

2017 SUSTAINABLE AG EXPO



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Soil Health



What does it mean?

How to increase soil health?

How to measure soil health improvements?

California's Healthy Soils Initiative:

Sustaining Soil...Combating Climate Change

Benefits of Healthy Soils

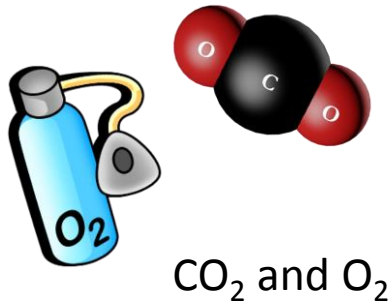
- **Improve plant health and yields** –contain important nutrients, that improve plant growth and yields.
- **Improve biological diversity and wildlife habitat** – at least a quarter of the world's biodiversity lives in the soil; healthy soils improve habitats and other natural resources.
- **Reduce sediment erosion and dust** – improve aeration, water infiltration, flood management and resistance to erosion and dust control.



- **Sequester and reduce greenhouse gases** – carbon stored in soil reduces overall greenhouse gas emissions from agriculture.
- **Improve water and air quality** –affects the persistence and biodegradability of pesticides and other inputs.
- **Increase water retention** – healthy soil has the ability to hold up to *20 times* its weight in water.



What does a plant need to grow?

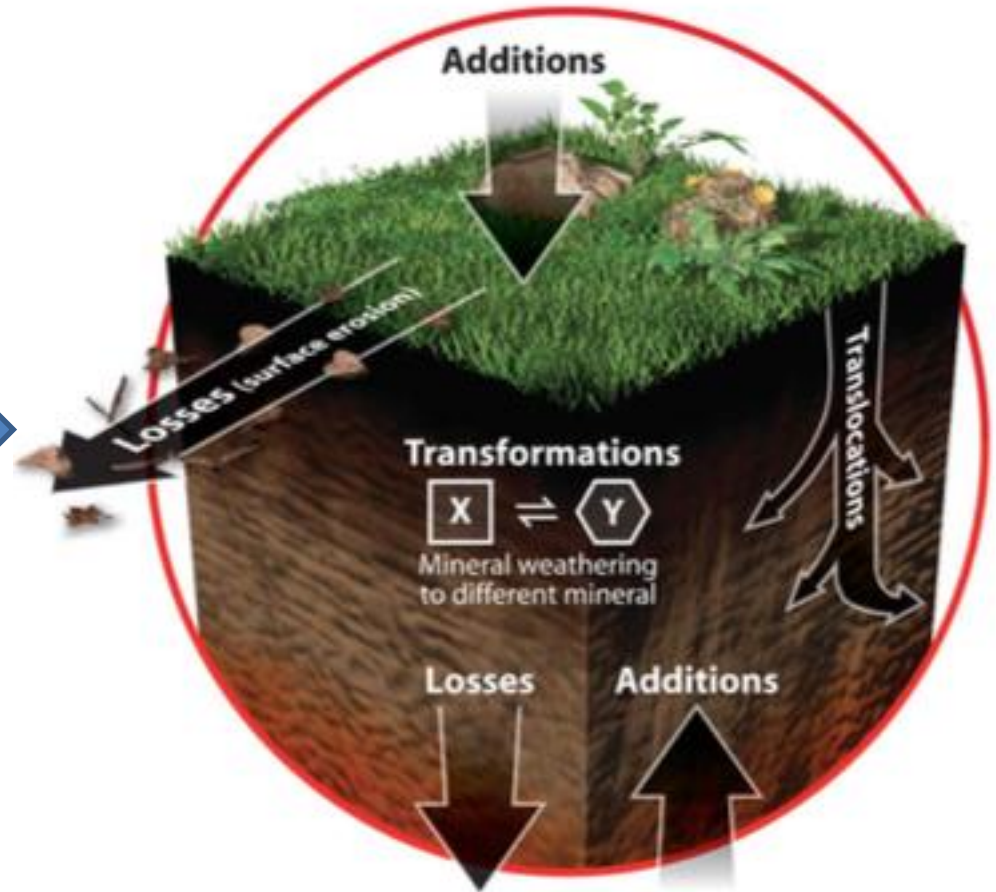


Structural support/space

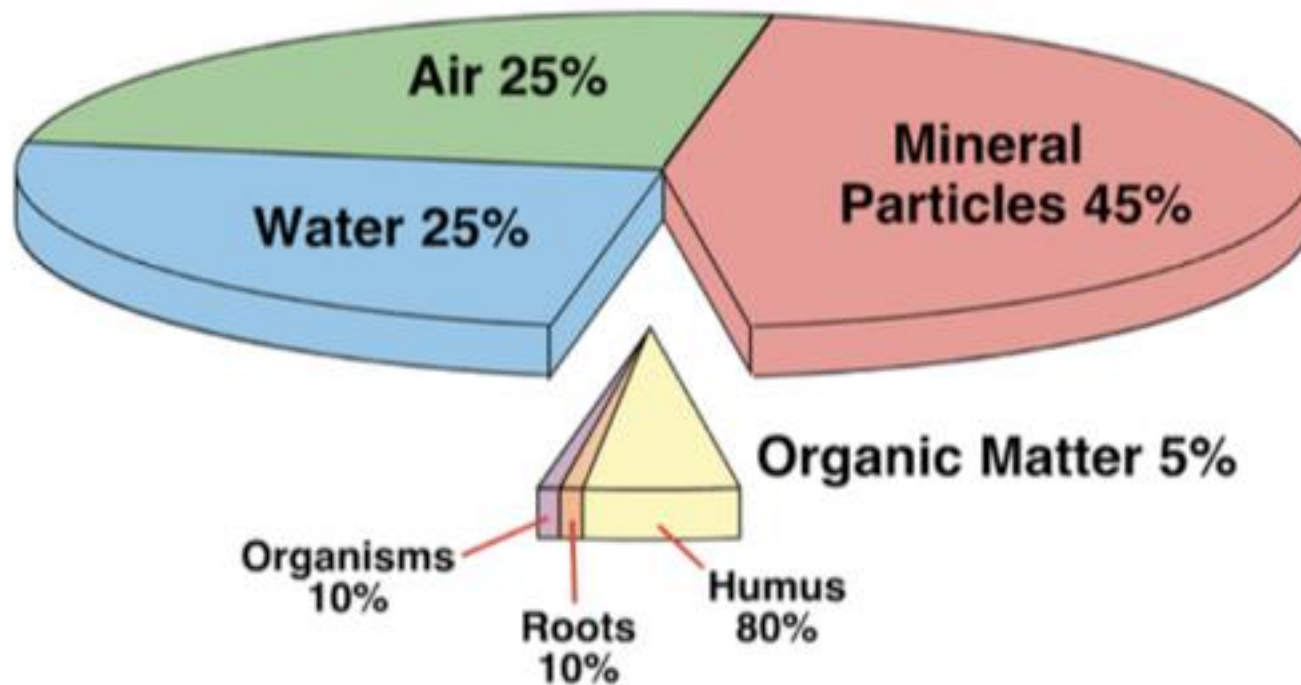
Some soil fundamentals - Soil formation

Soil forming factors

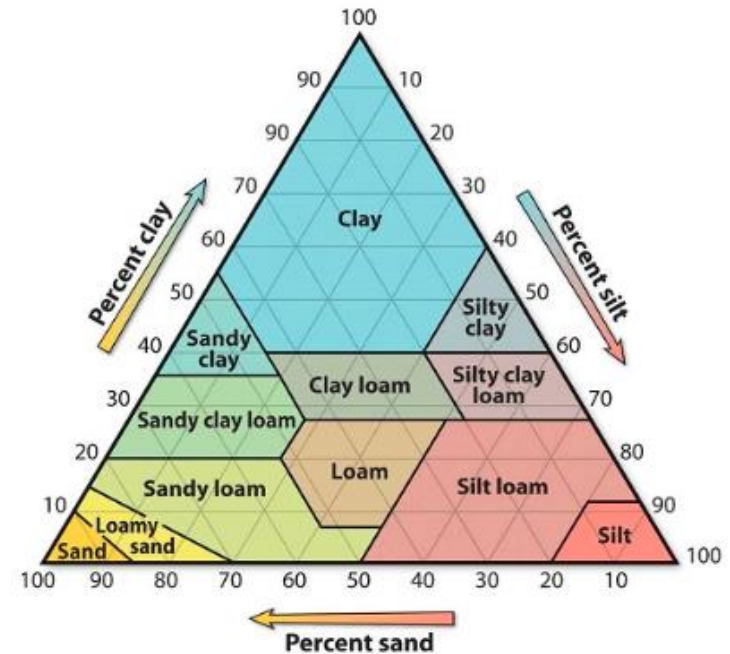
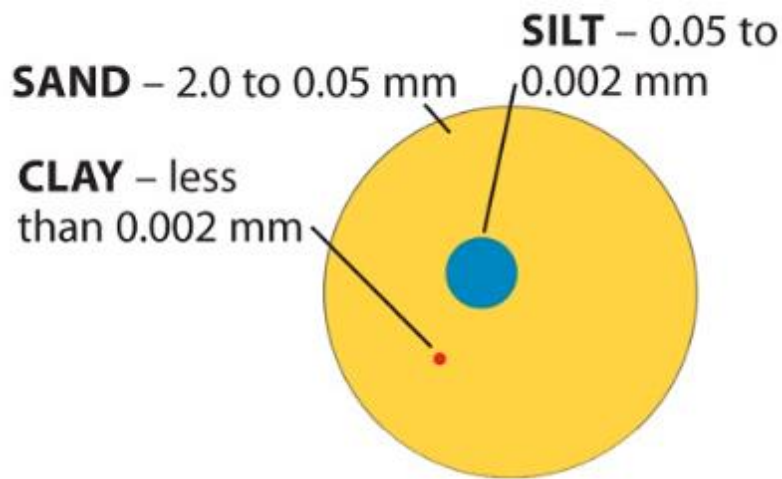
1. Climate
2. Organisms
3. Relief
4. Parent material
5. Time



Some soil fundamentals - Composition



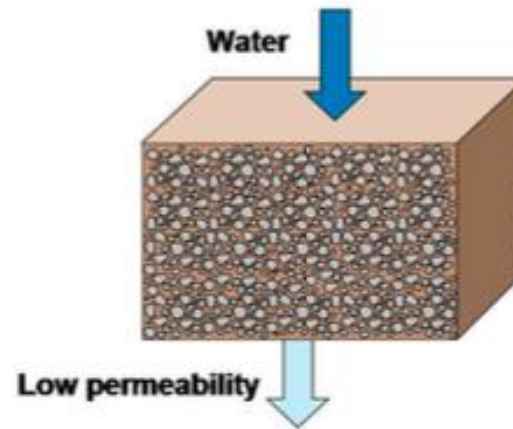
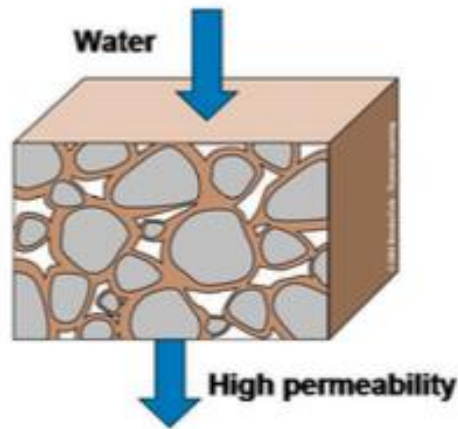
Some soil fundamentals - Texture



Relative proportion of sand, silt and clay particles

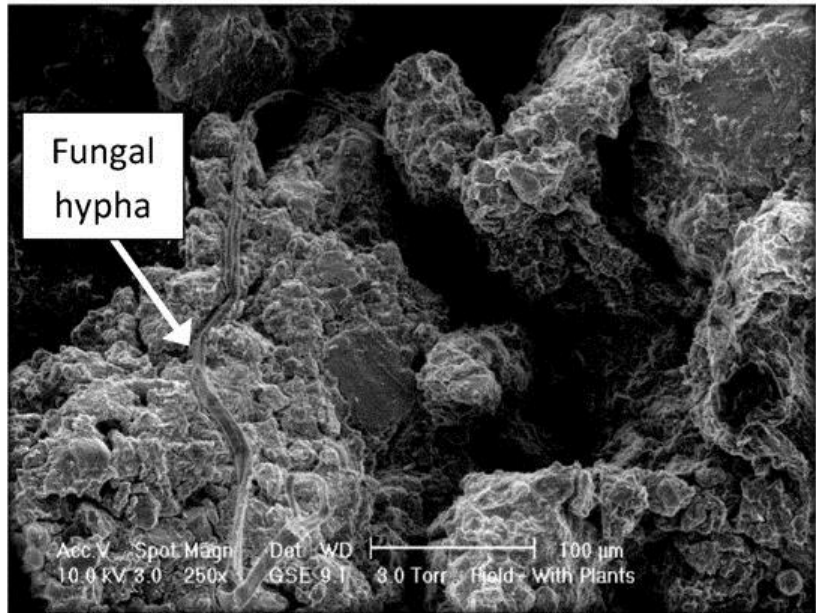
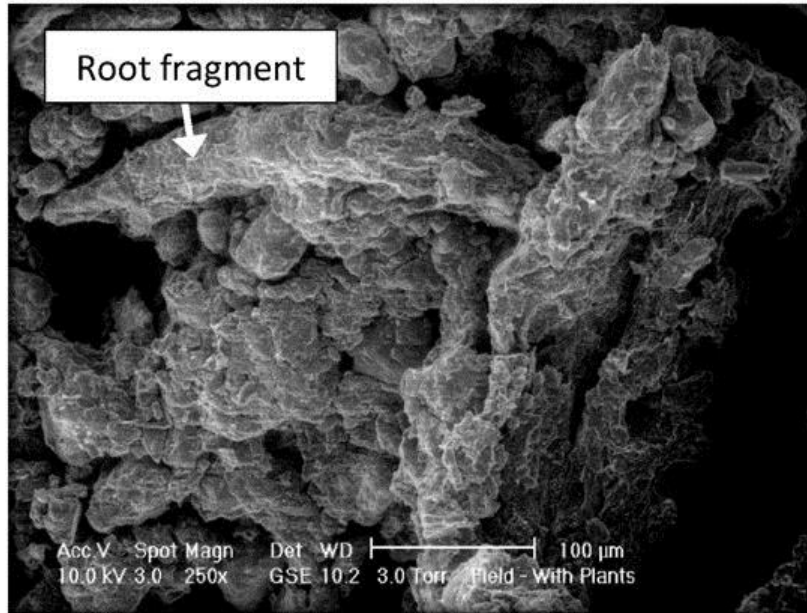
Some soil fundamentals - Texture

- Total pore space and pore size
- Specific surface area
- Water holding capacity
- Soil infiltration, permeability and leaching potential
- Carbon sequestration potential



Some soil fundamentals - Structure

Aggregates from plots with plants

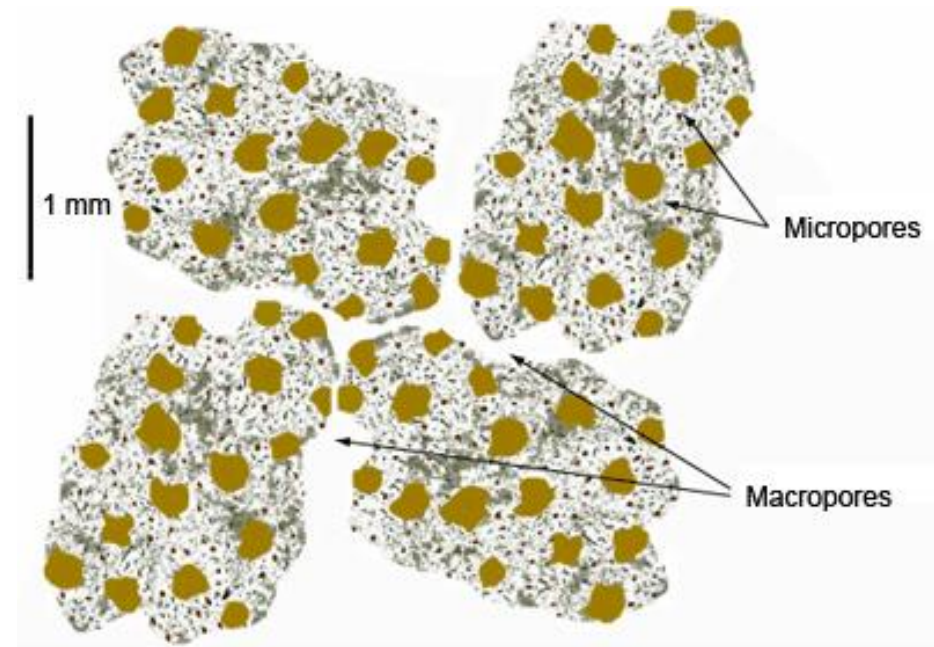


Soil structure defines how soil mineral particles (sand, silt and clay) are bound together and arranged in the three dimensional space

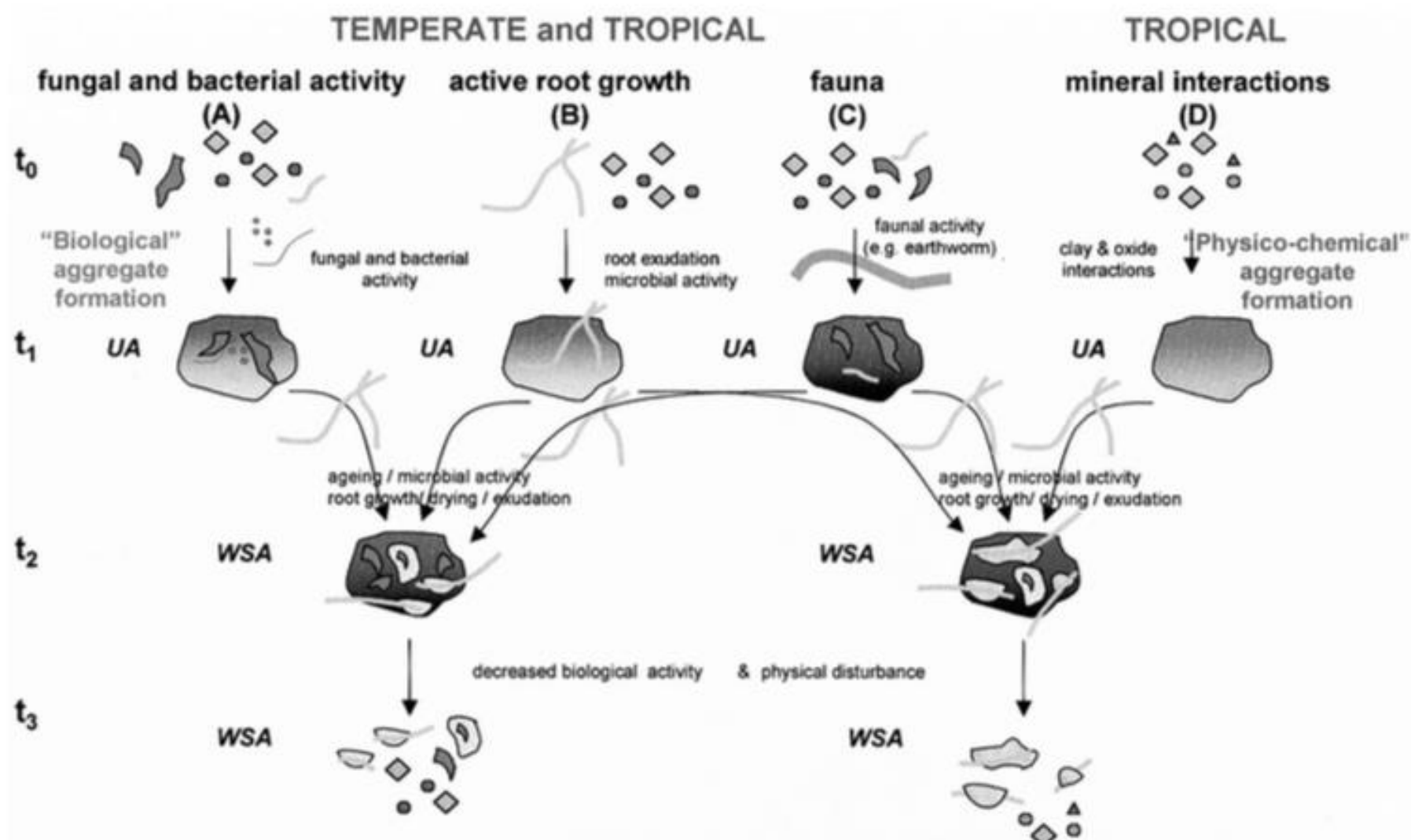
Aggregates are the structural units formed by particles bound together

Some soil fundamentals - Structure

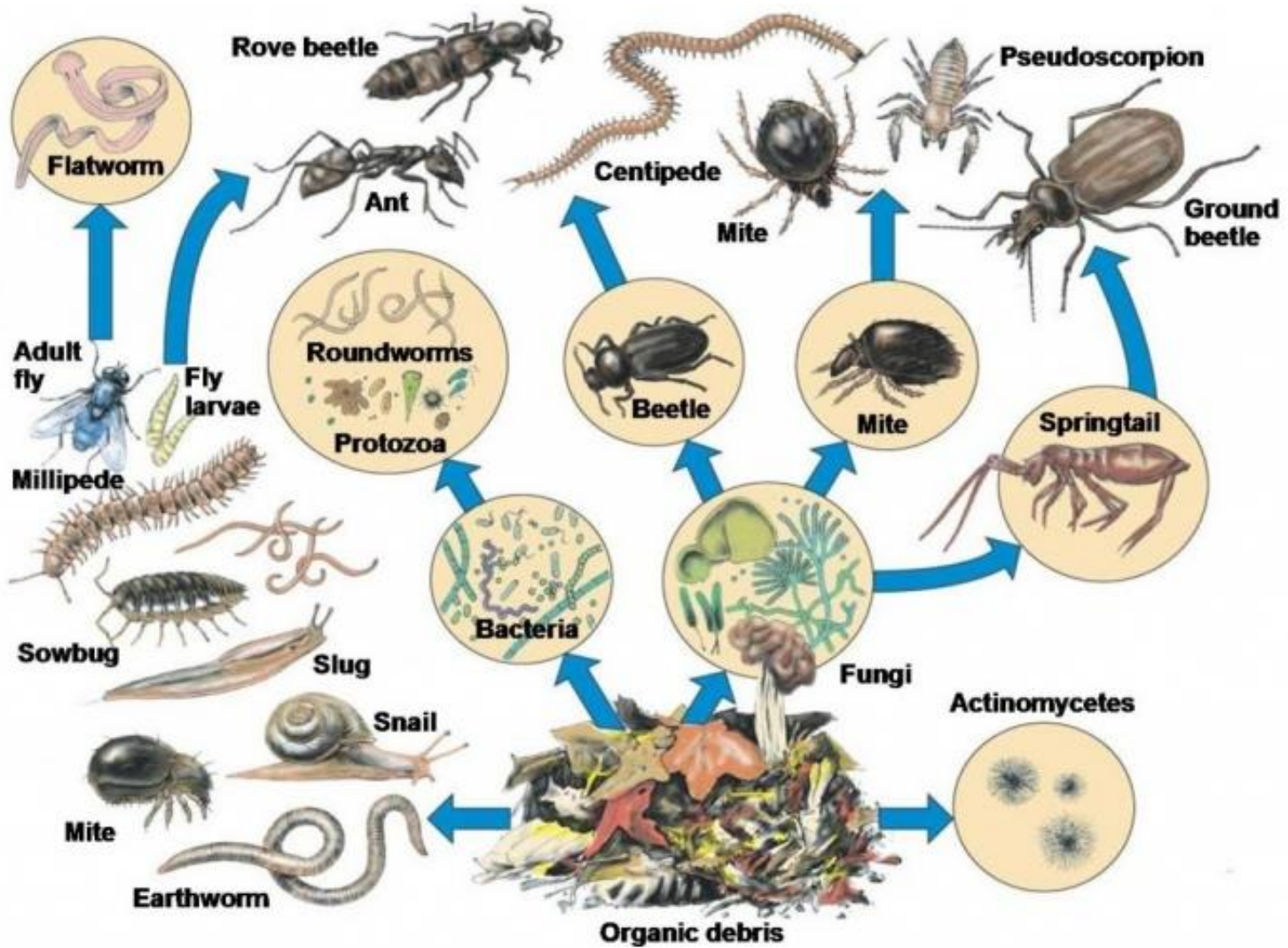
- Reduces soil crusting and erosion
- Determines the capacity of a soil to hold water and air
- Facilitates root development
- Provides microhabitat for soil organisms
- Contributes to C sequestration



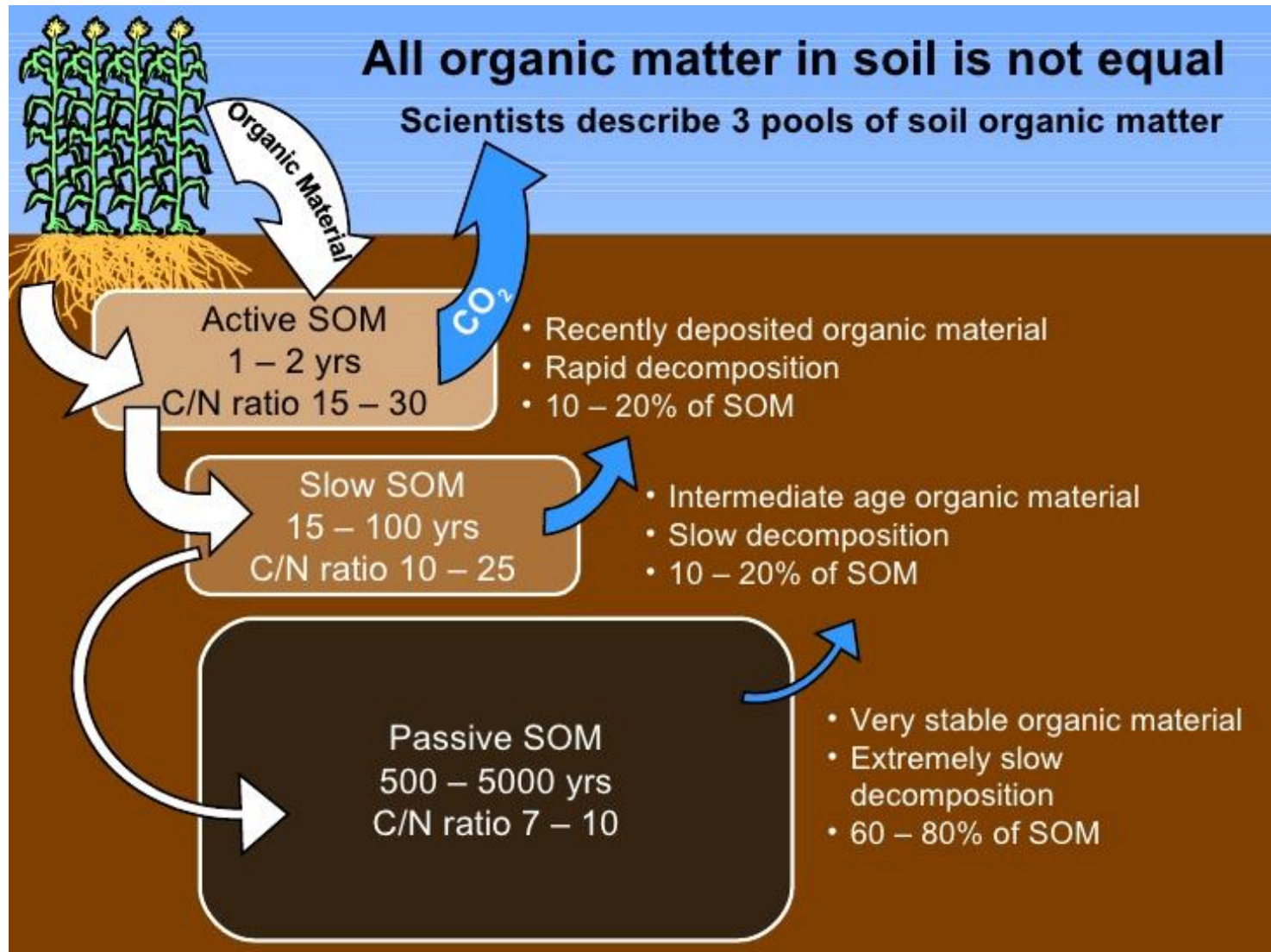
How aggregates form



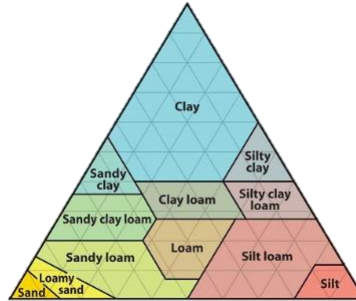
Soil food web



Soil carbon



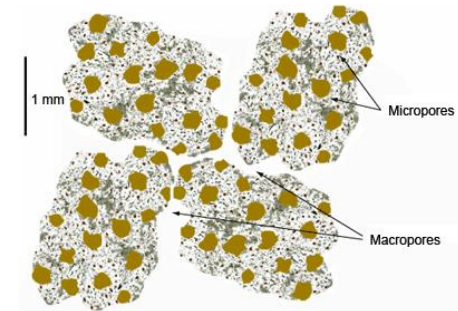
Relating texture, structure, organisms and organic matter



Chemical



Physical



Biological

Relating texture, structure, organisms and organic matter to obtain healthy soils



How to improve soil health?

- Reduced tillage intensity
- Compost application
- Cover cropping



Reduced tillage intensity

- Increases soil aggregation
- Higher soil carbon content
- Better drainage
- Decreased erosion risk



Cover crops



- Erosion control
- Green manure or nitrogen scavenger
- Organic matter input

Compost application

More **STABLE SOIL STRUCTURE**

- better infiltration
- better workability

Higher **NUTRIENT SORPTION** capacity

- Increased nutrient availability

Increased soil **TEMPERATURES**

- Improves plant growth in spring

Higher **WATER RETENTION** capacity

- reduces impacts of weather extremes

Soil maintenance through organic **[COMPOST]** fertilisation

PHYTOSANITARY effect

- Suppression of soil born plant diseases

Better **WORKABILITY** of soil

- reduces energy consumption

Reduced susceptibility for **EROSION**

- Reduced soil loss

Enhancing soil **BIODIVERSITY**

- increases transformation



How to measure soil health?

NRCS soil quality test kit



Chemical factors:

- Electrical Conductivity (EC)
- pH Test
- Soil Nitrate Test

Biological factors

- Soil Respiration
- Earthworms

Physical factors

- Infiltration Test
- Bulk Density Test
- Aggregate Stability/Slake Test

How to measure soil health?

Test Report

Measured Soil Textural Class: **sandy loam**

Sand: **59%** - Silt: **36%** - Clay: **5%**

Cornell assessment of soil health

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.09	28	
physical	Surface Hardness	255	14	Rooting, Water Transmission
physical	Subsurface Hardness	400	18	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	56.4	76	
biological	Organic Matter	2.1	54	
biological	ACE Soil Protein Index	6.9	44	
biological	Soil Respiration	0.6	55	
biological	Active Carbon	359	32	
chemical	Soil pH	5.9	54	
chemical	Extractable Phosphorus	2.3	66	
chemical	Extractable Potassium	175.3	100	
chemical	Minor Elements Mg: 134.0 / Fe: 3.4 / Mn: 2.7 / Zn: 1.3		100	

Overall Quality Score: **53** / Medium



Soil Health



Questions?

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