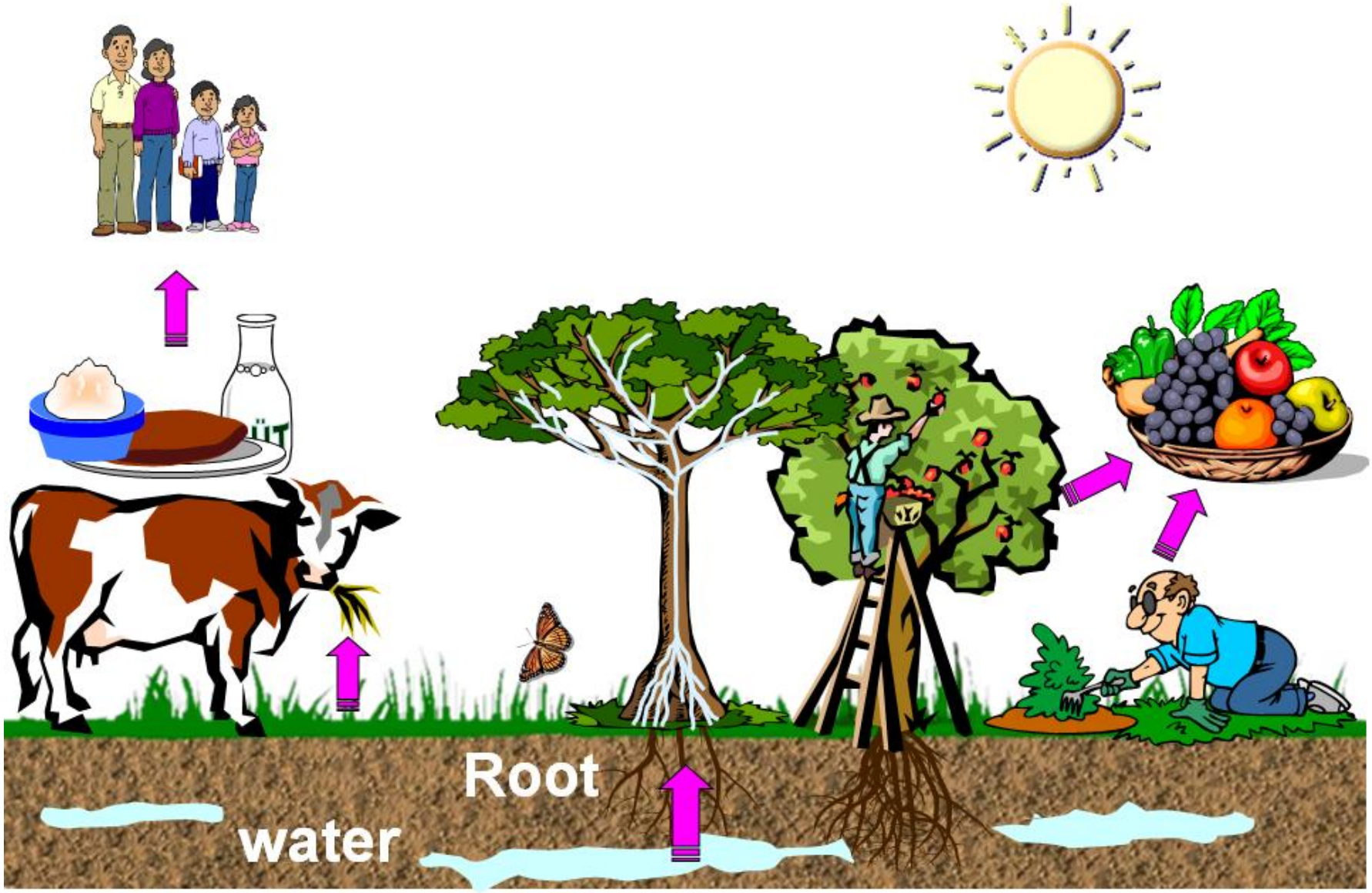
Why is soil important?



Functions of soil

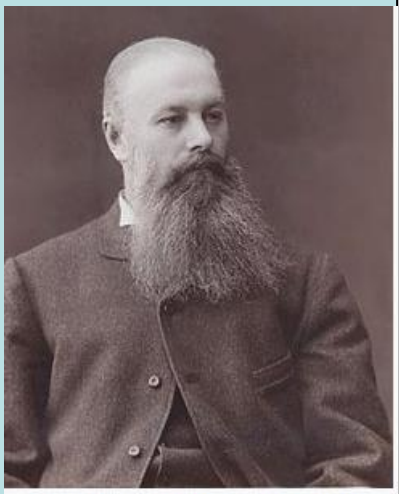
1. Food and biomass production
   - agricultural, forest, pasture, and wetland
2. Storing/filtration/transformation
   - Soil is responsible for the chemical conversions between minerals, organic matter and water.
   - Soil diversifies chemical substances during biochemical processes in soil.
   - Soil is a natural filtering barrier forming clear underground water sources.
3. Habitate and gene pool:
   - Soil hosts very large amount and variety of organisms as a living environment.
4. Soil as a raw material:
   - clay, sand, gravel, mineral and peat,

Soil as a definition

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Earth's body of soil, called the pedosphere, has four important functions as :

- a medium for plant growth
- a means of water storage, supply and purification
- a modifier of Earth's atmosphere
- a habitat for organisms

WIKIPEDIA

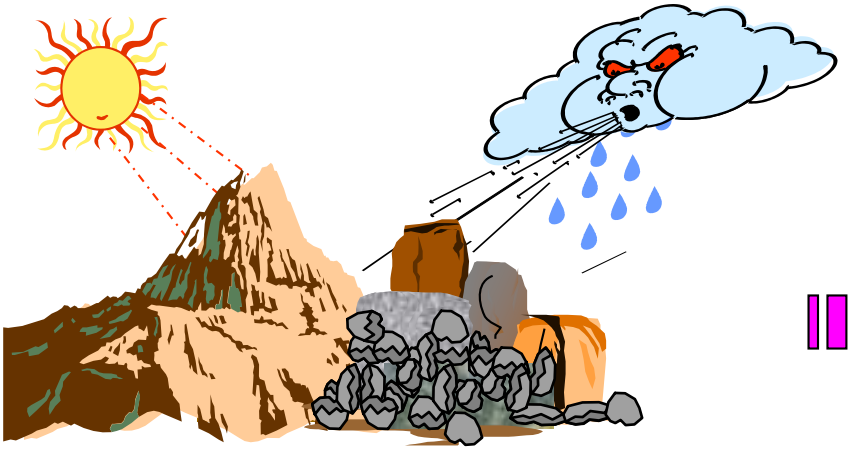


V. Dokuchaev (Saint Petersburg, 1888)

- geographical variations in soil type could be explained in relation not only to geological factors, but also to climate and topograpy factors,
- soil formation takes a long time

Using these ideas as a basis, Dokuchaev created the first soil classification and his ideas have been adopted very rapidly by the scientists all over the world.

Soil formation



Physical and chemical weathering

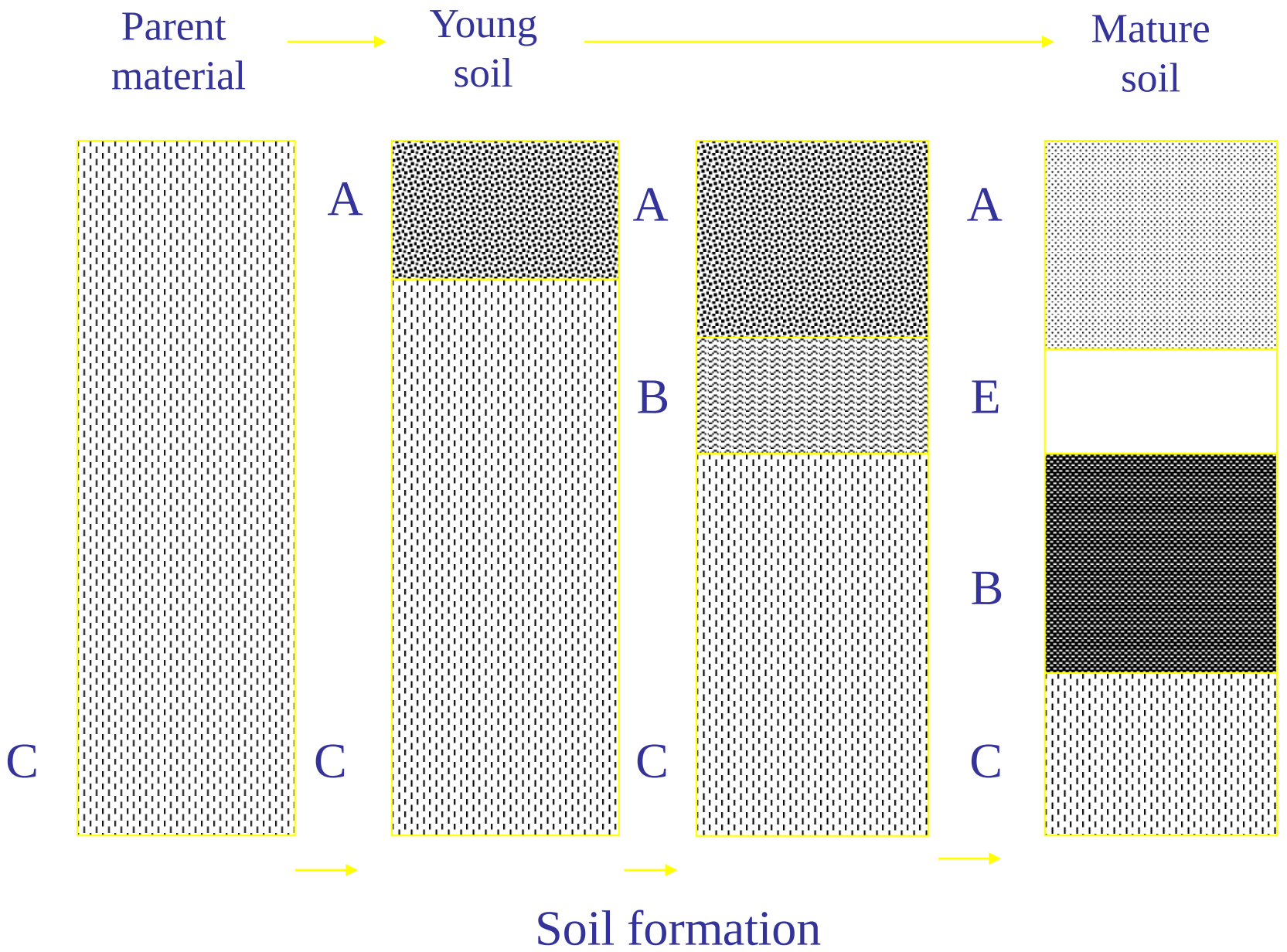
Plants, animals, human

200-1000 year

(average 500 yr)

Ideal agricultural soil

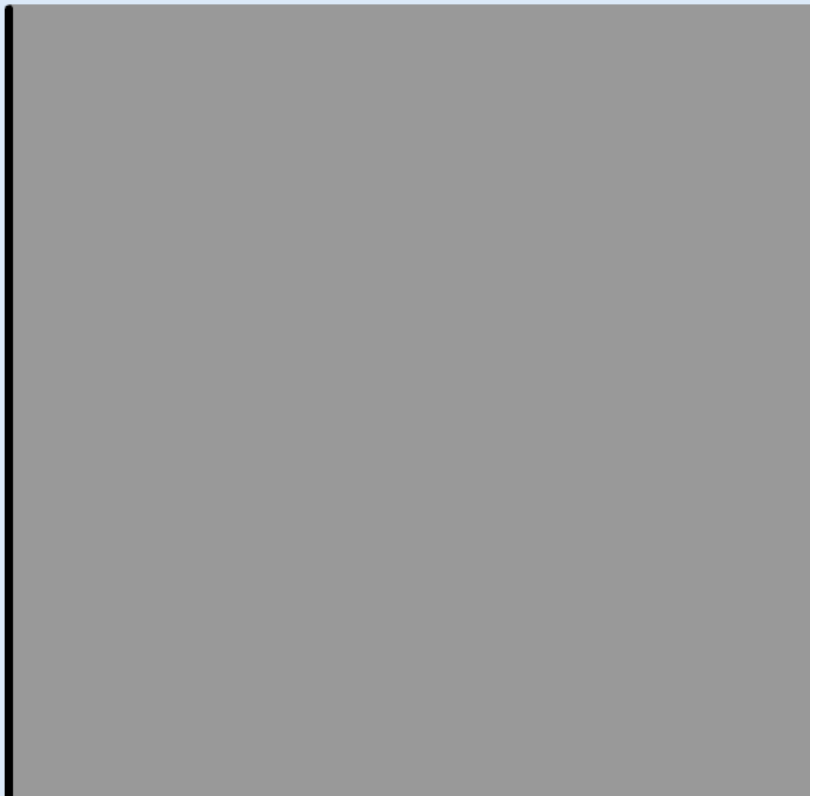
Humus formation


Parent material
Young soil
Mature soil
A
B
C
A
B
C
A
E
B
C
Soil formation

ELAPSED YEARS : 0 YR

Parent Material existed
in humid and hot region

R



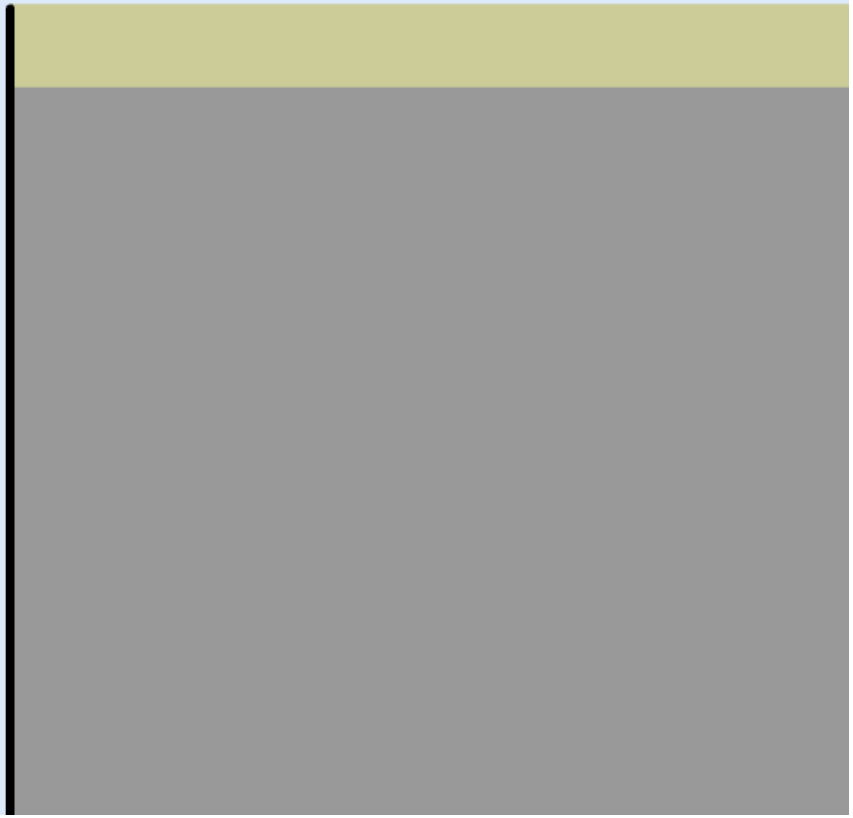
ELAPSED YEARS : 10 YR

Weathering Rocks

WEATHERING describes the means by which soil, rocks and minerals are changed by physical and chemical processes into other soil components.

Weathering is an integral part of soil development. Depending on the soil-forming factors in an area, weathering may proceed rapidly over a decade or slowly over millions of years.

C horizon develops on above Regolit.



https://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1130447038

ELAPSED YEARS: 100 YR

Vegetation formation, accumulation of organic matter

Dying plants are accumulated on Surface and form soil organic matter and horizon-A

Weathering process continue through below profile

Parent material (R), changes into Horizon-C.

ELAPSED YEARS : 1000 YR

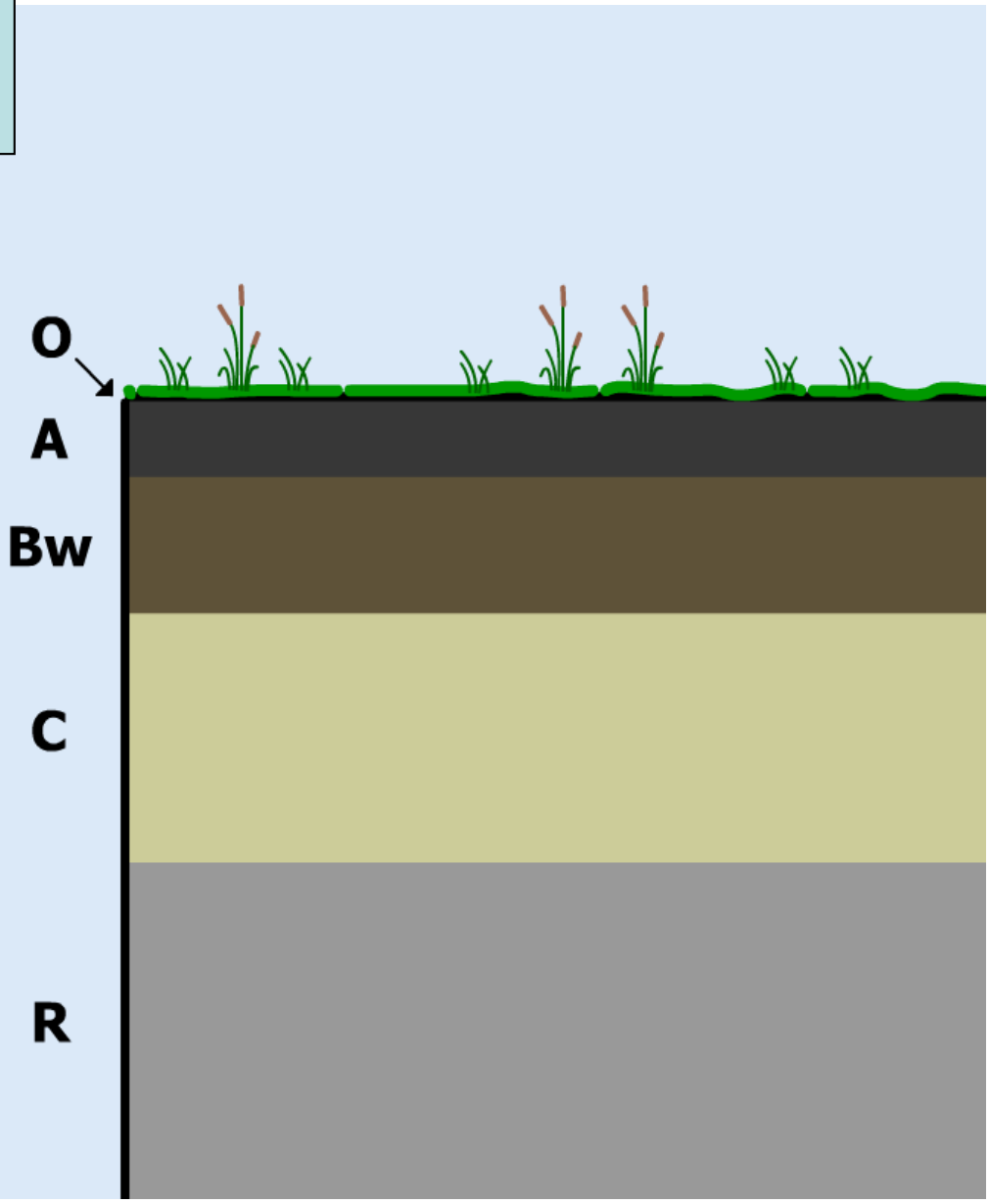
Color and structure development

Thickening horizon-A becomes dark color

Horizon-O can form by accumulating plant debris

Formation of Fe-oxides and clay minerals on the upper horizon and

Their transport to below layers causing formation of horizon-Bw



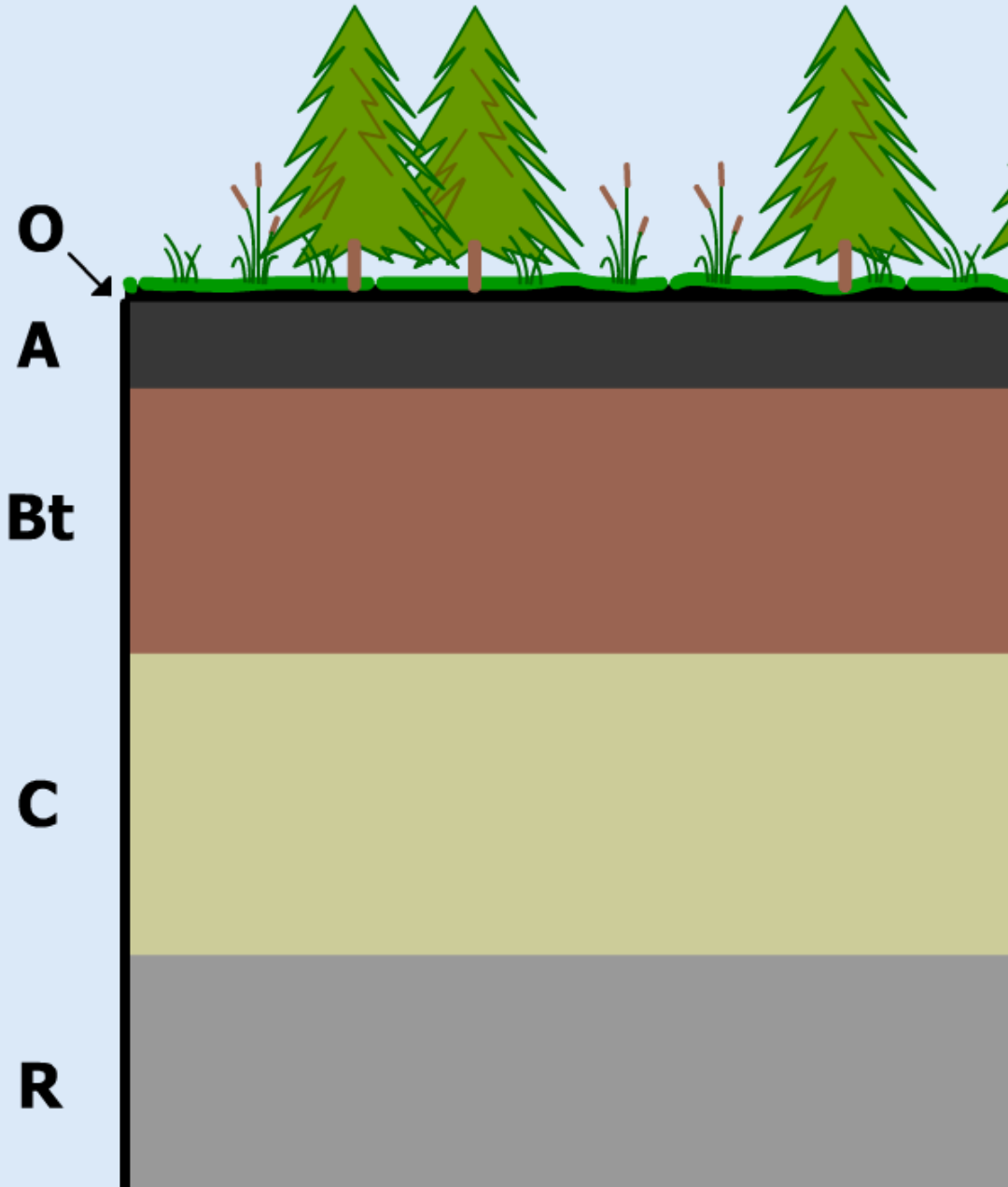
ELAPSED YEARS : 10,000 YR

Increasing clay transport
and accumulation in below layers

Fe-oxides and clays move down and, Horizon-B becomes more redish (formation of horizon-Bt

Thickening and darkening horizon-A by increasing organic matter accumulation

Weathering process continue through below layers

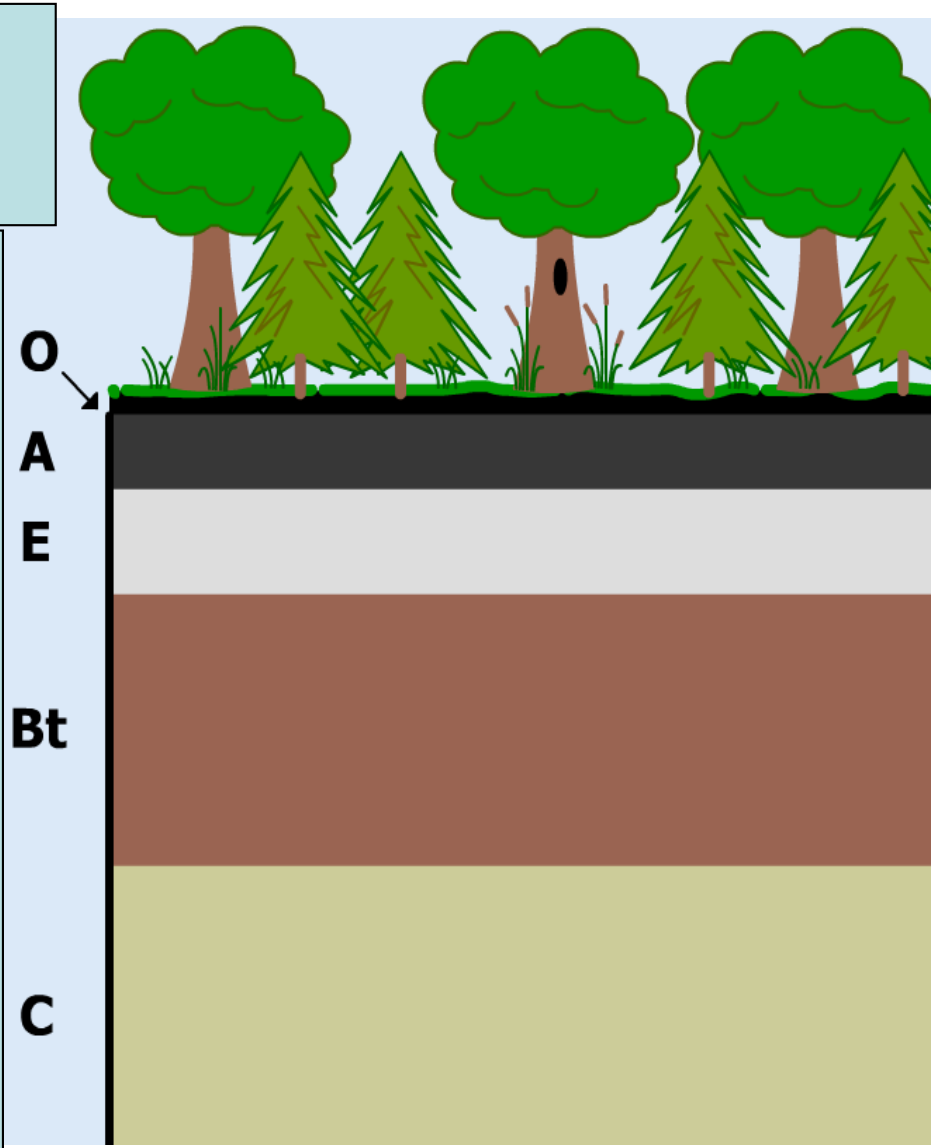


ELAPSED YEARS : 100,000 YR

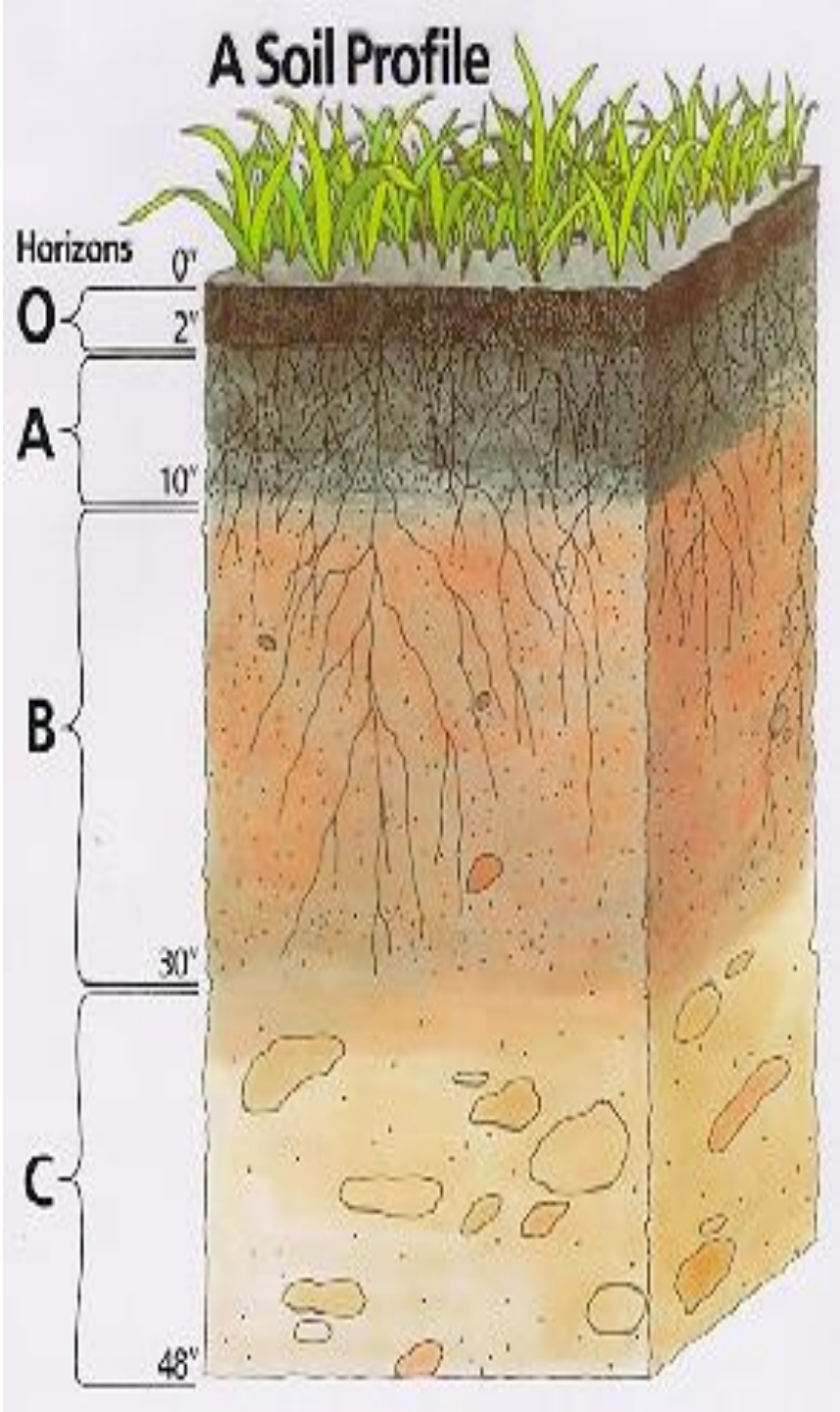
Continous leaching of Fe-oxides and silicate clays in upper layers resulted in the formation of Horizon-E.

Increasing clay transport forms a thick and deep horizon-Bt.

Weathering process continue through below layers



And 100,000 yr later...



Why is soil important?

1 grams of soil (within 15cm depth)

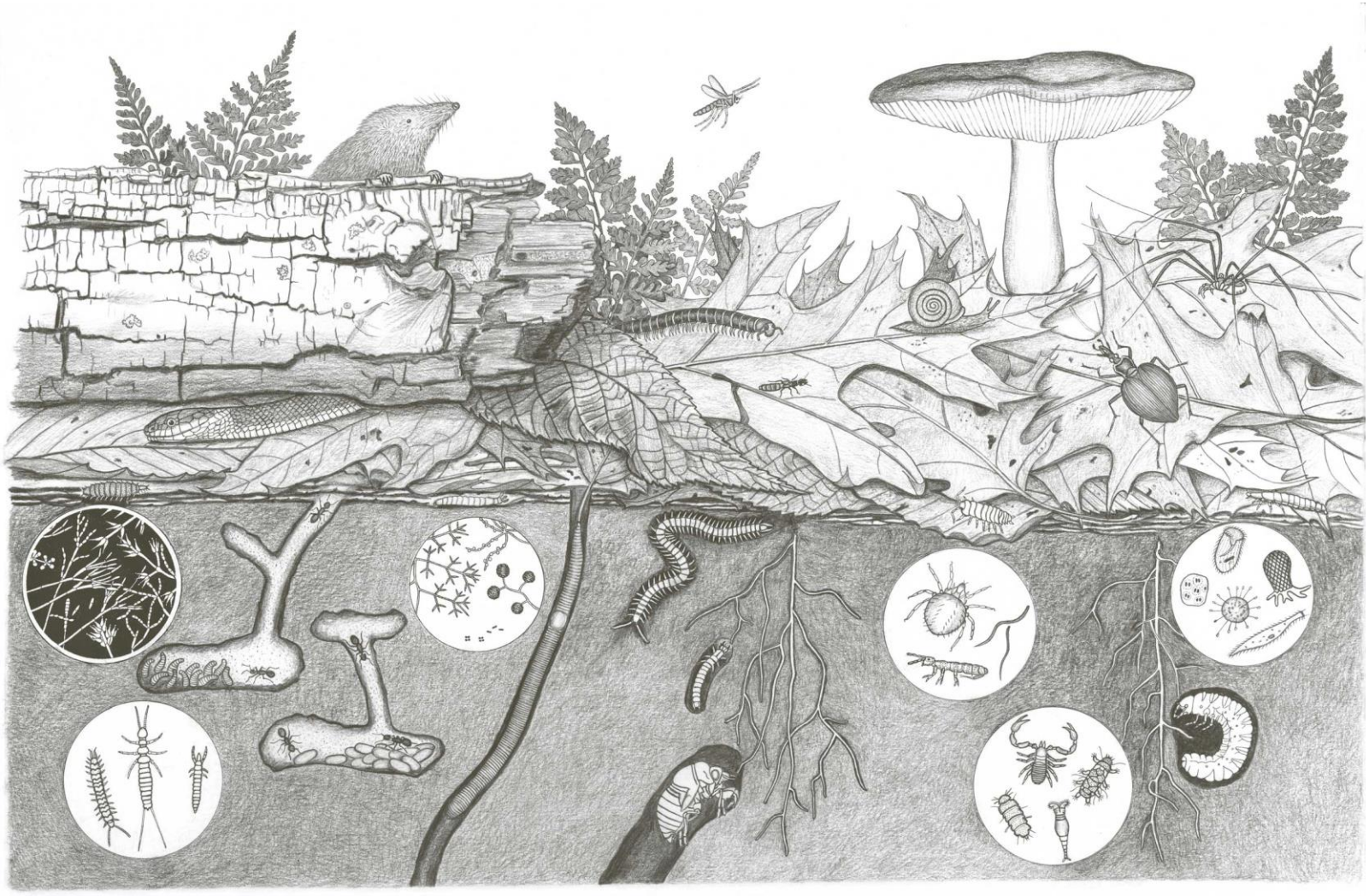
600.000.000 Bacteria

400.000 Fungi

100.000 Algae

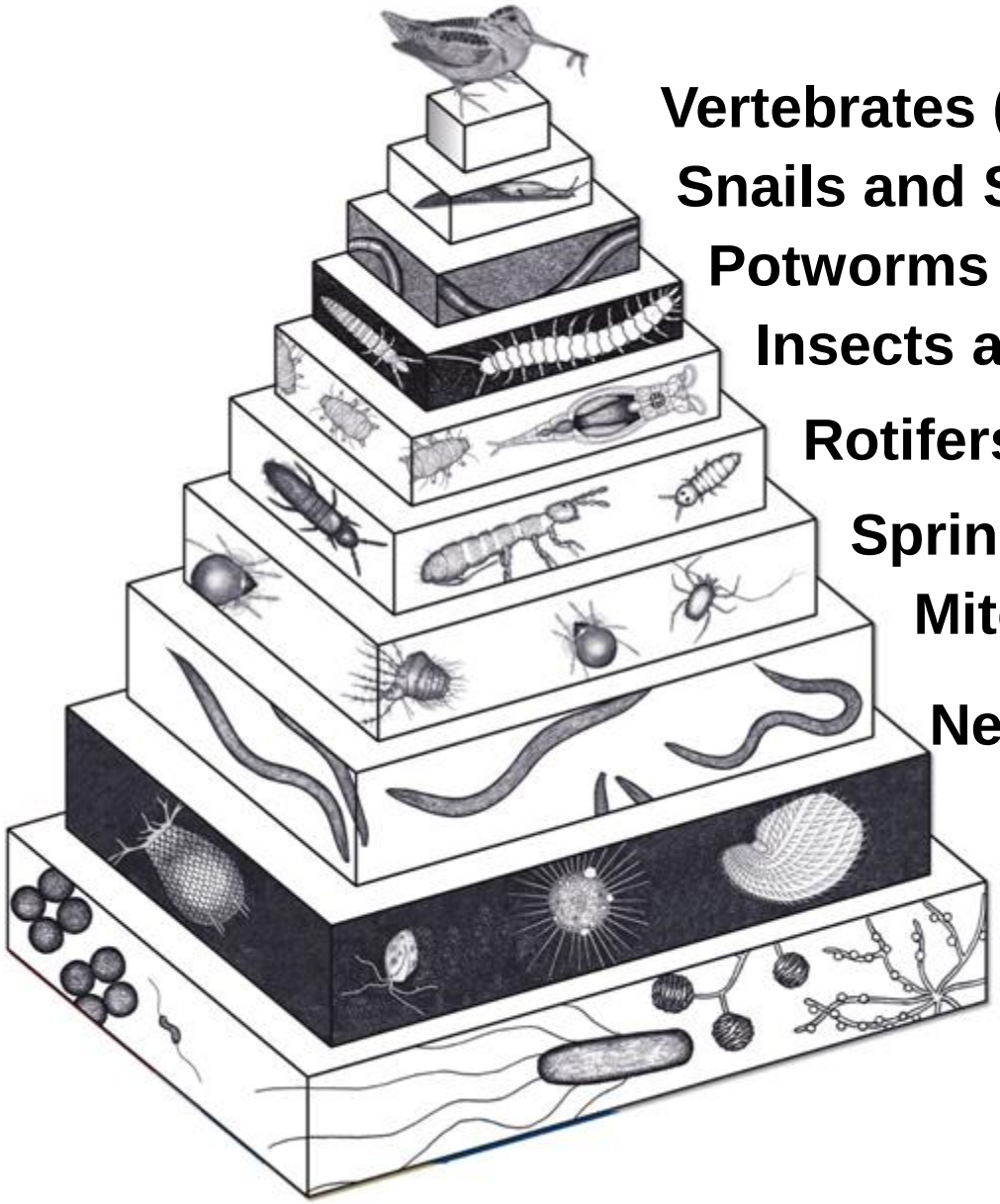
And many bugs and animals as well...

The UNESCO Courier / june1997



SOIL BIOLOGY is complicated..

Biology Pyramid in Soil



Vertebrates (1)

Snails and Slugs (100)

Potworms and Earthworms (3,000)

Insects and Spiders (5,000)

Rotifers (10,000)

Springtails (50,000)

Mites (100,000)

Nematodes (5,000,000)

Protozoa (10,000,000,000)

Fungi (100,000,000,000)

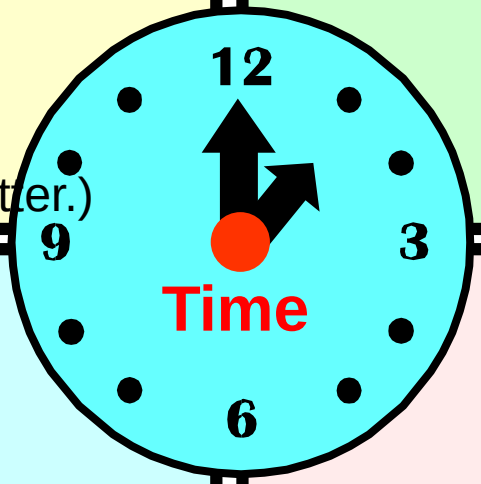
Bacteria (10,000,000,000,000)

Human being and soil

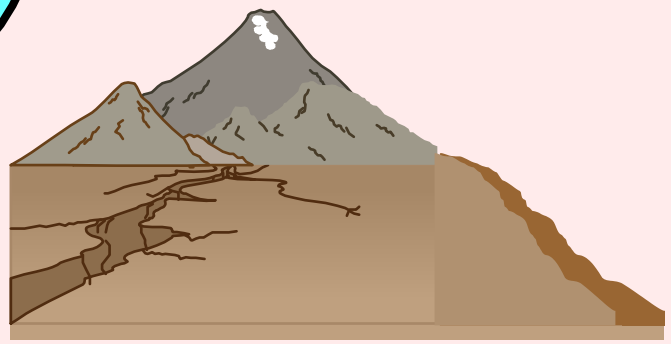
Soil forming factors...

Parent material
(Rocks, minerals, organic matter.)

Climate (Rainfall, temperature and wind)



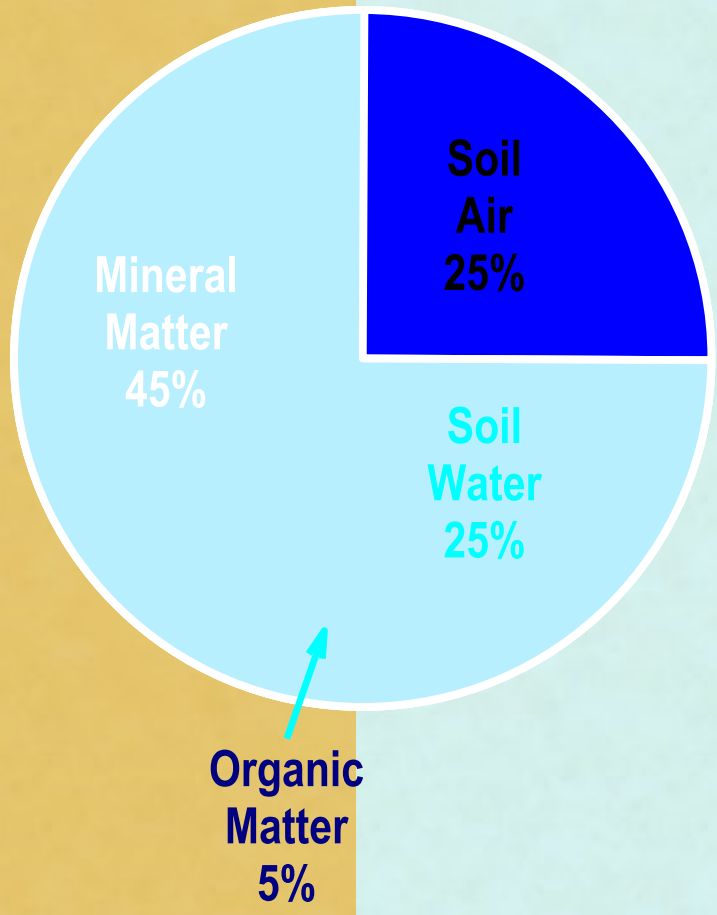
Organizms
(Plants and animals)



Topography
(Altitude, slope, vector)

SOIL COMPONENTS
(4 divisions)

Minerals almost in half



Pores in other half

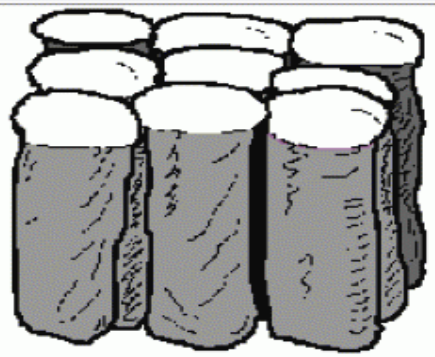
PHYSICAL CHARACTERISTICS OF SOIL

- Color
- Texture
- Structure
- Pores
- Soil water
- Soil air

https://www.qld.gov.au/environment/land/soil/soil-properties/colour/

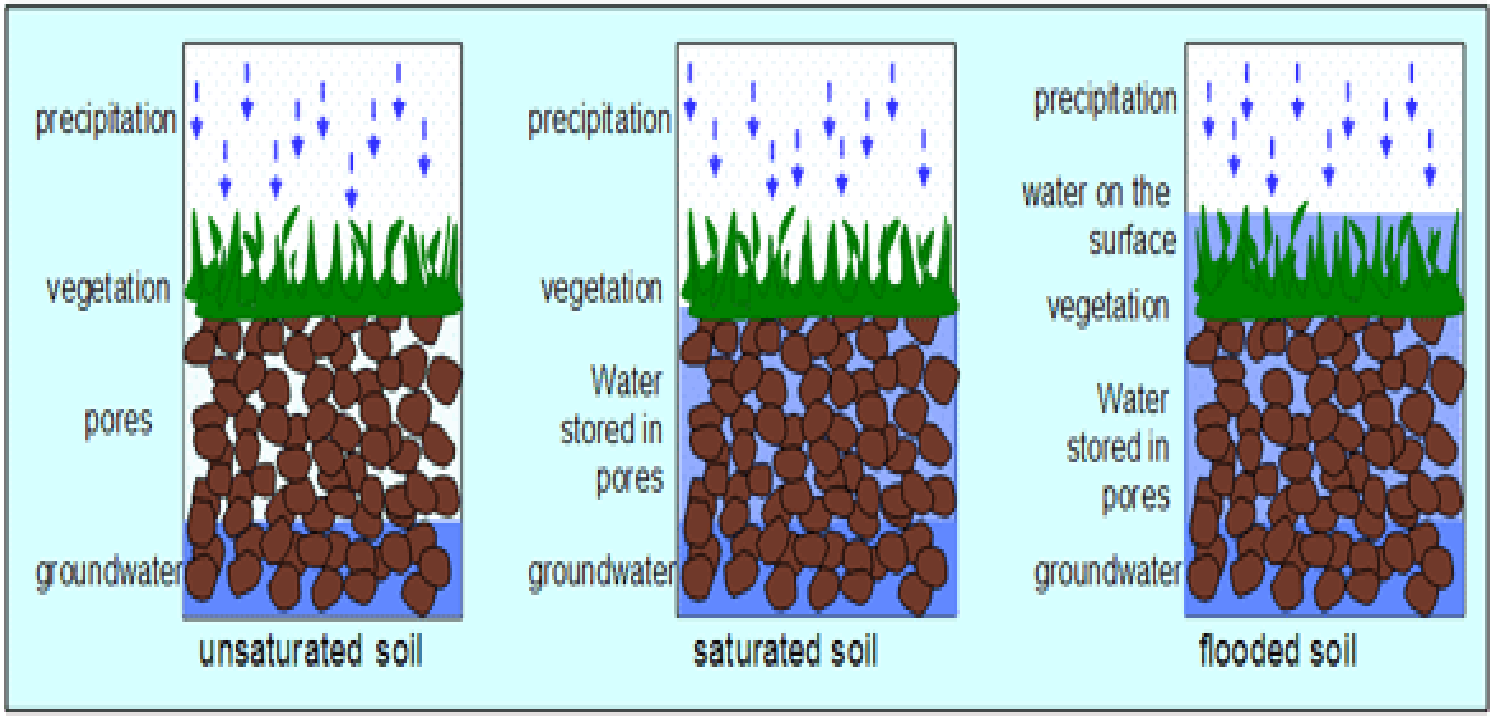
Why different color?

Why different pattern (structure)

		
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.	**Prismatic**: Vertical columns of soil that might be a number of cm long. Usually found in lower horizons.
		
Columnar: Vertical columns of soil that have a salt "cap" at the top. Found in soils of arid climates.	**Platy**: Thin, flat plates of soil that lie horizontally. Usually found in compacted soil.	**Single Grained**: Soil is broken into individual particles that do not stick together. Always accompanies a loose consistence. Commonly found in sandy soils.

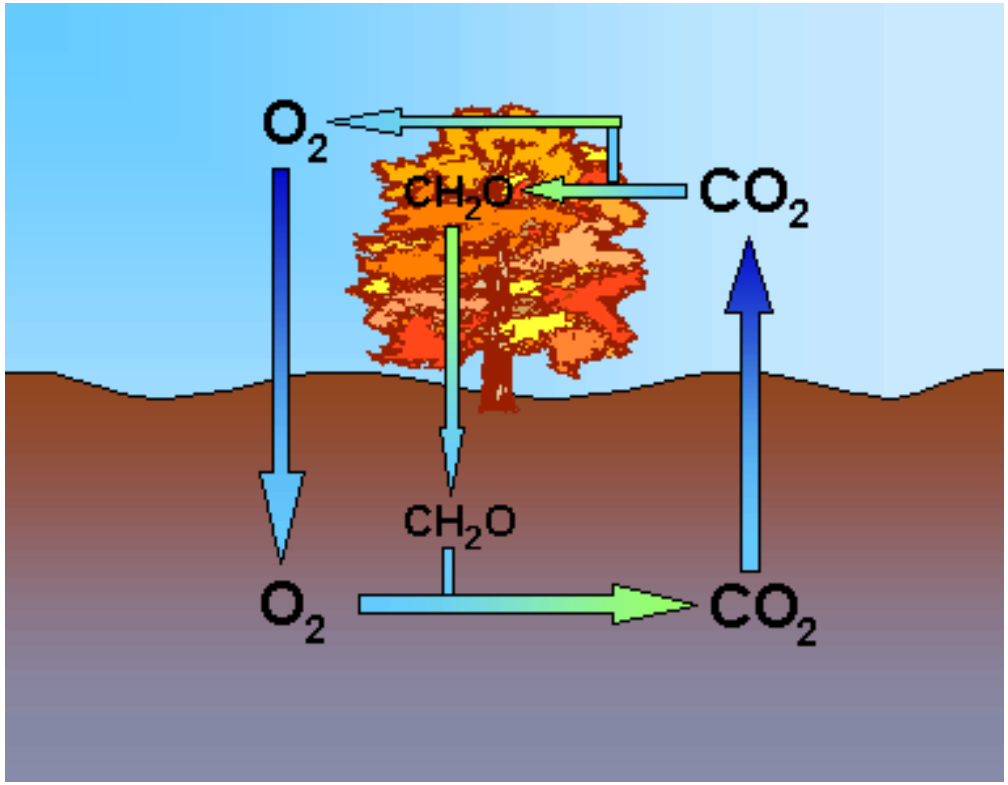
Space in soil (porosity)

Changing water in soil

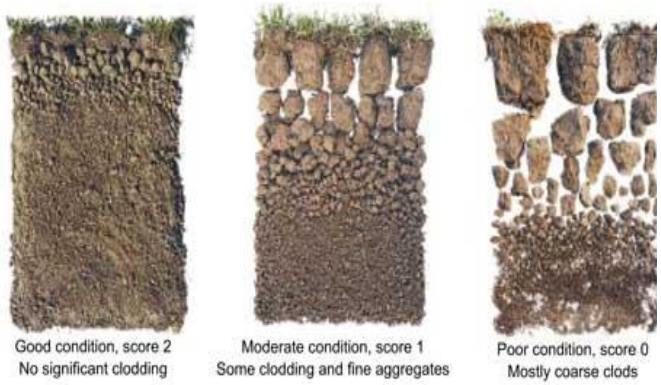


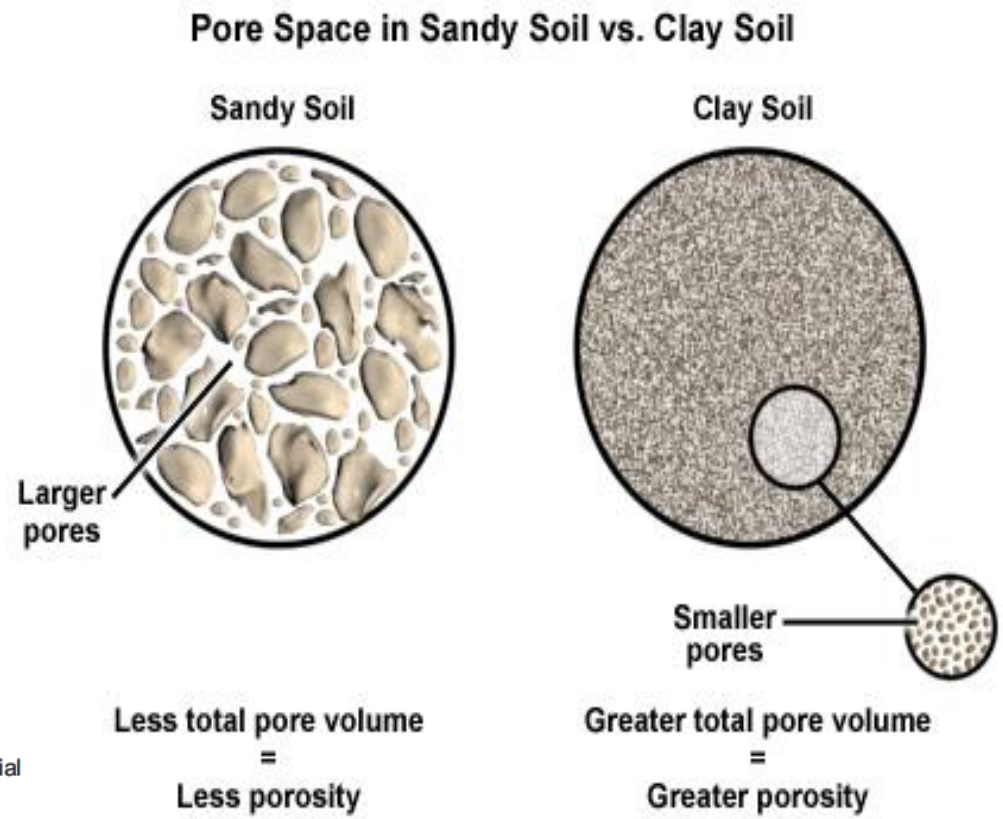
http://www.floodsite.net/juniorfloodsite/html/en/student/thingstoknow/hydrology/waterstorage2.html

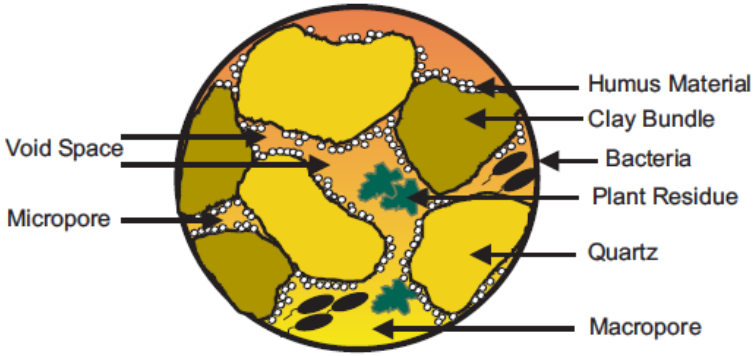
There is an air cycle in soil



Air in little spaces (Soil porosity)



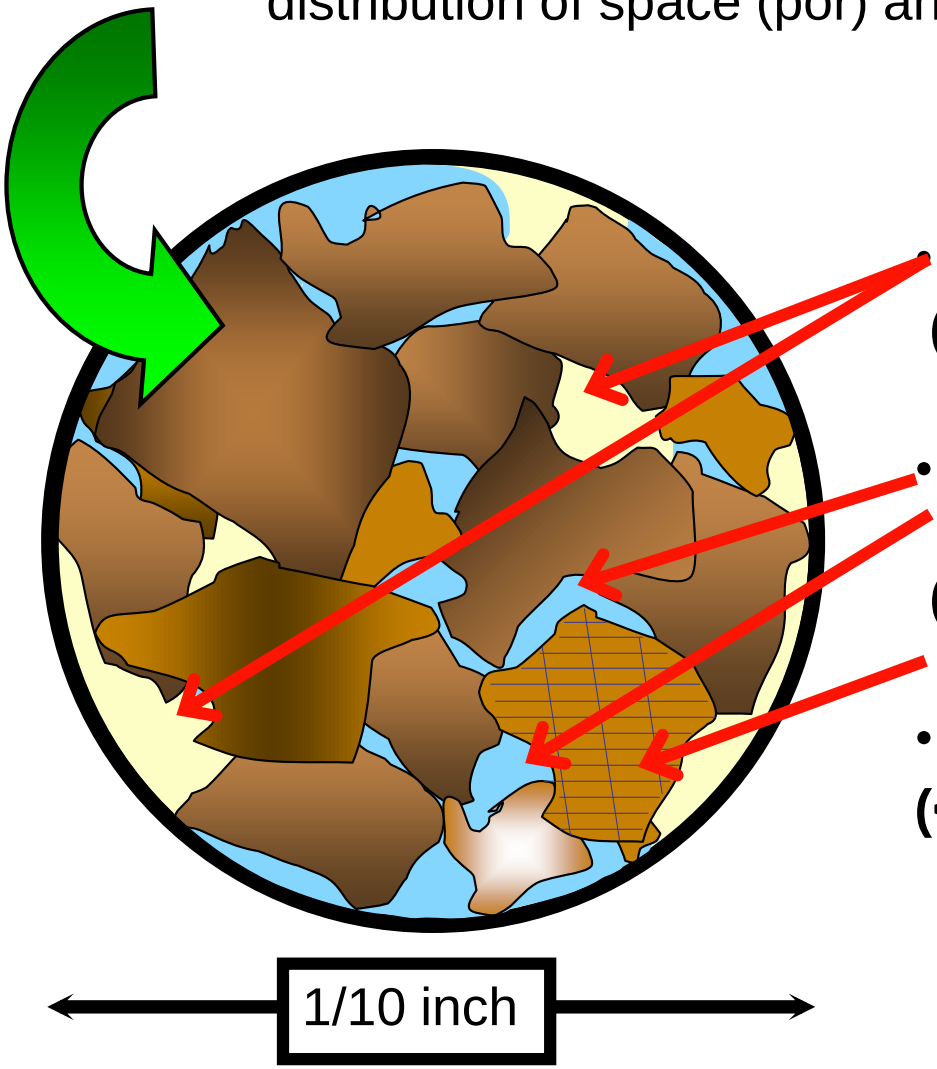




Model of a cross-section of a soil aggregate.
Note the size of the pore openings.

Soil structure

distribution of space (por) and natural soil particles in soil



- **Macropore (big pores)**

(>0.003 inch)

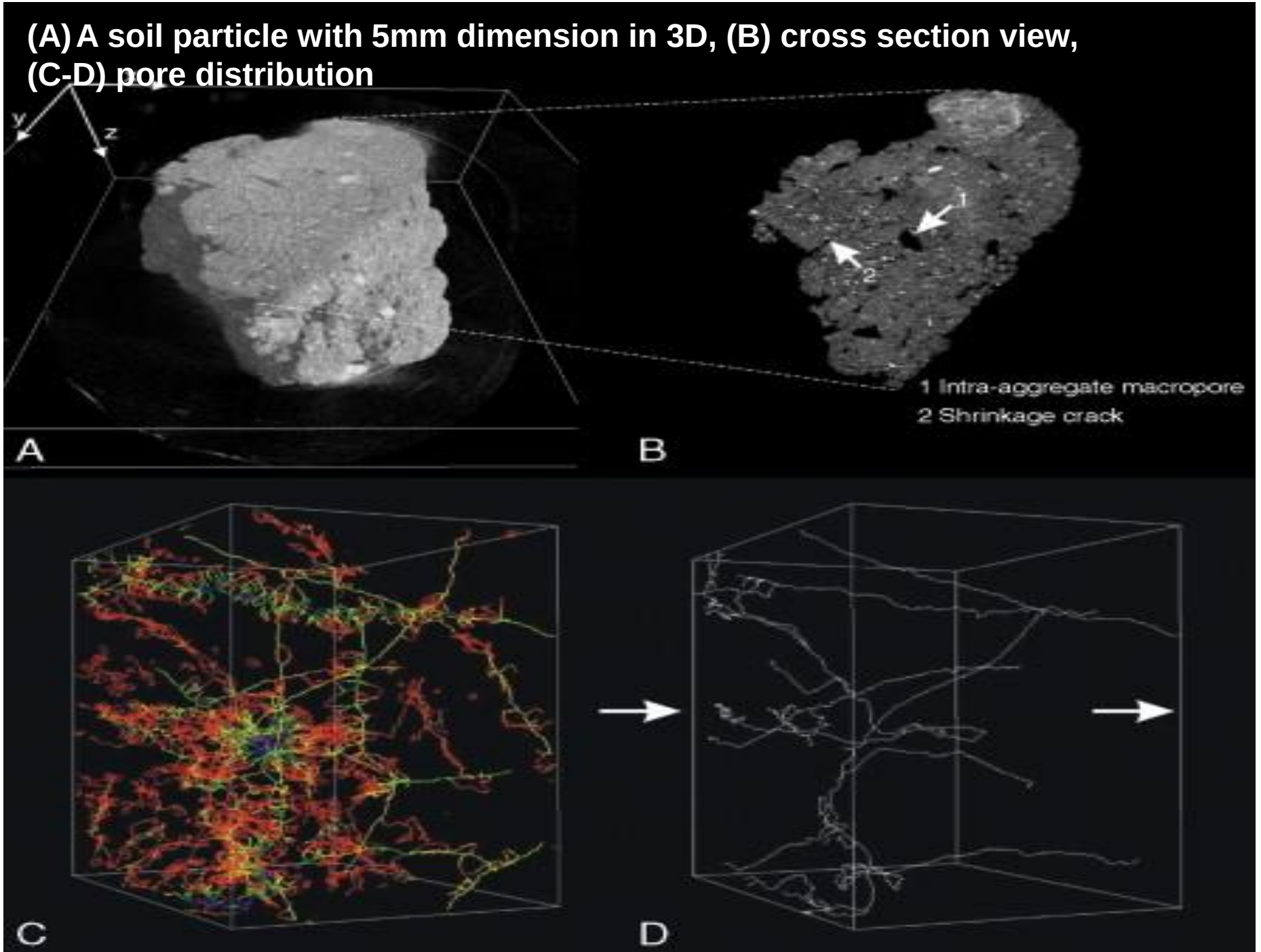
- **Mezopores (intermediate pores)**

(0.001 – 0.003 inch)

- **Micropores (small pores)**

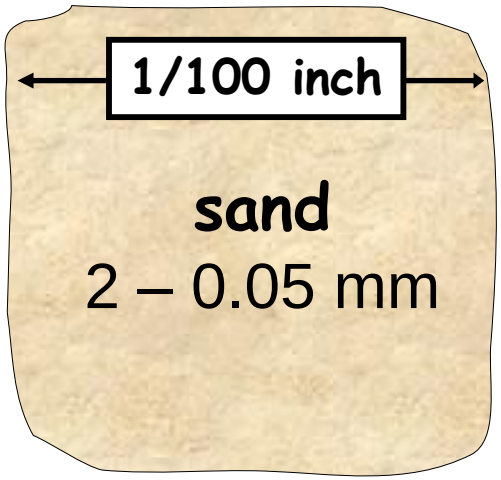
(<0.001 inch)

(A) A soil particle with 5mm dimension in 3D, (B) cross section view, (C-D) pore distribution



Soil texture

- **Soil mineral portion consists of 'clay', 'sand' and 'silt'**

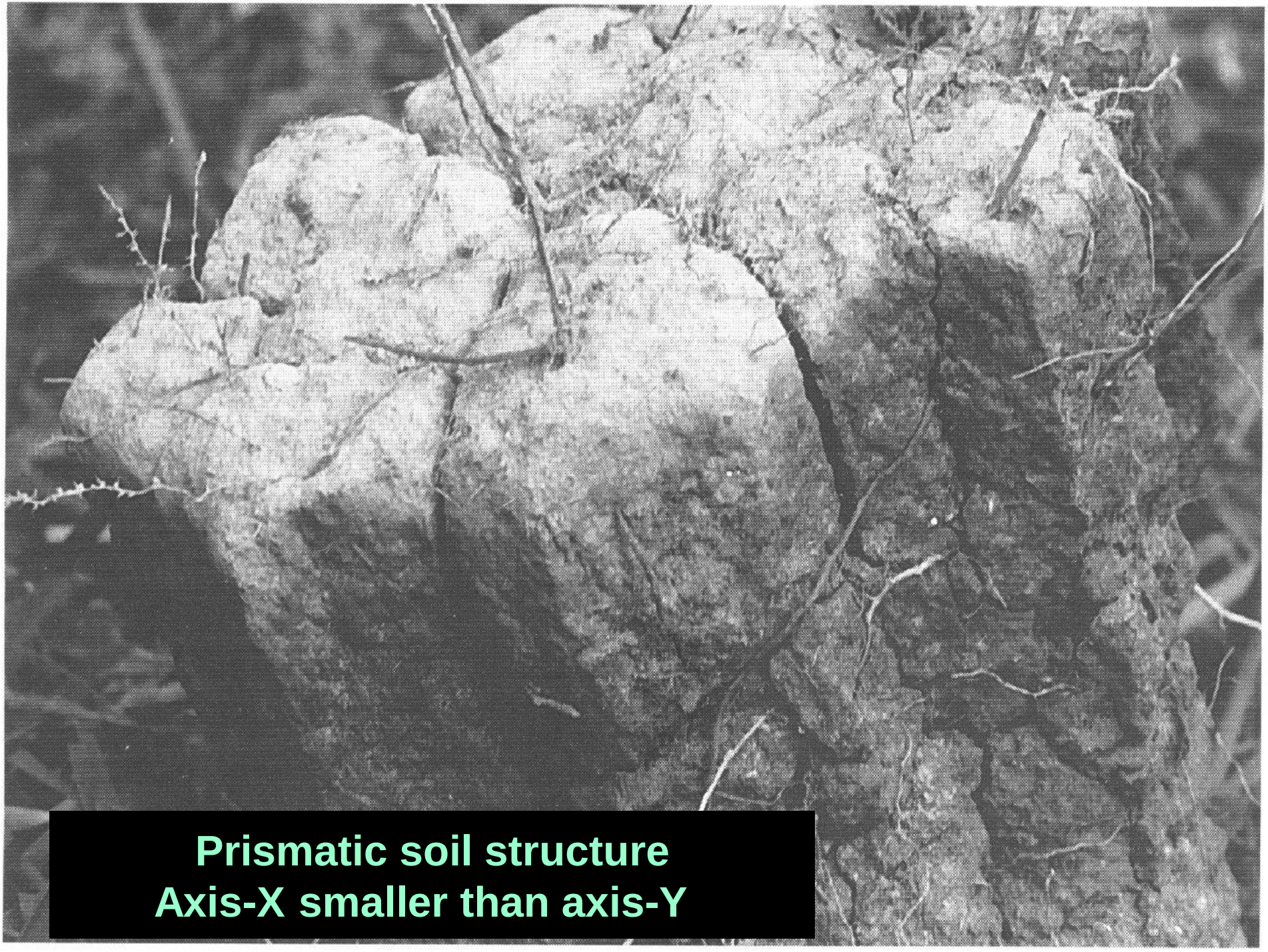


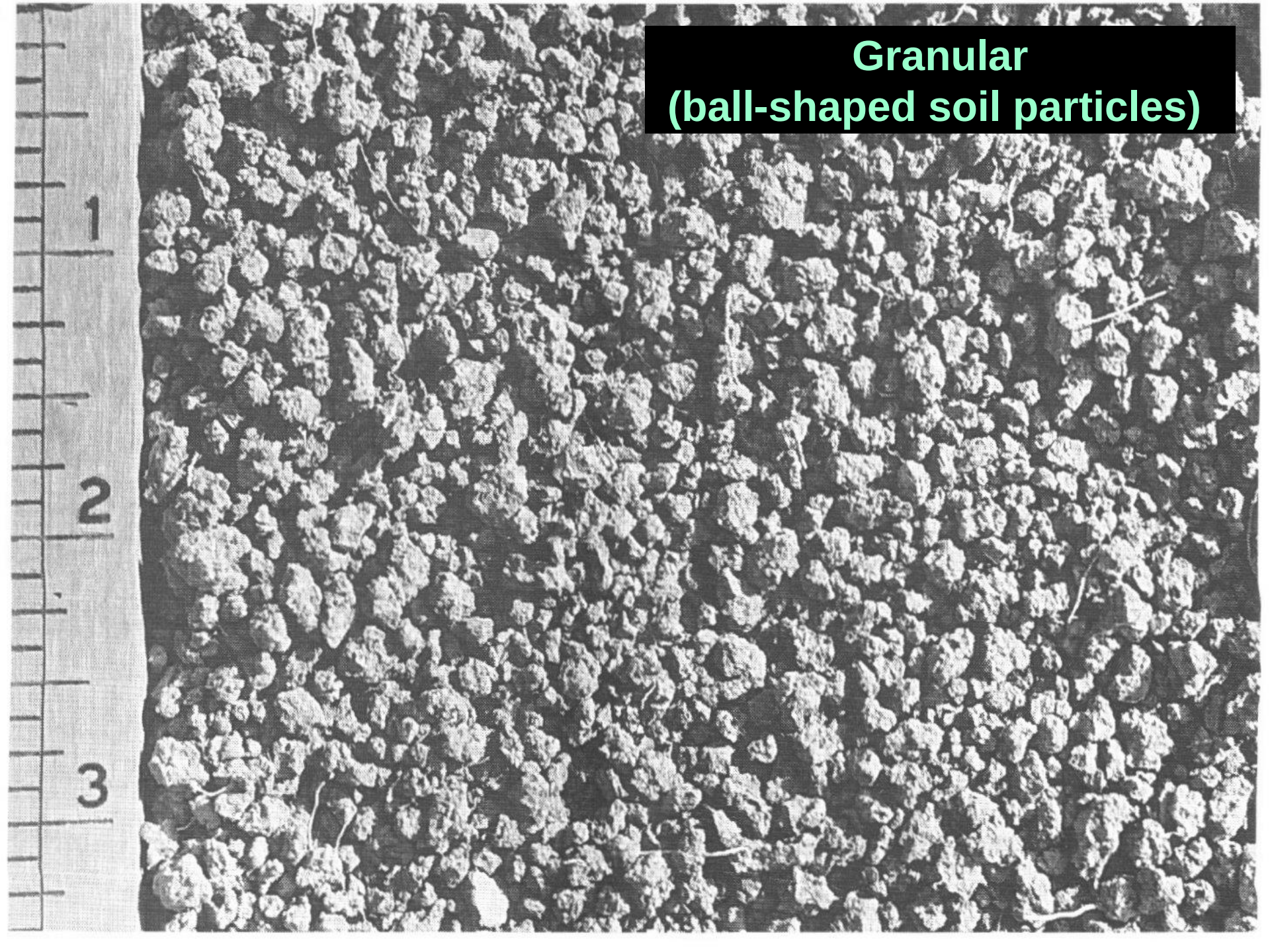
sand
2 – 0.05 mm

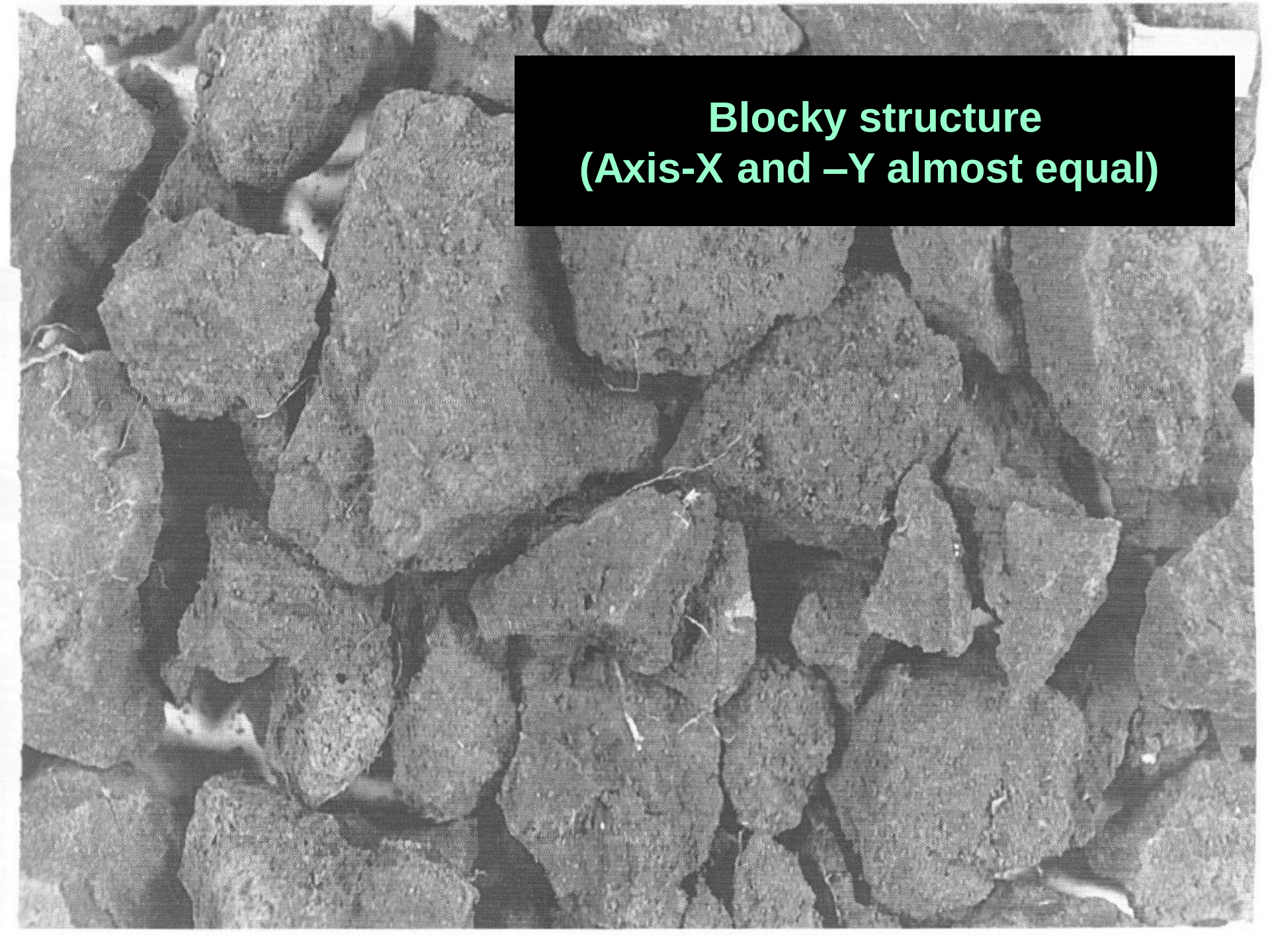
Silt
0.05 - 0.002 mm

clay
Less than 0.002 mm

- **A ratio between these particles (in %) determines soil texture**
  - Coarse texture (more sand-less clay)
  - Heavy texture (more clay –less sand)
  - Loamy(same amount of sand-clay-silt)


Prismatic soil structure
Axis-X smaller than axis-Y


Granular
(ball-shaped soil particles)
1
2
3

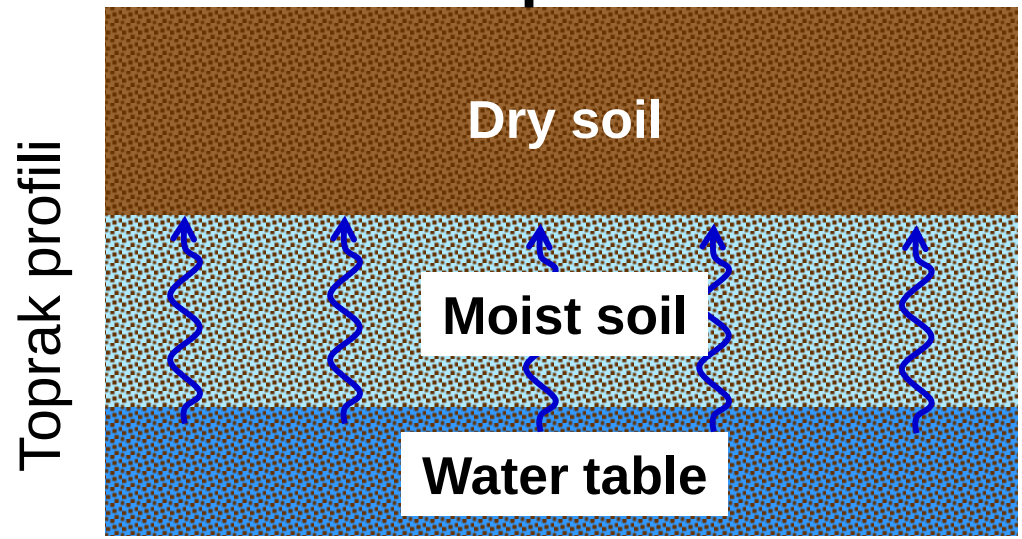

Blocky structure
(Axis-X and –Y almost equal)

Water in soil

Two main forces moving water in soil

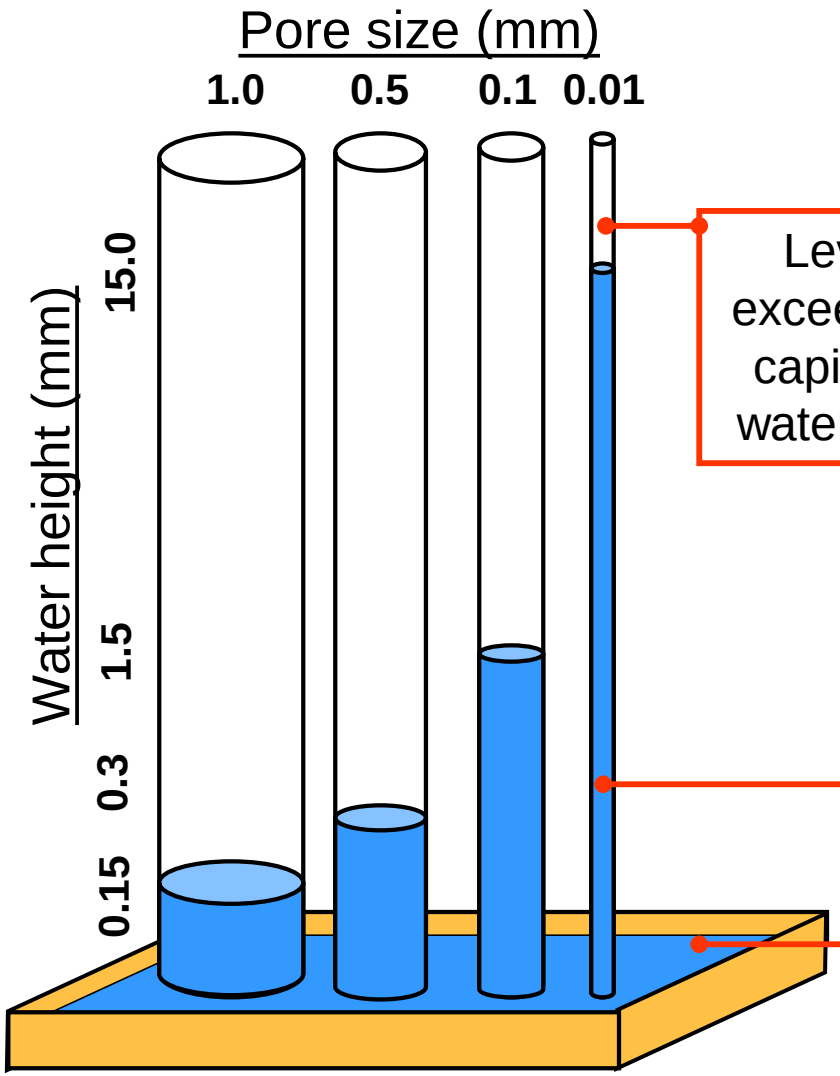
gravity

Matric potential

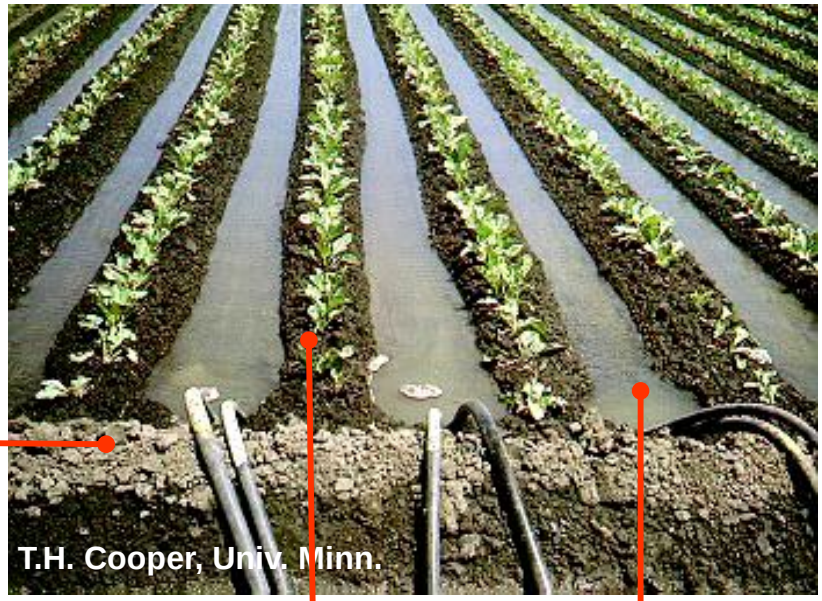


In conditions with less water in the micropores, physical attraction force between soil-water surface is driven by slow water movement called "capillarity"

Capillary water movement in soil



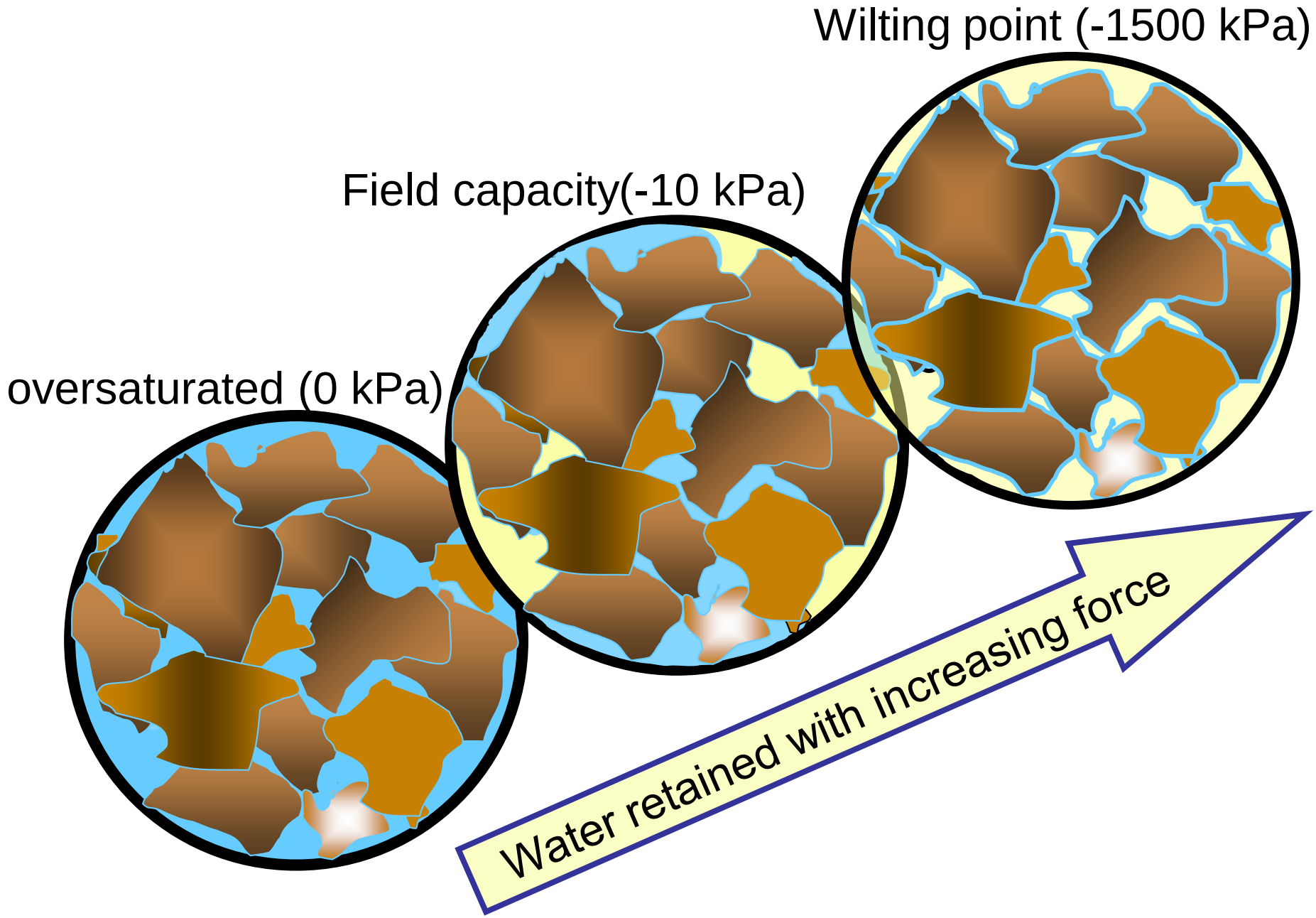
Level exceeding capillary water rise



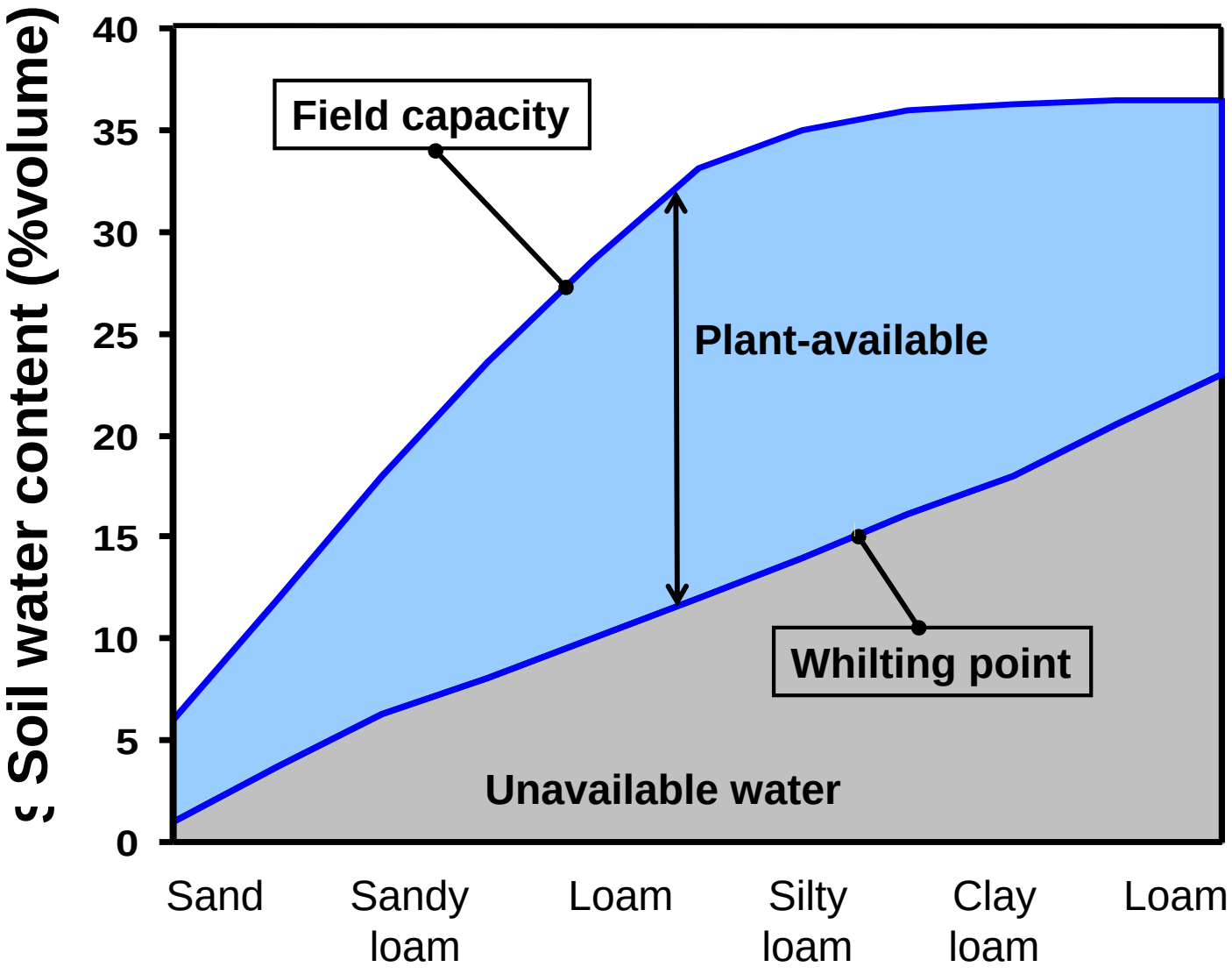
Capillary rise

Free water

Water retention in soil

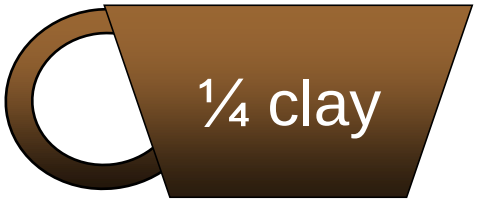


Plant available water

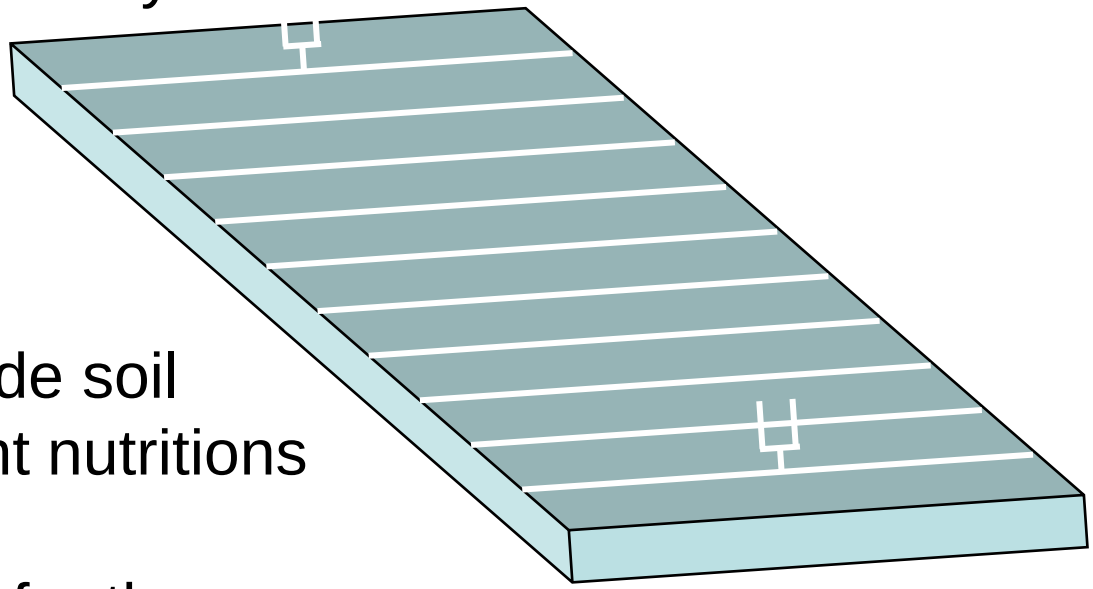


Brady and Weil. 1999. *The Nature and Properties of Soil*. Prentice Hall

“CLAY SURFACE”

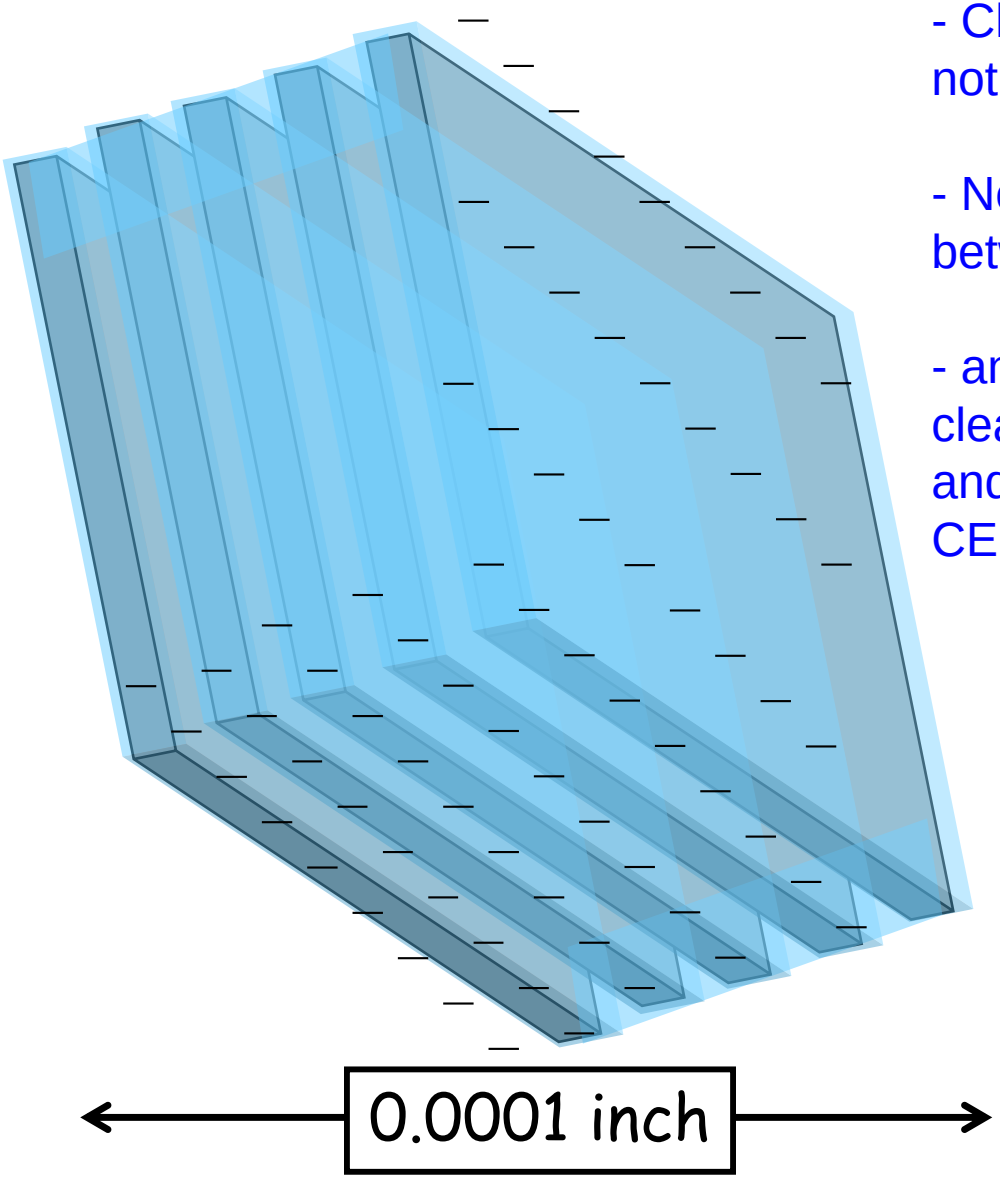


Half of a coffe cup filled with pure clay equals a football field in terms of chemically active surfaces



Clay surface areas provide soil
- to retain water and plant nutritions and
- adhesive characteristic for the development of different soil structures

Clay characteristics



- Cleavage design (like pages of a notbook)

- Negatively charged regions within and between clay cleavages (called colloid).

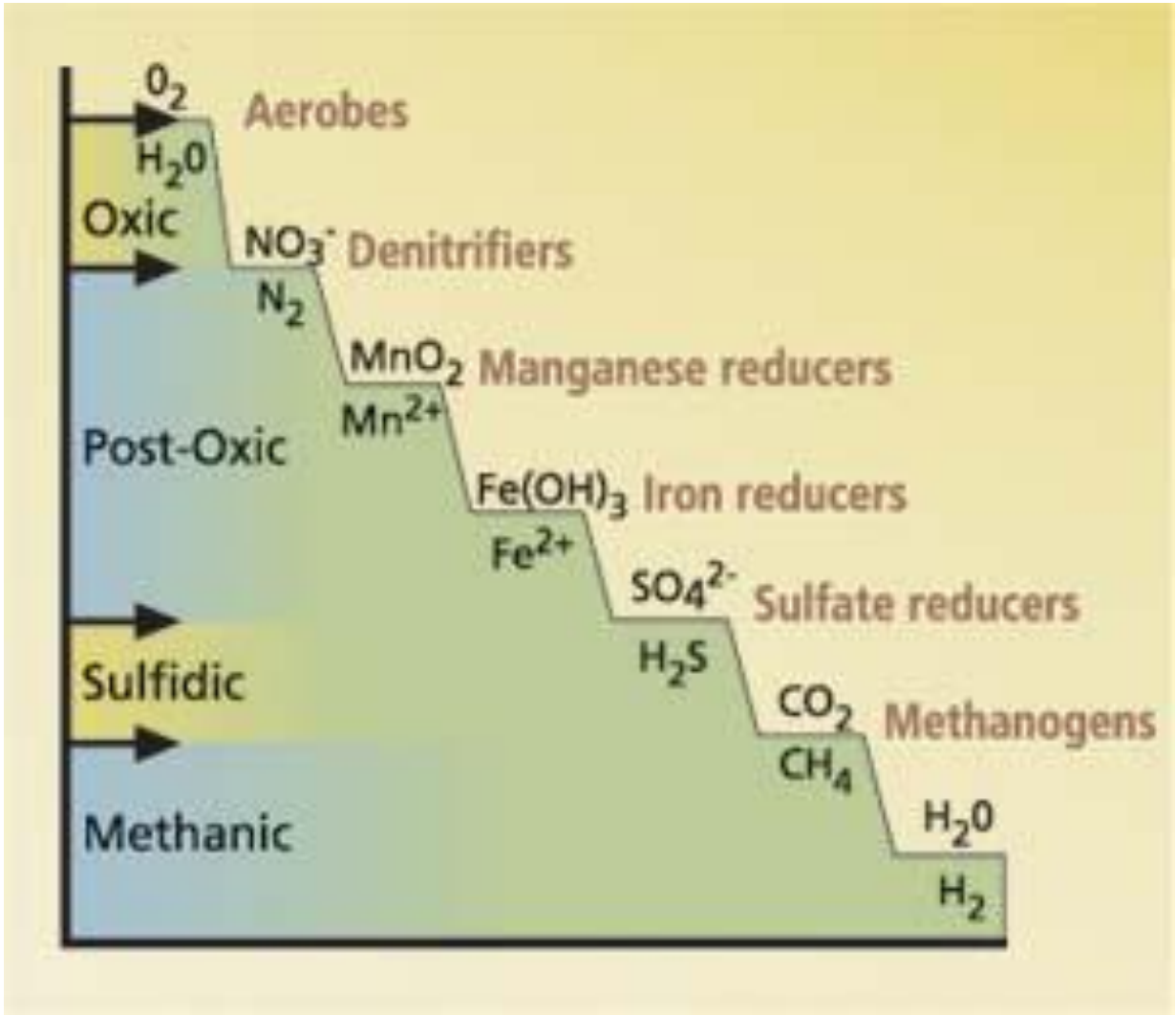
- anion/cataion changes between clay cleavages and soil water define adsorbtion and desorption (which are basis of SOIL CEHMISTRY)

Soil Reaction
(soil pH)

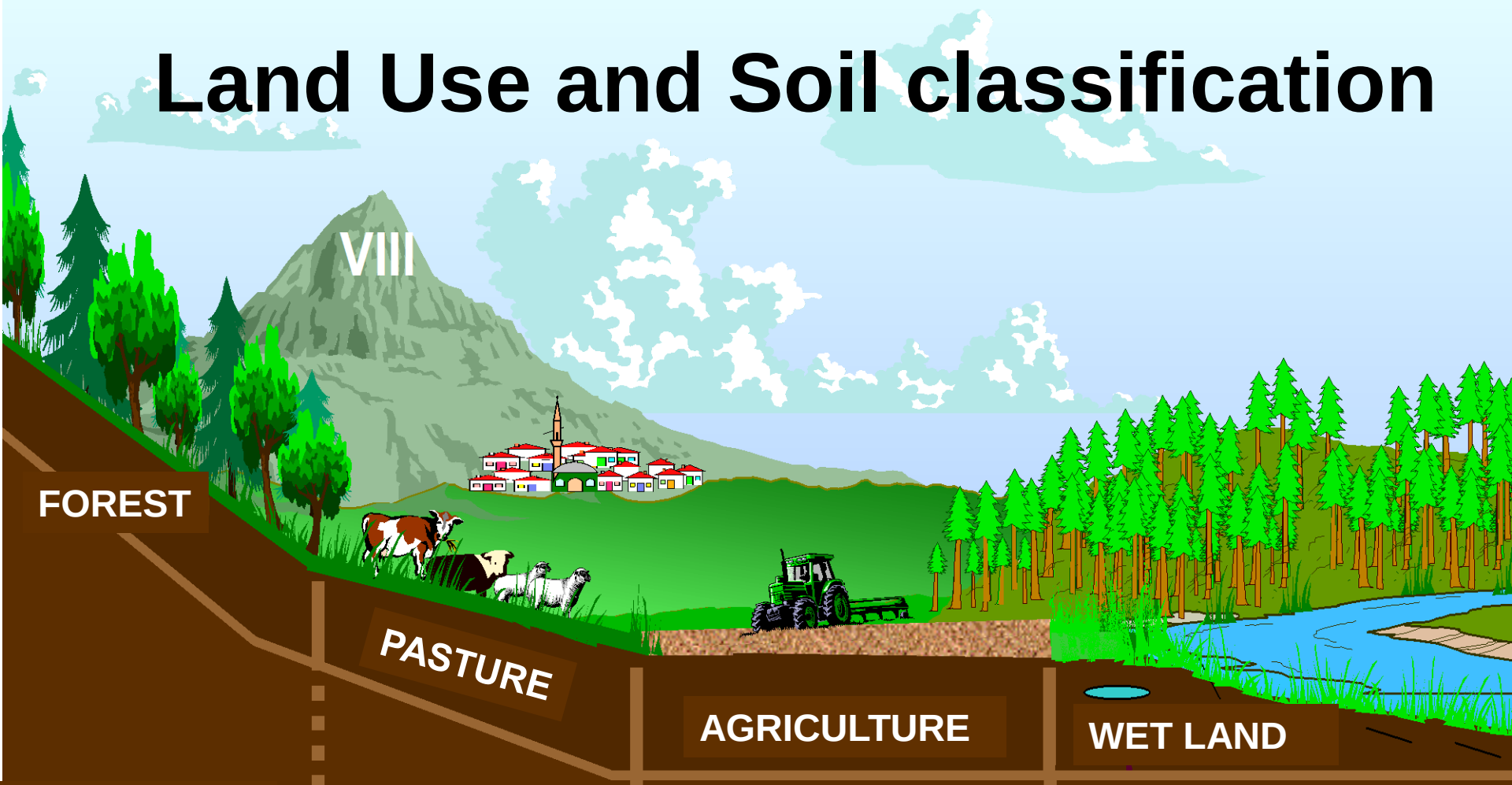
- Defines soil acidity/alkalinity/neutrality
- Function of concentrations of H^+ ve OH^- ions in soil
- pH+pOH = 14 ;
- pH<7 **acidic** ;
- pH=7 **neutral**
- pH>7 **alkaline**
- **pH of agricultural soils** usually change between 5 and 8.5, rarely goes below pH 4 (i.e. Ordu Region, Black Sea Turkey)
- **Potential soil acidity**; acidity of clay surface due to H ions adsorbed onto clay colloids
- **Acitive soil acidity**; acidity due to H ions in soil water
- The balance between potential and active soil acidity creates **soil buffering capcity**

Acid rains do this so imagine what it can do in soil!

Soil redox potential
(ooxidation and reduction processes)



Land Use and Soil classification



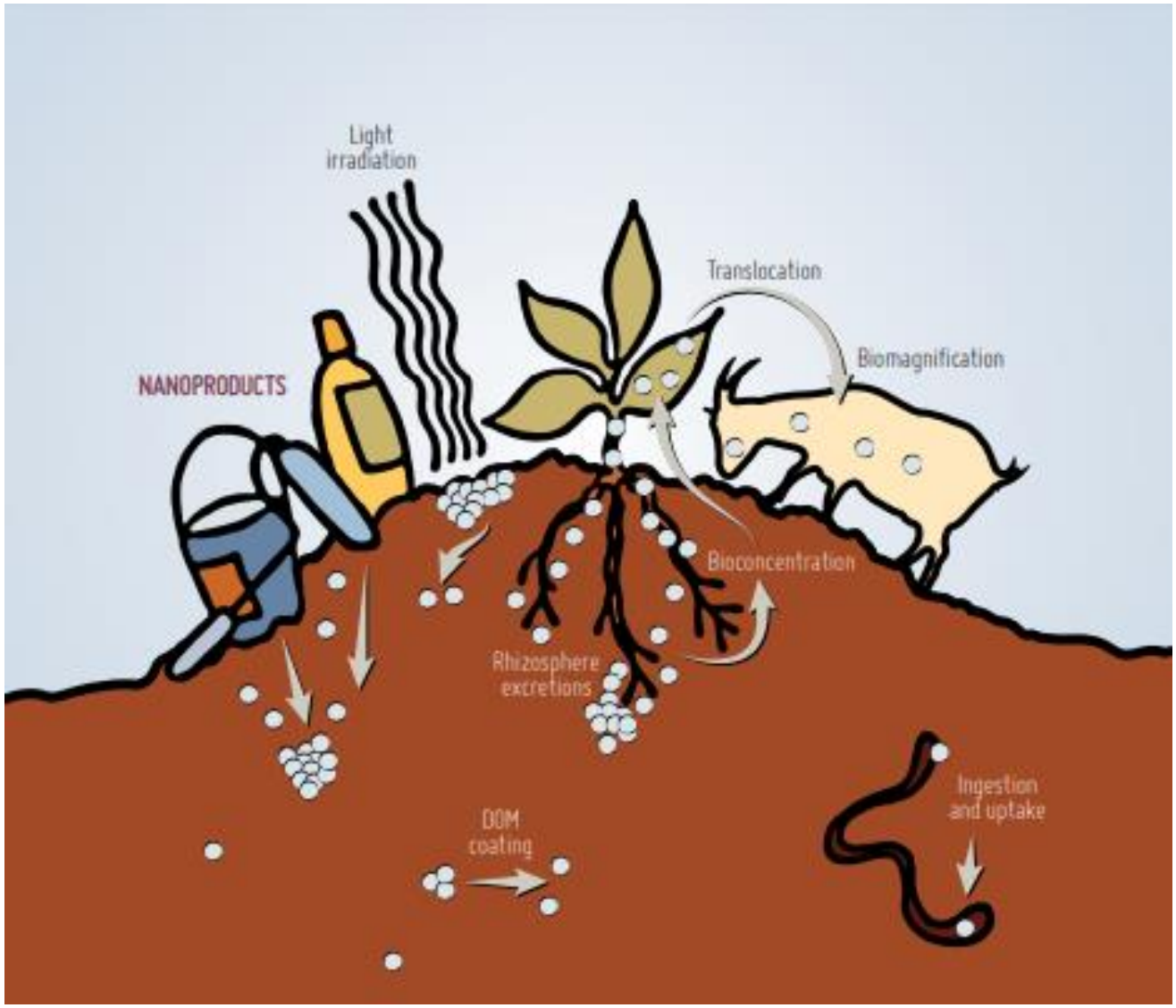
FOREST	PASTURE	AGRICULTURE	WET LAND
20% slope	10 – 20% slope	0 – 10% slope	0 – 10% slope
20,2 Mil. Ha.	21,7 Mil. Ha.	26,5 Mil. Ha.	Total: 77,8 Mil.Ha.
V- VI - VII		I - II - III - IV	V

Common Soil Problems

Common Soil Problems

Common Soil Problems

Common Soil Problems



Common Soil Problems

Common Soil Problems

Common Soil Problems

Crusting and compaction