Soil Physical Observations and Estimations

By Clarence Chavez

Items Needed

5 - Soil Forming Factors

Time

Topography or Landscape Position

Aspect, slope, Depth

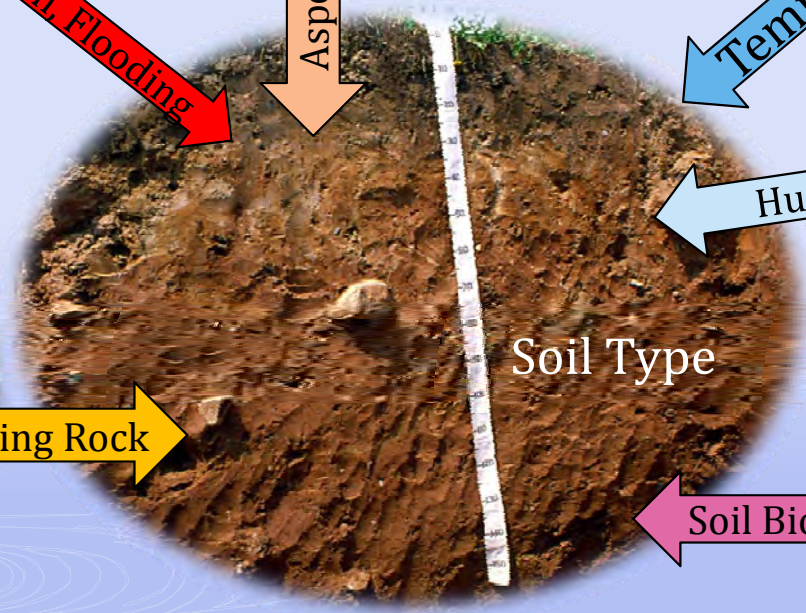
Climate

Decomposition, Erosion, Flooding

Temperature and Moisture

Biological factors

Parent Material



Soil Type

Human & Animal

Weathering Rock

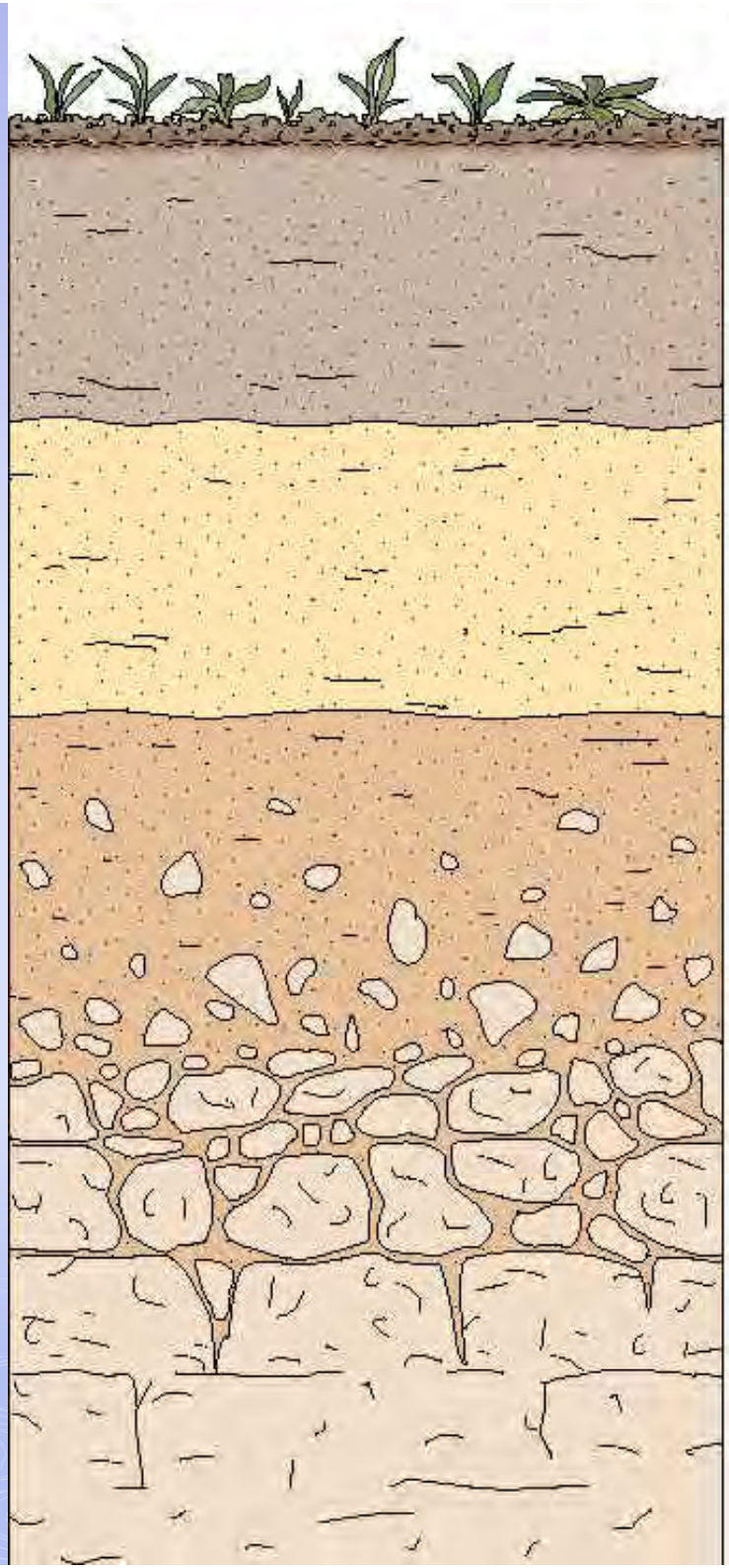
Soil Biota, & Plants

USDA NRCS

USDA is an equal opportunity provider and employer

cchavez2011

Measure the Depth of Soil



0”	– 10”	Very Shallow
10”	– 20”	Shallow
20”	- 40”	Mod Deep
40”	- 60”	Deep
>60 “		Very Deep

Plant Roots: diversity

© 2008 National Geographic Society. All rights reserved.

Determine Resistance / Compaction

Soil Peds / Aggregates

- Soil Structural units are called *peds*, and have distinct boundaries and well-defined planes of weakness between the aggregates.

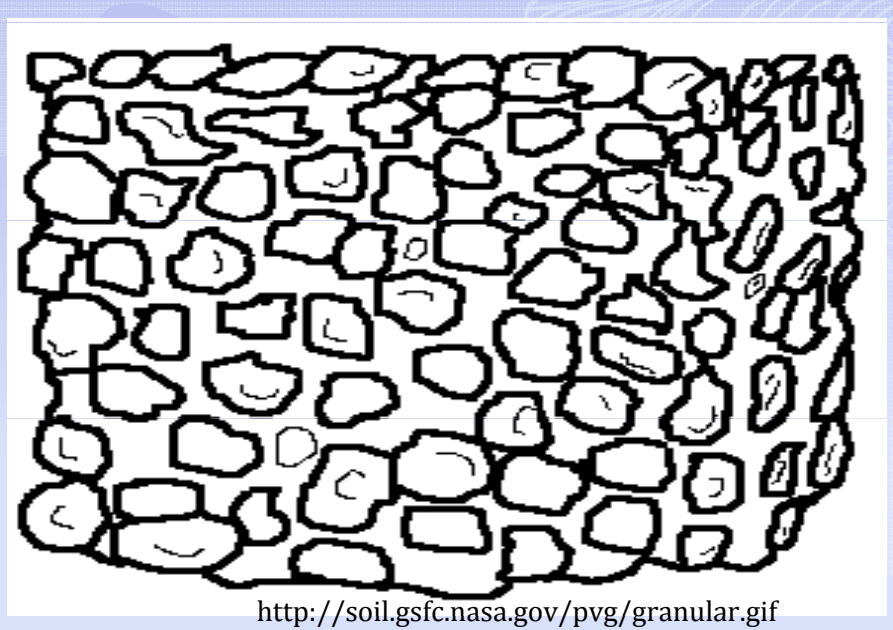
- Peds consist of primary particles bound together by cementing agents like organic matter, clay, Glomalin, Root Exudates and hydrous oxides of iron and aluminum.

- Peds (soil aggregate) can take several shapes.

Size does matter: Micro Aggregate or Macro Aggregate

Granular Structure

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

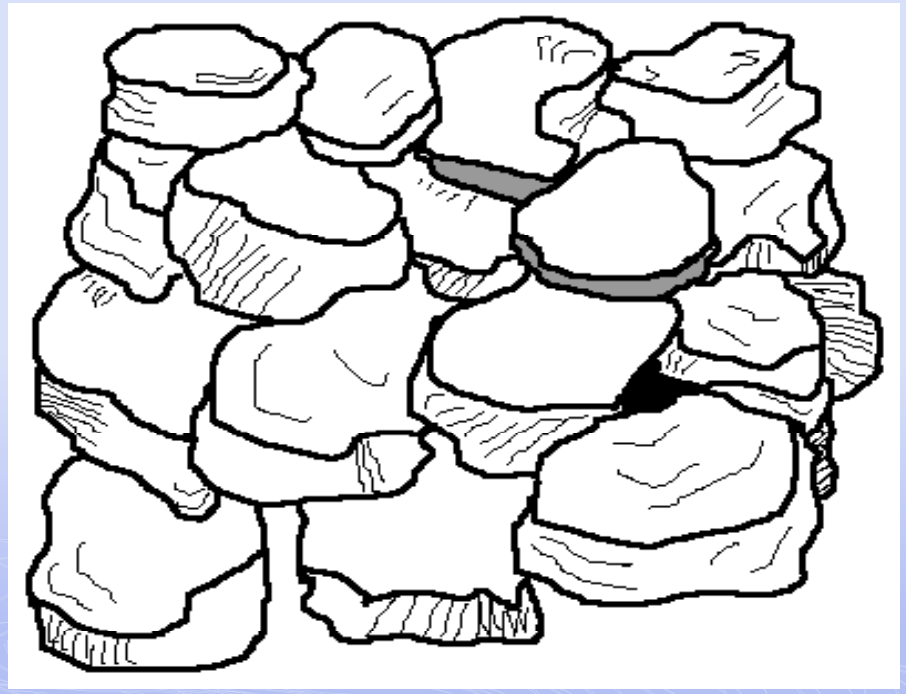


http://soil.gsfc.nasa.gov/pvg/granular.gif

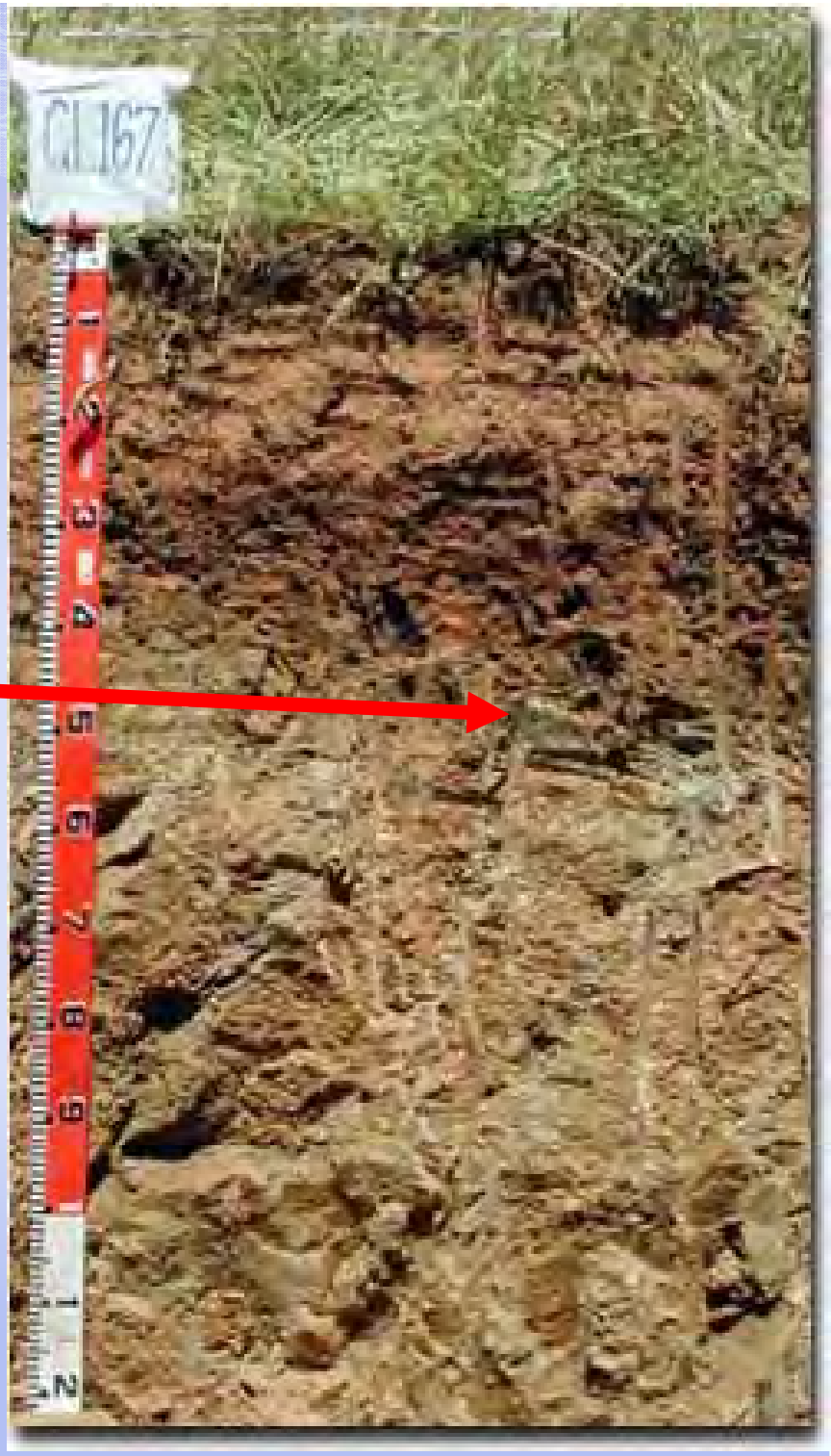
http://soils.usda.gov/technical/manual/images/fig3-30_large.jpg

Blocky Structure

- Irregular blocks that are usually 1.5 - 5.0 cm in diameter.
- Can be subangular or angular blocky.



http://soil.gsfc.nasa.gov/pvg/blocky.gif

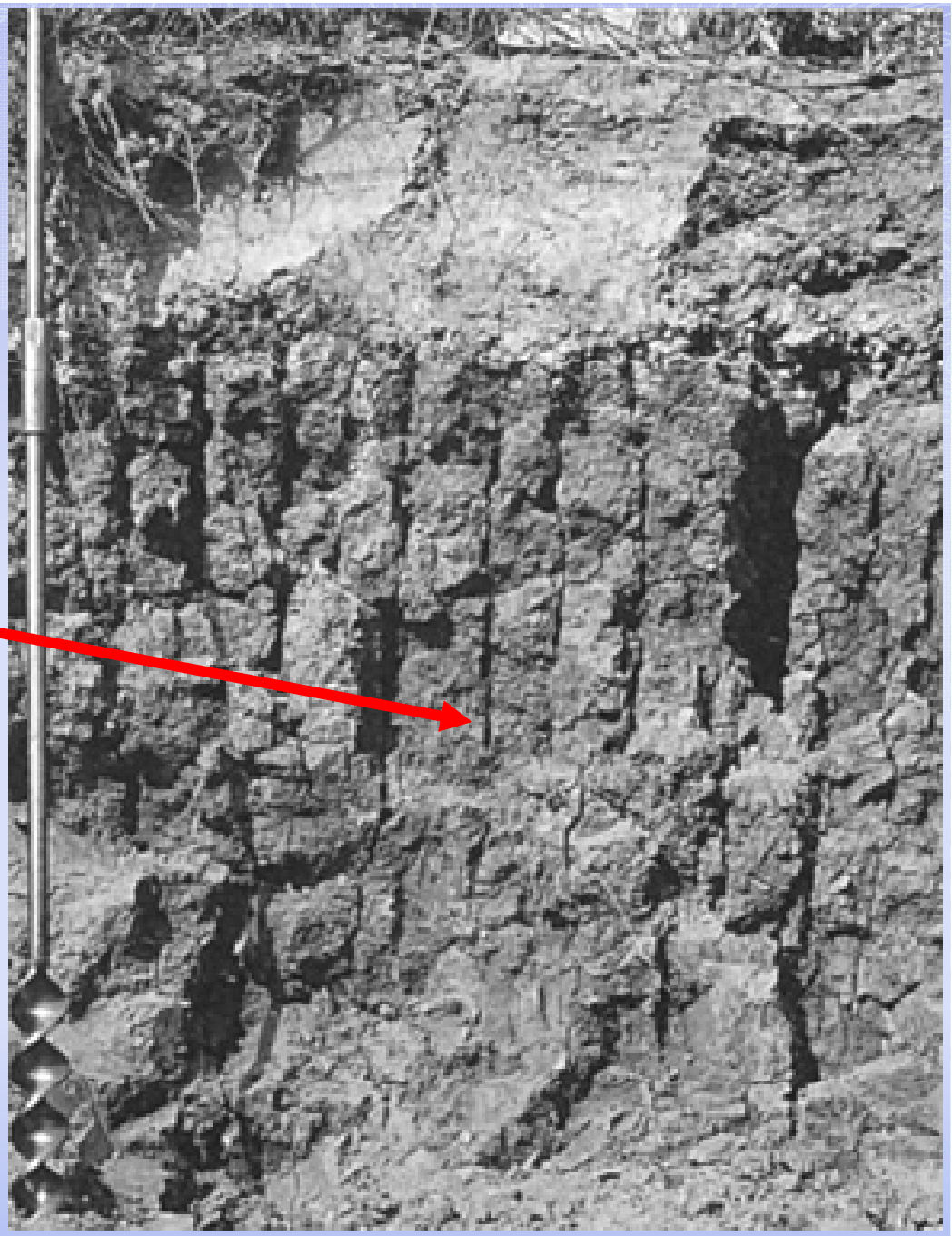


http://www.dpi.vic.gov.au/dpi/vro/glenimages.nsf/Images/gl167_profile/$File/gl167_profile.jpg

Prismatic Structure

- Vertical columns of soil that might be a number of cm long.
- Usually found in lower horizons.

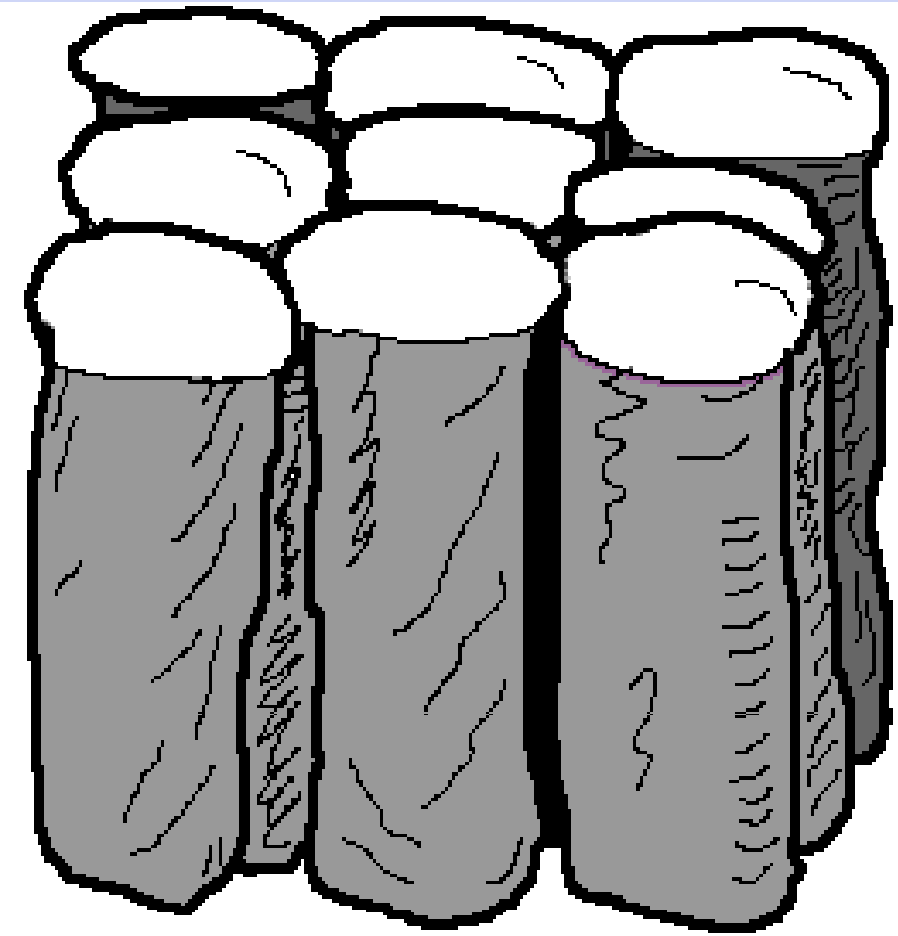
http://soil.gsfc.nasa.gov/pvg/prismatic.gif



http://soils.usda.gov/technical/manual/images/fig3-27_large.jpg

Columnar Structure

- Vertical columns of soil that have a salt "cap" at the top.
- Found in soils of arid climates.

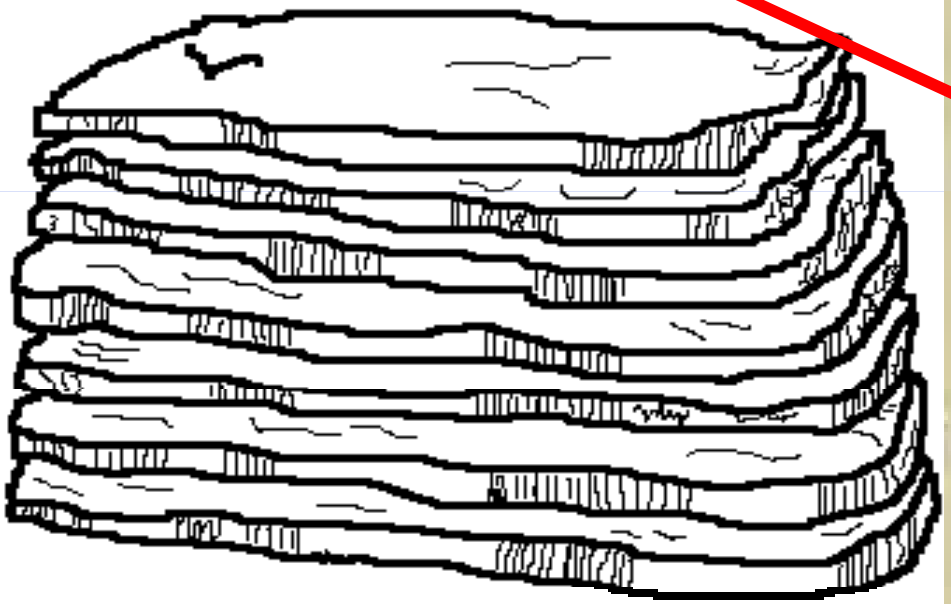


http://soil.gsfc.nasa.gov/pvg/columnar.gif

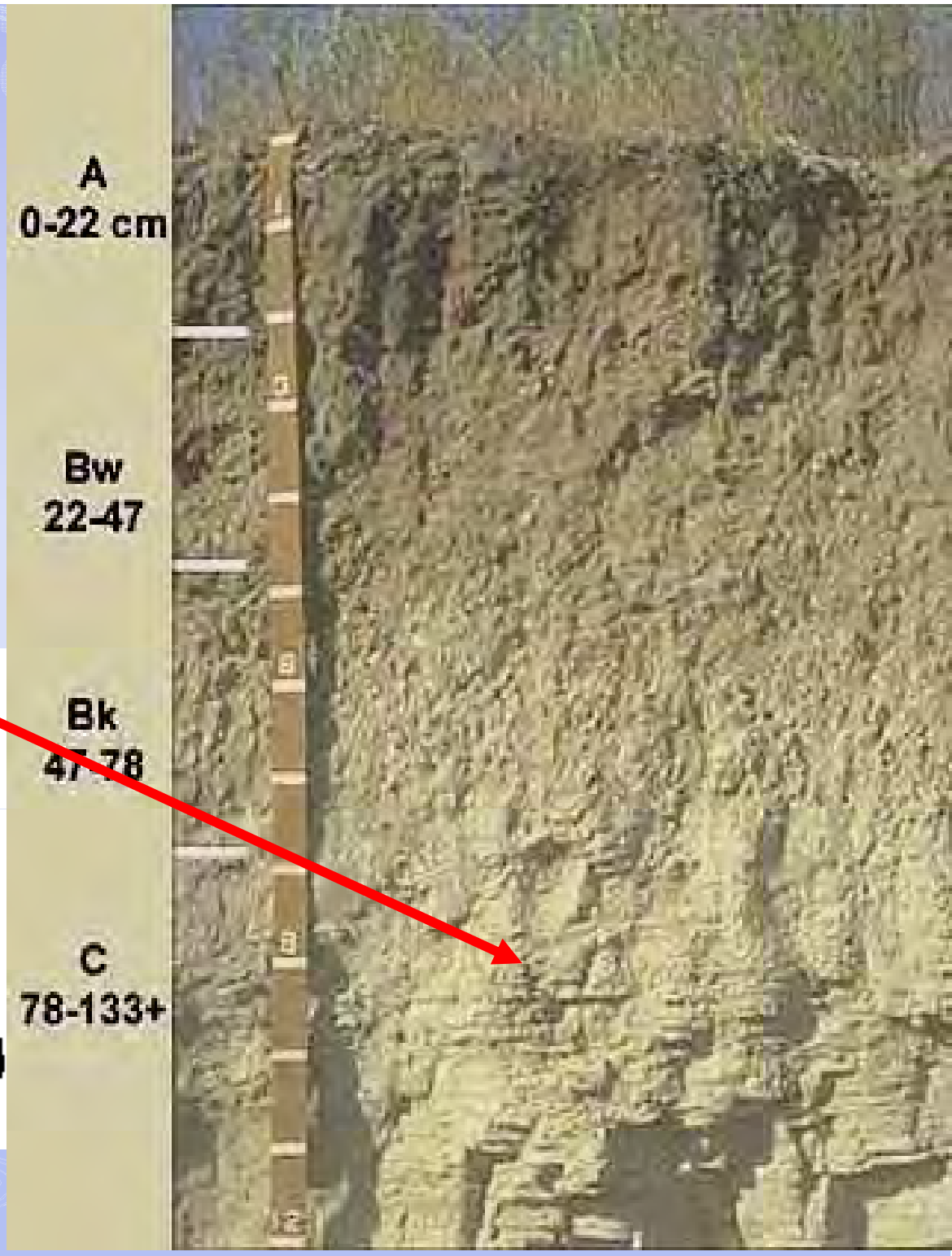
http://soils.usda.gov/technical/manual/images/fig3-28_large.jpg

Platy Structure

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



http://soil.gsfc.nasa.gov/pvg/platy.gif



http://soils.ag.uidaho.edu/soilorders/i/Arid_03.jpg

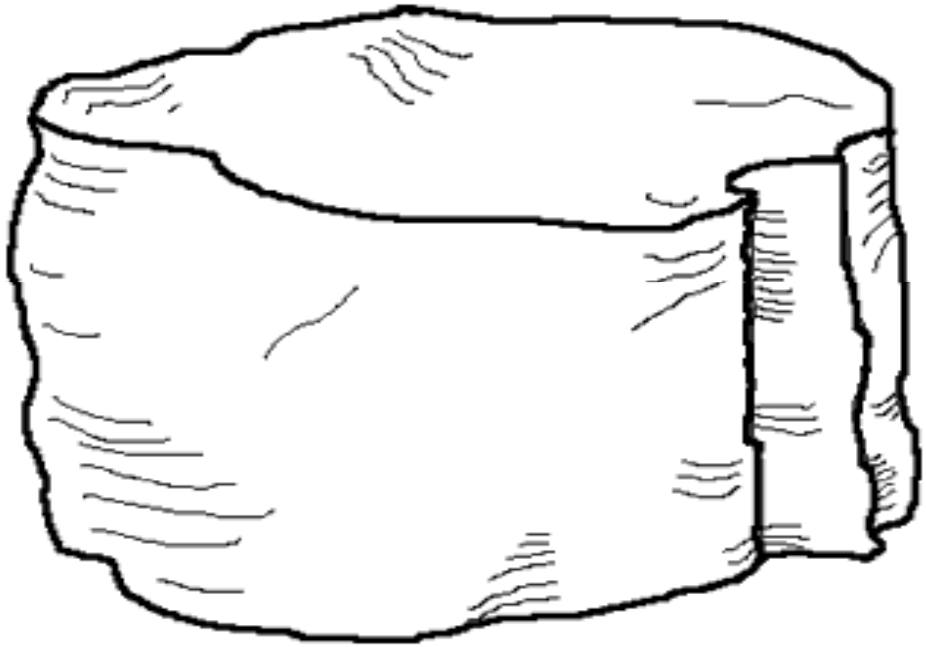
Single-grained Structure

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

http://soil.gsfc.nasa.gov/pvg/singlegrained.gif

Massive Structure

- Soil has no visible structure, is hard to break apart and appears in very large clods.



http://soil.gsfc.nasa.gov/pvg/massive.gif

http://soils.usda.gov/technical/manual/images/fig3-31_large.jpg

Soil Structure -Grade

- The terms weak, moderate, or strong are used to describe the grade or how stable the peds are and how hard they are to break apart.

- What do you think the grade would be for this picture?

http://soils.usda.gov/technical/manual/images/fig3-27_large.jpg

Description of Structure

Three class of grade (Excluding Structureless (0)):

1) Weak (1)– the units are barely observable in place and when gently disturbed, the soil parts into a mixture of whole and broken units.

2) Moderate (2) – The units are well formed and evident in undisturbed soil. When disturbed, the soil material parts into a mixture of whole with some broken units.

3) Strong (3) – The units are distinct in undisturbed soil. They separate cleanly when the soil is disturbed and when removed the soil separates into whole units.

Soil Texture Particle Size

Barrel

Sand
(feels gritty)
(2.00 - 0.05 mm, USDA)

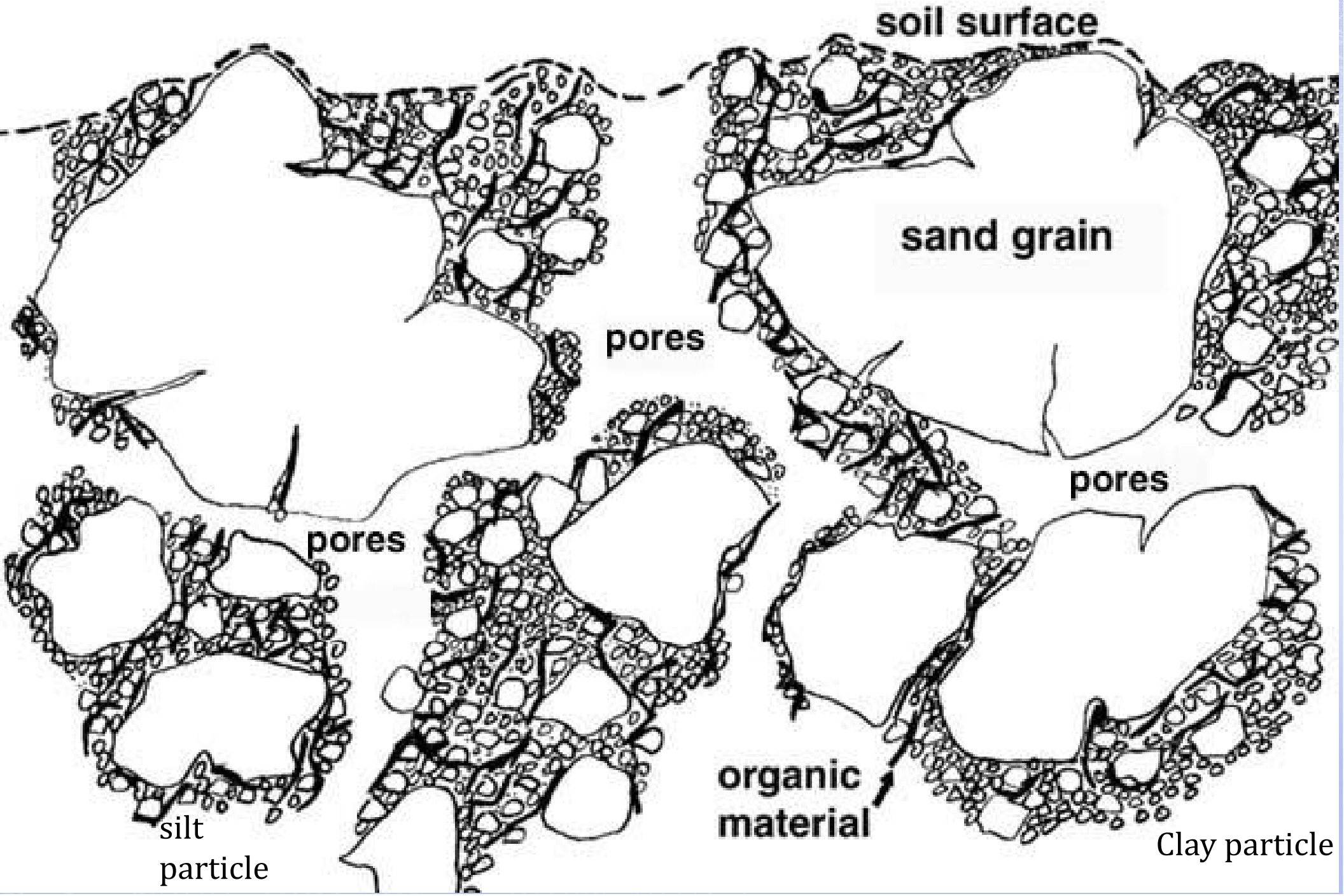
Plate

Silt
(feels floury)
(0.05 - 0.002 mm, USDA)

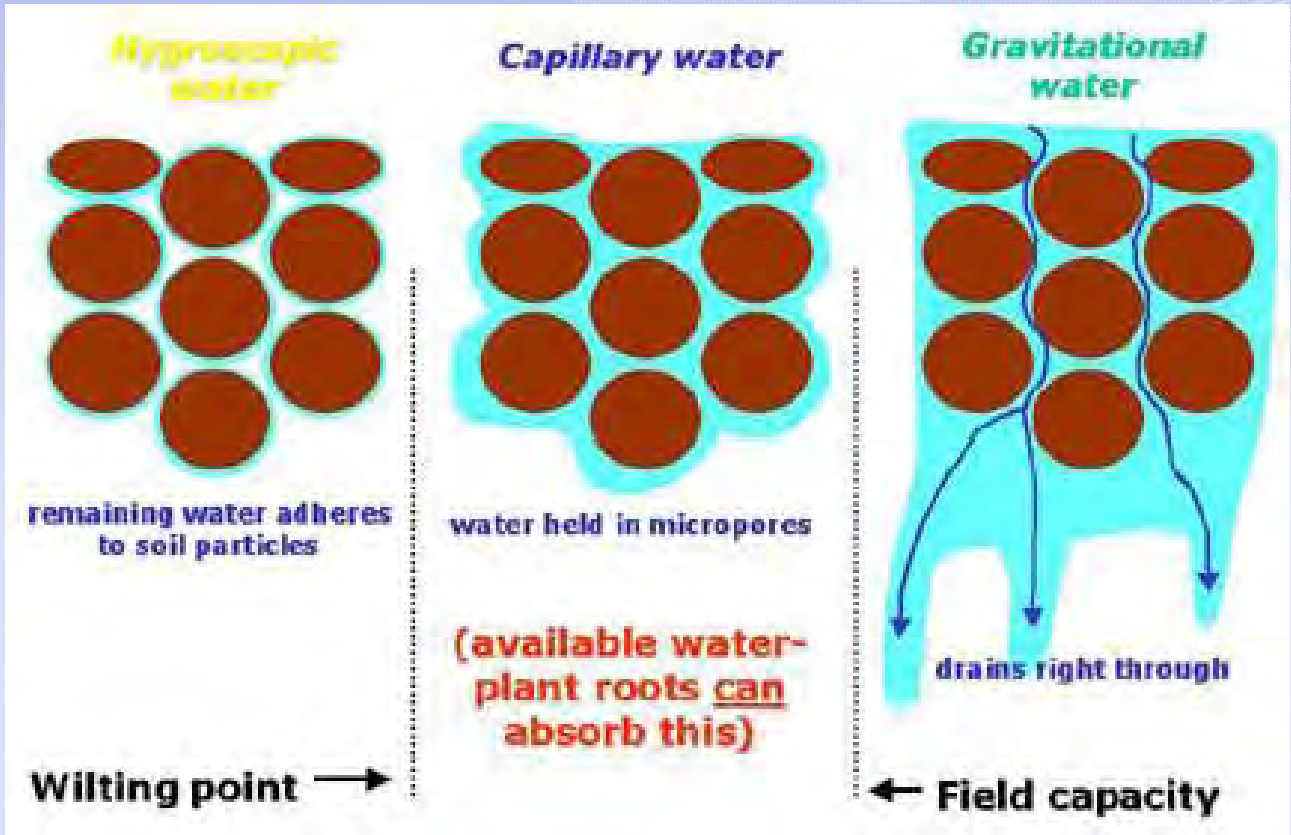
Coin

Clay
(feels sticky)
(< 0.002 mm, USDA) (<

What makes up structure



What does structure do?



Soil water controls movement of nutrients, dissolved organic matter

- Without it many soil organisms can't move around
- Much of it is adsorbed onto soil particles/aggregates
- Soil water holding capacity (WHC) determined by OM and clay content, as well as sand

ESTIMATING SOIL MOISTURE BY FEEL AND APPEARANCE

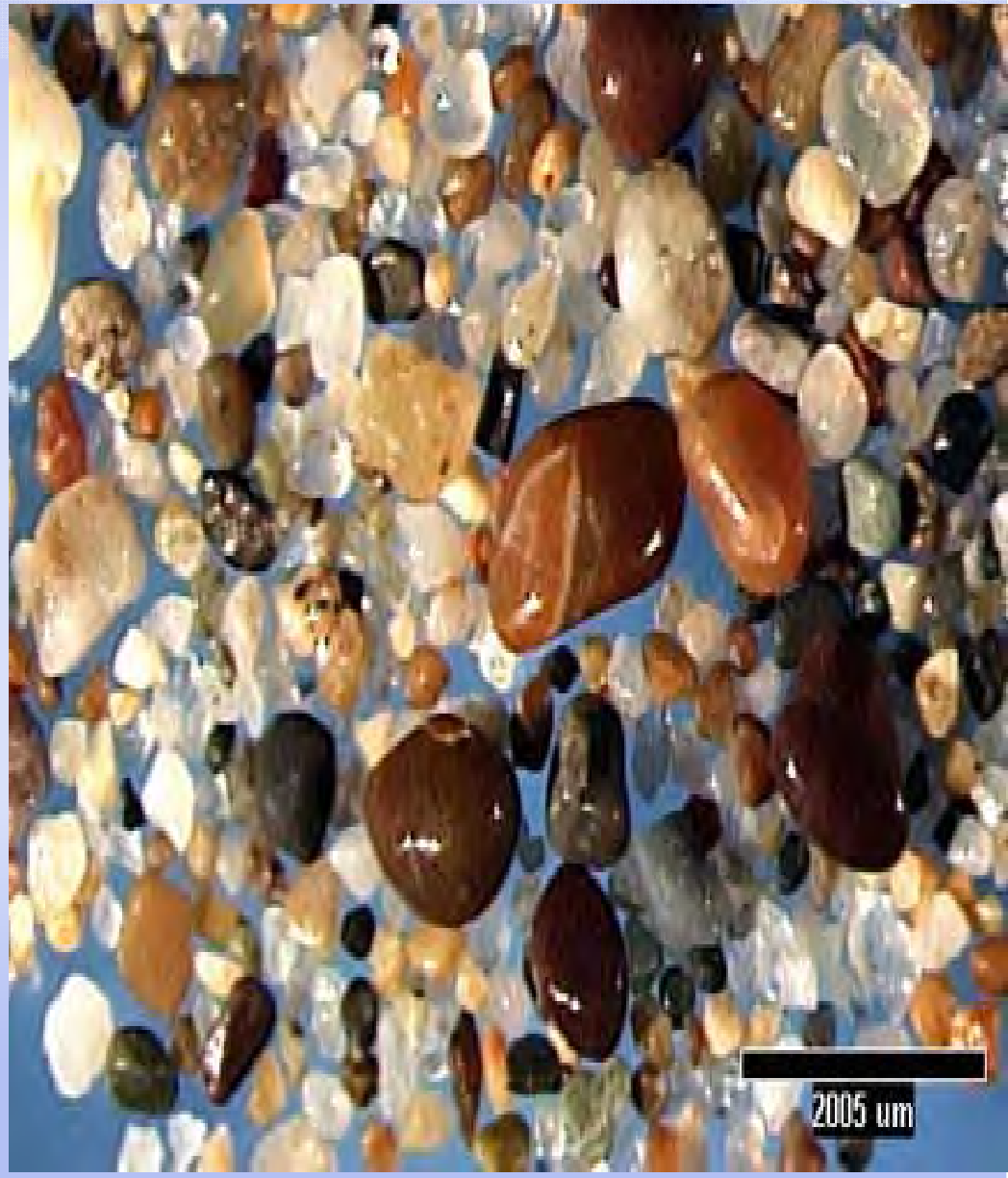
http://www.nm.nrcs.usda.gov/technical/tech-notes/agro/ag72.pdf

Particle Diameter Size

- Soil particle diameters range over 6 orders of magnitude
  - 2 m boulders
  - Coarse fragments > 2 mm
  - Sand < 2 mm to 0.05 mm
  - Silt < 0.05 mm to 0.002 mm
  - Clay < 0.002 m

Sand

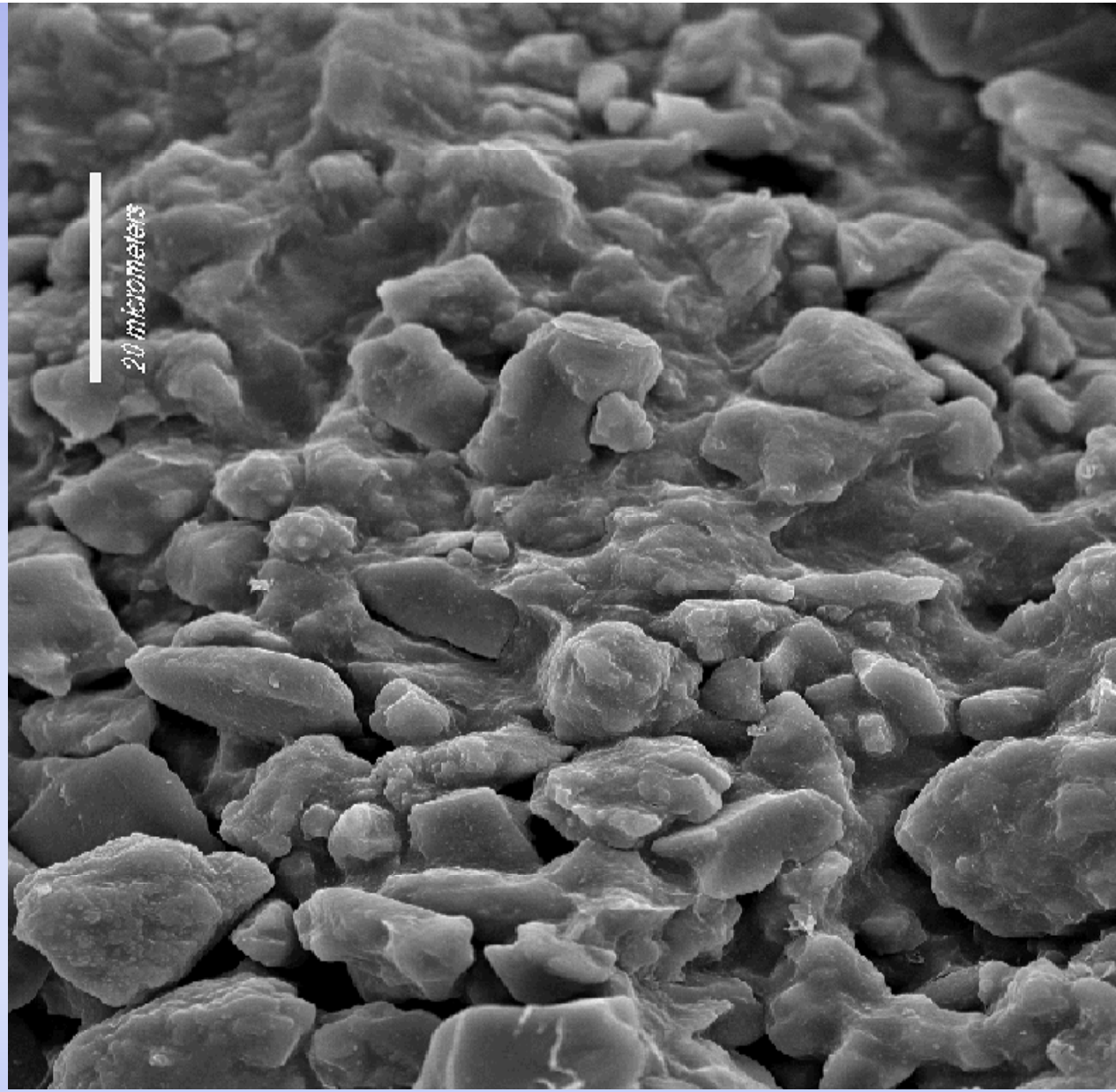
- < 2 mm to > 0.05 mm
- Visible without microscope
- Rounded or angular in shape
- Sand grains usually quartz if sand looks white or many minerals if sand looks brown,
- Some sands in soil will be brown, yellow, or red because of Fe and/or Al oxide coatings.



Silt

< 0.05 mm to > 0.002 mm

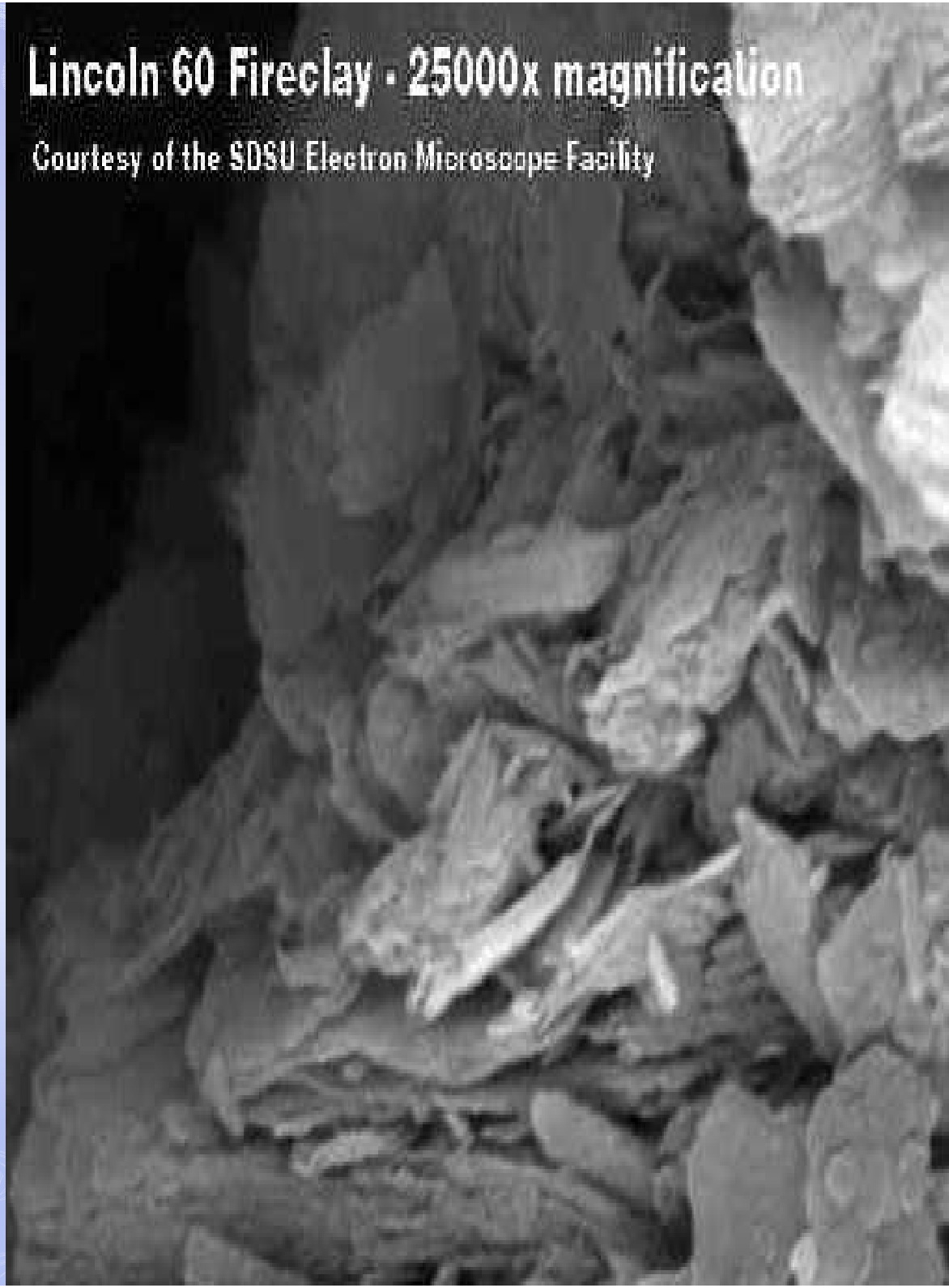
Not visible without microscope



Quartz often dominant mineral in silt since other minerals have weathered away.

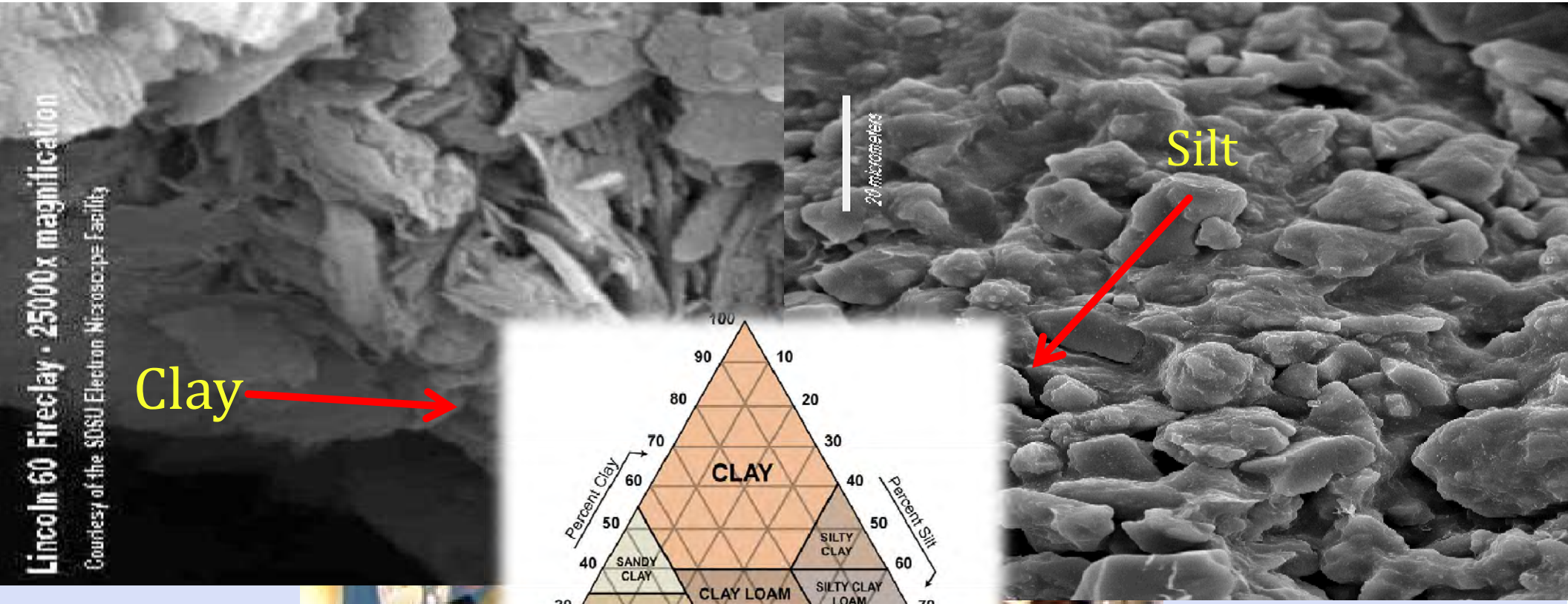
Clay

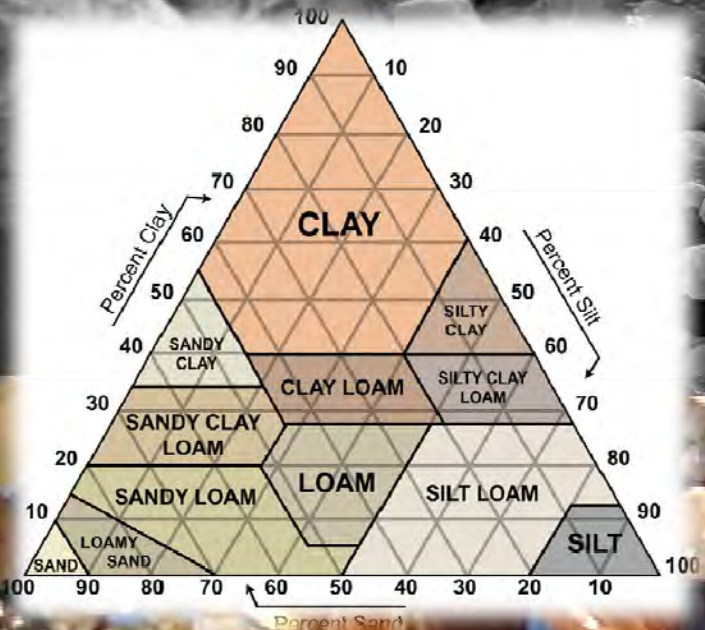
- < 0.002 mm
- Flat plates or tiny flakes
- Small clay particles are colloids
  - If suspended in water will not settle
- Large surface area
  - spoonful = football field

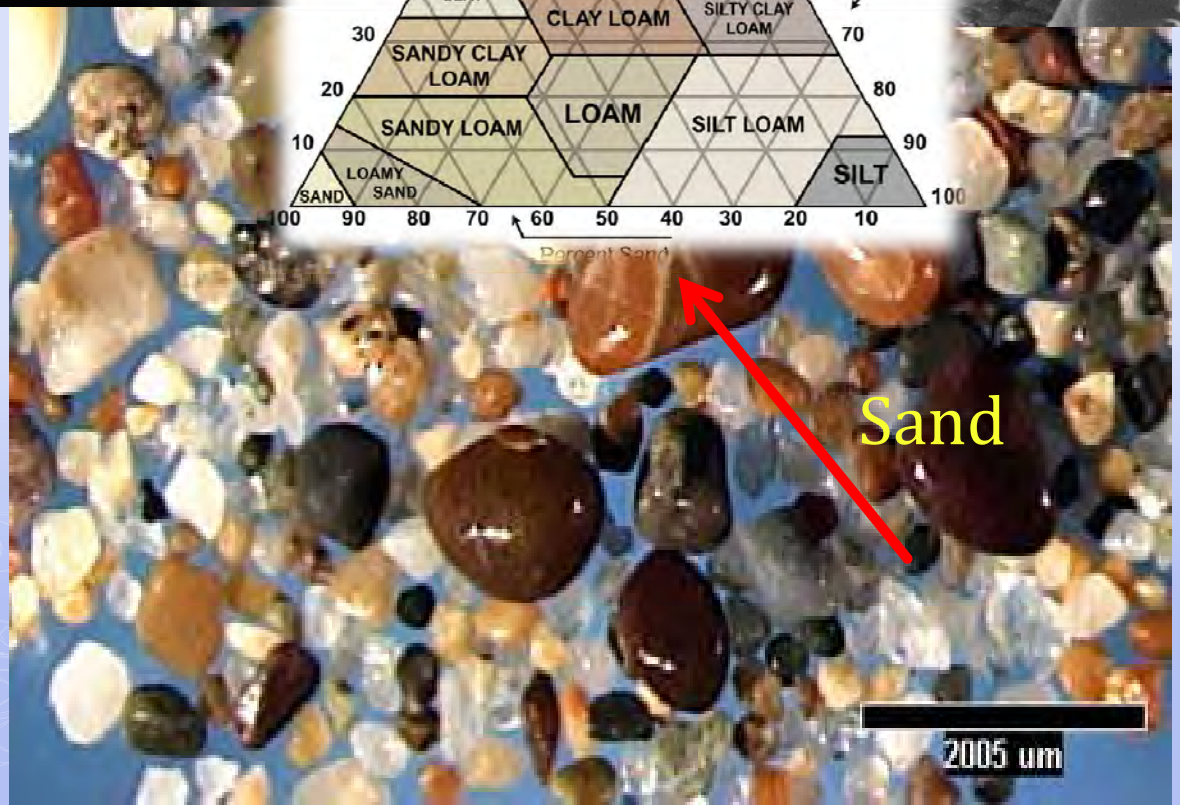


Determining Soil Texture - Feel Method

1) Wet soil in hand
2) Make ribbon
3) Length of ribbon indicates clay content also stickiness
4) Grit or lack of grit indicates sand
5) Smoothness or slickness indicates silt





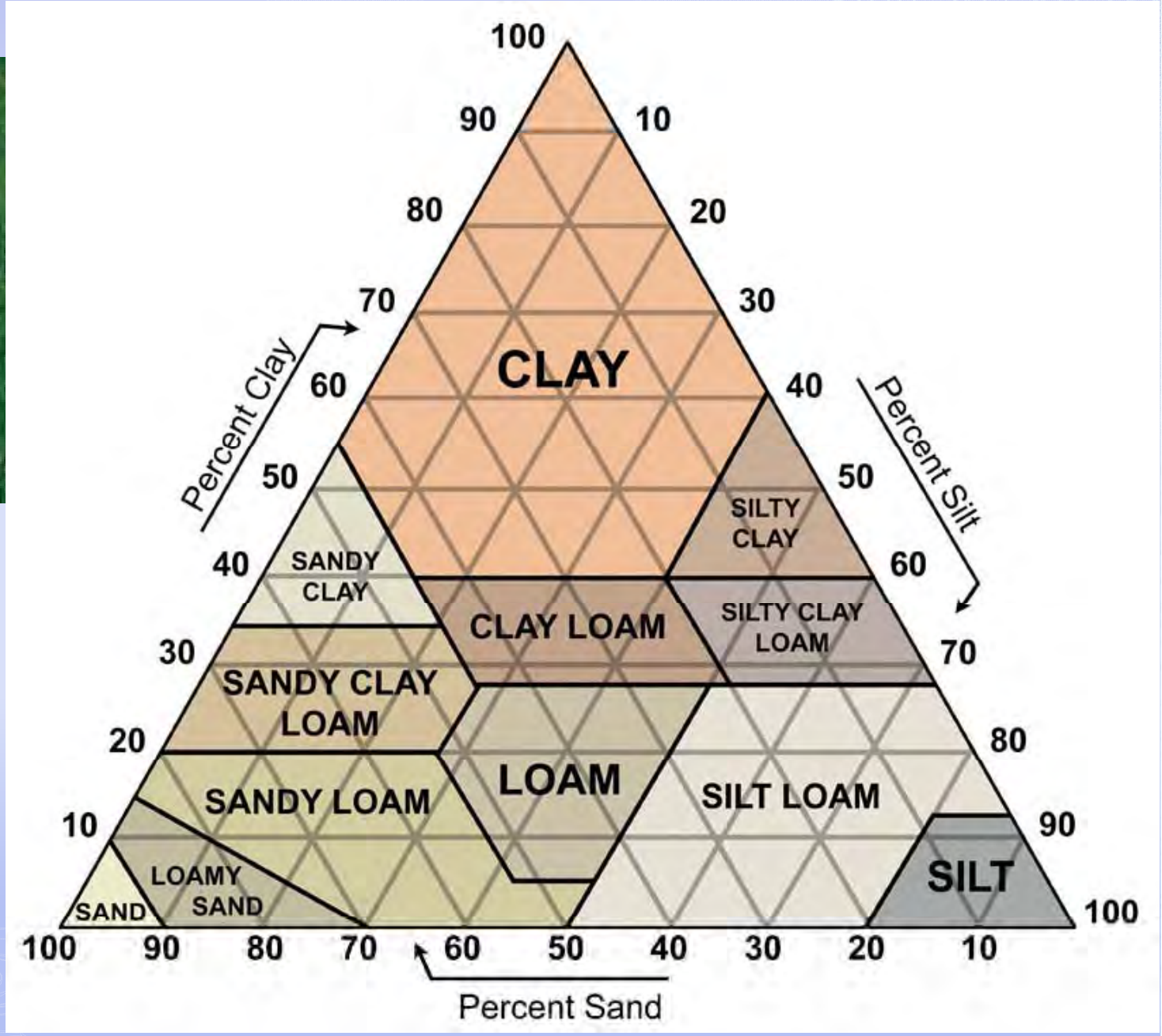


Know how to read your

Texture Triangle and 21 Soil Categories

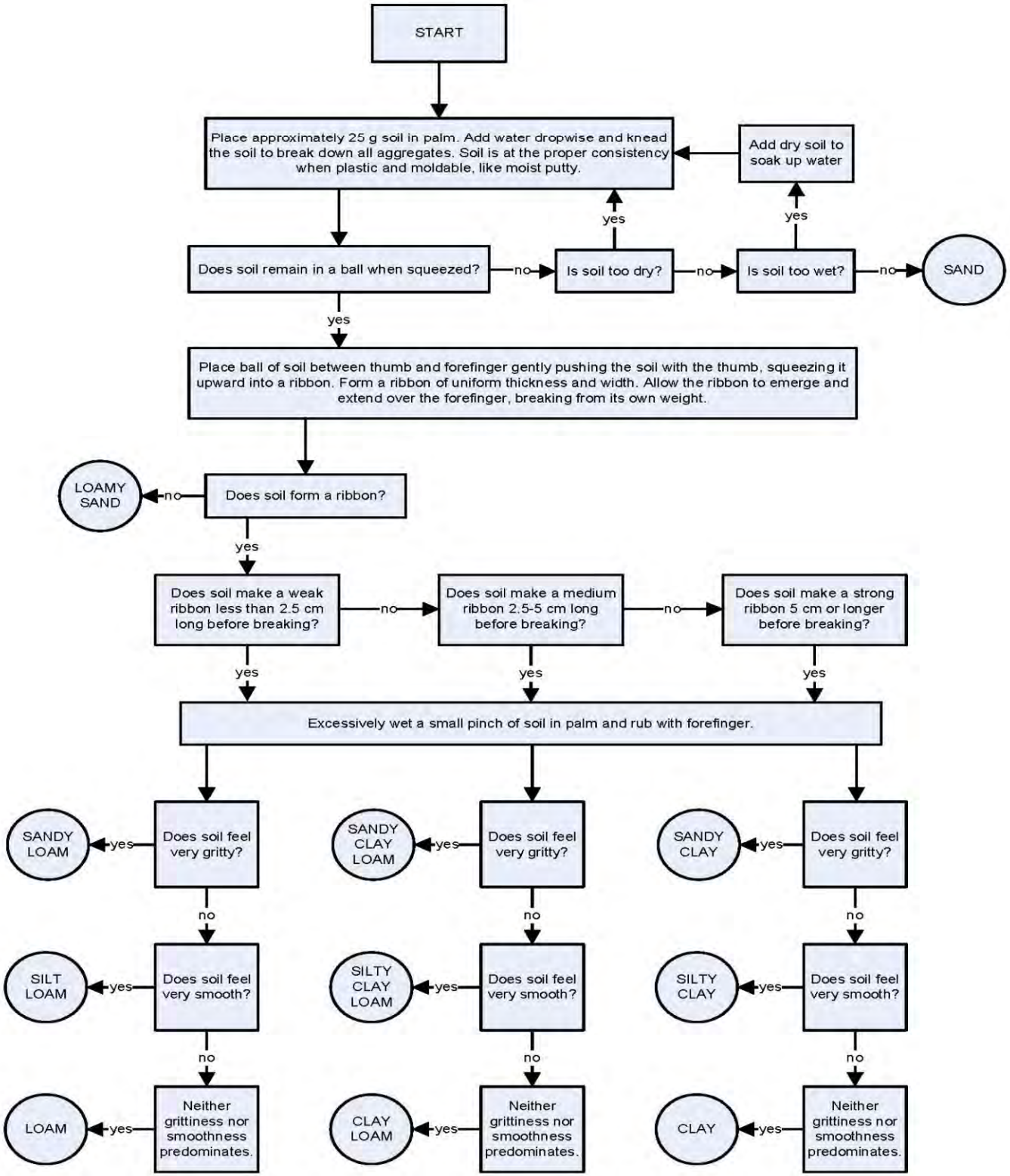
Determine Soil Texture

Texture by feel: The percent of – Sand, Silt and Clay

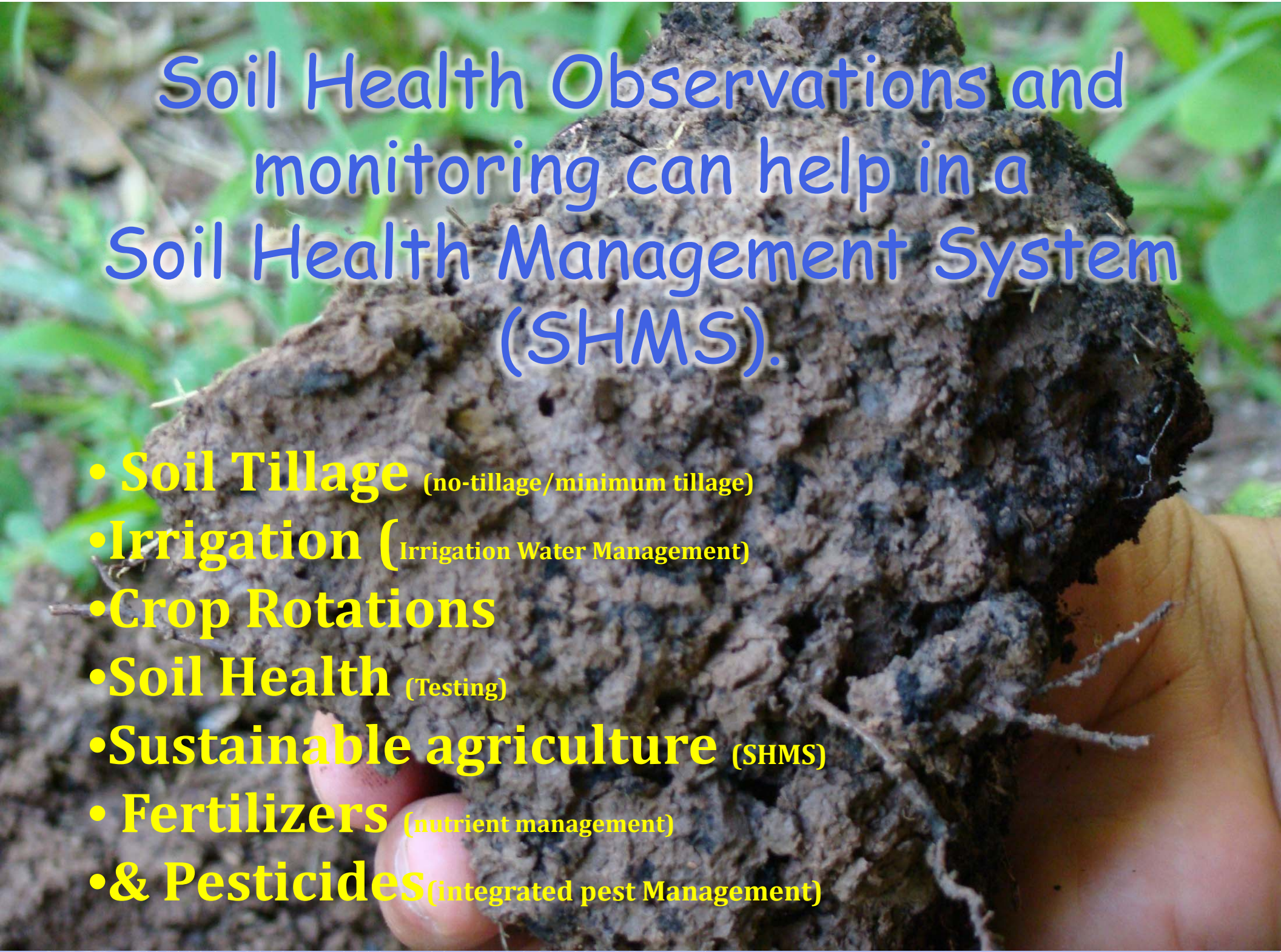


Guide to Texture by Feel

Modified from S.J. Thien. 1979. *A flow diagram for teaching texture by feel analysis.* Journal of Agronomic Education. 8:54-55.



Critical effects if soil behavior by management is not observed and recorded.
•Soil degradation
•Erosion
•Desertification
•Overgrazing
•Stalinization
•Weed encroachment
•Insects
•Compaction
•Salts
•Water Quality



Soil Health Observations and monitoring can help in a Soil Health Management System (SHMS).

- **Soil Tillage** (no-tillage/minimum tillage)
- **Irrigation (**Irrigation Water Management)
- **Crop Rotations**
- **Soil Health** (Testing)
- **Sustainable agriculture** (SHMS)
- **Fertilizers** (nutrient management)
- **& Pesticides**(integrated pest Management)

For more information Please Contact Your Local Office of the:

Natural Resources Conservation Service

or

Soil and Water Conservation District

Non-Discrimination Statement

- "The U.S. Department of Agriculture (USDA) prohibits discrimination in all of its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD)."

USDA NRCS

United States Department of Agriculture
Natural Resources Conservation Service