and positive charges
-they form chains and these chains stick to clay and organic matter because they have negative charges

2. Water movement in the soil
Thorough watering allows water to fill all the pore spaces. Gravity pulls out the excess. After gravity has done its work, the soil is at 'field capacity' where capillary action holds water loosely around the soil particles, but some pore space becomes filled with air. Plant roots need both air and water and we want to keep our soil at this point as much as we can.

Soil residents: micro-organisms

1. Benefits:
-decompose organic matter and enrich the soil
-take nitrogen from the air and put it into the soil
-improve soil structure
-mycorrhizal fungi aid in water absorption and nutrient uptake
-promote plant growth
-produce natural pest control products

2. Encouraging micro-organisms:
-amend disturbed soils with native soils
-maintain good aeration
-don't amend with perlite or vermiculite
-avoid excess use of inorganic fertilizer, especially phosphorus
-avoid unnecessary use of soil-applied fungicides

Plant nutrients:

1. Macro-nutrients, needed in large quantities
   -nitrogen, phosphorus, potassium, calcium, magnesium and sulfur
2. Micro-nutrients, no less important, but needed in smaller amounts
   -iron, boron, manganese, zinc, molybdenum, chlorine and copper

Nutrient functions:

1. Nitrogen is used for leaf development and green color
2. Phosphorus promotes root growth and stimulates flower and fruit production
3. Potassium regulates many cellular processes and aids in disease resistance and cold hardiness

Soil pH:

Soil pH measures soil acidity or alkalinity. Most plants grow best between 6.0 and 6.6. Our soils are higher than that, so are not optimum for plant growth. This is due to the fact that soil pH influences nutrient availability. Between pH 6.0 and 6.6, all the nutrients are readily available. At higher pH, some of them are less available. It is not that they are not there, but they are in a chemical form that the plant cannot absorb.

Changing pH is hard to do. A better option is to choose plants that tolerate our soil pH. Deficiencies in iron or manganese can be treated with chelated forms of those nutrients. The chelated forms are not affected by soil pH.

Fertilizing: Match the fertilizer to the needs of the plant. Every fertilizer has three numbers that represent Nitrogen-Phosphorus-Potassium.

Good, all-purpose fertilizers have equal amounts of each nutrient
12-12-12 10-10-10

High nitrogen fertilizers are often best for lawn growth and green color
16-4-8 10-3-7

High phosphorus fertilizers will favor flower and fruit production
5-10-5 6-12-6