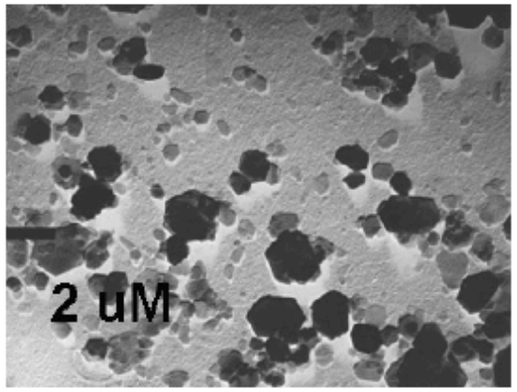
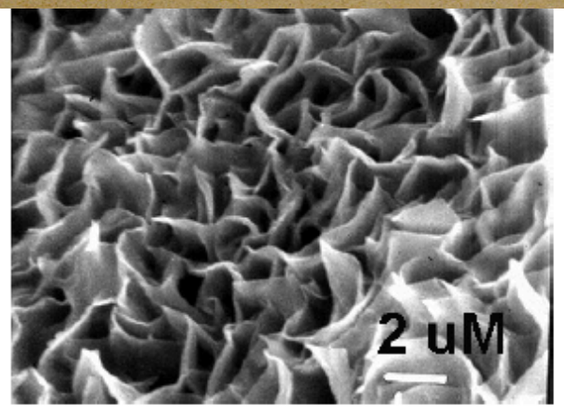
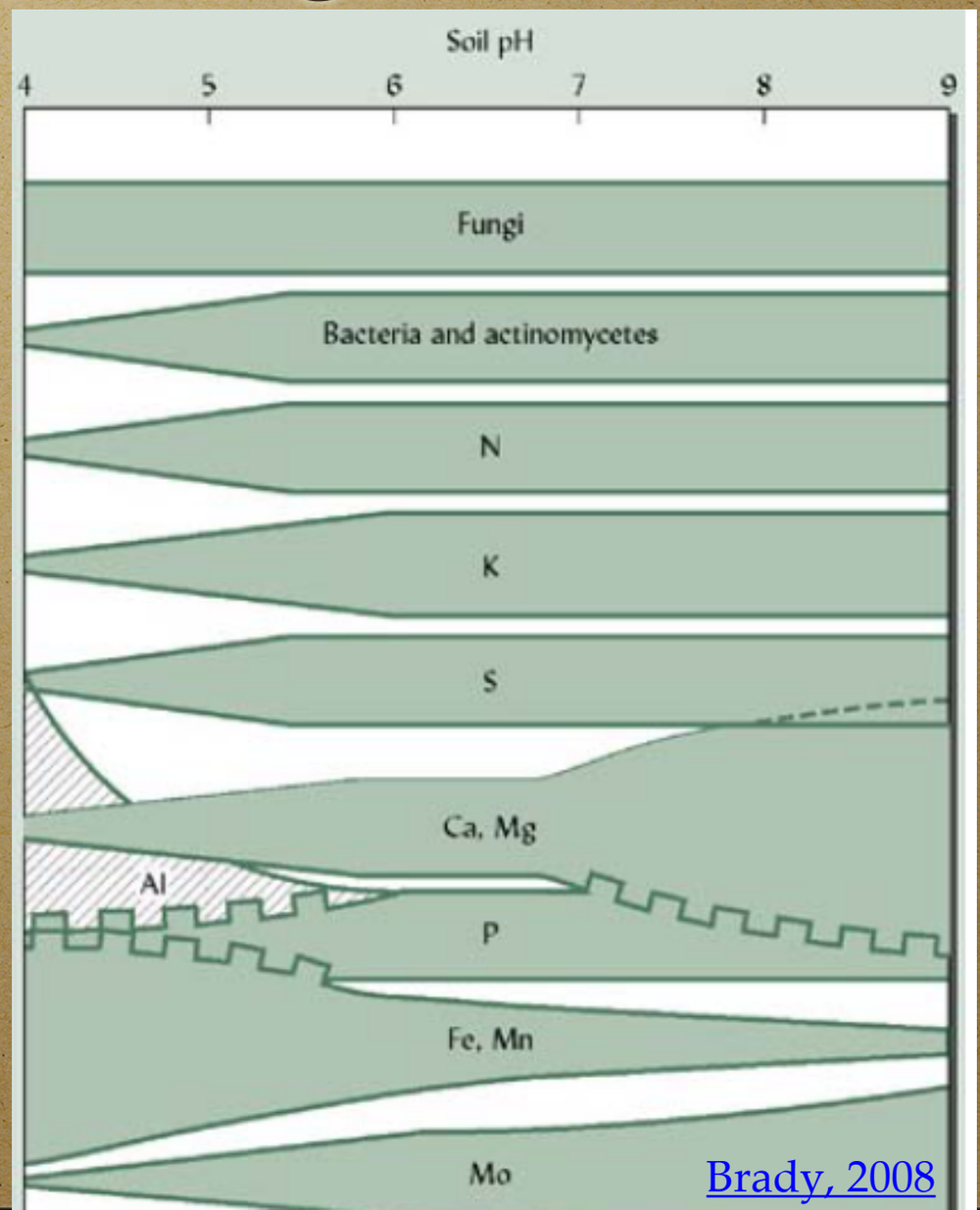
Soil Structure, Soil Materials, and Soil Chemistry



1: 1 kaolinite



2:1 smectite

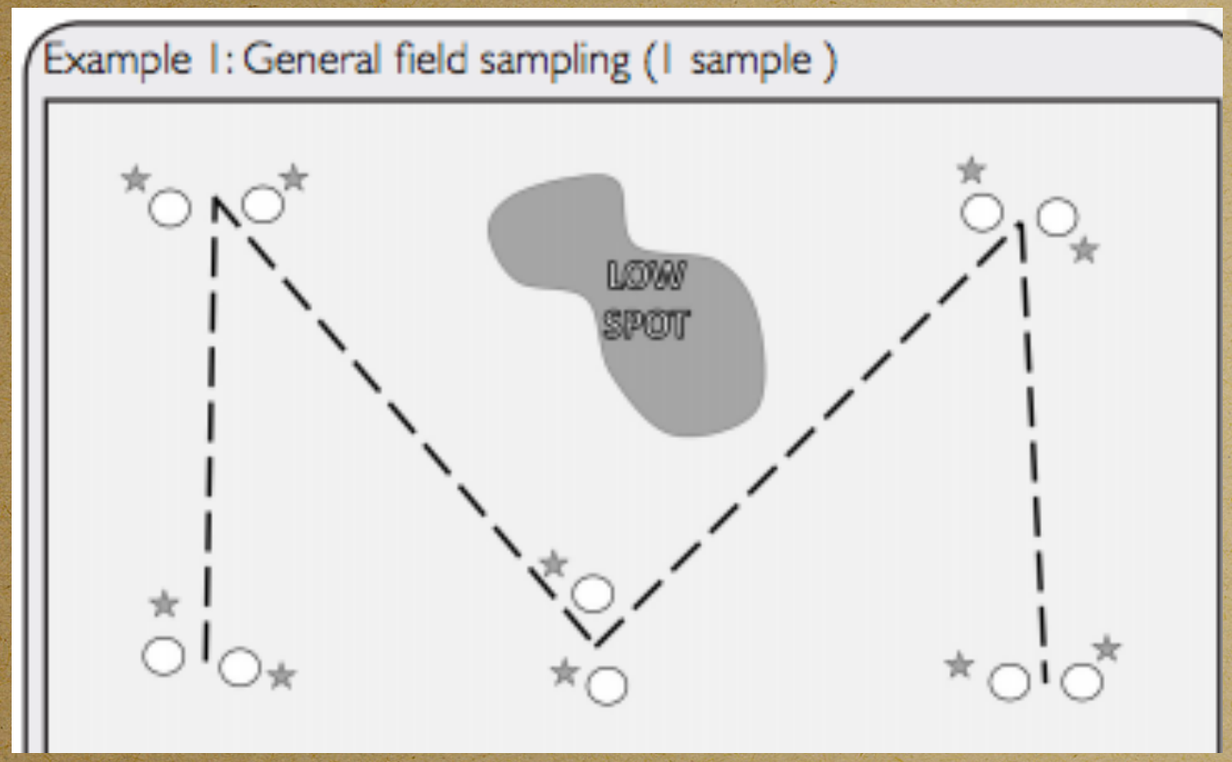


Brady, 2008

Outline:

- Soil Sampling and Web Soil Survey
- Soil Profiles of Tompkins County
- Soil Materials: Sand, Silt, and Clay → Texture
- Soil Structure
- Clays
- Soil Chemistry Basics: Nutrients, pH and CEC
- Activity: Mineral ID, Hand Texturing, and Soil pH

Soil Sampling



- **Poor Sample = Poor Soil Test Data, Poor Repeatibility**
- **Randomly sample different locations in the field you are sampling**

- **Represent 0-6″ equally**
- **Use push probe or trowel/rectangular shovel**
- **Mix the soils from all the different soil sampling locations within that target area.**

Youth Farm Project

Search

Map Unit Legend

Tompkins County, New York (NY109)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BgD	Bath and Valois gravelly silt loams, 15 to 25 percent slopes	5.6	19.4%
EbB	Erie channery silt loam, 3 to 8 percent slopes	5.8	19.9%
EcA	Ellery, Chippewa, and Alden soils, 0 to 8 percent slopes	0.0	0.0%
LaB	Langford channery silt loam, 2 to 8 percent slopes	17.7	60.7%
Totals for Area of Interest		29.1	100.0%

Soil Map

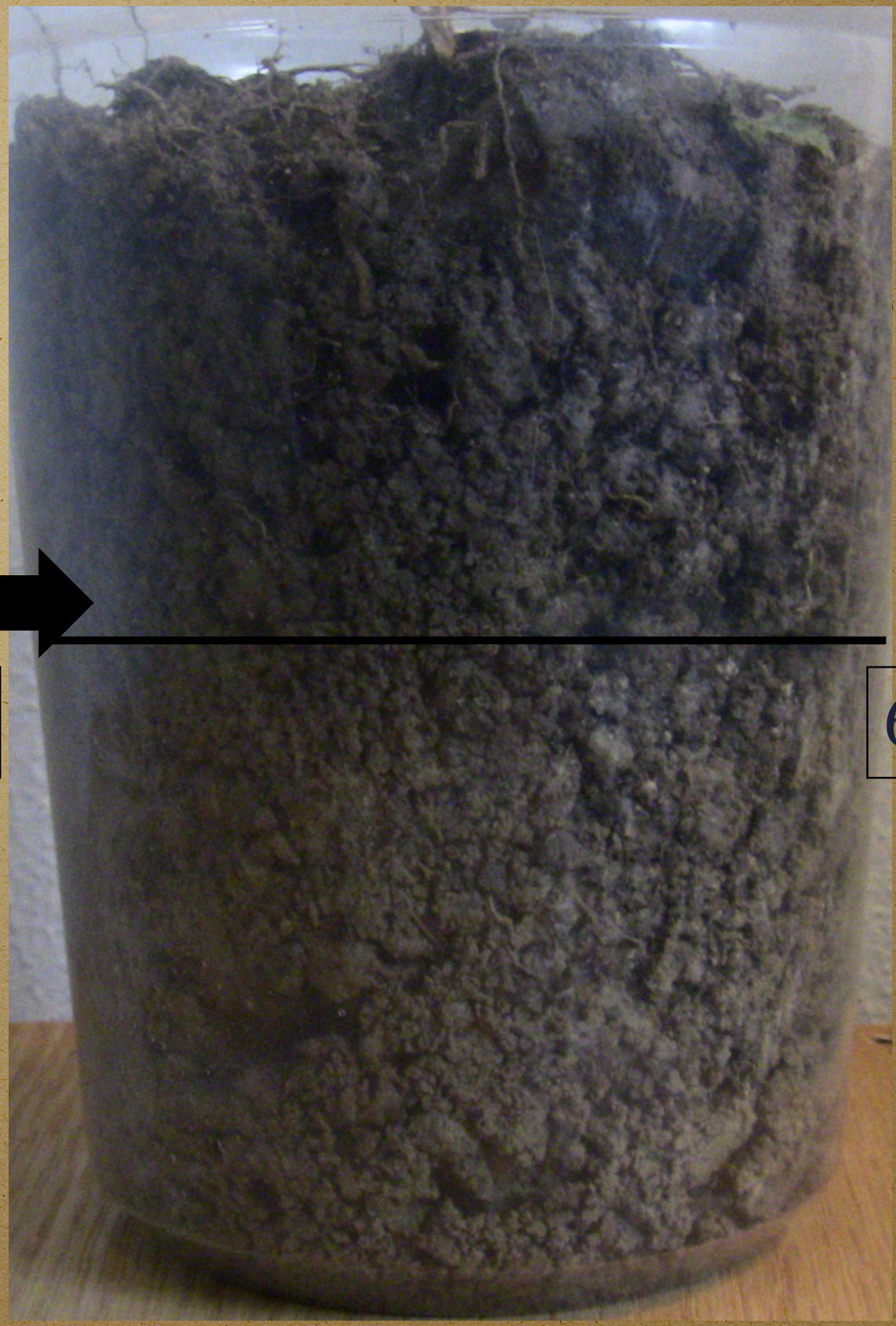
Elevation: 1300ft

LANGFORD SERIES

The Langford series consists of very deep, moderately well drained soils formed in loamy till. These soils are in glaciated upland areas. They have a fragipan starting between 15 and 28 inches below the soil surface. Permeability is moderate above the fragipan, and slow or very slow in and below the fragipan. Slope ranges from 0 to 50 percent. Mean annual temperature is about 49 degrees F., and mean annual precipitation is about 38 inches.

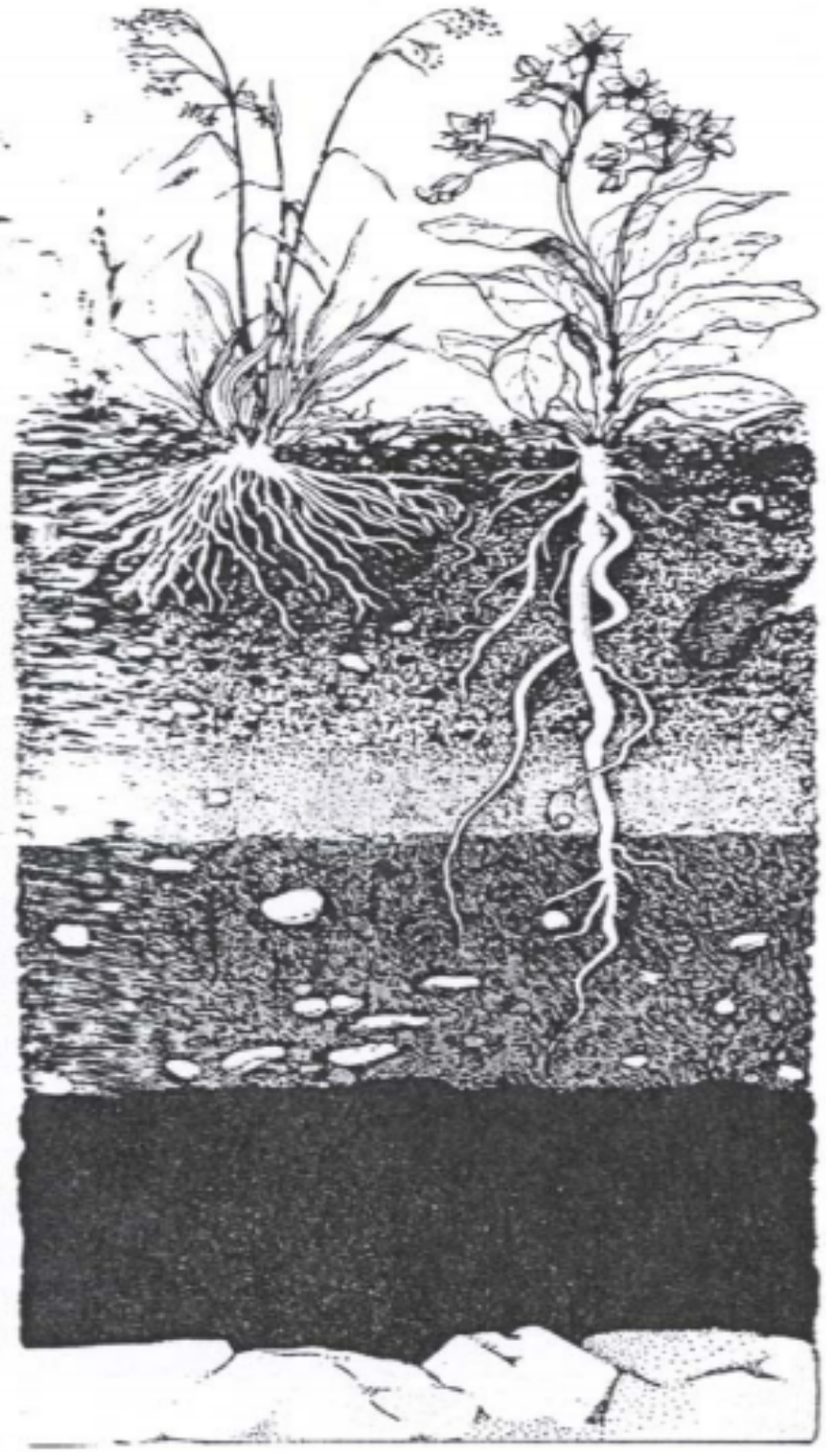
Ellis Hollow Channery Silt Loam @ Elevation: 1300ft

18″



6″

Soil Horizons



O–Horizon

A–Horizon

E–Horizon

B--Horizon

C–Horizon

R

Surface litter:
Freshly fallen leaves and organic debris and partially decomposed organic matter

Topsoil:
Partially decomposed organic matter (humus), plant roots, living organisms, and some inorganic minerals

Zone of leaching:
Area through which dissolved or suspended materials move downward

Subsoil:
Unique colors and often an accumulation of iron, aluminum, and humic compounds, and clay leached down from above layers

Parent material:
Partially broken-down inorganic materials

Bedrock:
Impenetrable layer, except for fractures

Soil Horizons: Honeoye

Soil Monoliths of Tompkins County: Glacial Till

Soil Monoliths of Tompkins County: Lacustrian

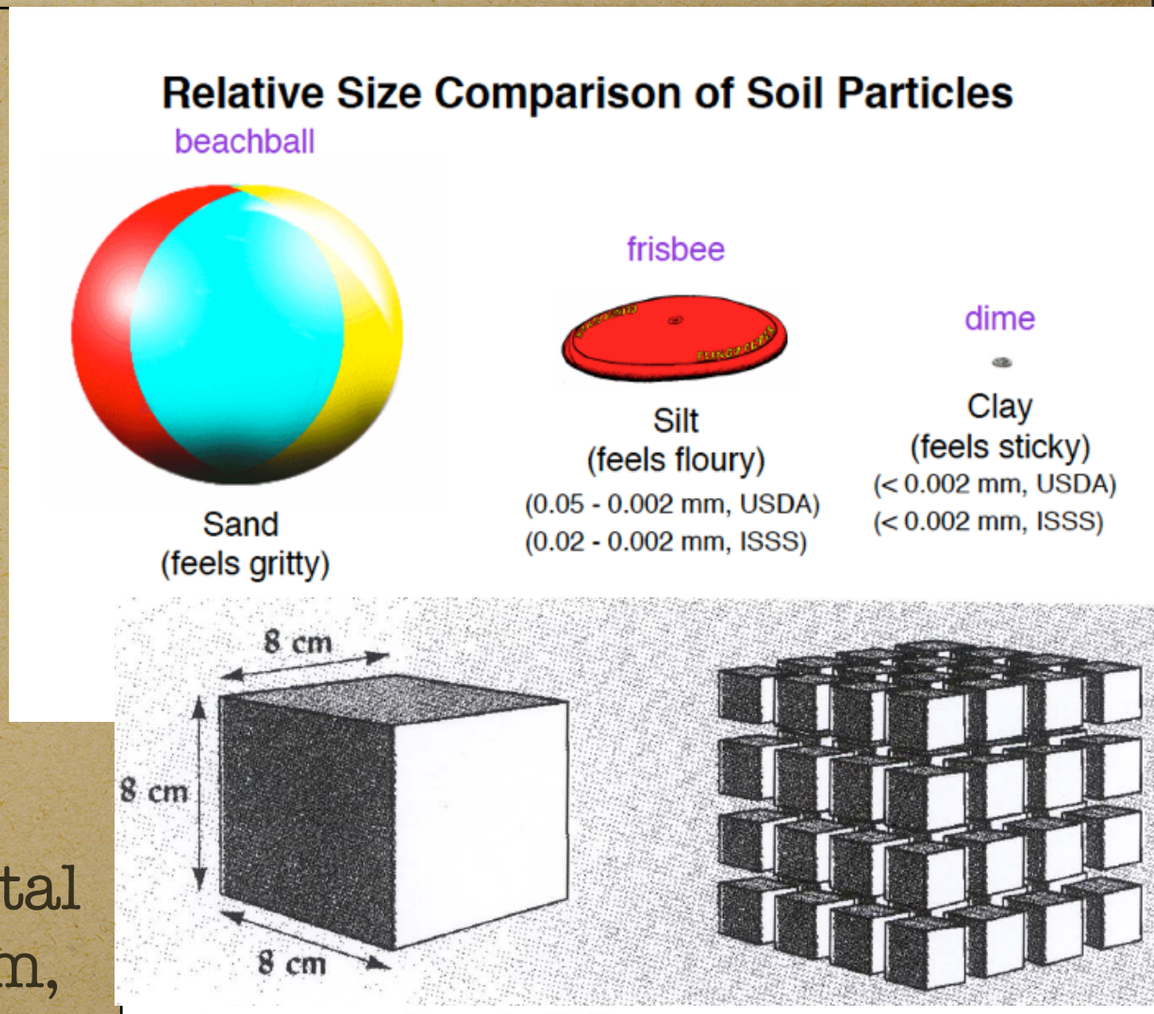
Mineral Fraction of Soil

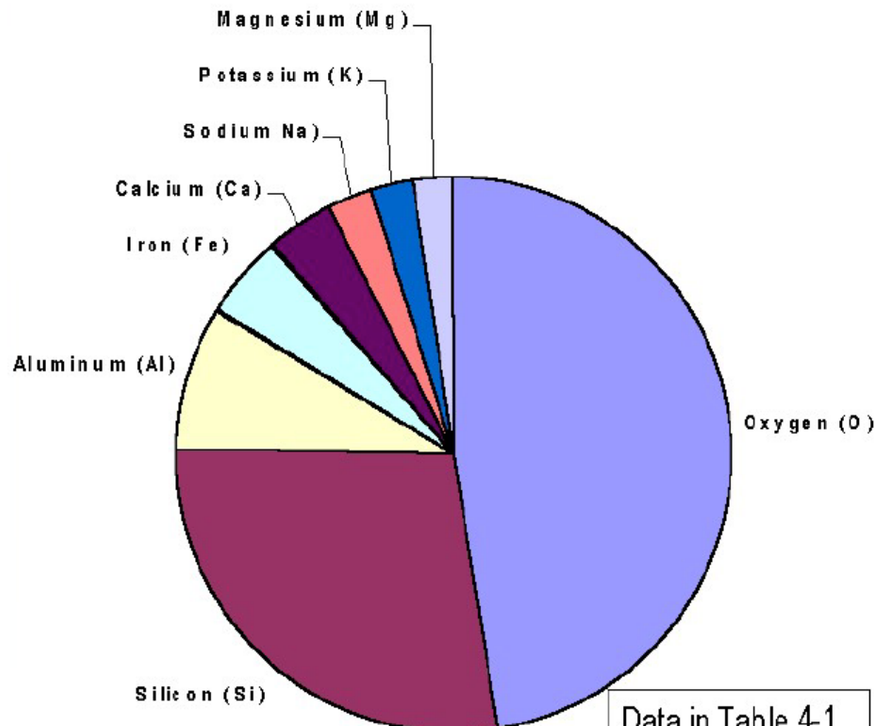
- **Particle Size:** Sand, Silt, and Clay
- **Sand:** 2mm-.05mm
- **Silt:** .05mm-.002mm
- **Clay:** <.002mm

- It's all about **Surface Area!**

- **Chemistry of Mineral Fraction:** Elemental Composition of the Crust: Silicon, Aluminum, Iron, Calcium, Sodium, Potassium, Magnesium, also Phosphorus

- **Mineralogy:**
- Sand: **Primary Minerals**
- Clay: **Secondary Minerals**





Mineral Fraction of Soil

- **Texture:** the proportion of sand, silt, and clay

- **Macropores:** pores in between sand particles

- **Micropores:** pores between silt and clay particles

- Capillary Action, Adhesion, and Cohesion

- **Micropores:** hold water well (+), water drains more slowly, restrict aeration (-)

- **Macropores:** hold water poorly (-), water drains rapidly, improve aeration (+)

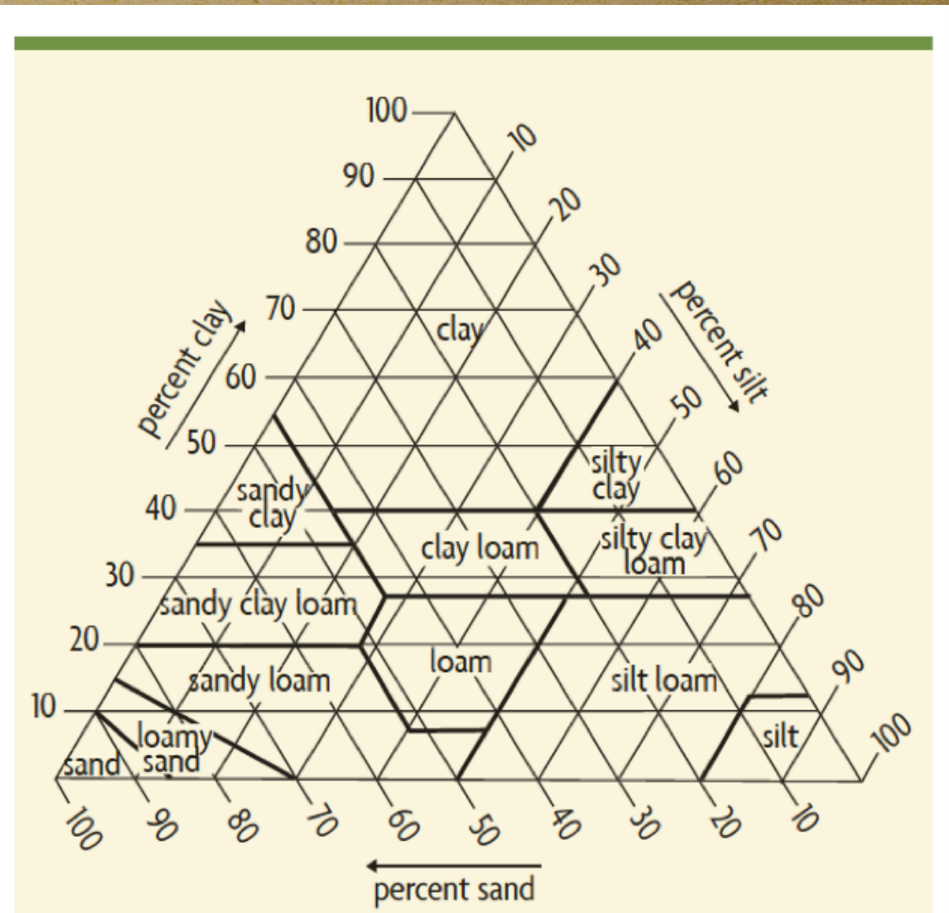
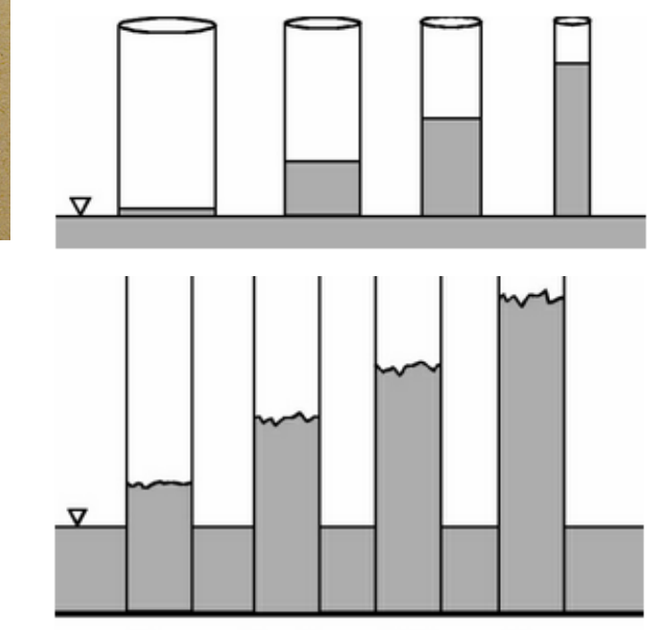
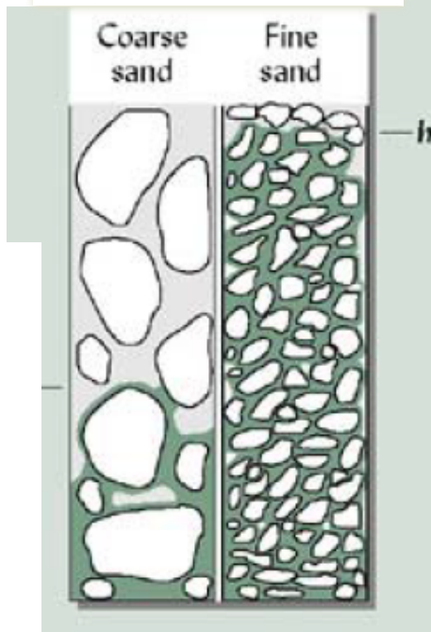


Figure 5.2. The percentages of sand, silt, and clay in the soil textural classes. From USDA-NRCS.

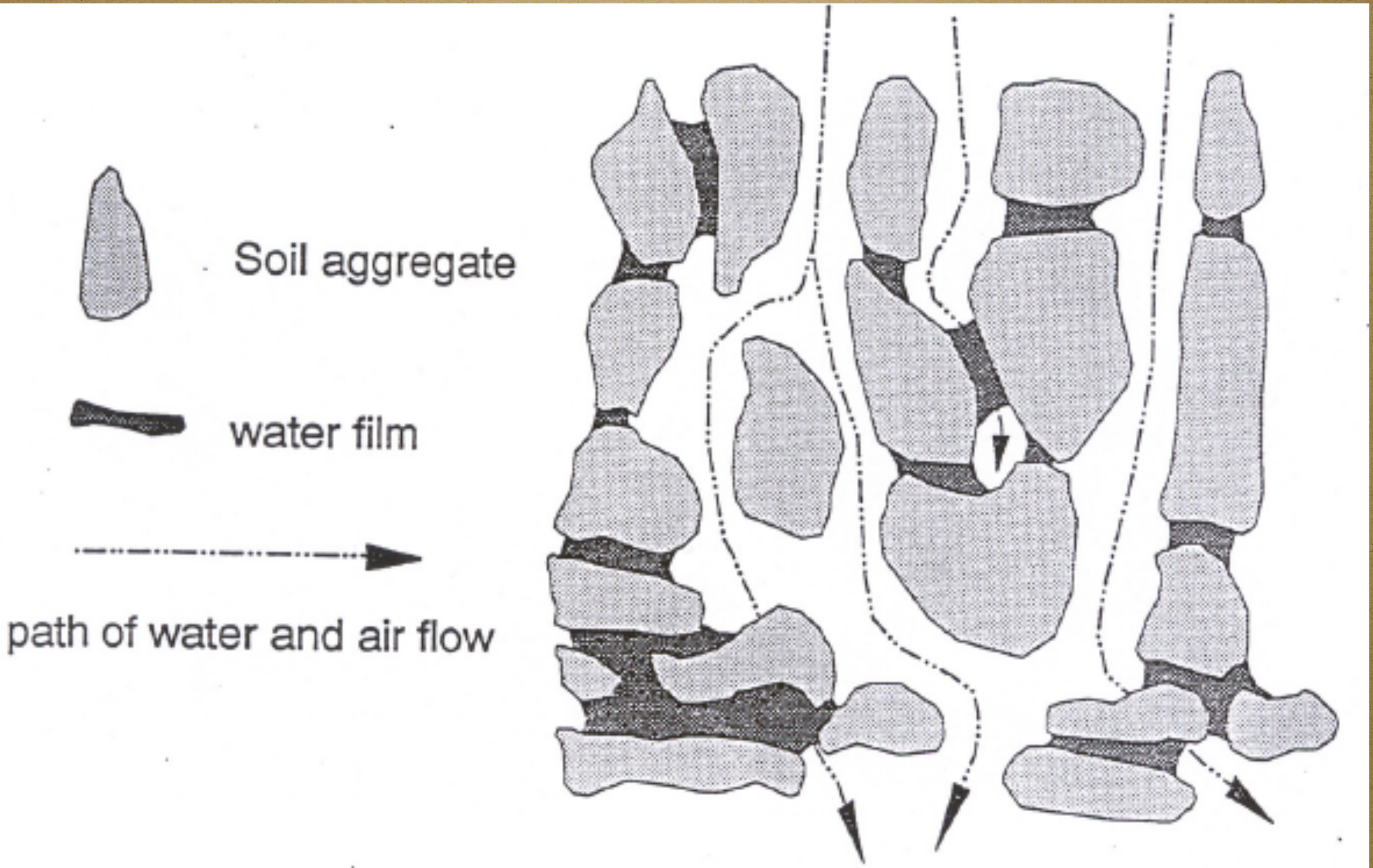
Magdoff, and Van Es, 2009





University of Nebraska

Mineral Fraction of Soil



Hand Texturing Soil

Student page

KEY TO SOIL TEXTURE BY FEEL

[Adapted from flow chart by Steve Thien, 1979, source unknown.]

Begin at the place marked "Start" and follow the flow chart by answering the questions, until you identify the soil sample.

START

Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it is moldable and feels like moist putty.

Add dry soil to soak up water.

Add drops to make wetter.

Does soil remain in a ball when squeezed? YES NO

YES Is soil too dry? NO

YES Is soil too wet? NO

SAND

Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over forefinger, until it breaks from its own weight. **Does soil form a ribbon?** NO YES

LOAMY SAND

Wet a small pinch of soil in palm until it is very wet. Rub soil around with your finger.

Does soil make a weak ribbon <1" long before it breaks? YES

Does soil make a medium ribbon 1-2" long before it breaks? YES

Does soil make a strong ribbon >2" or longer before it breaks? YES

Does soil feel very gritty? YES NO

SANDY LOAM

SANDY CLAY LOAM

SANDY CLAY

Is soil really neither gritty nor smooth? YES NO

LOAM

CLAY LOAM

CLAY

Does soil feel very smooth? YES

SILTY LOAM

SILTY CLAY LOAM

SILTY CLAY

HI ↑ % SAND ↓ LO

LO ← % CLAY → HI

WOW!: The Wonders Of Wetlands Environmental Concern Inc., P.O.Box P, St. Michaels, Maryland 21663

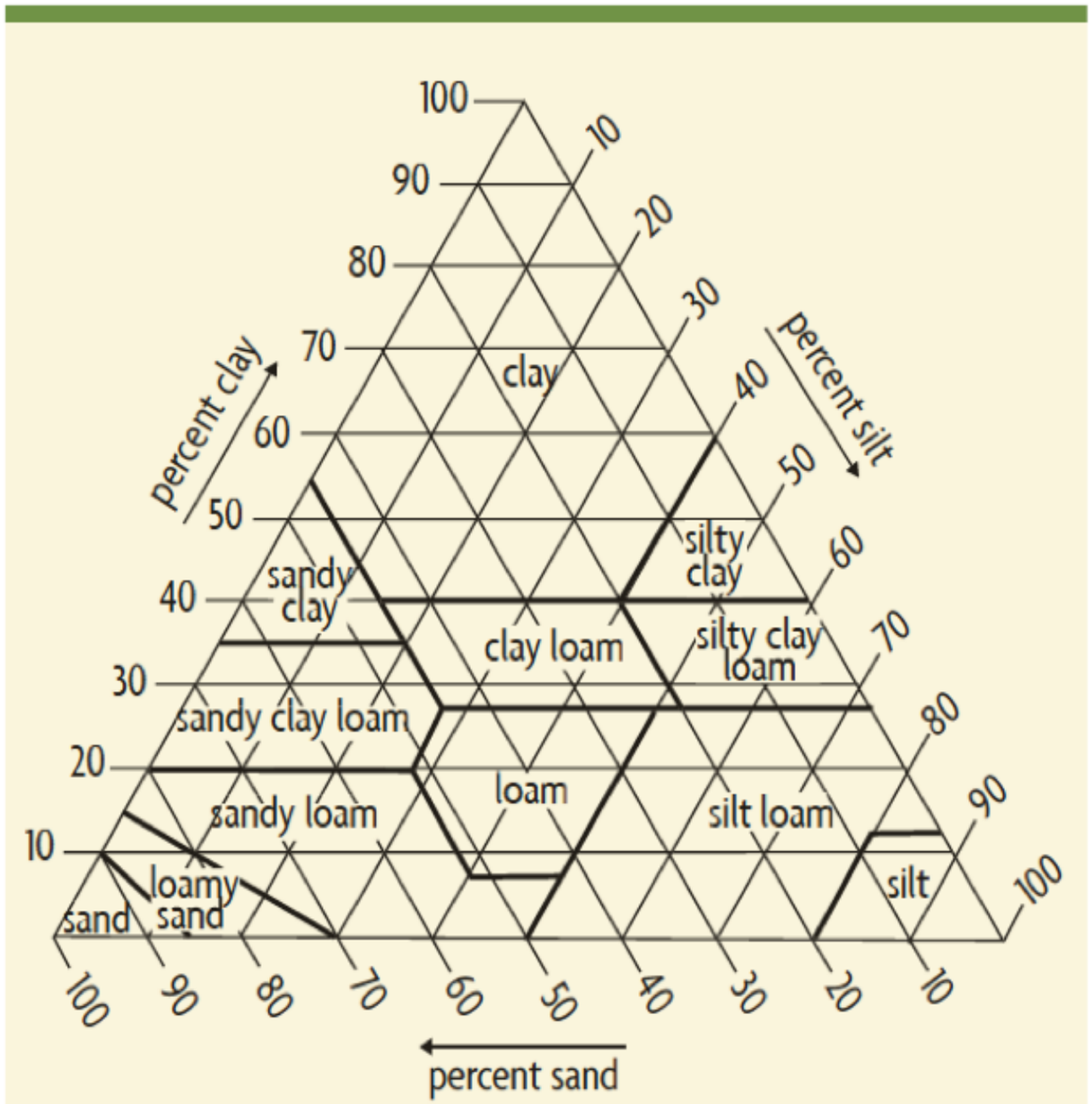


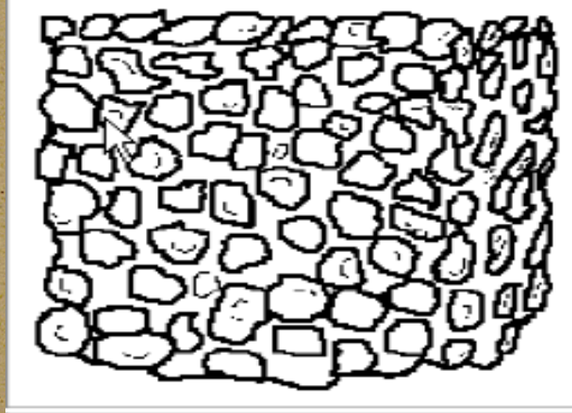
Figure 5.2. The percentages of sand, silt, and clay in the soil textural classes. From USDA-NRCS.

Magdoff, and Van Es, 2009

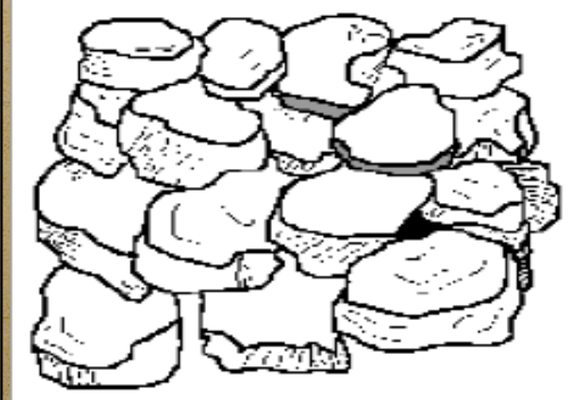
Soil Structure

- Soils Have Structure:
- **Single Grained:** Stucture-less
- **Granular:** Surface soil structure (Biologically Mediated)
- **Blocky:** Subsoil structure (Physically Mediated)
- **Platy:** Compacted soil structure

Single Grained: Soil is broken into individual particles that do not stick together. Always accompanies a loose consistence. Commonly found in sandy soils.



Granular: Resembles cookie crumbs and is usually less than 0.5 cm in diameter. Commonly found in surface horizons where roots have been growing.

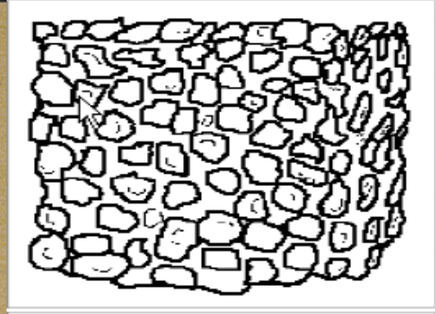


Blocky: Irregular blocks that are usually 1.5 - 5.0 cm in diameter.

Platy: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.

Soil Structure: Aggregation

AMF fungal hyphae that is entangled with soil aggregates. Miller and Jastrow, 2000



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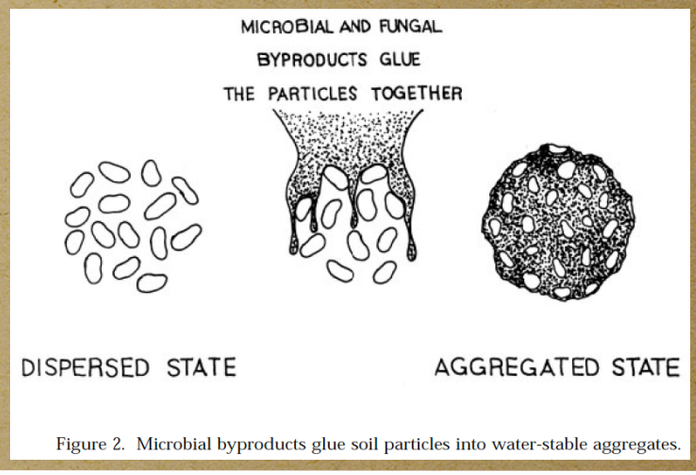
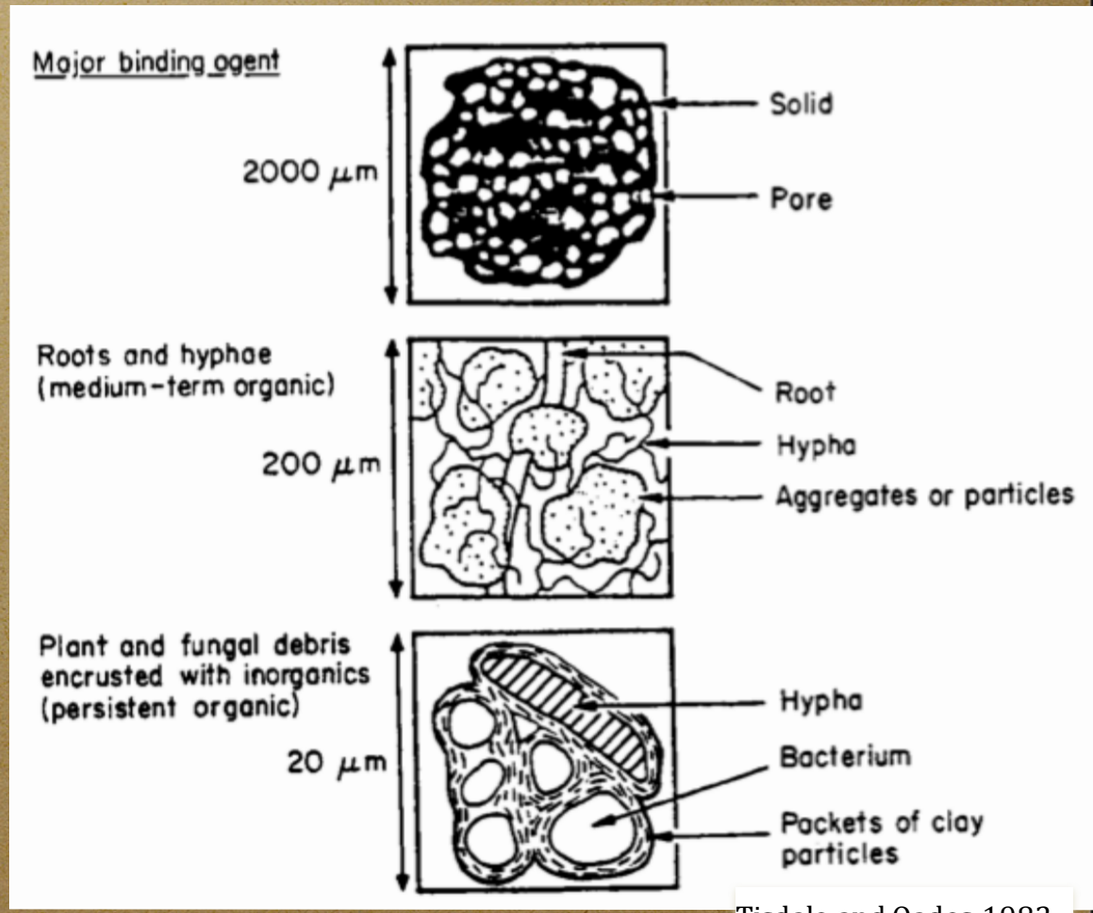


Figure 2. Microbial byproducts glue soil particles into water-stable aggregates.

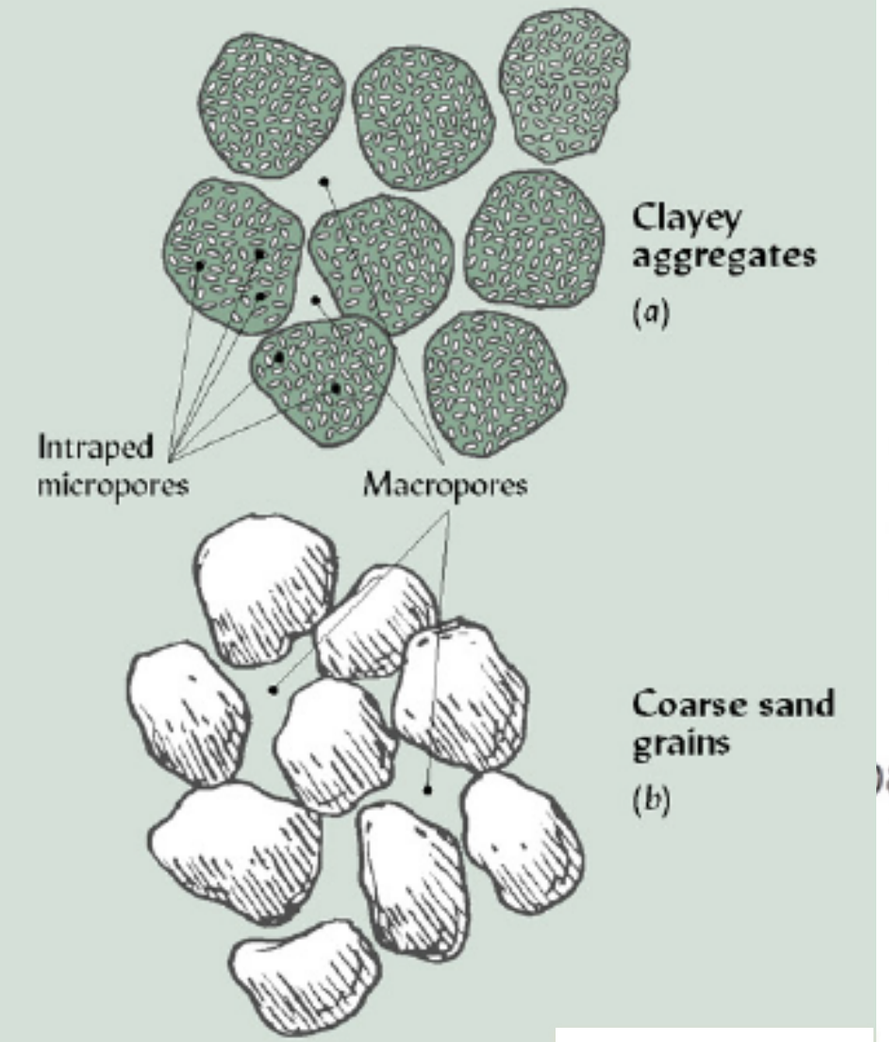
- Aggregates: "assemblages of mineral particles and organic material"
- Macroaggregates: .25mm-10mm
- Roots, hyphae, activity of earthworms, and sticky byproducts of plant and microbial life are responsible for creating stable aggregates in the surface soil



Tisdale and Oades, 1982

Improving Aggregation of the Soil

- Why is aggregation of the soil so important?



Brady and Weil, 2008