Up By Roots

Healthy Soils and Trees in the Built Environment

Basic Soil

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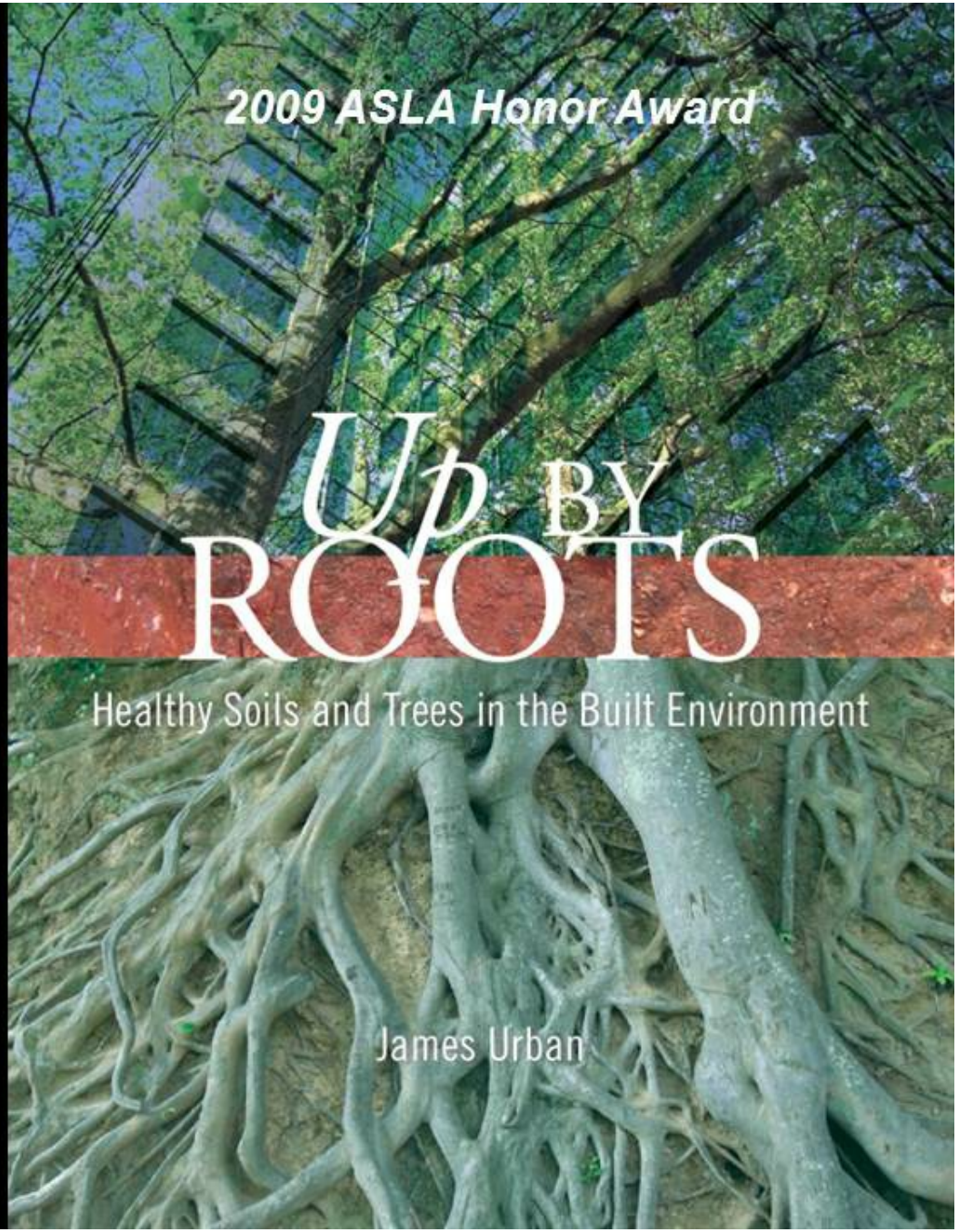
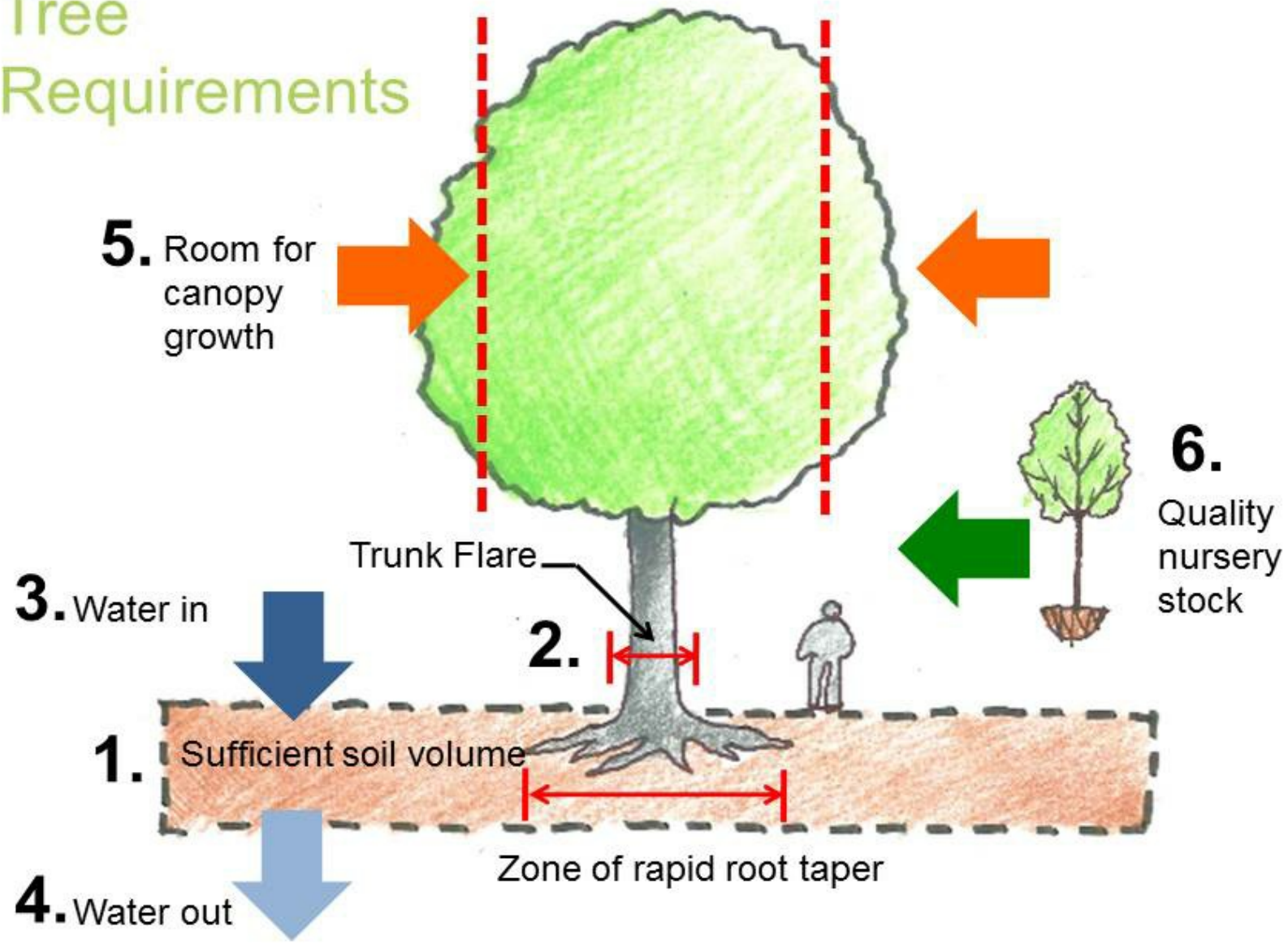
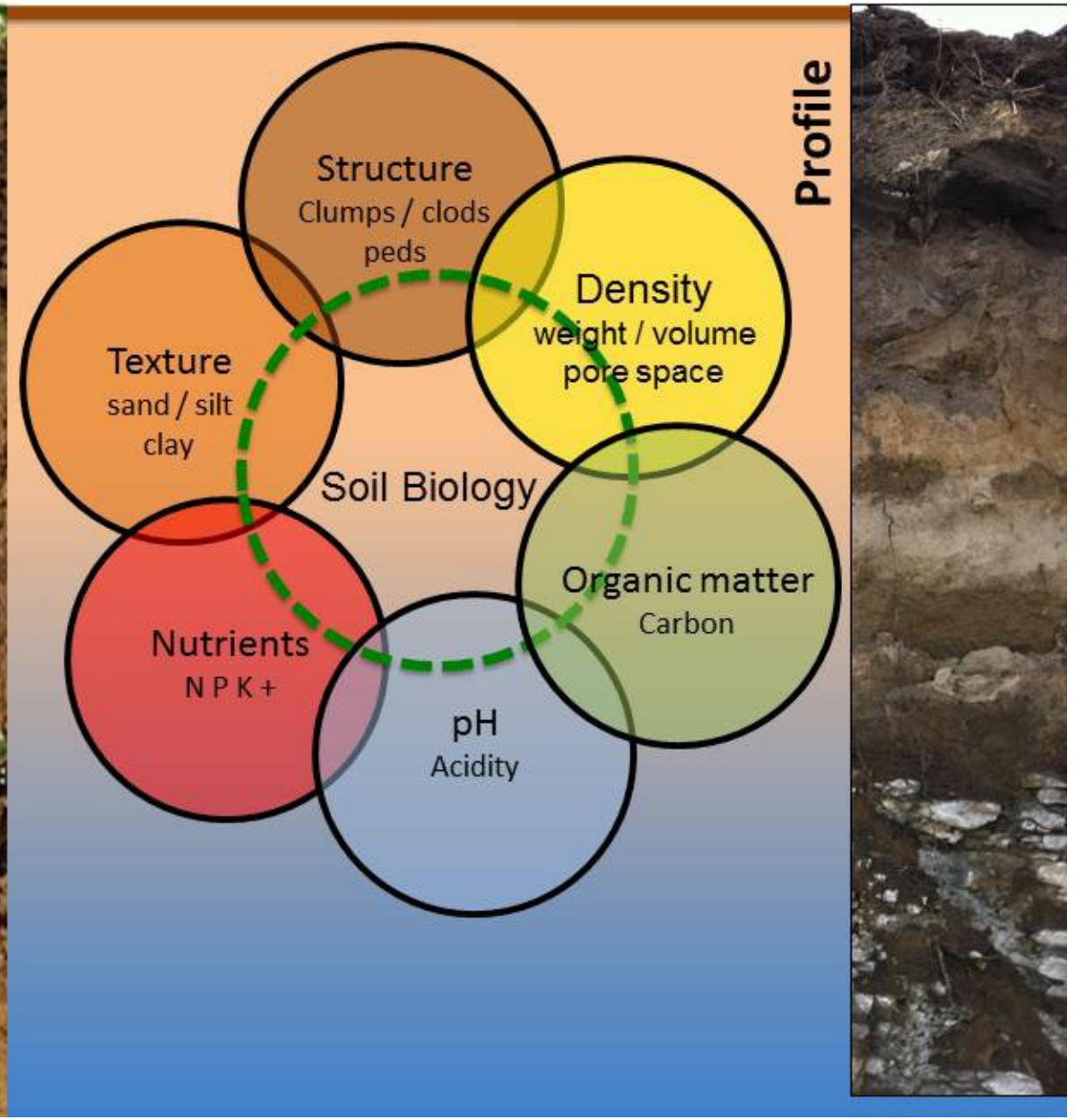
Urbantree@toad.net



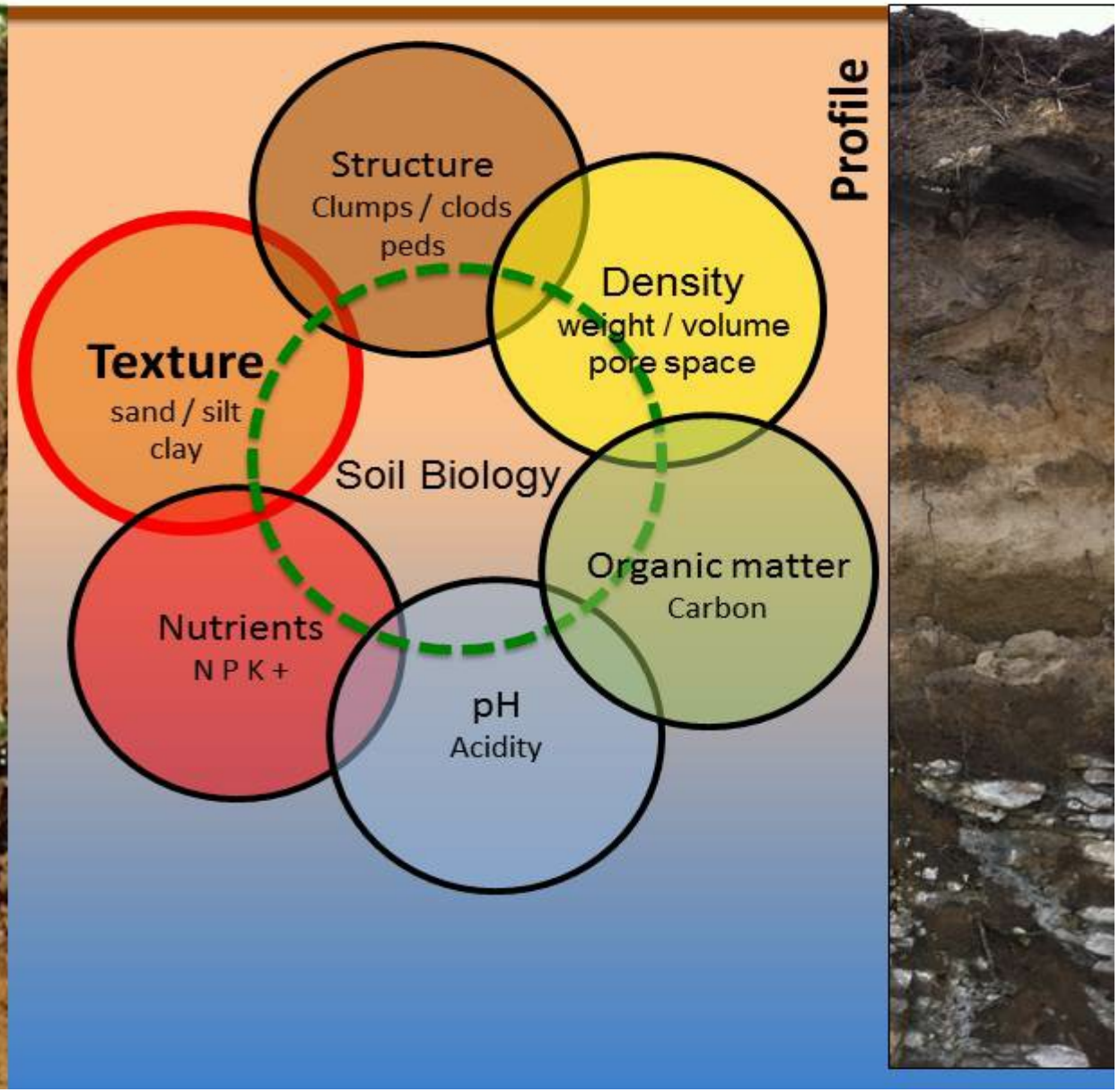
Tree Requirements

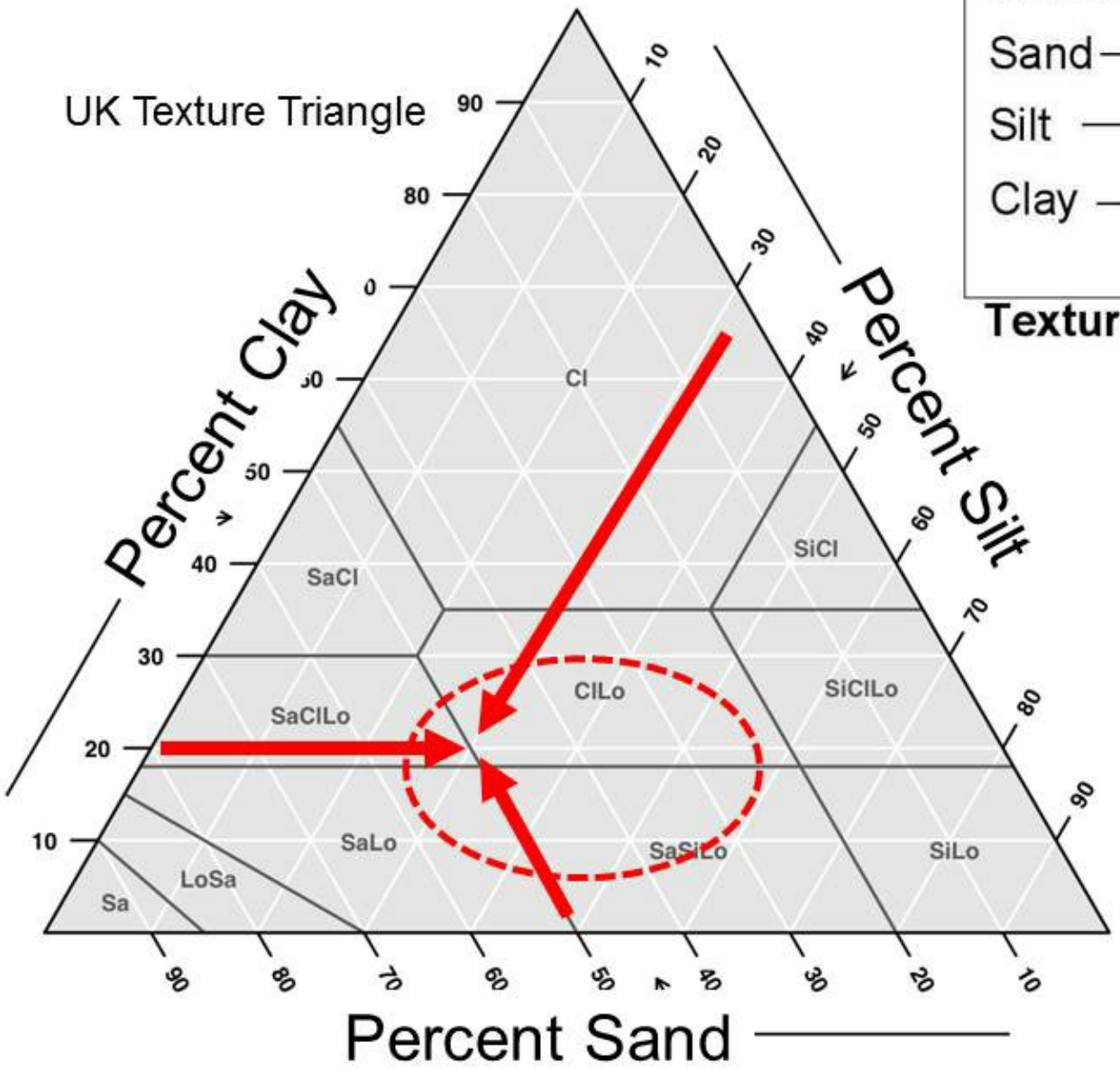


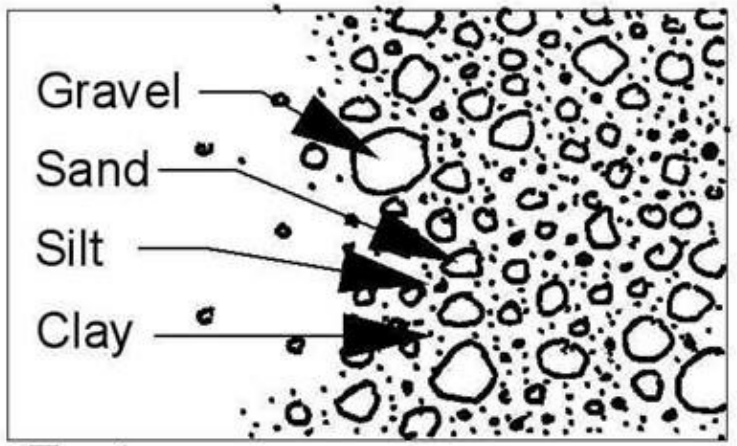
Critical Aspects of Soil



Critical Aspects of Soil



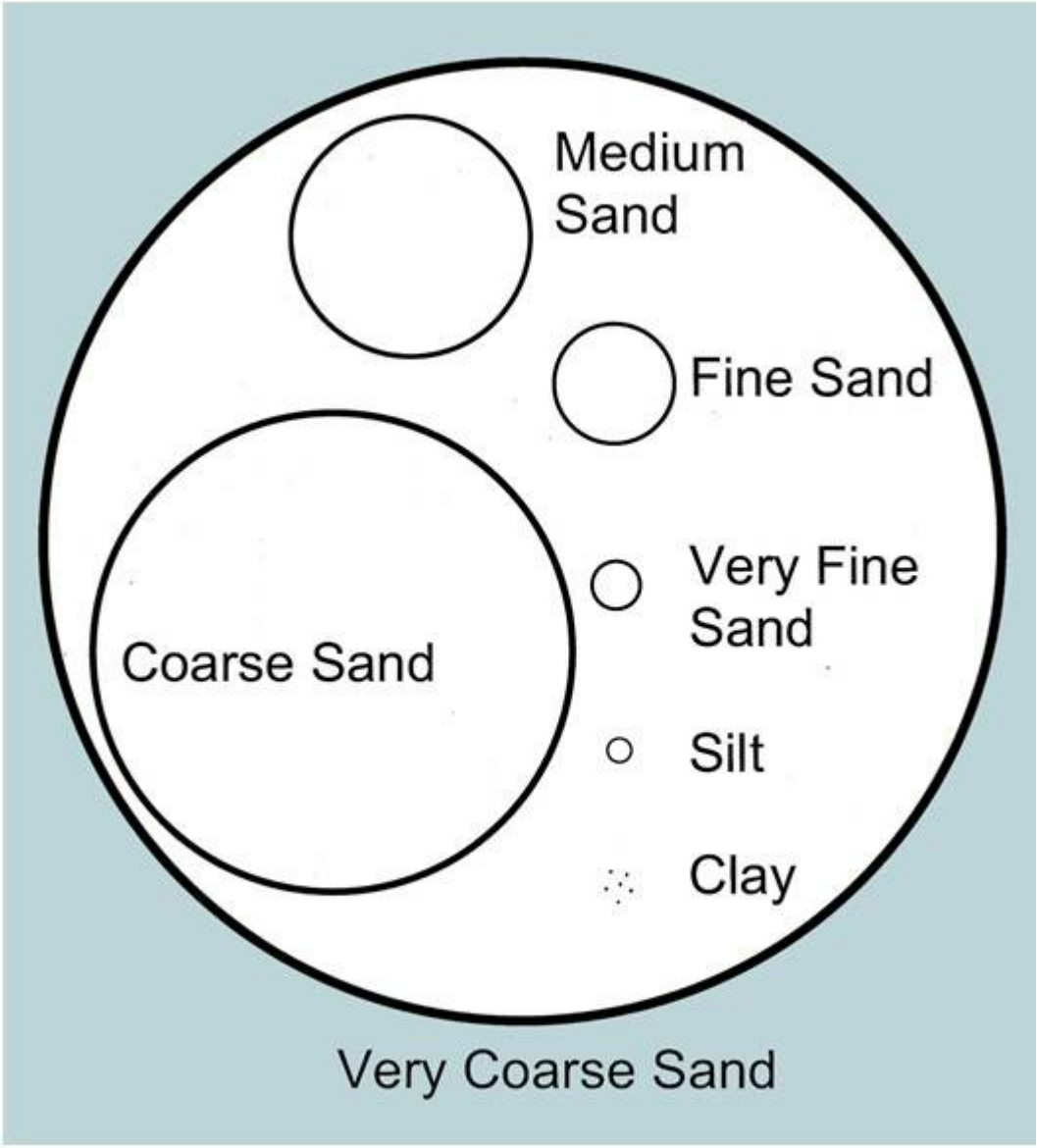




Texture

Texture
sand / silt
clay

Soil Material	Size (mm)
Clay	<0.002
Silt	0.002 - 0.05
Silt, fine	0.002 - 0.02
Silt, coarse	0.02 - 0.05
Sand	0.05 - 2.00
Very fine sand	0.05 - 0.10
Fine sand	0.10 - 0.25
Medium sand	0.25 - 0.50
Coarse sand	0.50 - 1.00
Very coarse sand	1.00 - 2.00
Gravel	2.0 - 75.0
Cobbles	75.0 - 250.0
Stones	250 - 600
Boulders	> 600



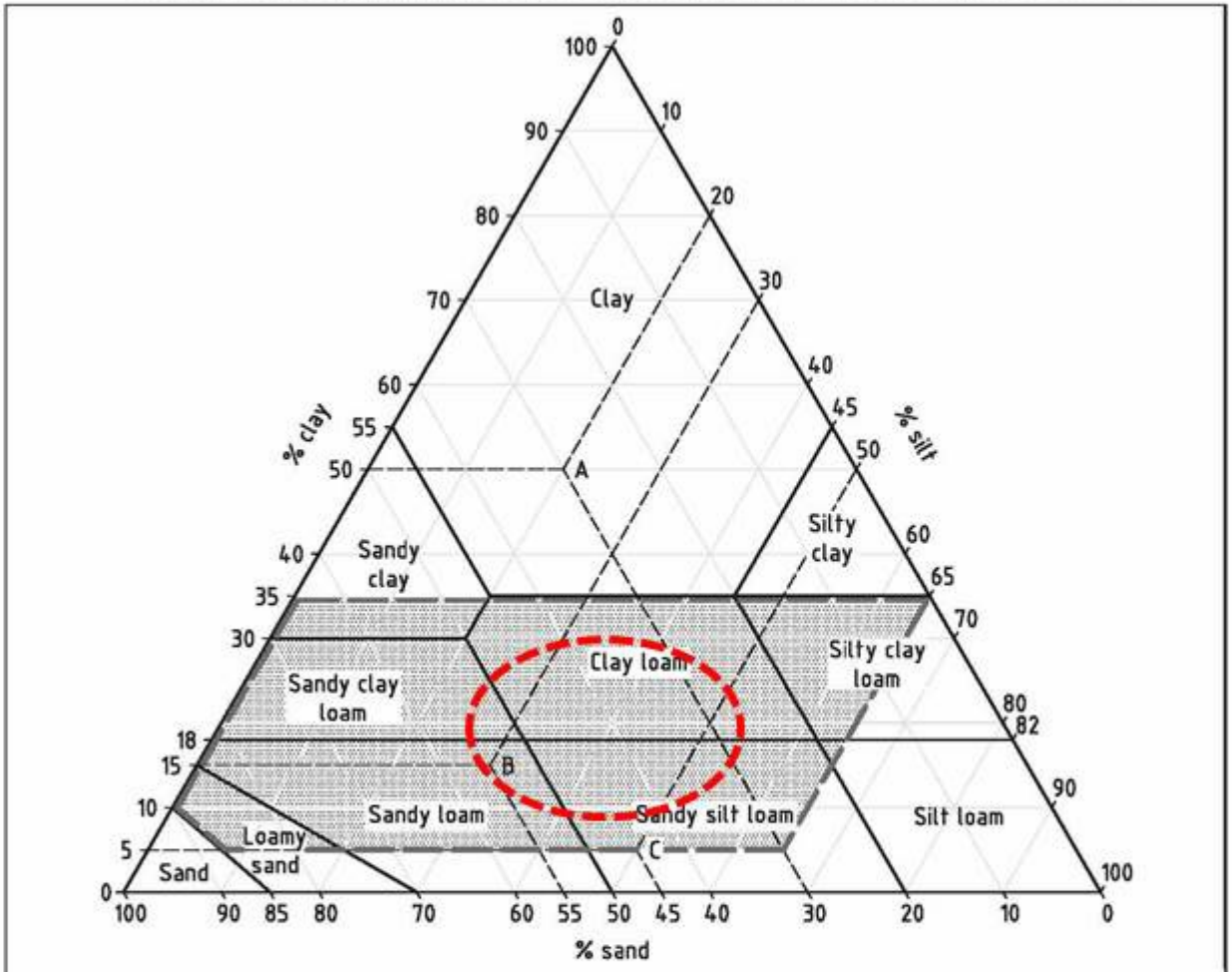
BS 3882:2015

BSI Standards Publication

Specification for topsoil

British Standards

Figure 1 **Textural classification (limiting percentages of sand, silt and clay sized particles for the mineral texture class) and the area of textures that are acceptable within BS 3882:2015**

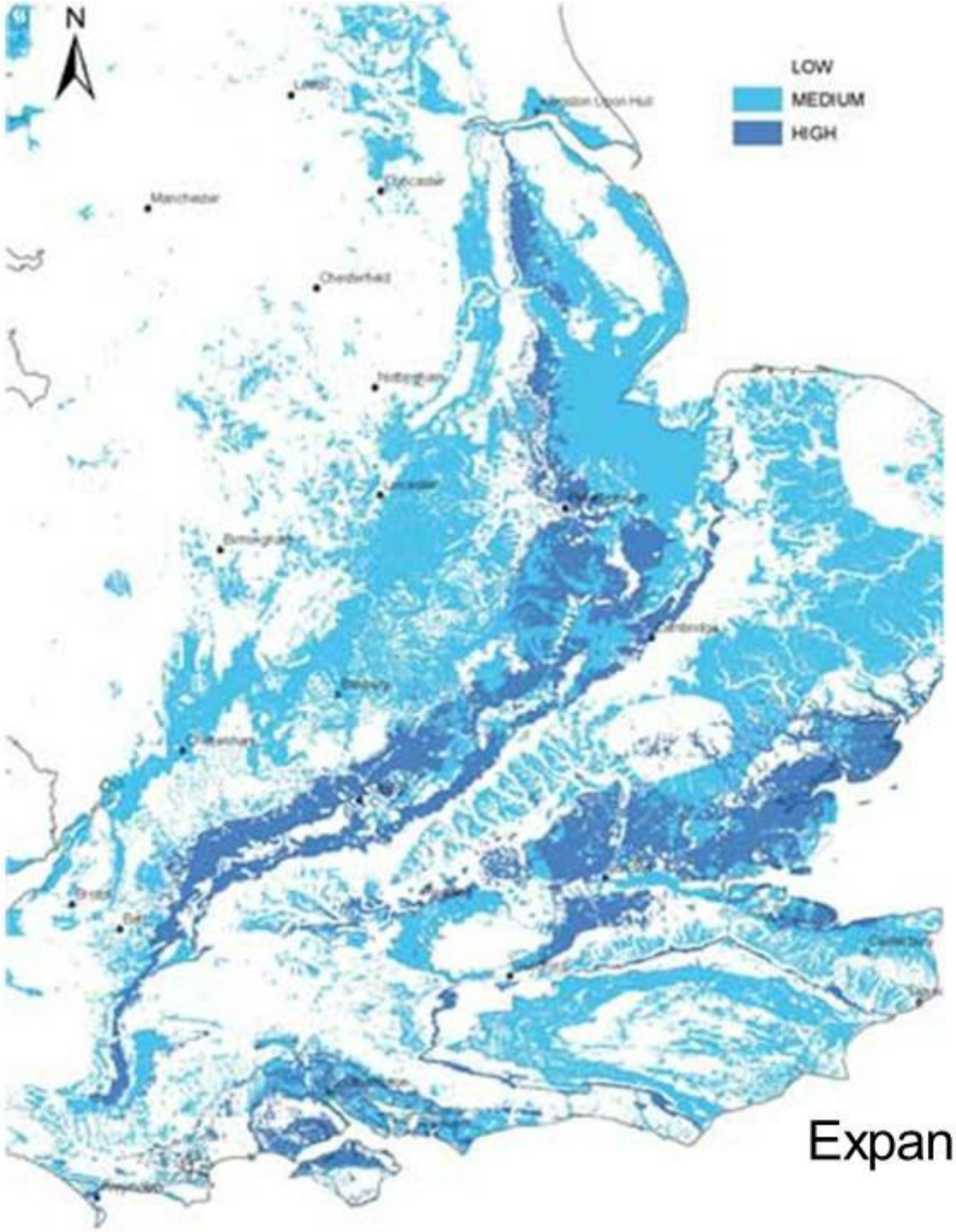


Key

Area within which the texture of topsoil is required to fall

NOTE Examples of textural classification are as follows.

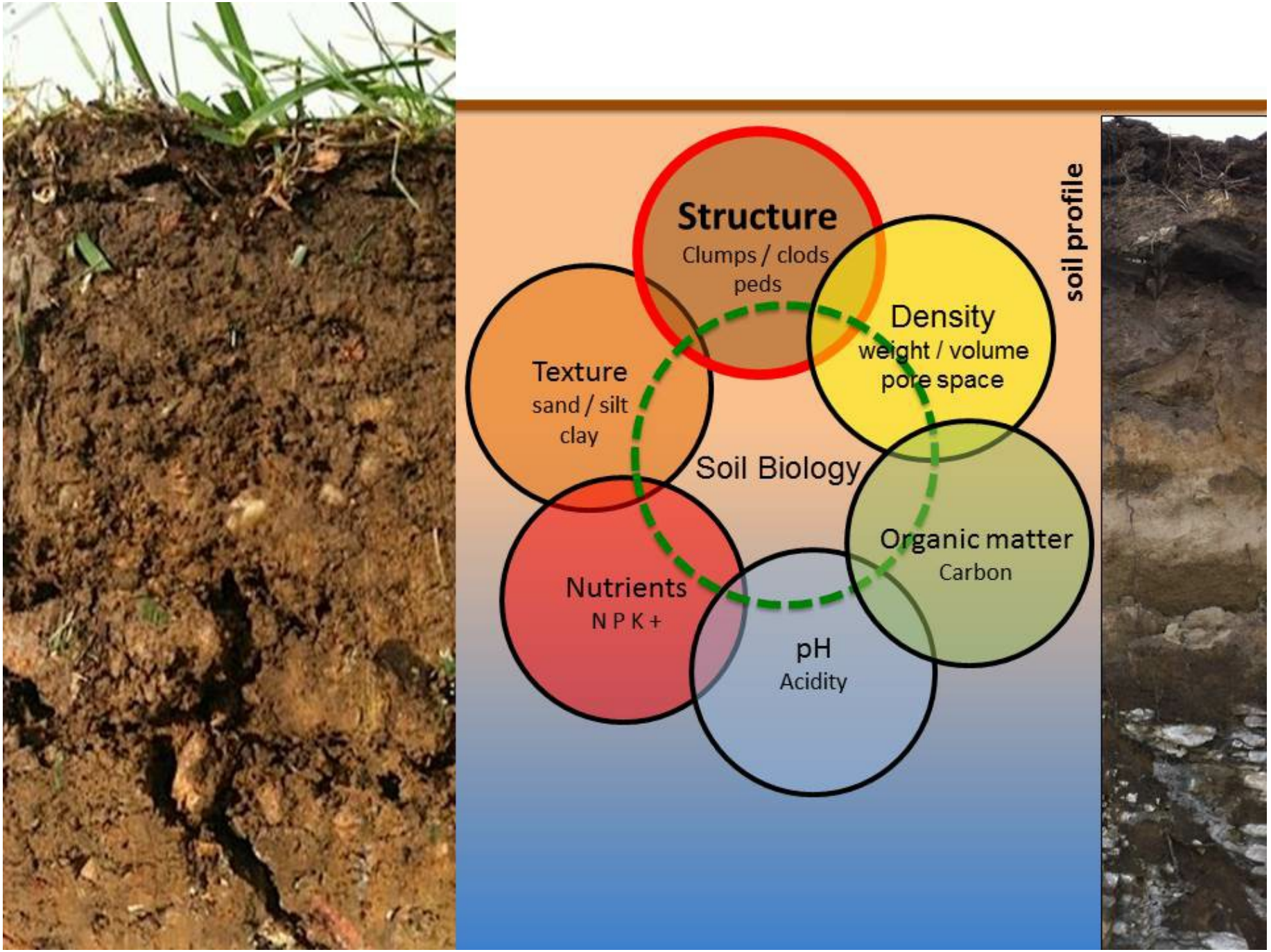
- *Soil A with 30% sand, 20% silt and 50% clay is in the "clay" textural class.*
- *Soil B with 55% sand, 30% silt and 15% clay is in the "sandy loam" textural class.*
- *Soil C with 45% sand, 50% silt and 5% clay is in the "sandy silt loam" textural class.*



Expansive Clay Soil

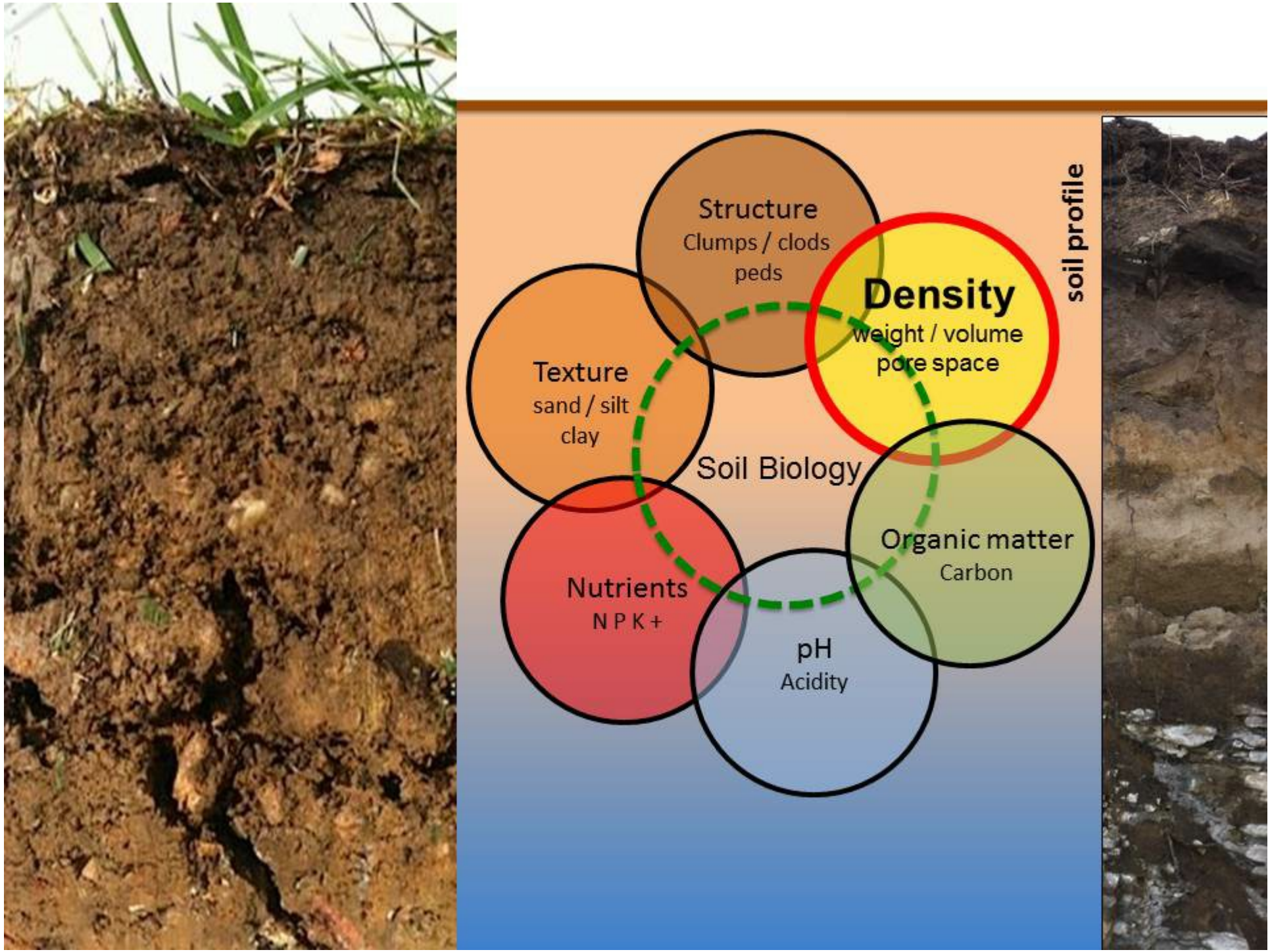
Sandy Loam Topsoil


Sandy Clay Loam Topsoil


Structure
Clumps / clods
peds
Density
weight / volume
pore space
Texture
sand / silt
clay
Soil Biology
Organic matter
Carbon
Nutrients
N P K +
pH
Acidity
soil profile

Structure
Clumps / clods
peds


Soil strength determines how much soil stricture will be damaged when graded


Structure
Clumps / clods
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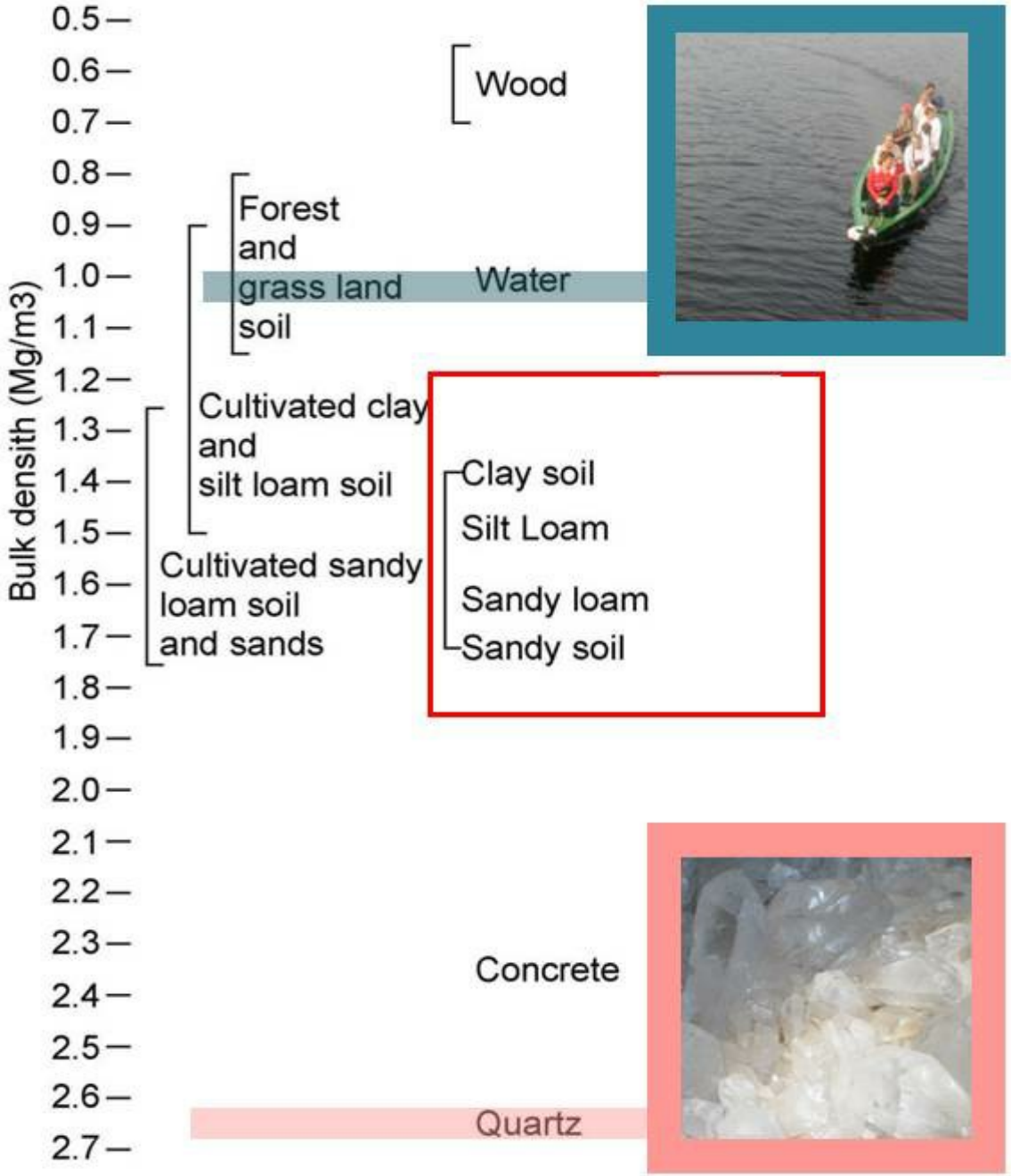
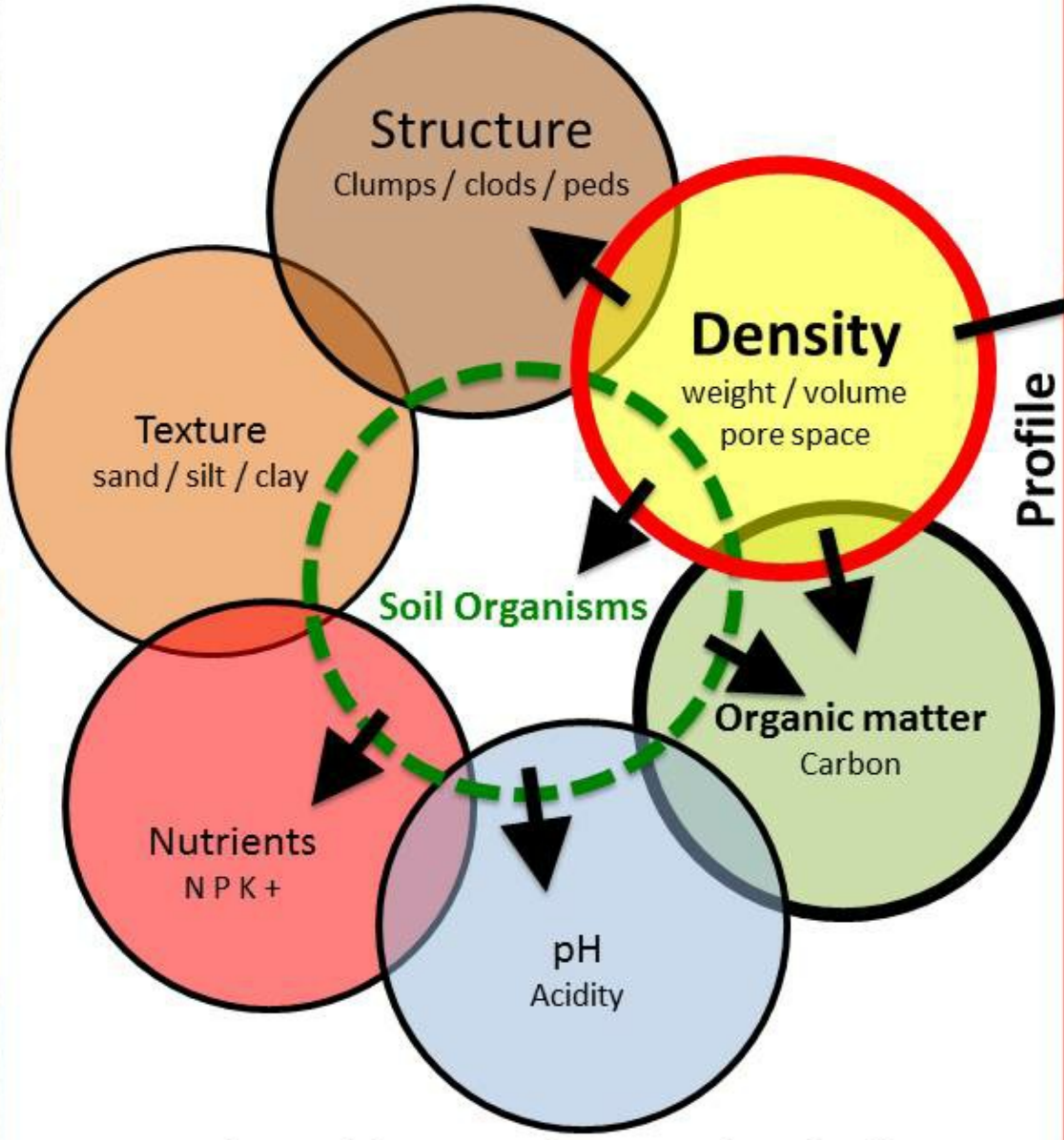
Texture
sand / silt
clay
Soil Biology
Organic matter
Carbon
Nutrients
N P K +
pH
Acidity
soil profile

Soil Density

Density
weight / volume
pore space

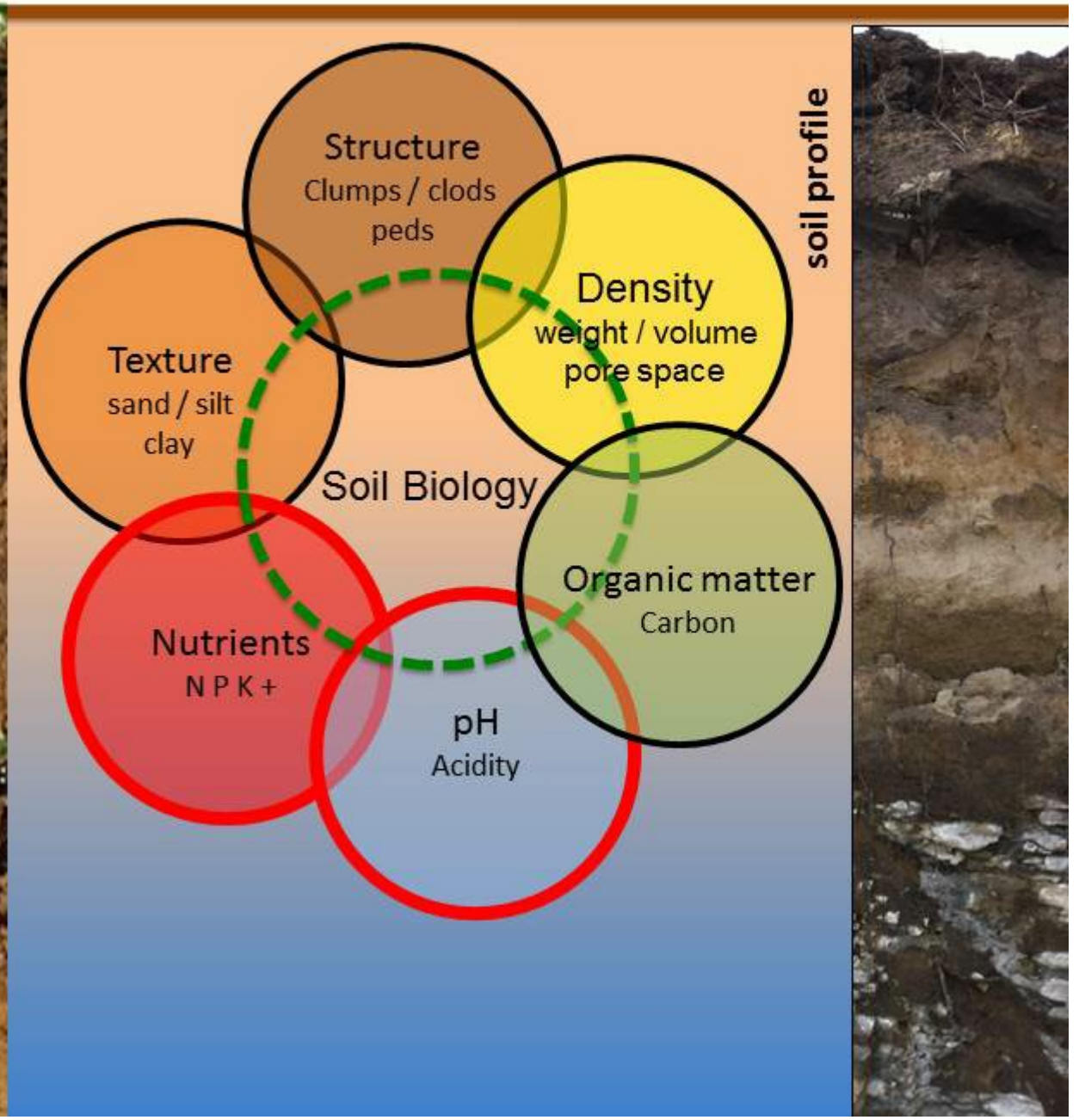
Bulk Density of
Different Soils



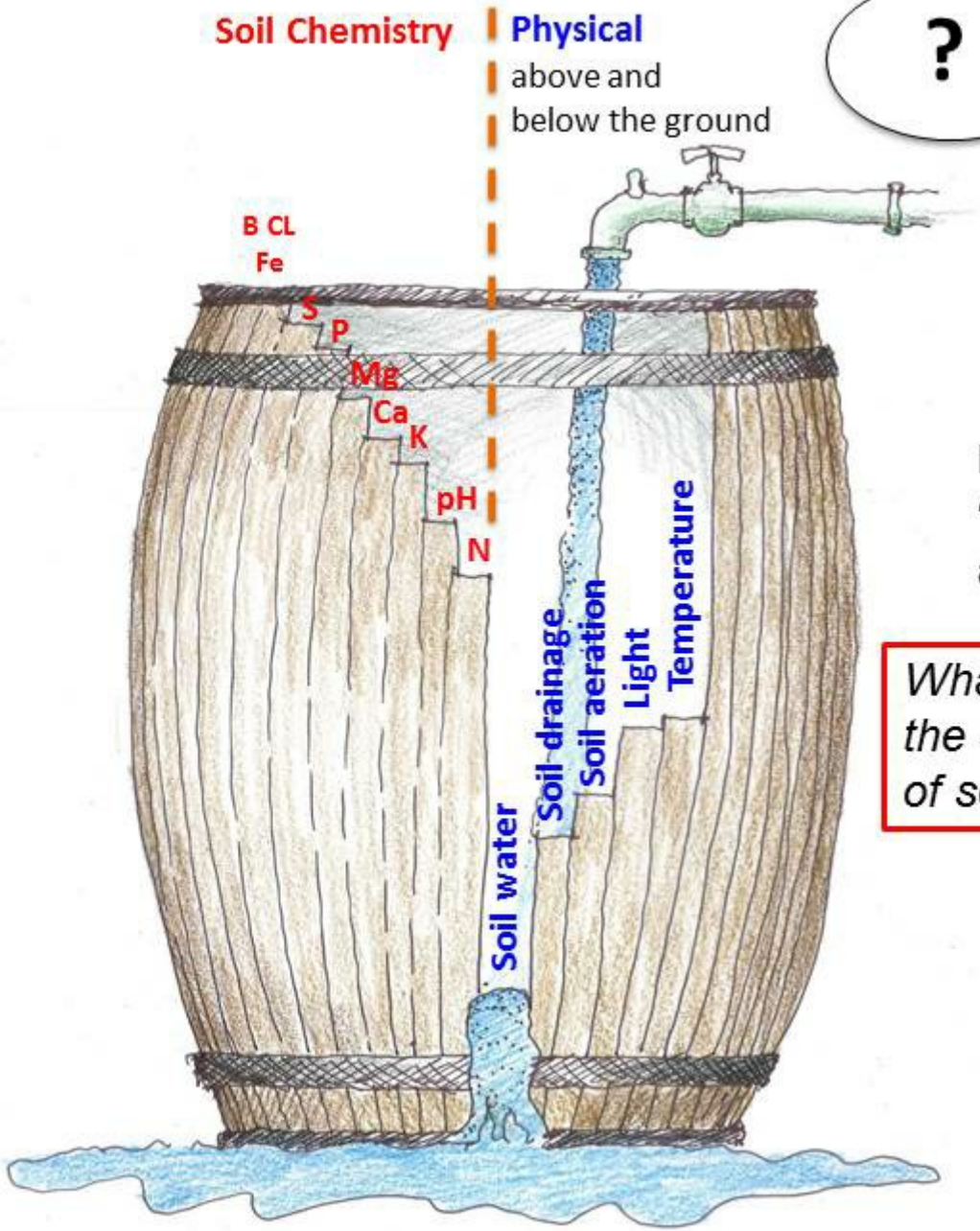


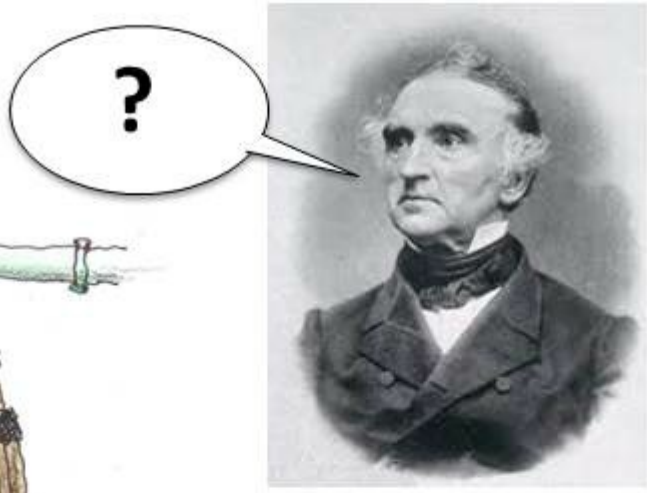
Density and the Organic Properties of soil

Chemical properties of soil



Limitations

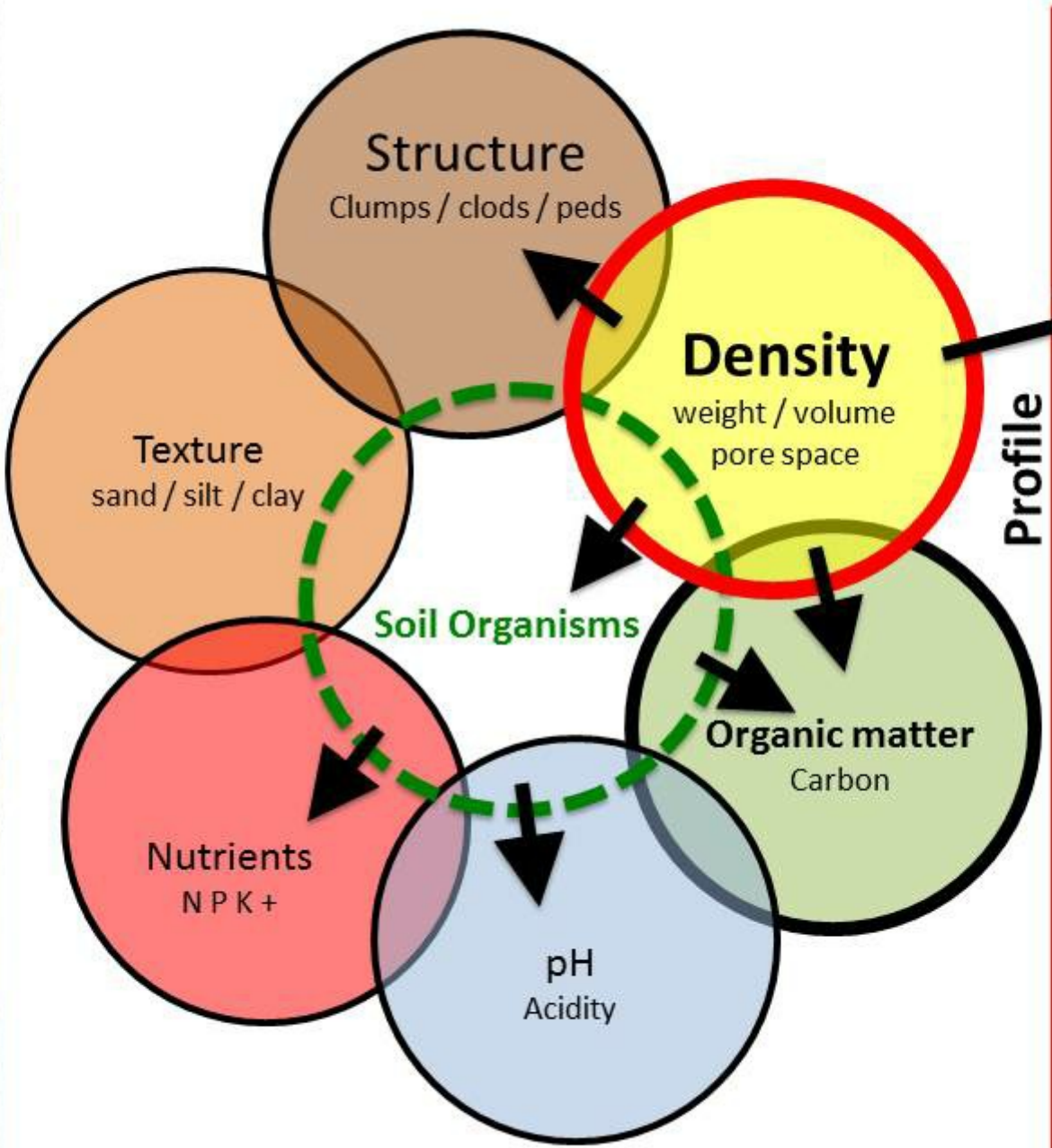




Liebig's barrel
"Law of the limited"
applied to landscape plants

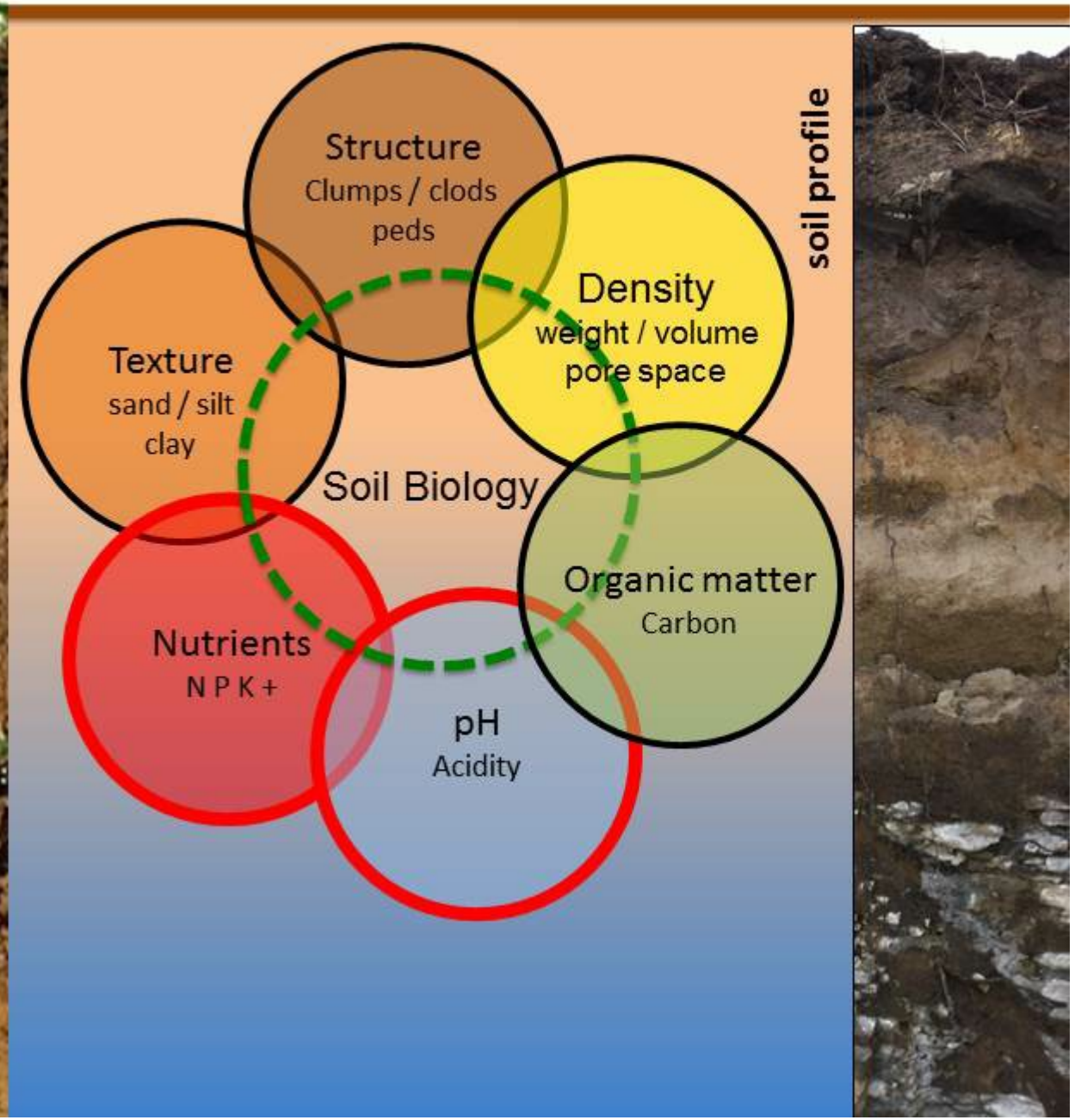
What is more important in the specification and review of soil?

Data Source: Kim Coder
Sketch Interpretation: James Urban
With apologies to Justis and Kim



Density and the Organic Properties of soil

Chemical properties of soil

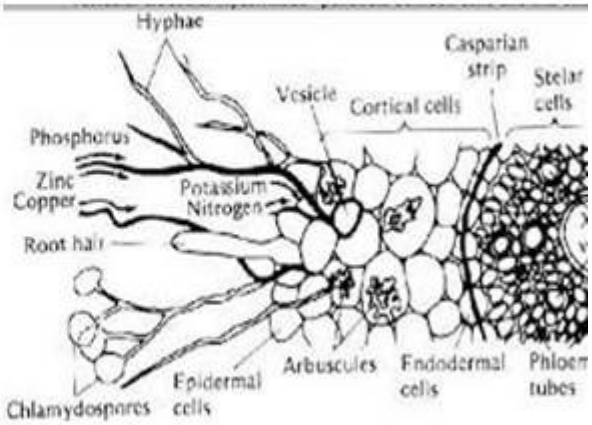


Soil biology: Do forest soil concepts translate to urban landscape soils?
Its complicated!

Christiana Wells (Clemson) Adding mycorrhizae products did not improve tree growth.
Shelf life and shipping of mycorrhizae products.
While mycorrhizae improve the trees ability to gather resources but they also take resources from the tree.

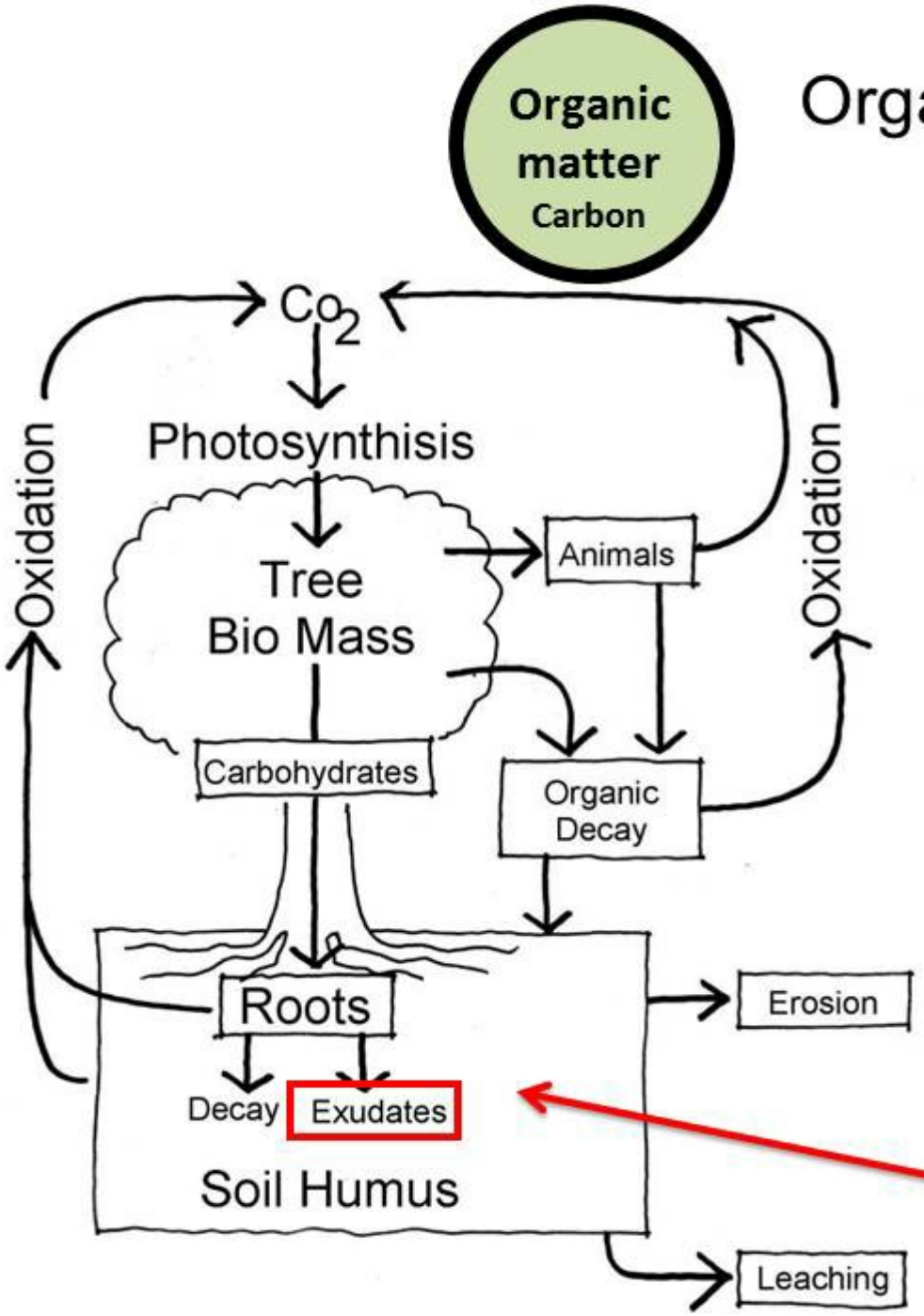
Francesco Ferrini (Italy)
Good results in urban soils with the mycorrhizae cultured specific to the tree species and delivery/storage issues solved.

Don Marks – USA If the soil conditions good for mycorrhizal they will be there. If soil conditions are not suitable, adding product likely does not increase association.



Build it and they will come!

Organic matter vs compost



How can trees grow well when completely covered with paving?

Exudates may be an important source of organic matter.

Compost vs Soil Organic Matter

Compost

Early stages of decomposition to stable Soil Organic Matter, a 50 year or longer process.

Much of the carbon and compost **volume is lost to atmosphere as CO2.**

Compost pieces and soil peds are **separated in matrix.**

Holds water, maybe too much above 5% dry weight.

10% compost by volume equates to adding between 1 and **1.5% SOM** by dry weight.

Soil Organic Matter (SOM)

Stable carbon compounds.

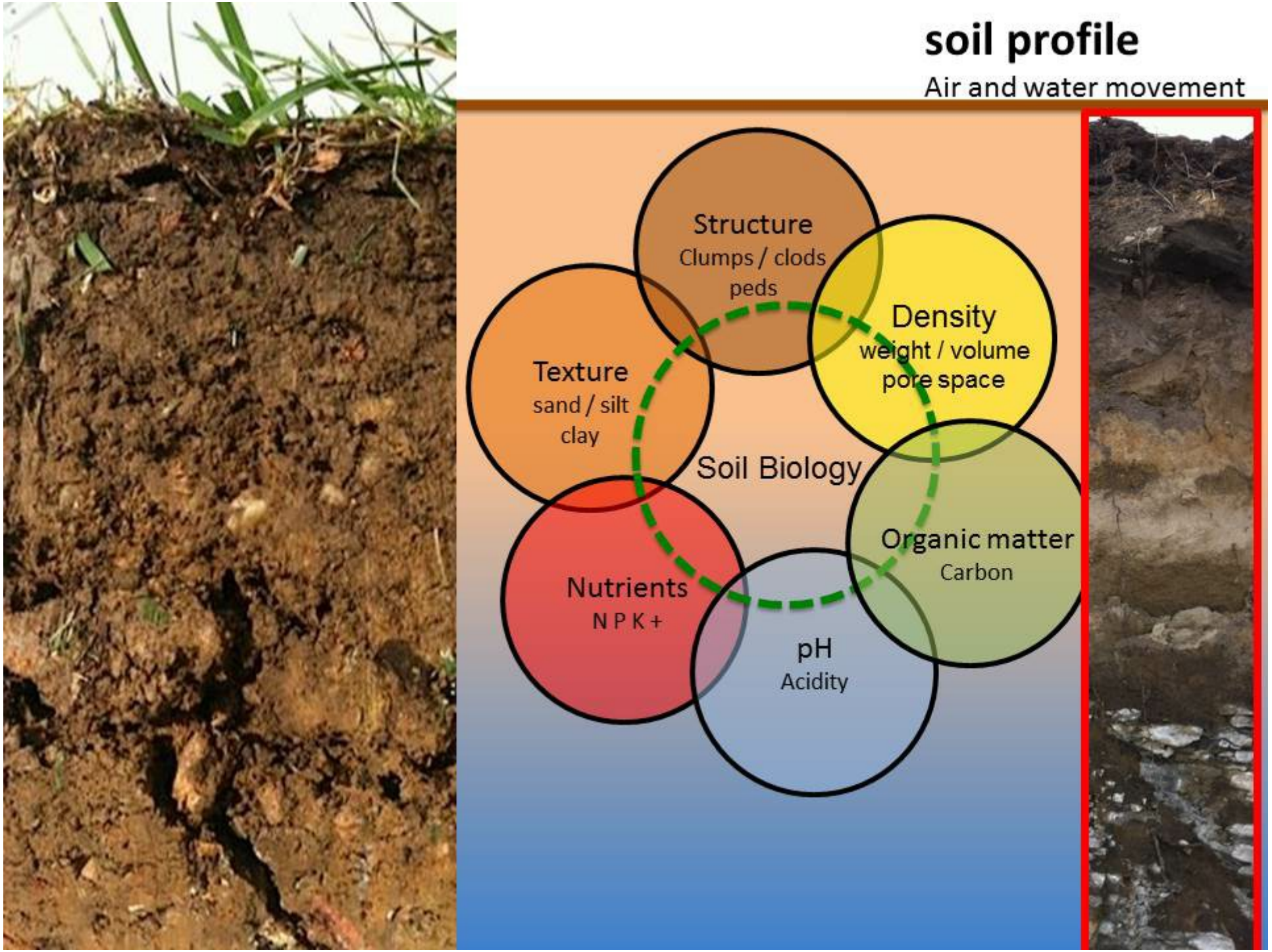
Coating soil particles.

Sticks soil structure together.

SOM is why top soils are **brown to black/brown**

More SOM

Less SOM


soil profile
Air and water movement
Structure
Clumps / clods
peds
Density
weight / volume
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Texture
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Soil Biology
Organic matter
Carbon
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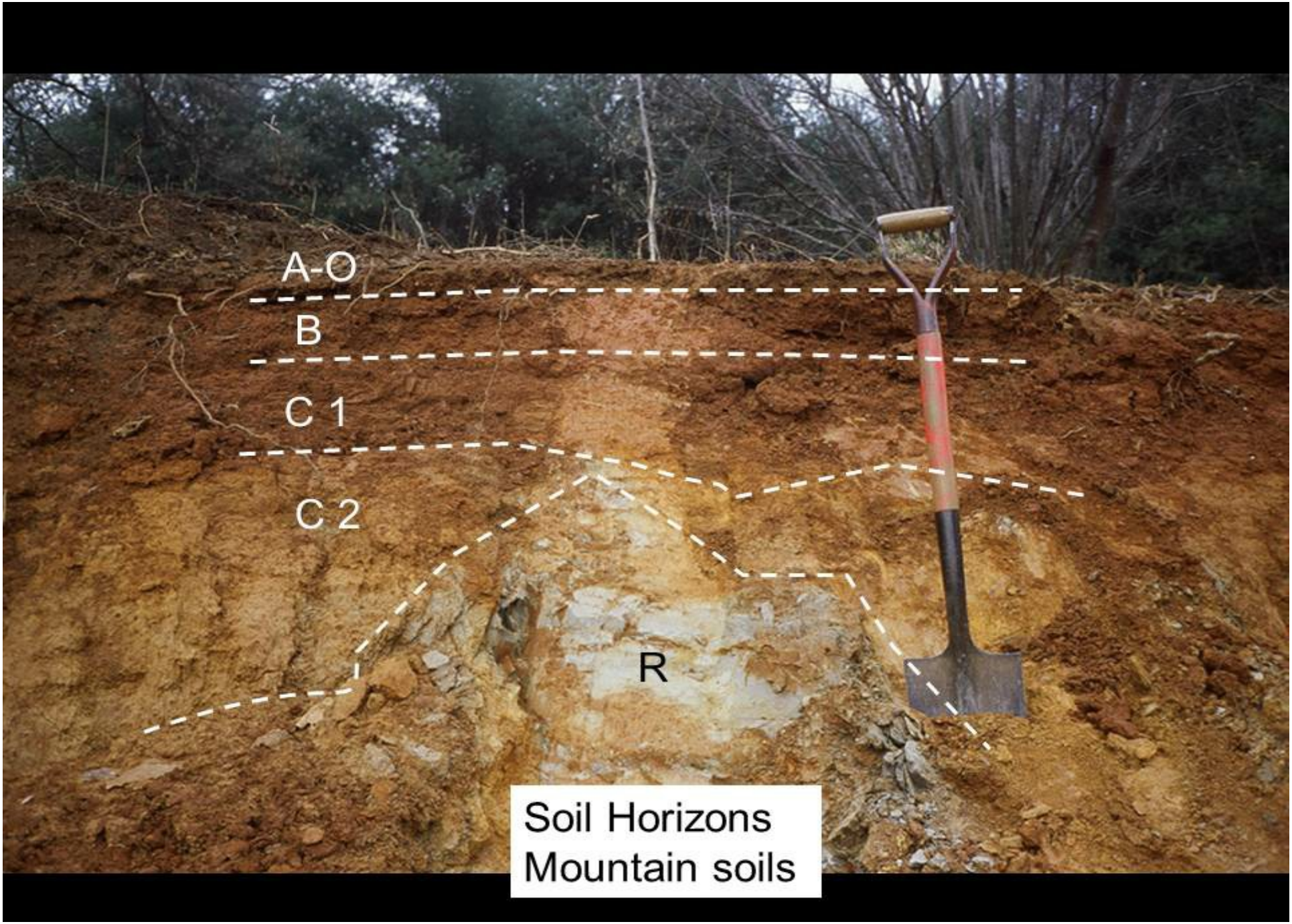
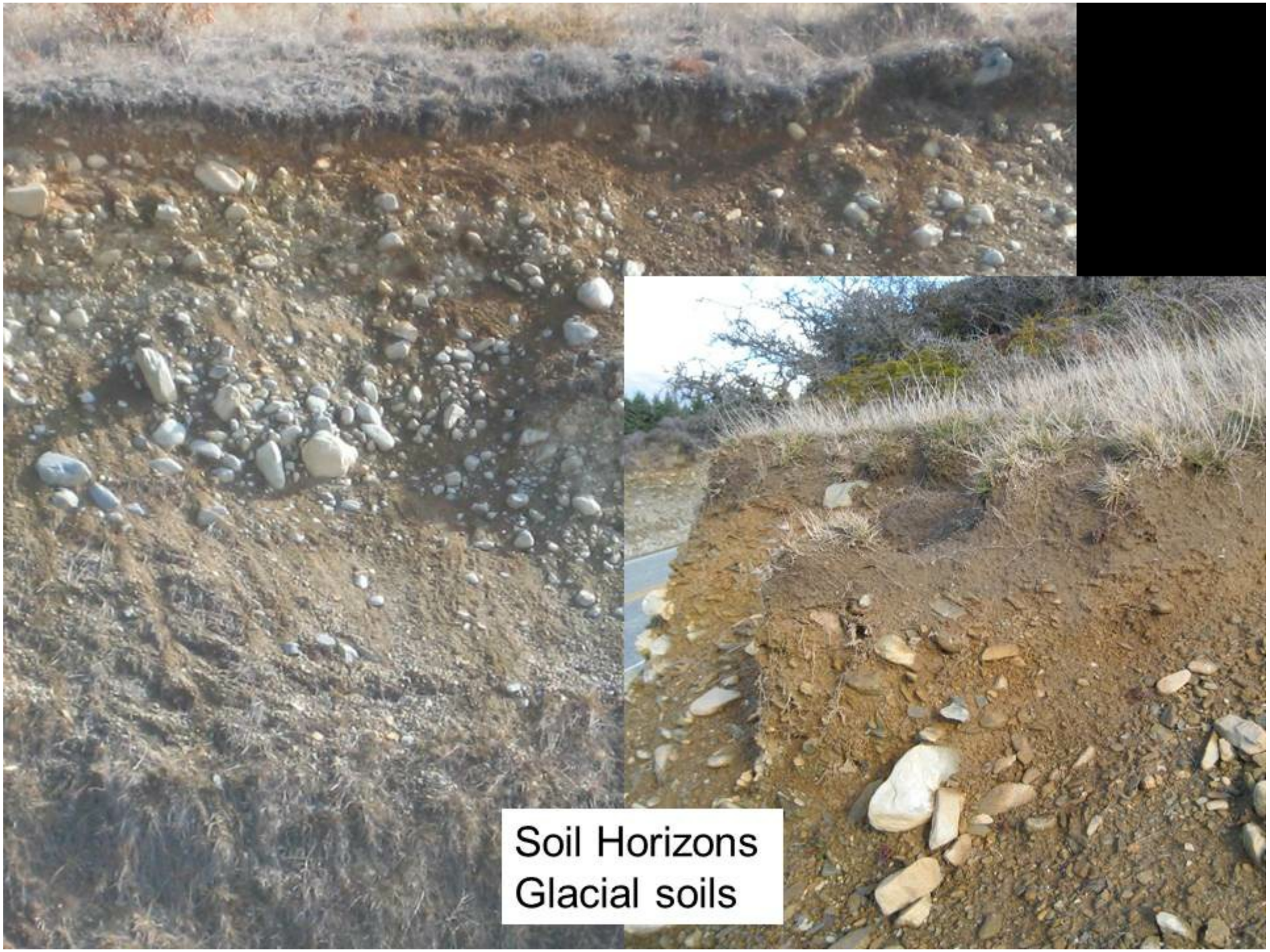
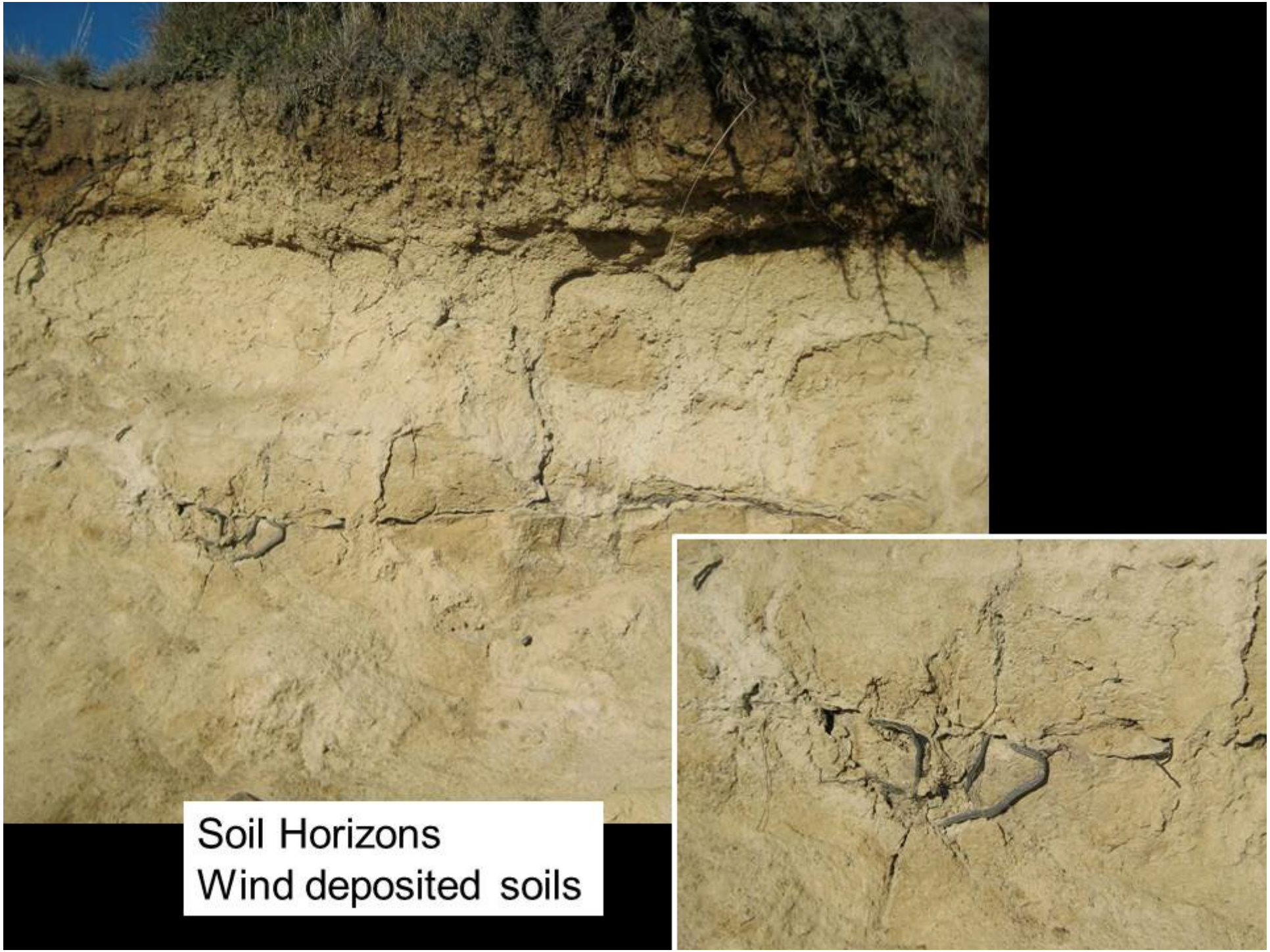
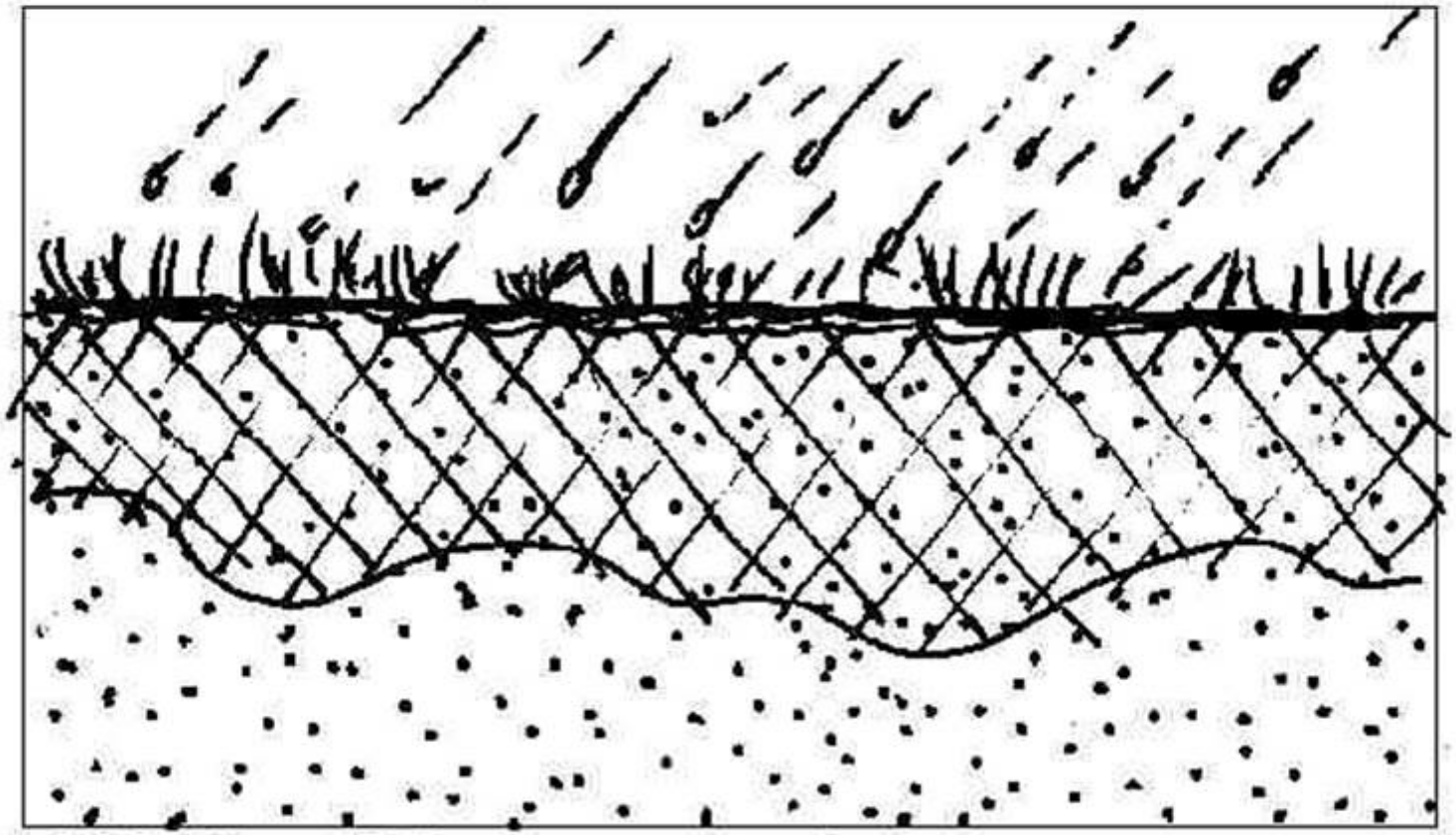
N P K +
pH
Acidity

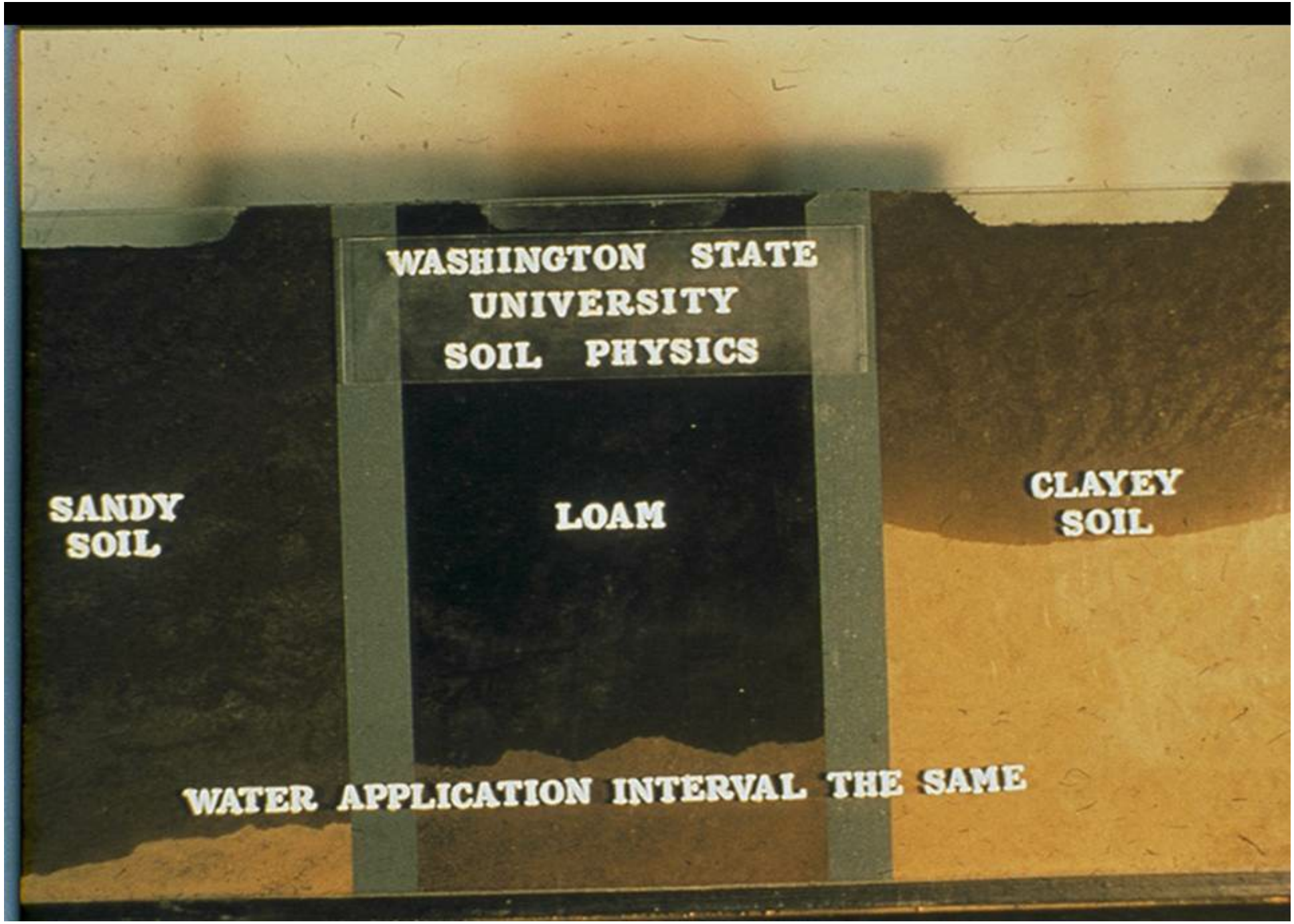

A-O
B
C 1
C 2
R
Soil Horizons
Mountain soils

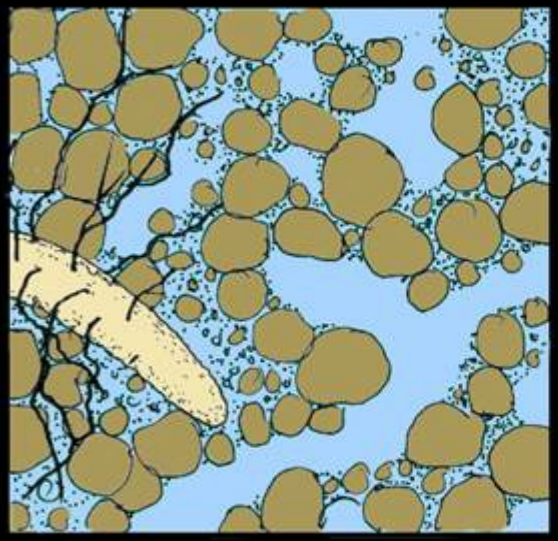

Soil Horizons
Glacial soils


Soil Horizons
Wind deposited soils

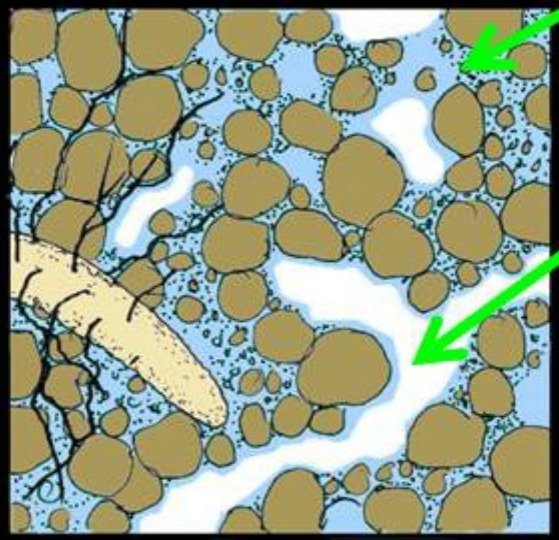


Water Movement


WASHINGTON STATE
UNIVERSITY
SOIL PHYSICS
SANDY
SOIL
LOAM
CLAYEY
SOIL
WATER APPLICATION INTERVAL THE SAME



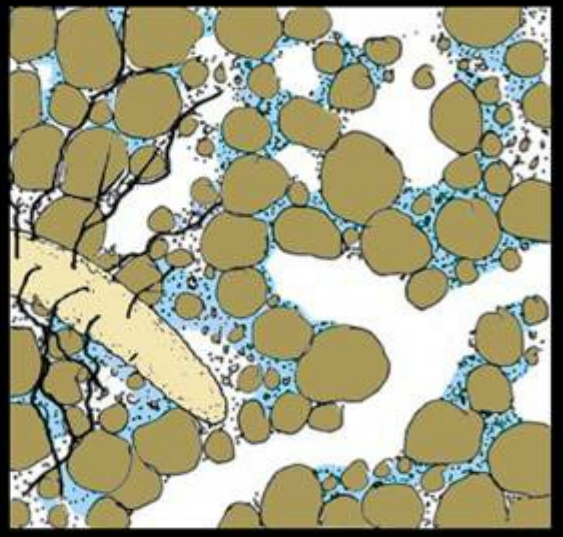
Saturation Point



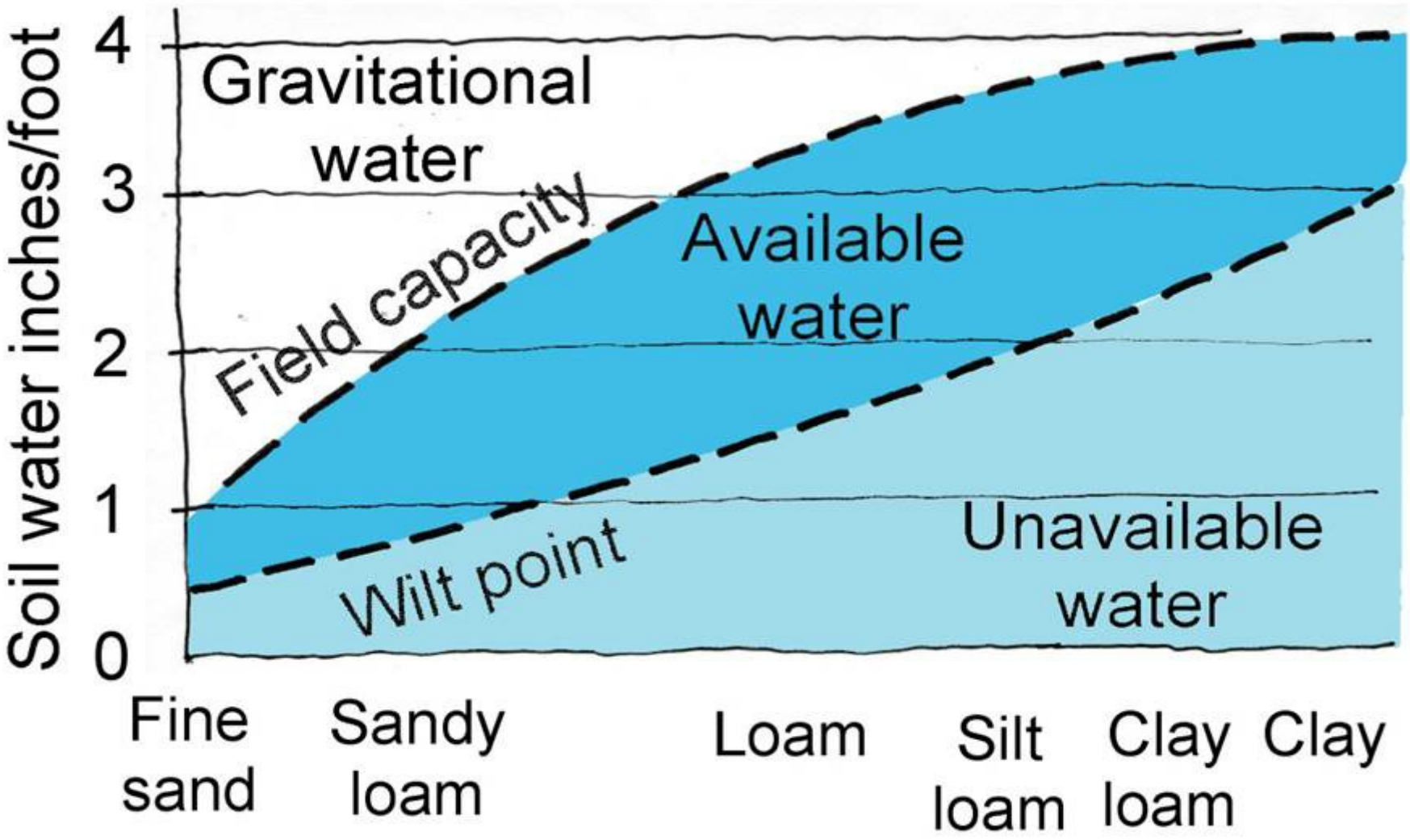
Micro-pores

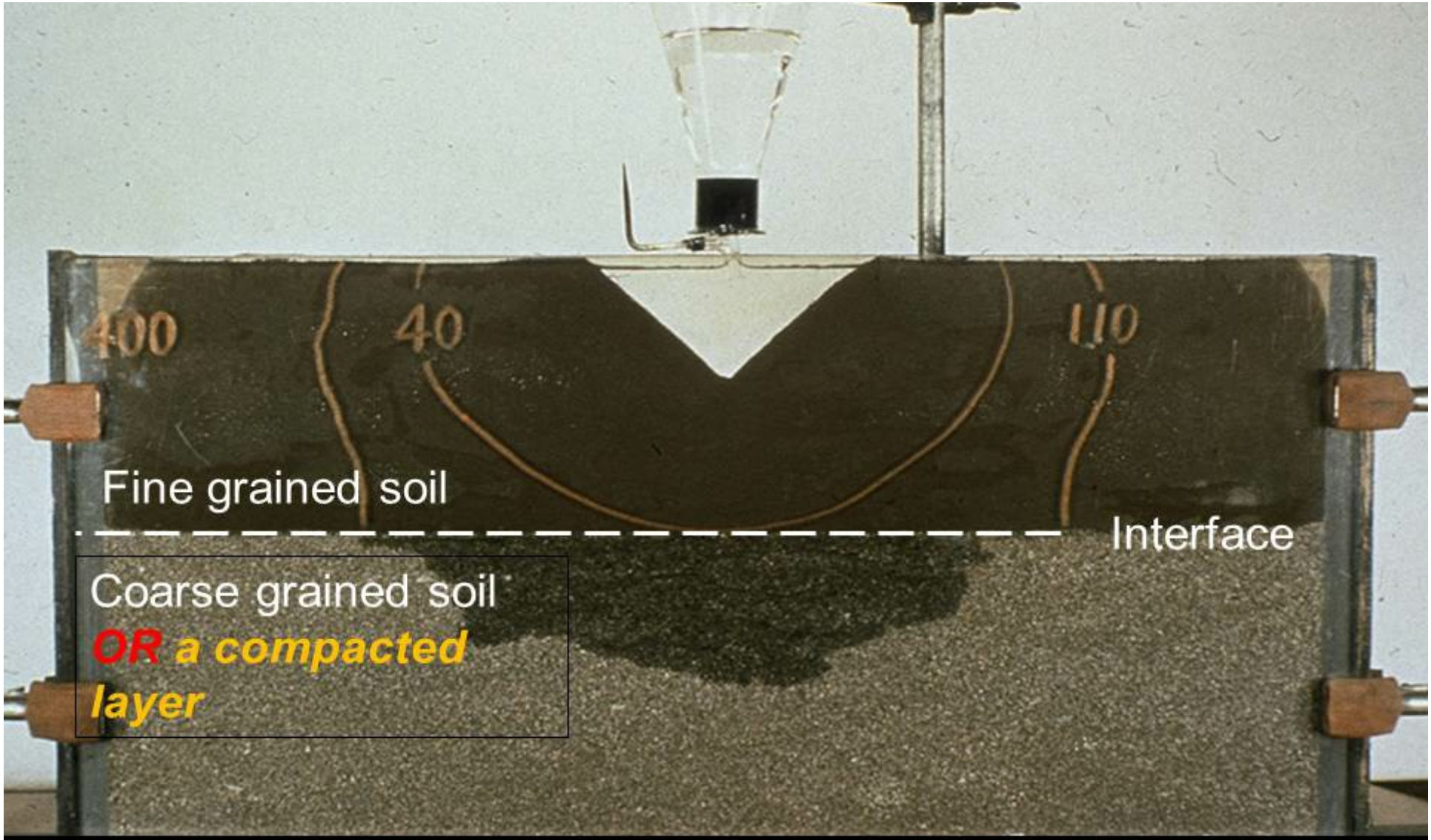
Macro-pores

Field Capacity

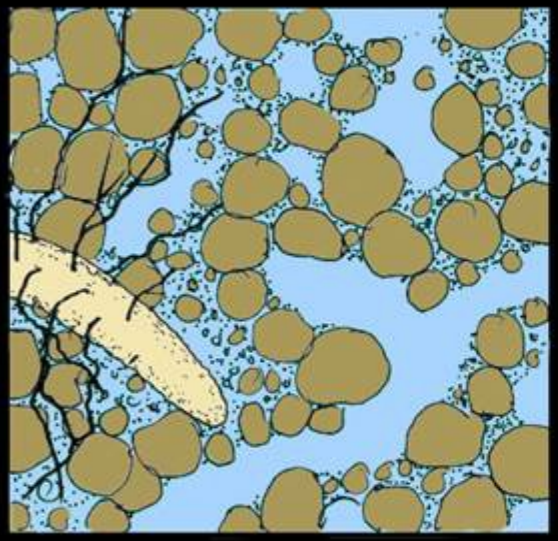


Wilt Point

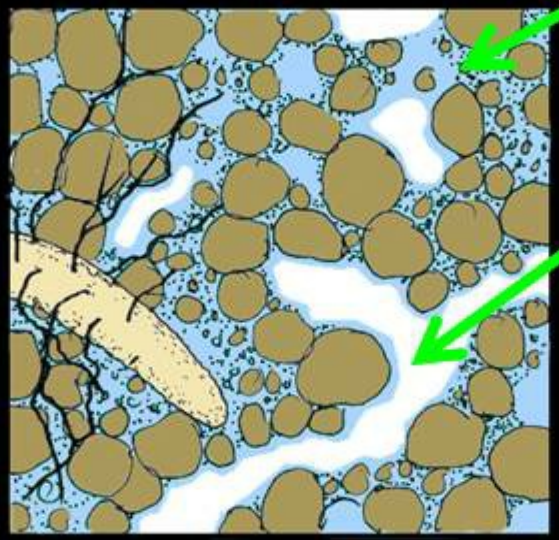

Soil water inches/foot
4
3
2
1
0
Gravitational water
Field capacity
Available water
Wilt point
Unavailable water
Fine sand
Sandy loam
Loam
Silt loam
Clay loam
Clay



Soil interface slowing the flow of water
Upper layer must become saturated
before water moves into lower layer



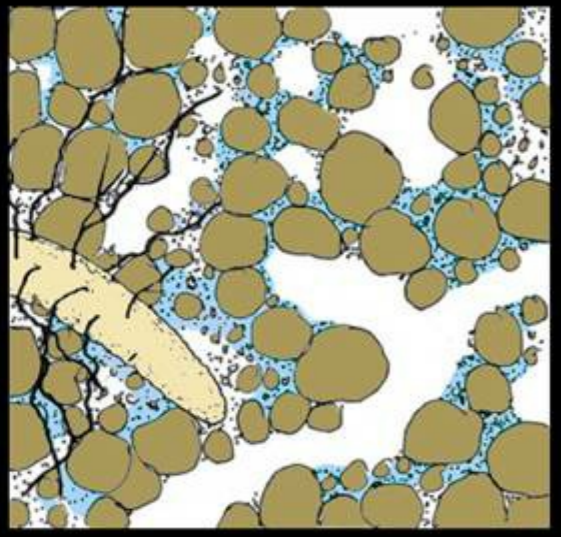
Saturation Point



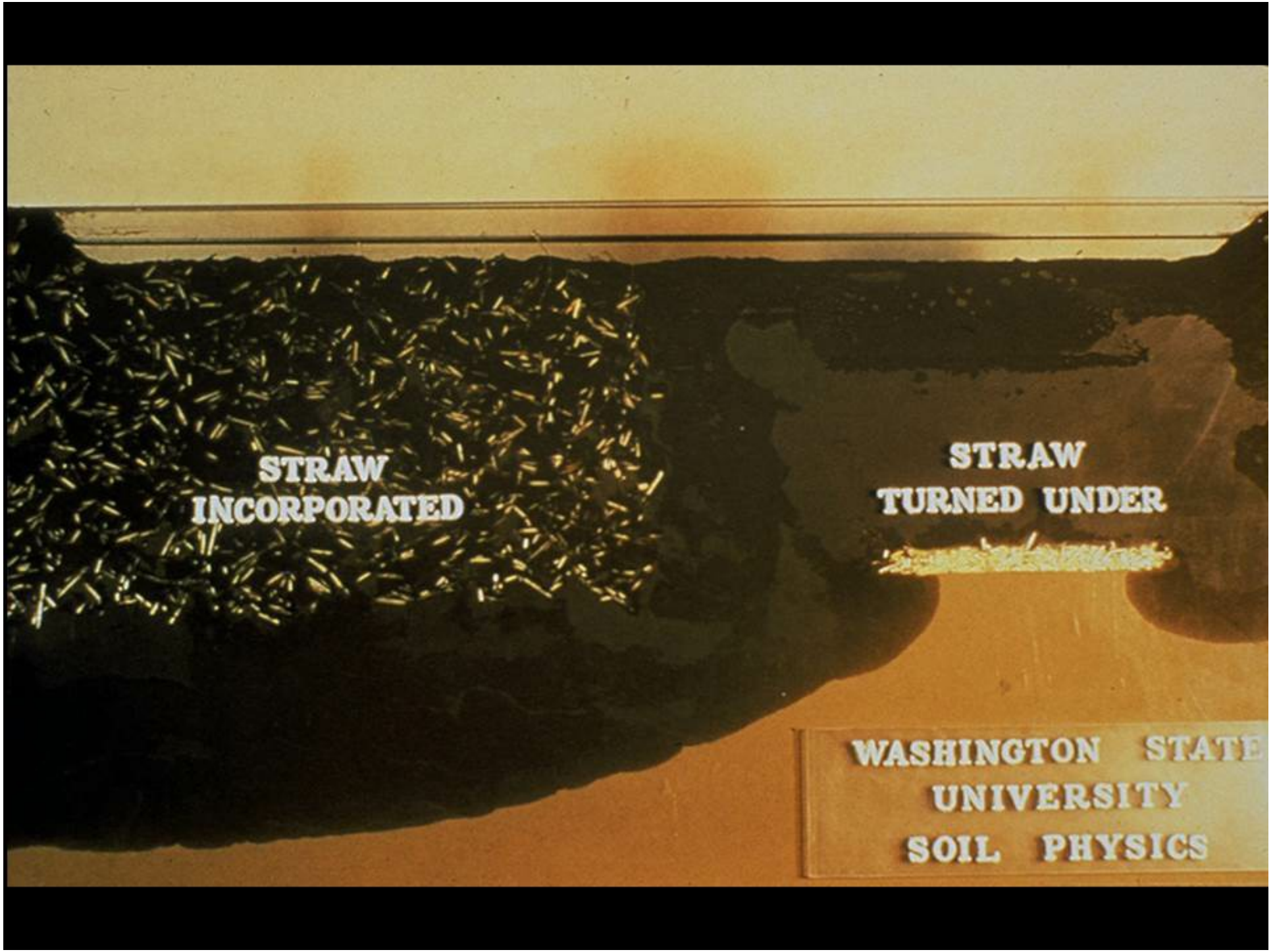
Micro-pores

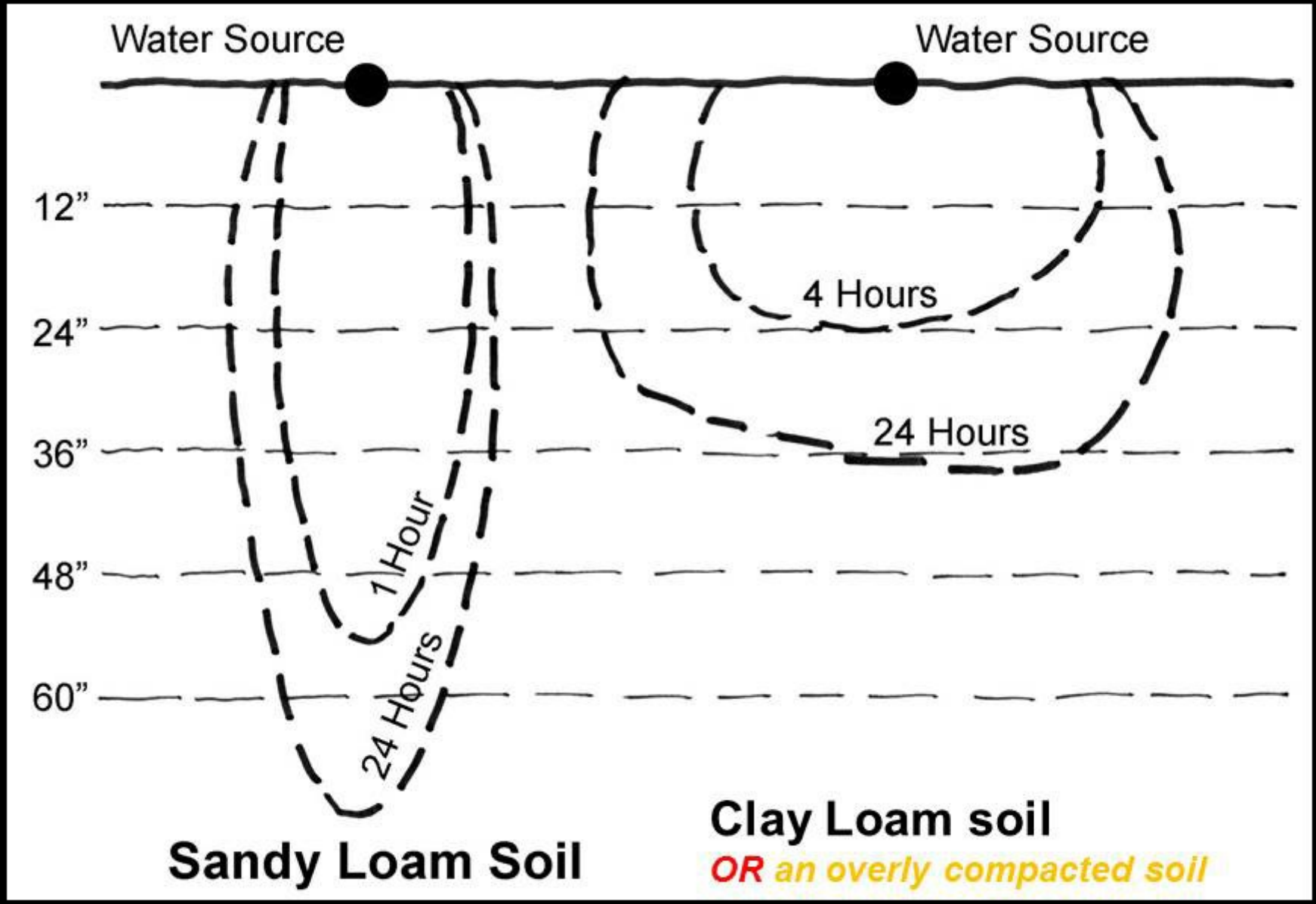
Macro-pores

Field Capacity

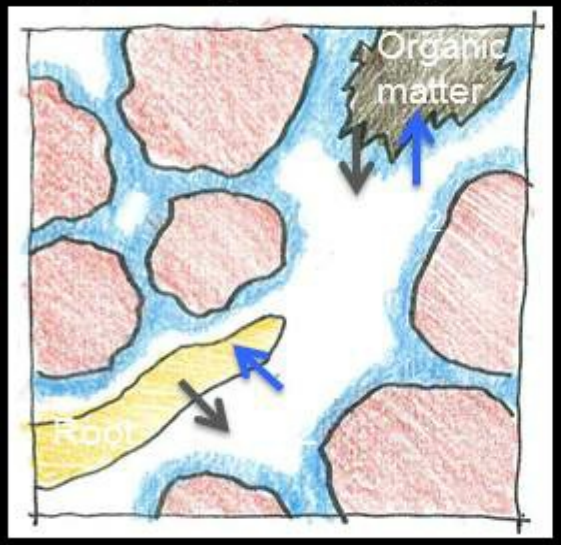


Wilt Point


STRAW
INCORPORATED
STRAW
TURNED UNDER
WASHINGTON STATE
UNIVERSITY
SOIL PHYSICS

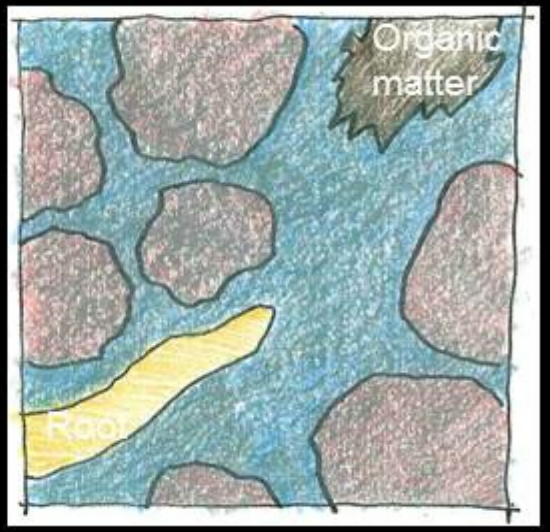

Water Source
Water Source
12”
24”
36”
48”
60”
4 Hours
24 Hours
1 Hour
24 Hours
Sandy Loam Soil
Clay Loam soil
OR an overly compacted soil

Plants and decaying organic matter in soil must respire
(bring in oxygen expire carbon)



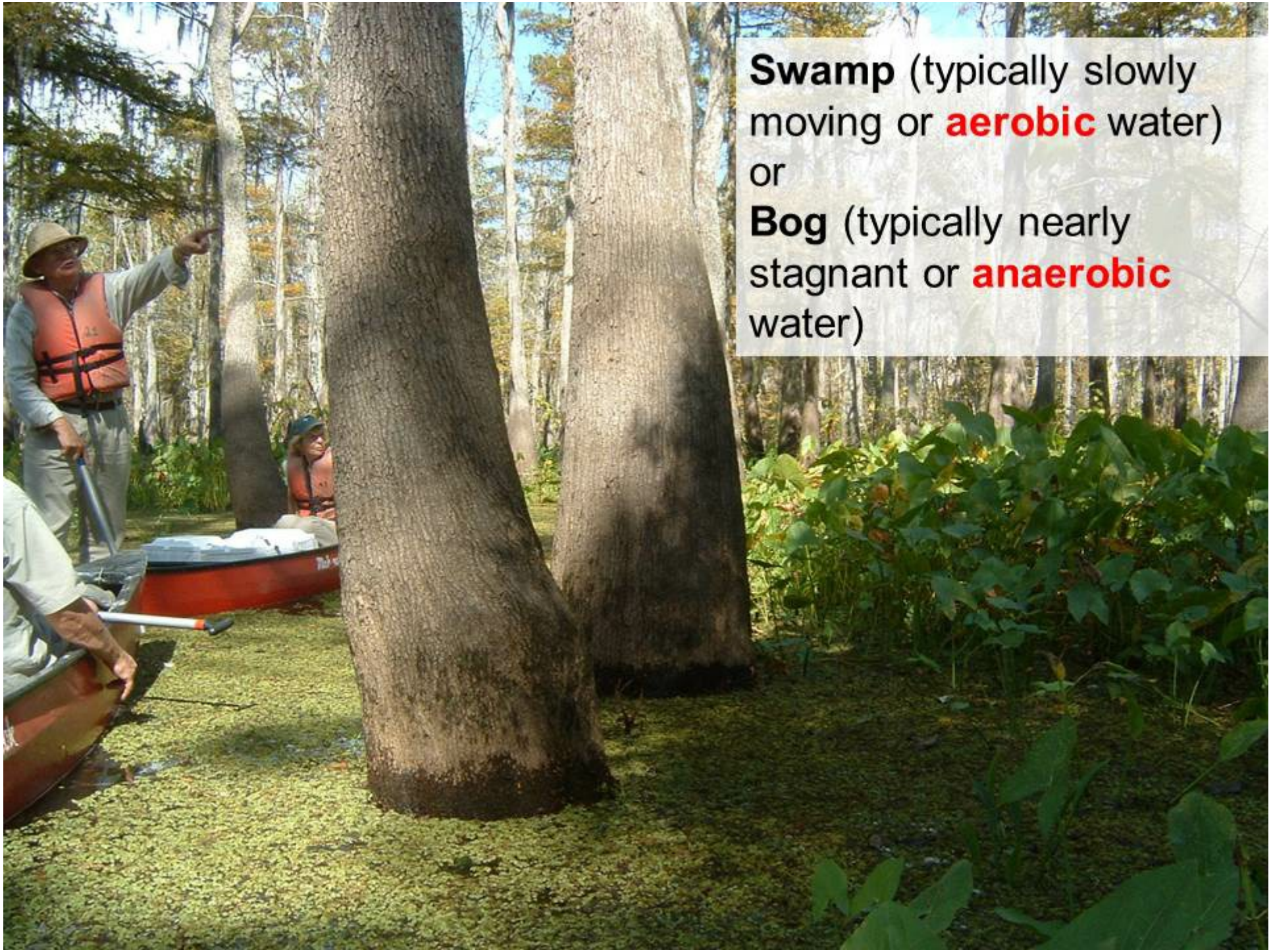
Aerobic Soil
Good respiration

Saturated Soil
Slow respiration



Anaerobic Soil
No respiration

Plants will die more quickly with
too much water than too little !!!!!


Swamp (typically slowly moving or **aerobic** water)
or
Bog (typically nearly stagnant or **anaerobic** water)

Learn different soil odors
Sweet smell is good respiration
Sour smell is no respiration

Soil Odor

Soil Color

Bight red or orange or orange soil = Good soil oxygen

Grey soil = Poor soil oxygen