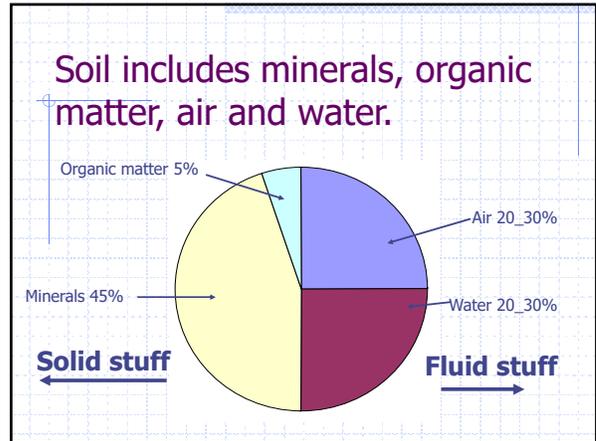


Plain Talk About Soil

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Soil texture is the percentage of sand, silt and clay.

Soil texture cannot be changed. ☹️

Sand, Silt, and Clay

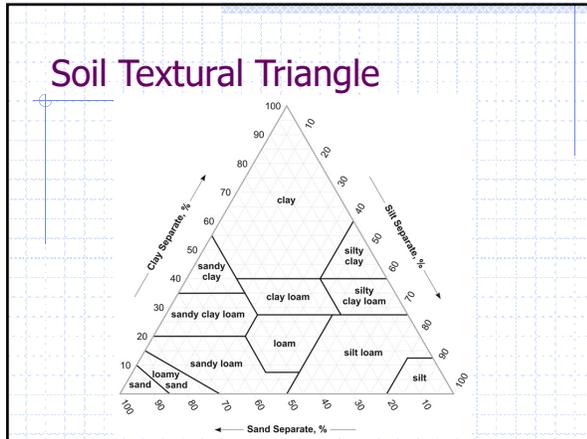
Source/Formation	Photo	Close-up	Particle Size
(silicate) minerals or rock fragments Sand			0.05mm-2mm
glacial friction against bedrock Silt			0.002mm-0.05mm
slow action of dilute acids on silicate rocks Clay			<0.002mm

Not all clays are the same!

Soil minerals exist as sand, silt and clay particles.

Sand particles are big. **Clay particles are small.**

Sand: big particles, big pores. **Clay: little particles, little pores.**



Soil structure: arrangement of sand, silt and clay into aggregates.

Photo credit: Angela Straathof, OSCIA

Soil Structure

- ◆ Changes with depth
- ◆ Quick to destroy, slow to rebuild

The diagram shows a vertical soil profile with horizons O, A, B, and C. O horizon is undifferentiated organic material. A horizon is topsoil where translocation of clay and organic matter occurs. B horizon is subsoil where clay and organic matter accumulate. C horizon is undifferentiated parent material. A 3D view shows soil type and parent material.

Soil Profile Figure 13.3

Soil Biology and Soil Structure

Charged nutrients attract oppositely charged soil particles.

Soluble nutrients

Fragmentation

Mineralization

Bacteria and fungi release enzymes that convert organic molecules from residues into soluble nutrients (N, P, S)

Biology Builds Soil Structure

Roots exude into the soil at least 20% of the carbon fixed by the plant.

Binding action of soil fungi build soil structure.

Chemistry Builds Soil Structure

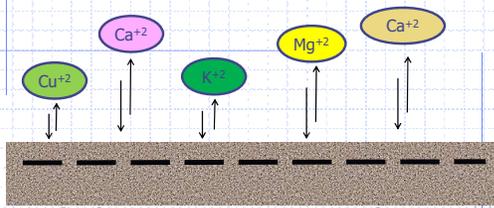
CLAY

Organic Matter

Ca, Mg, K, P (all cations + charge)

Soil Aggregate

Many essential plant nutrients have a positive charge.



Soils have a negative charge.
Soil structure

Soil Pore Size Controls Water Movement in Soils

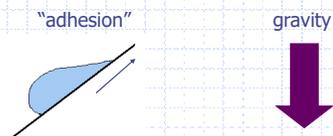
Infiltration admits water through holes and cracks.



Increasing infiltration

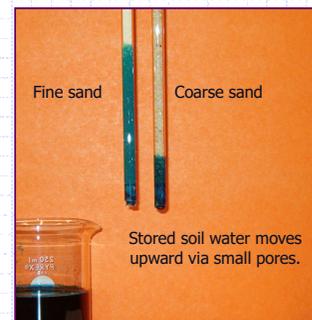
1. Increase soil organic matter
 1. Leave crop residues on the surface
 2. Leave surface soils on the surface
2. Maintain surface cover
 1. Reduce rainfall impact
 2. Reduce evaporation of soil water
3. Minimize crusting – minimize disruption

Two major forces control water movement through soil.



Soil texture dictates which is in control.

Adhesive Force in Action





Size of soil pores controls uphill flow.
Little pores let water climb higher.
Capillary Action

Infiltration and Percolation in Action

Water moves as a film in soils.

Water is under surface tension.

1

2

3

Infiltration speed controlled by amount of water at the surface.

- More water = faster
- Less water = slower

The weight of the water above overcomes surface tension. Infiltration. Gravity.

Contact between soil particles advances wetting front.

Soil crusting

Disaggregated soil particles.

1

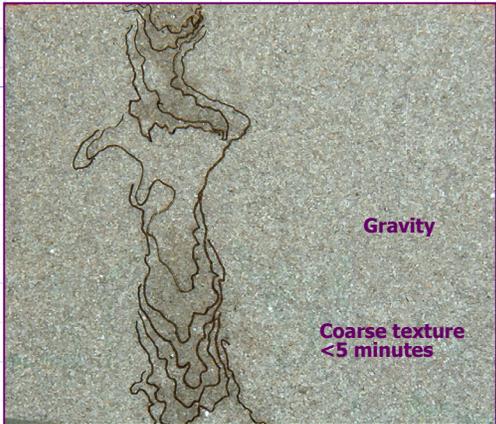
2

3

crust

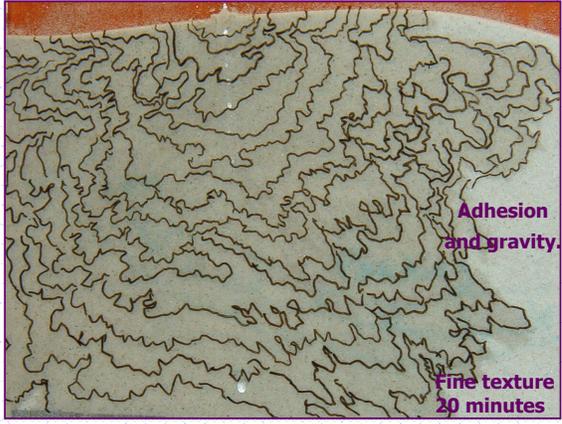
Particles travel downward with water.

Pores plug, infiltration stops. Crust forms at soil surface.



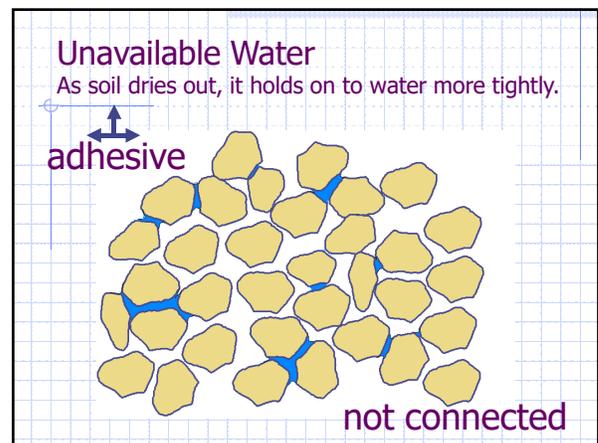
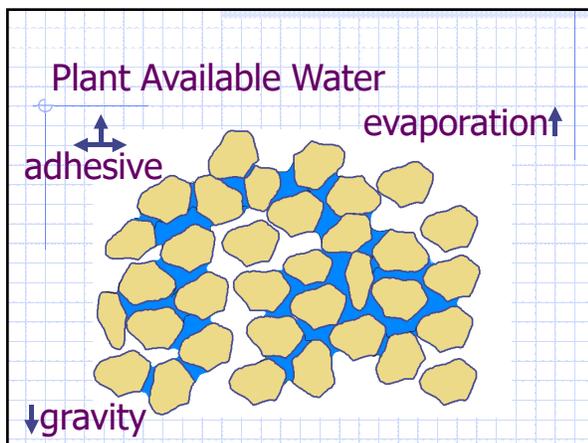
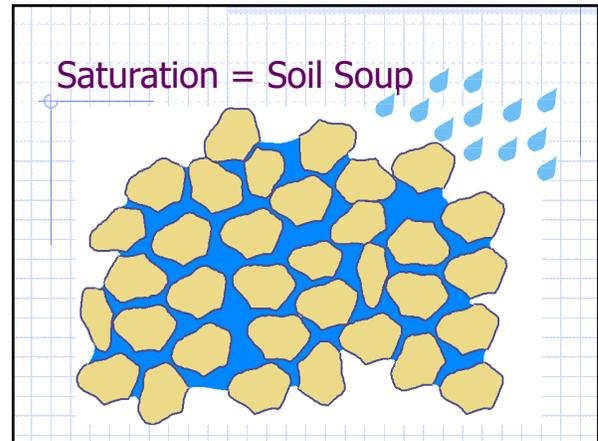
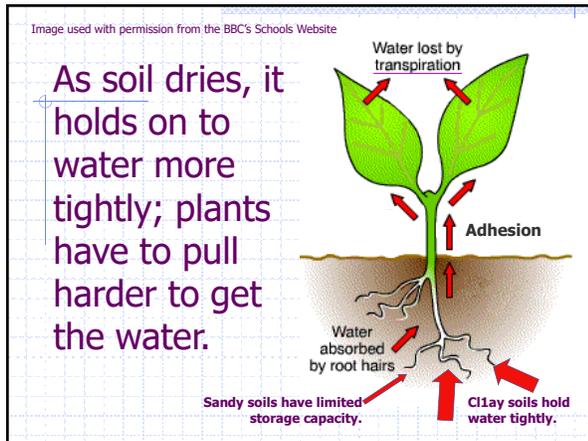
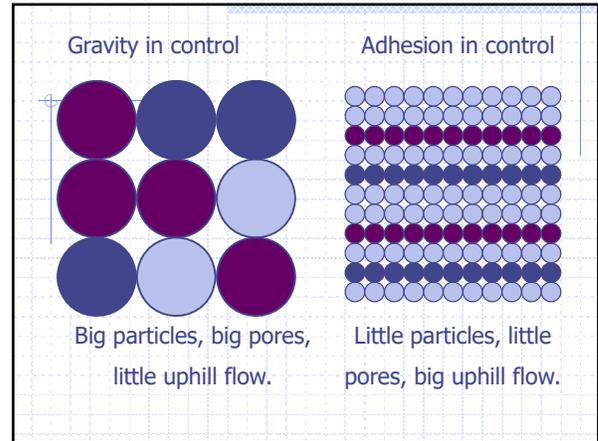
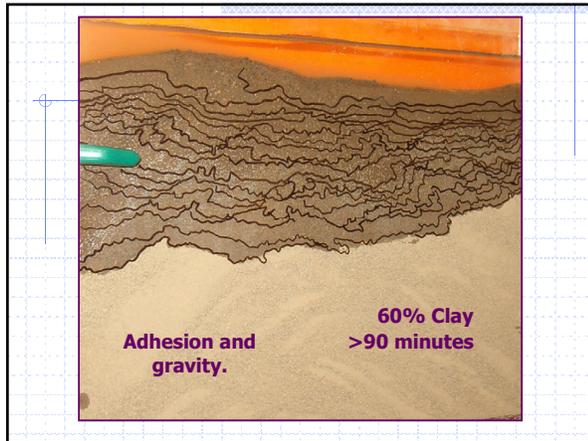
Gravity

Coarse texture <5 minutes

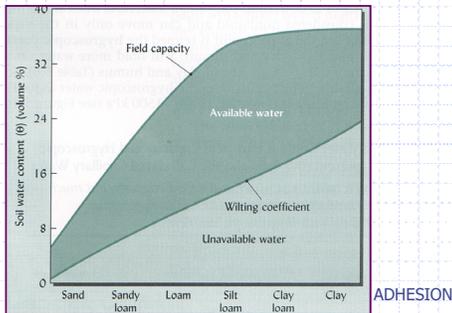


Adhesion and gravity.

Fine texture 20 minutes



Stored water available to plants varies with soil texture.



Soil Practices for Healthy Soils

Promoting Soil Health

Minimize mechanical and chemical disturbance	Keep a living root in the soil as long as possible	Keep the soil surface covered as much as possible	Diversify plant, insect, animal community

- Also:
- Optimize solar collection – photosynthesis
 - Optimize carbon cycling

Minimize disturbance

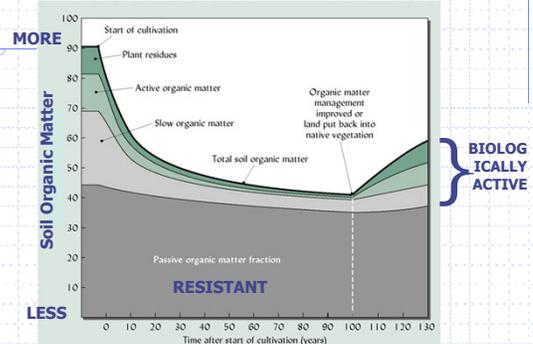
- ◆ Mechanical
- ◆ Chemical
 - Amend soils according to soil test
 - Avoid excessive depletion/buildup of plant nutrients

Mechanical disturbance

Soil Structure	Soil Chemistry	Plant Life
Weakens soil structure	Slows water infiltration	Reduces organic matter
		Increases weeds

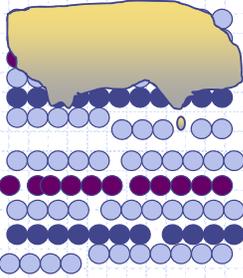
and soil structure

Mechanical disturbance



and soil biology

Mechanical disturbance



1. Contact points between soil particles reduced, infiltration is slowed.
2. Water forced across the void by the weight (pressure) of water above.
3. Water hangs from the water above until gravity overcomes surface tension.
4. Voids slow percolation, soil above void saturates until water spans the gap or falls.

and infiltration

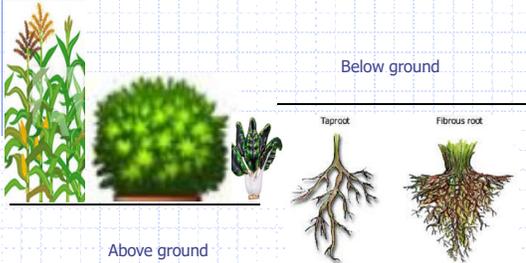
Keep a living root in the soil



Cover the soil surface



Diversify plant architecture



Above ground

Below ground

Taproot

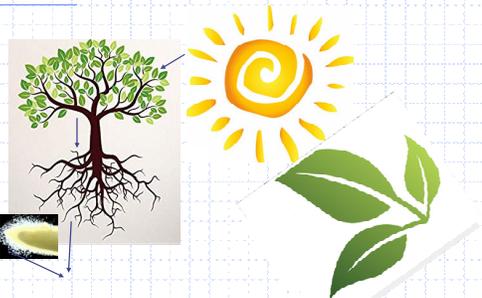
Fibrous root

For diverse habitats

Diversify plant architecture



Optimize carbon sequestration



and solar energy capture

