The Nexus of Soil Health and Soil Fertility

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What is *Soil Health*?

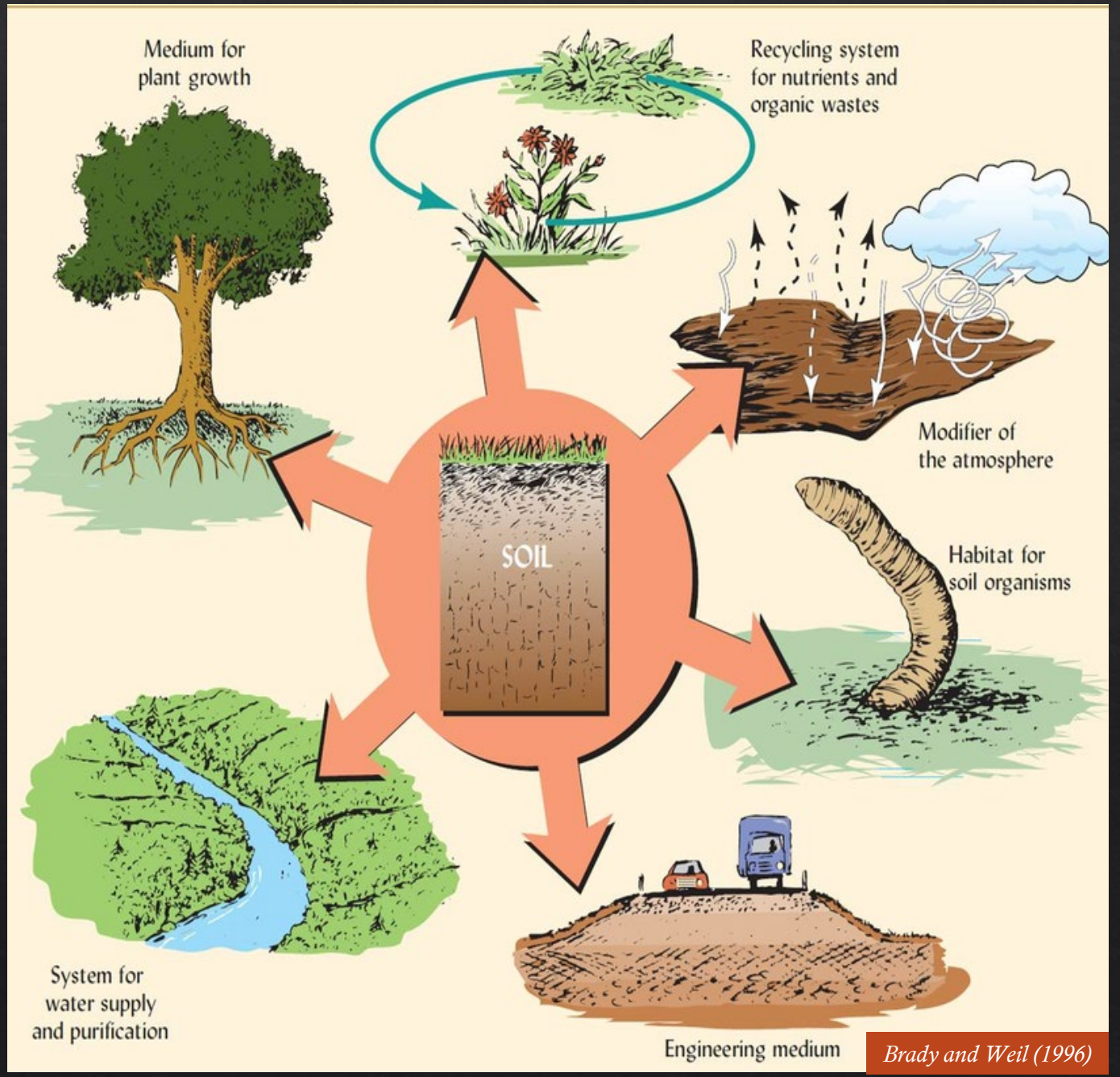
The continued *capacity* of soil to **function** as a vital living system, within ecosystem and land-use boundaries, to ***sustain*** biological productivity, promote the ***quality*** of air and water environments, and maintain *plant, animal, and human* health

(Doran and Zeiss, 2000)

Soil health emphasizes the role of 'Soil Biology'

Soil *Functions*

- Provide plant nutrition
- Improve soil structure
- Facilitate Water Movement
- Maintain biodiversity
- Boost crop production



Brady and Weil (1996)

Soil Health Parameters

Organic Matter

Soil Fertility

Biology

Water Movement

Soil Structure

Soil Carbon

Improve soil structure

Water infiltration & storage

Boost soil biology

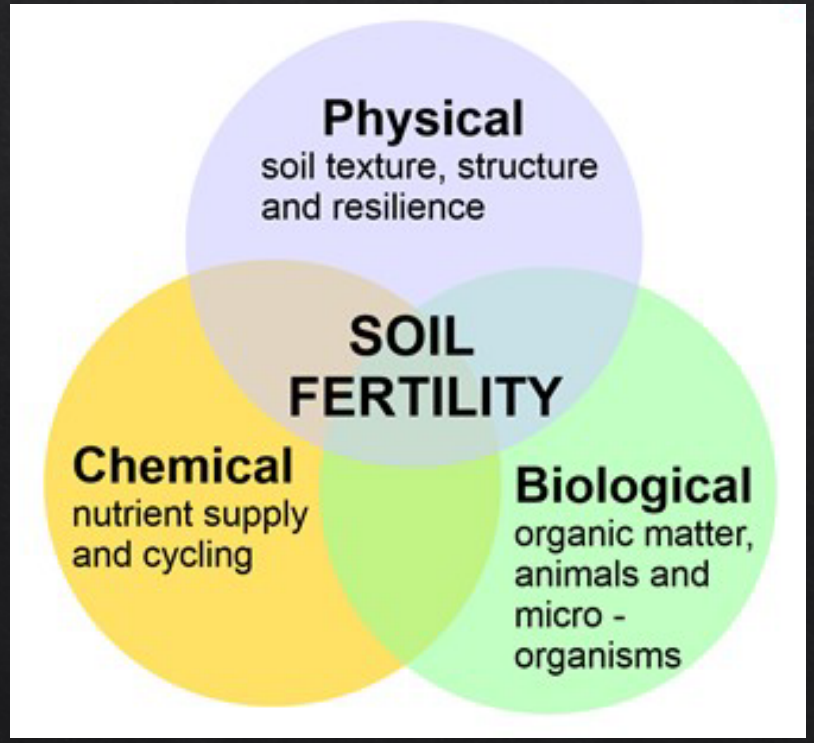
Store & release nutrients

Sustainable farm and food

Build ***healthy soils***

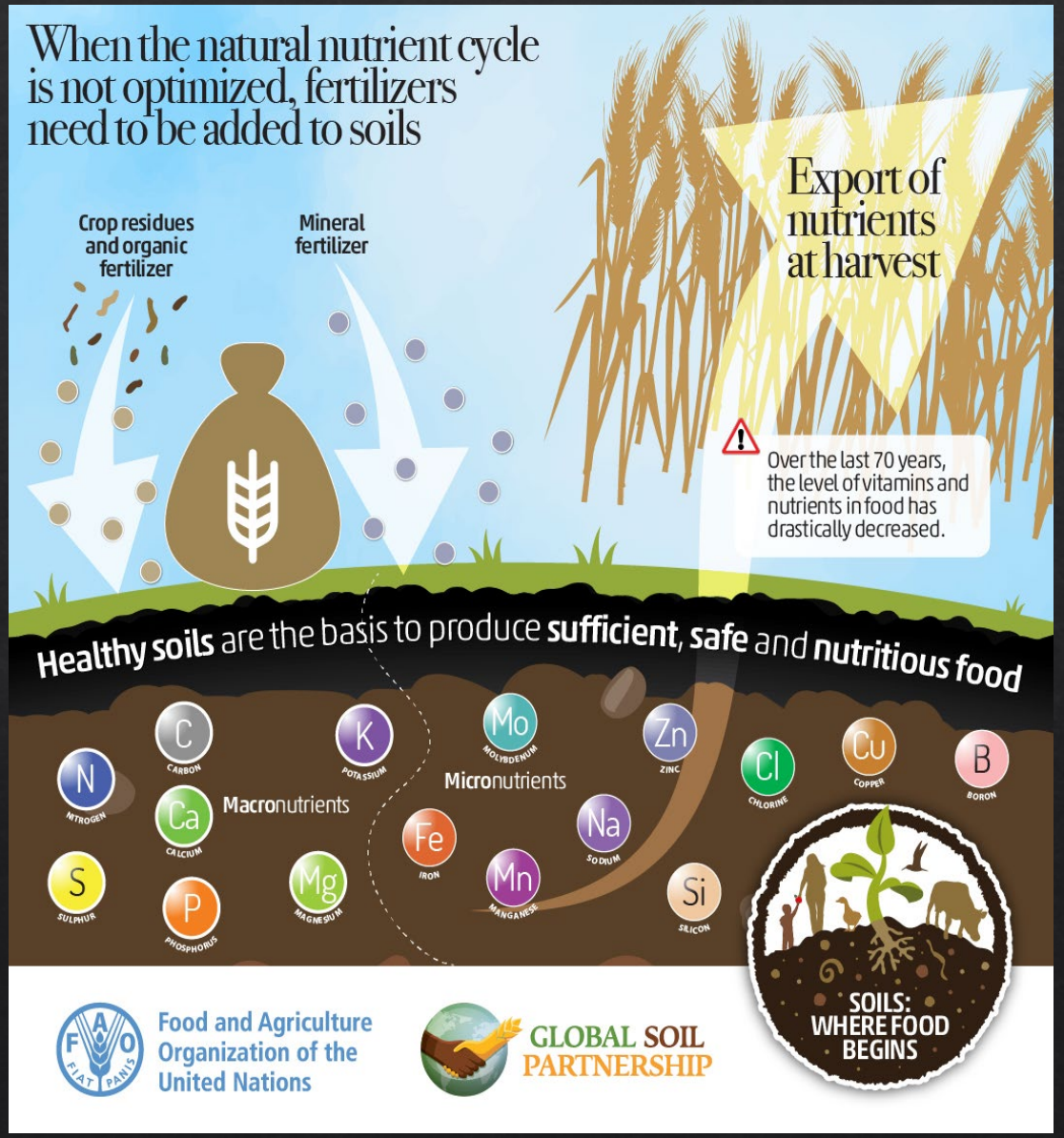
Soil Fertility

The ability of the soil to provide nutrients to plants in proper amounts and proportions.

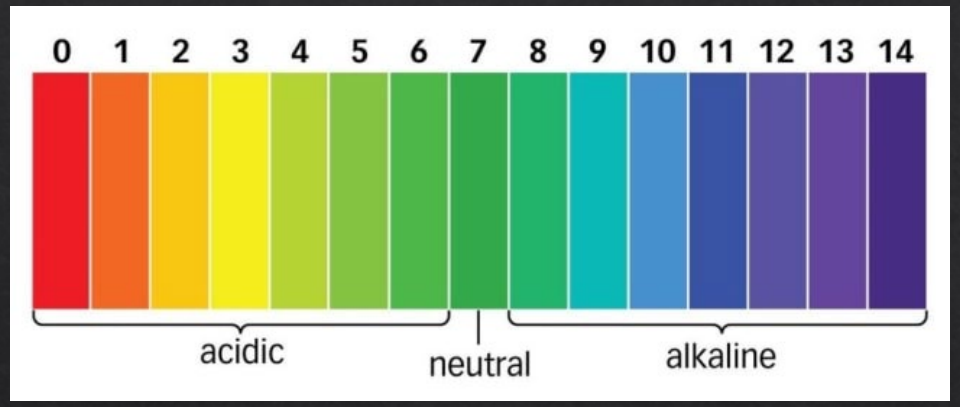


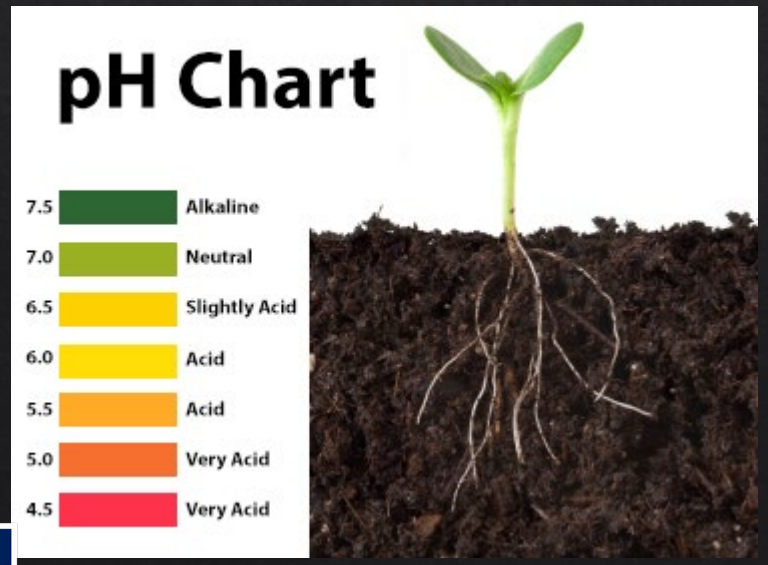
Soil Health and Soil Fertility

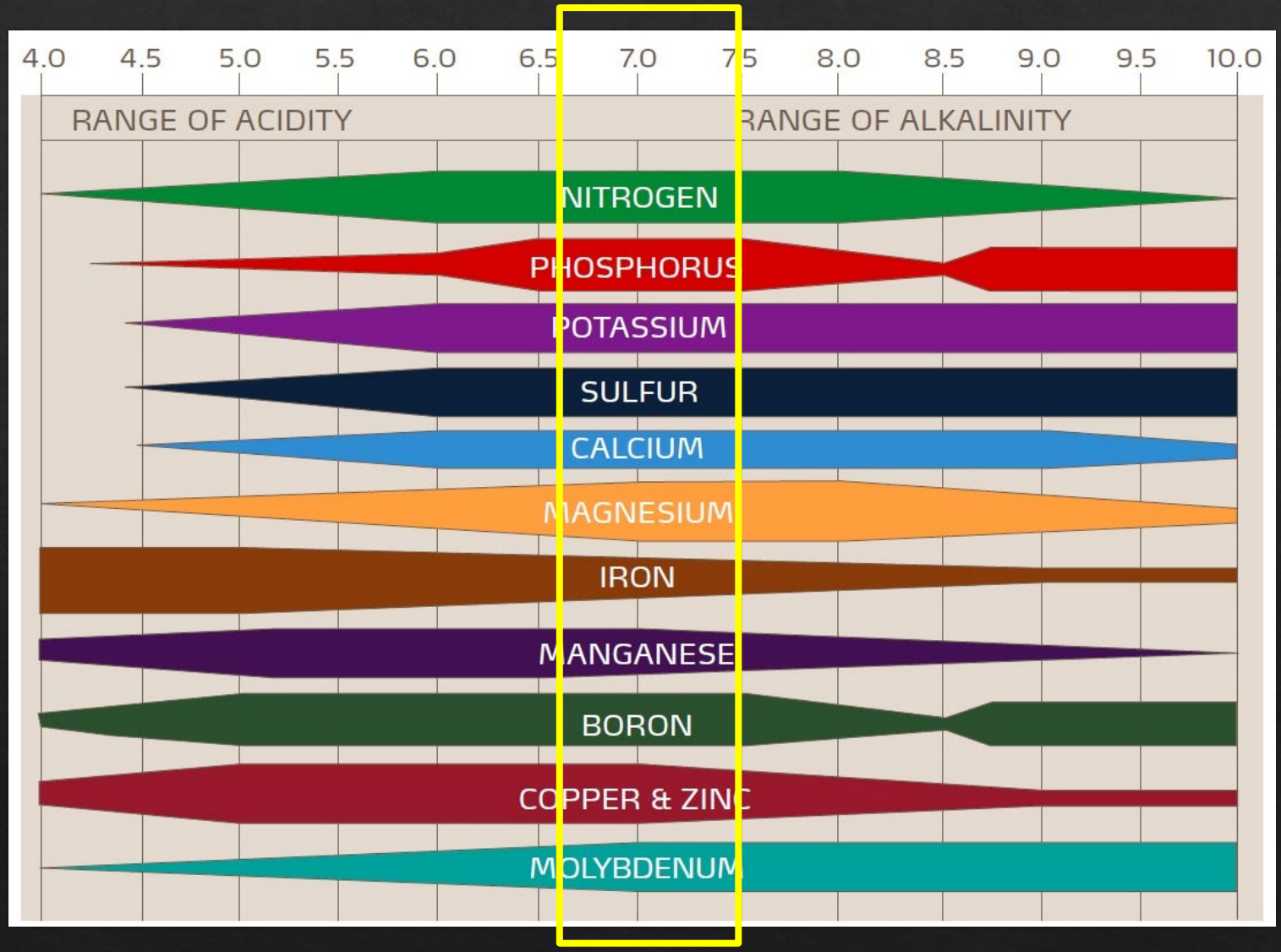
- Healthy soils provide optimum plant nutrition
  - *Nutrient cycling and storage*
  - *Water and air movement*
- Require less chemical input
- Produce nutritious food
- Less pollution; Sustainable



pH and Nutrient Availability

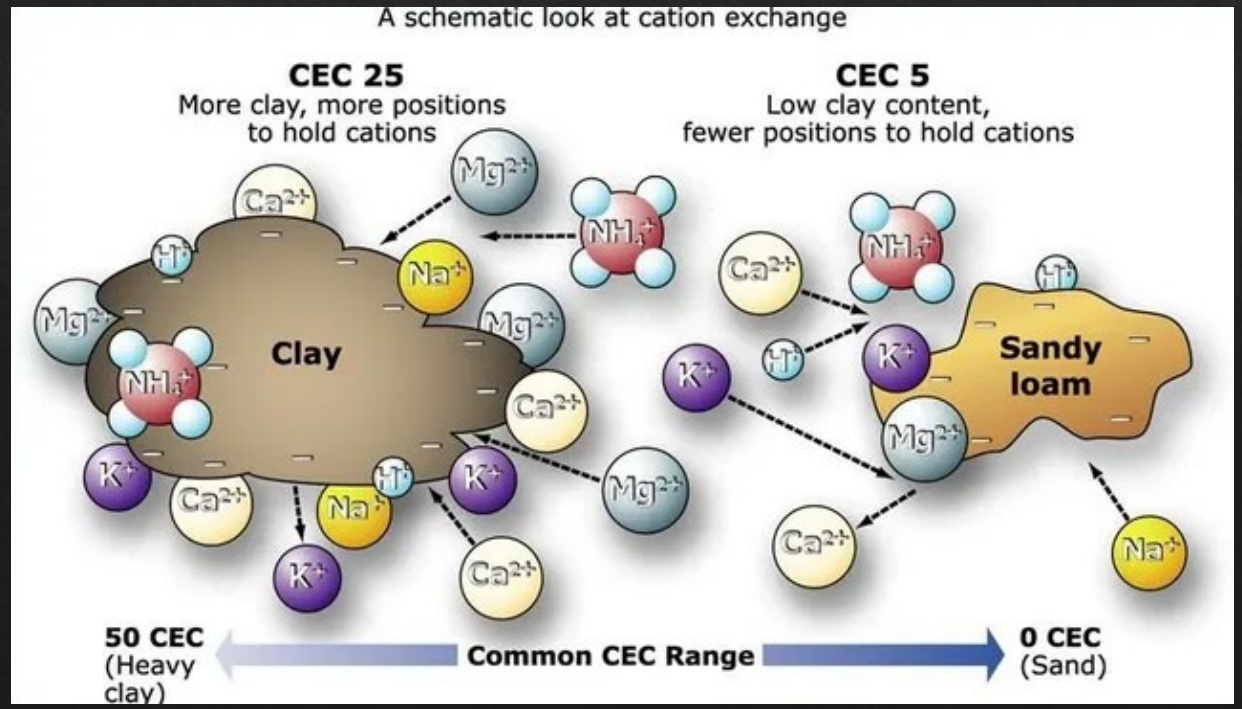


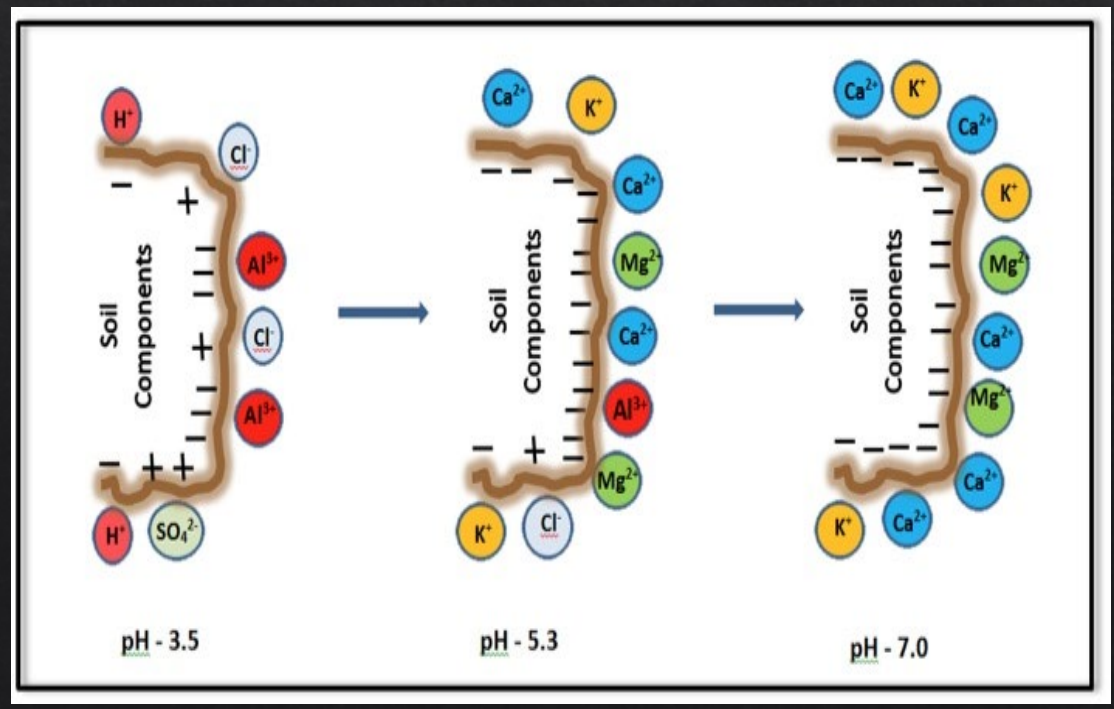




Cation Exchange Capacity (CEC)

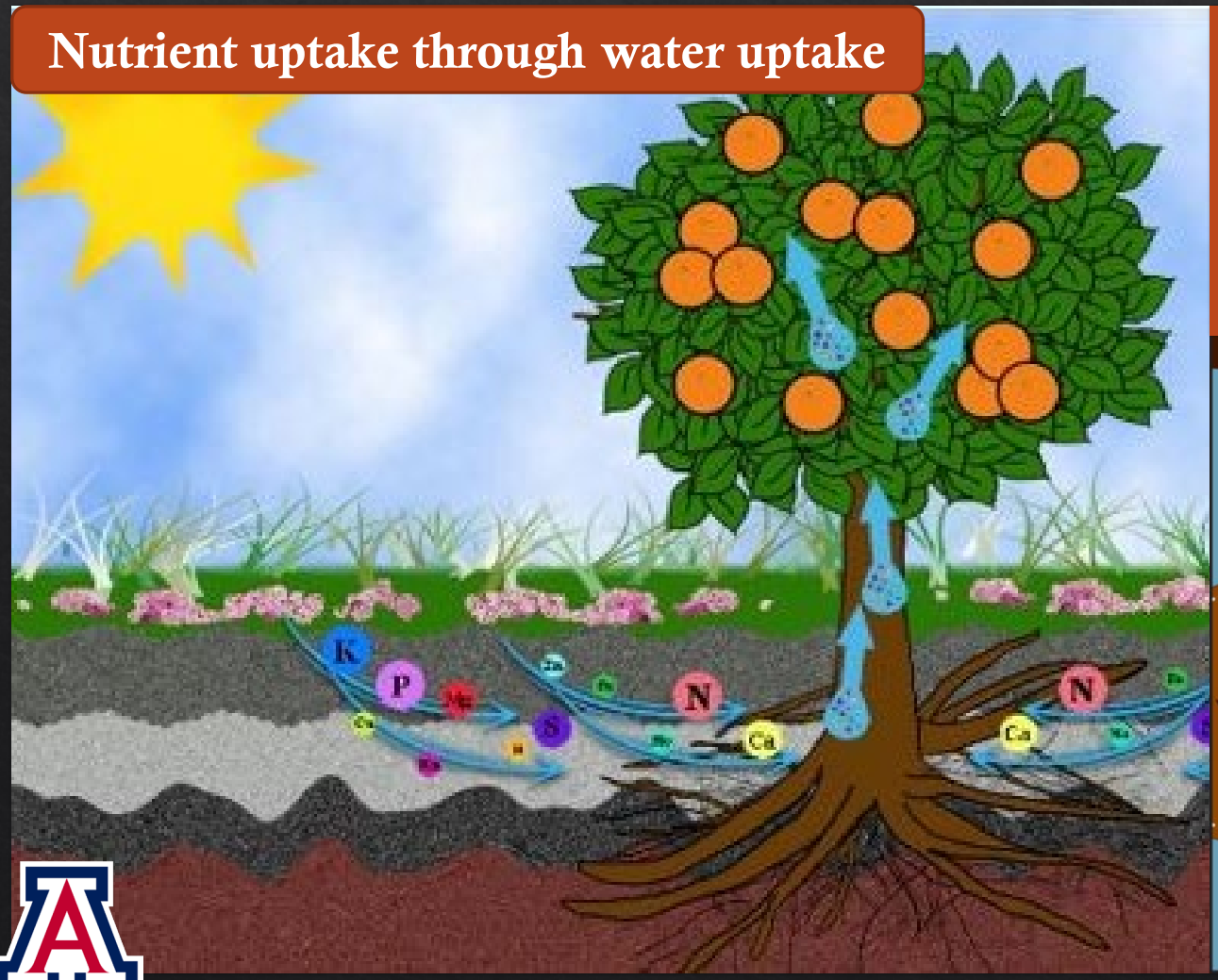
- A measure of the **total negative charges** within the soil
- Soil's ability to supply important plant nutrients



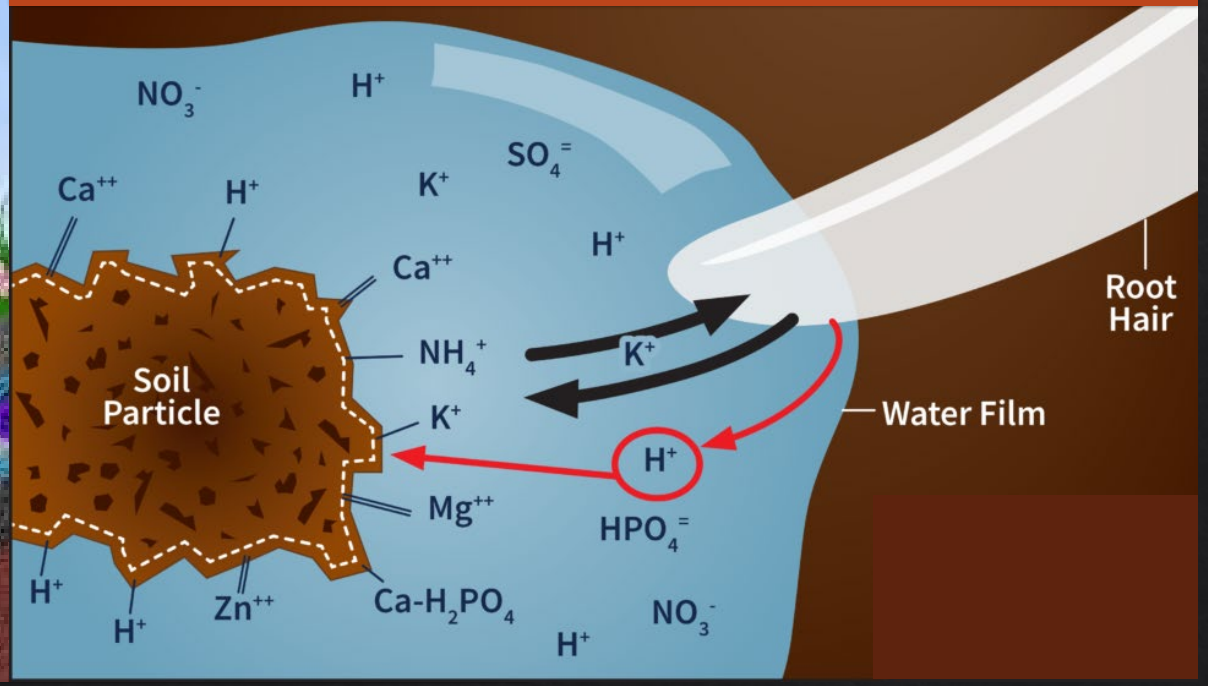


Nutrient Uptake

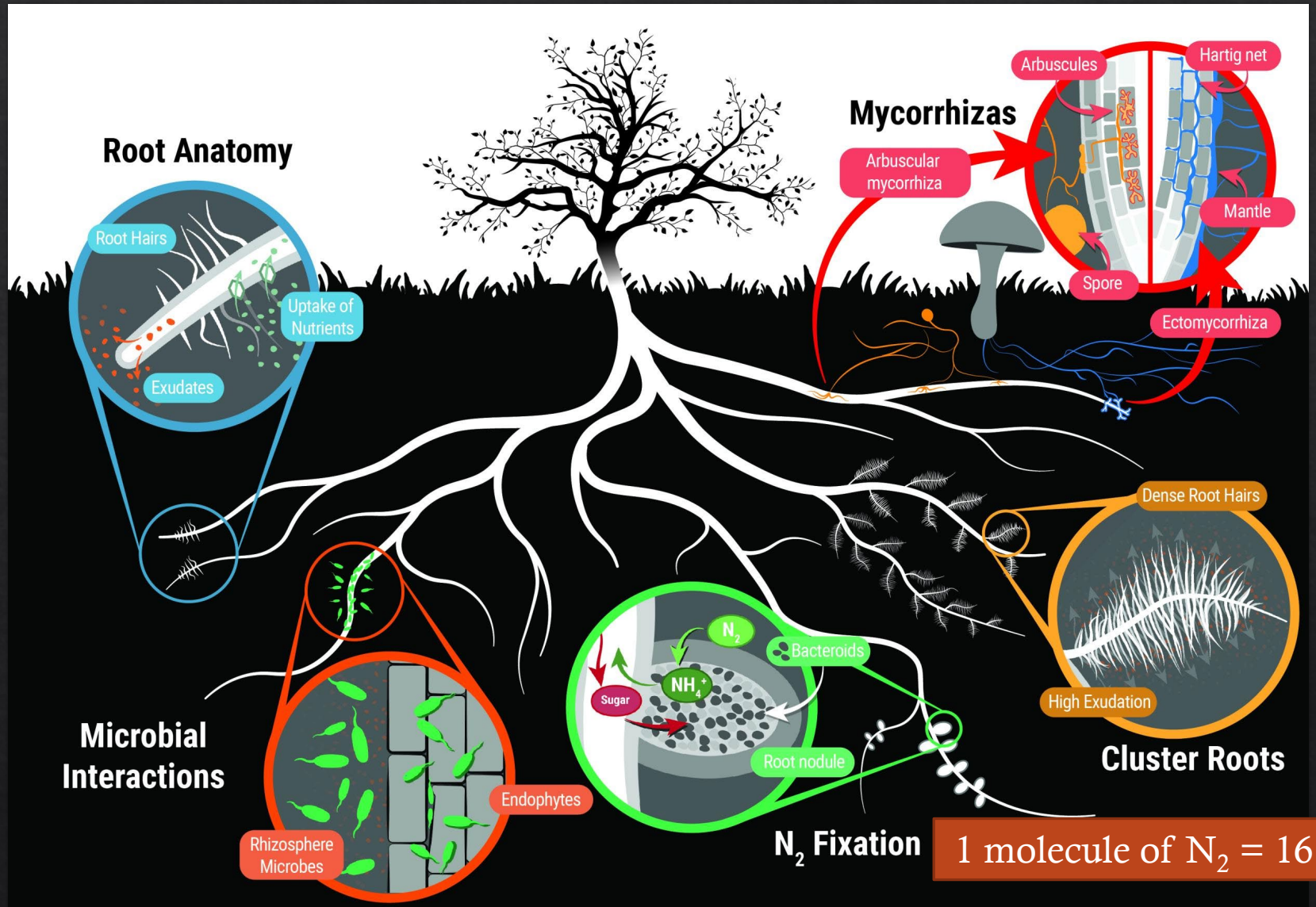
Nutrient uptake through water uptake



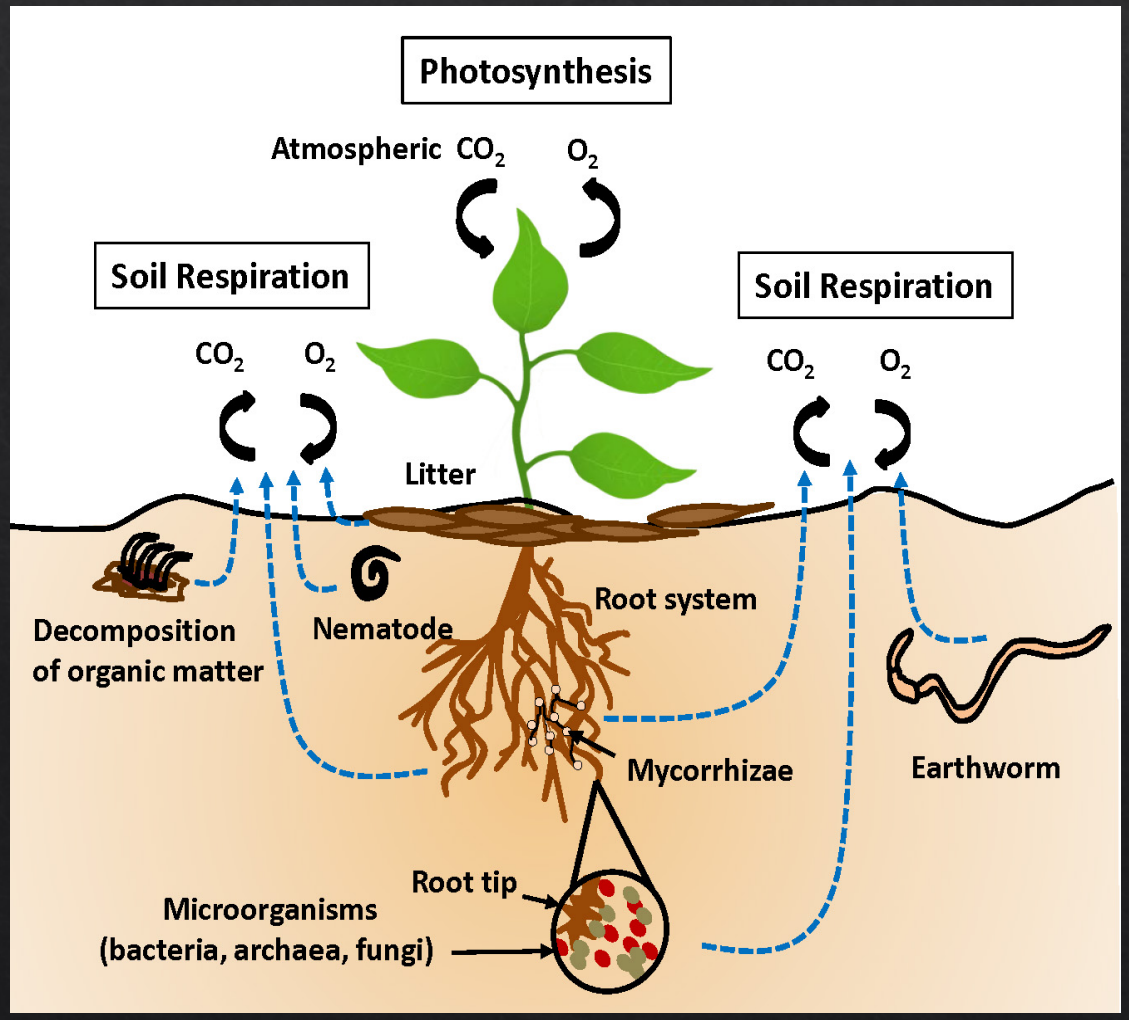
- Plants can only uptake **water-soluble ionic** forms.
- Therefore, insoluble forms should be transformed into soluble forms.



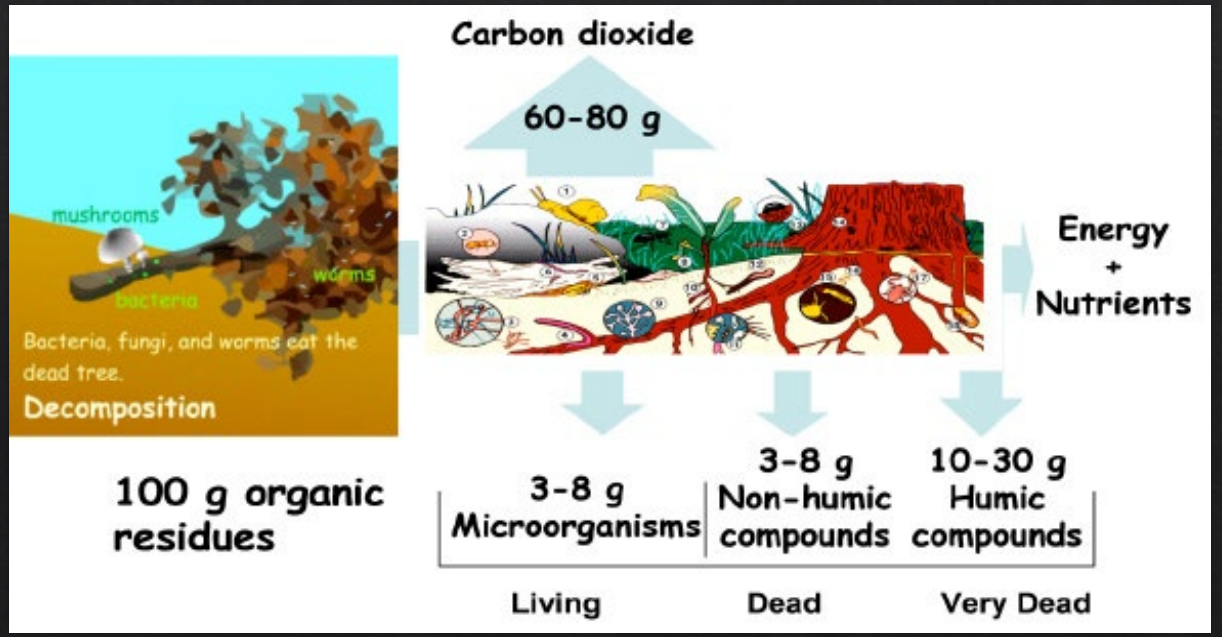
Nutrient Uptake: Communicating with Soil Biology



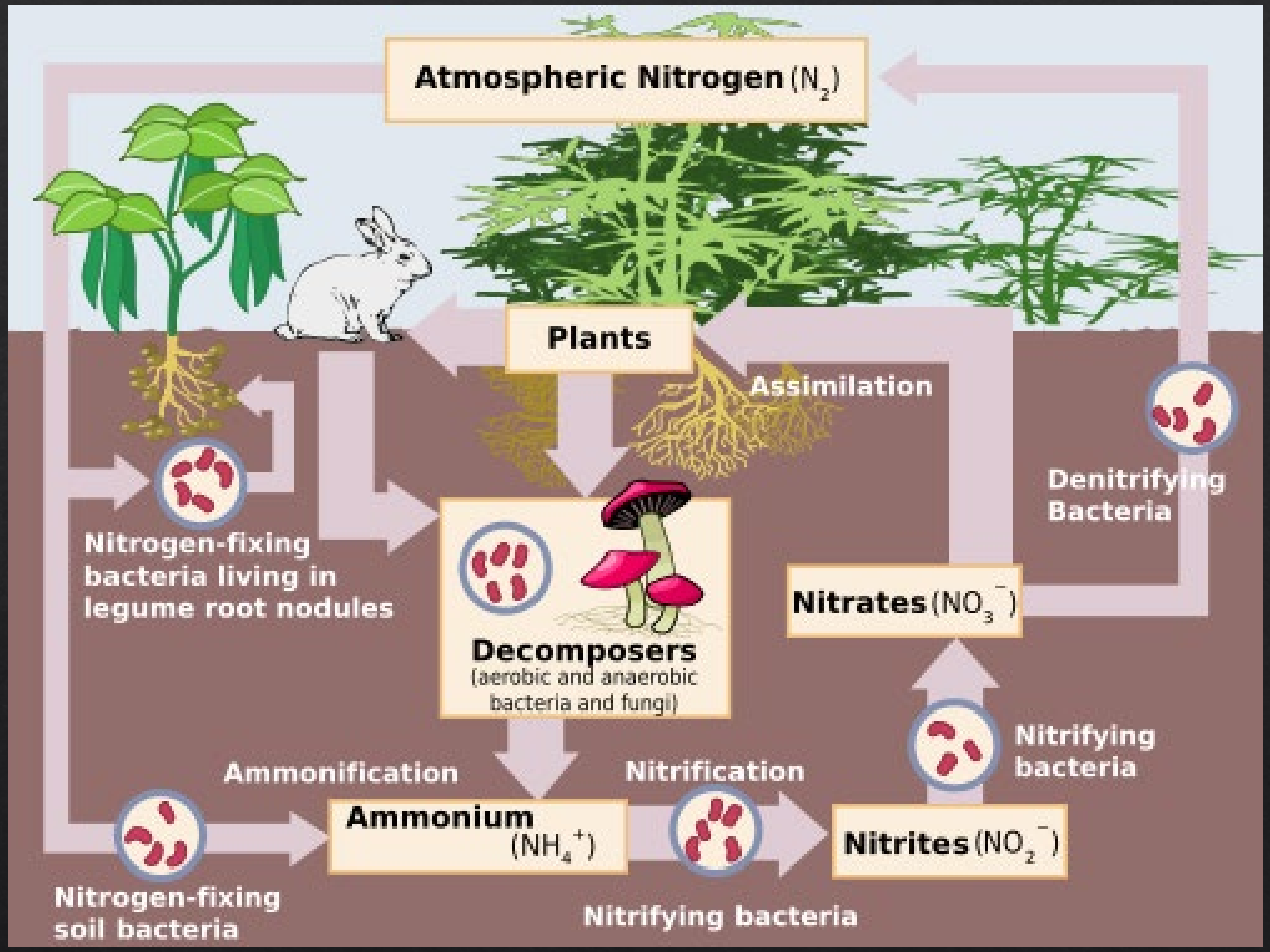
Nutrient cycling: SOM decomposition



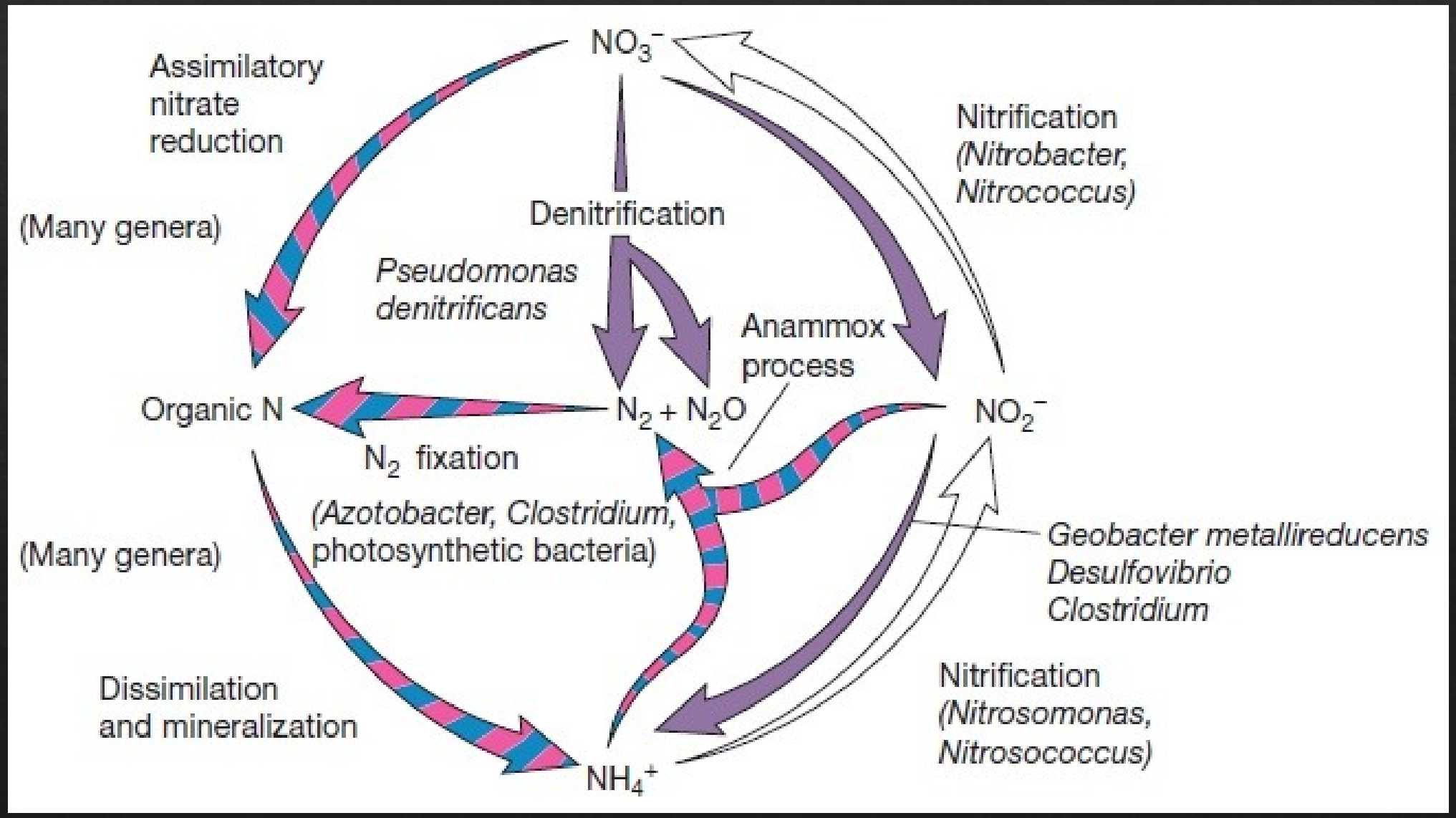
SOM is the reservoir of nutrients and **carbon**; releases nutrients through microbial decomposition



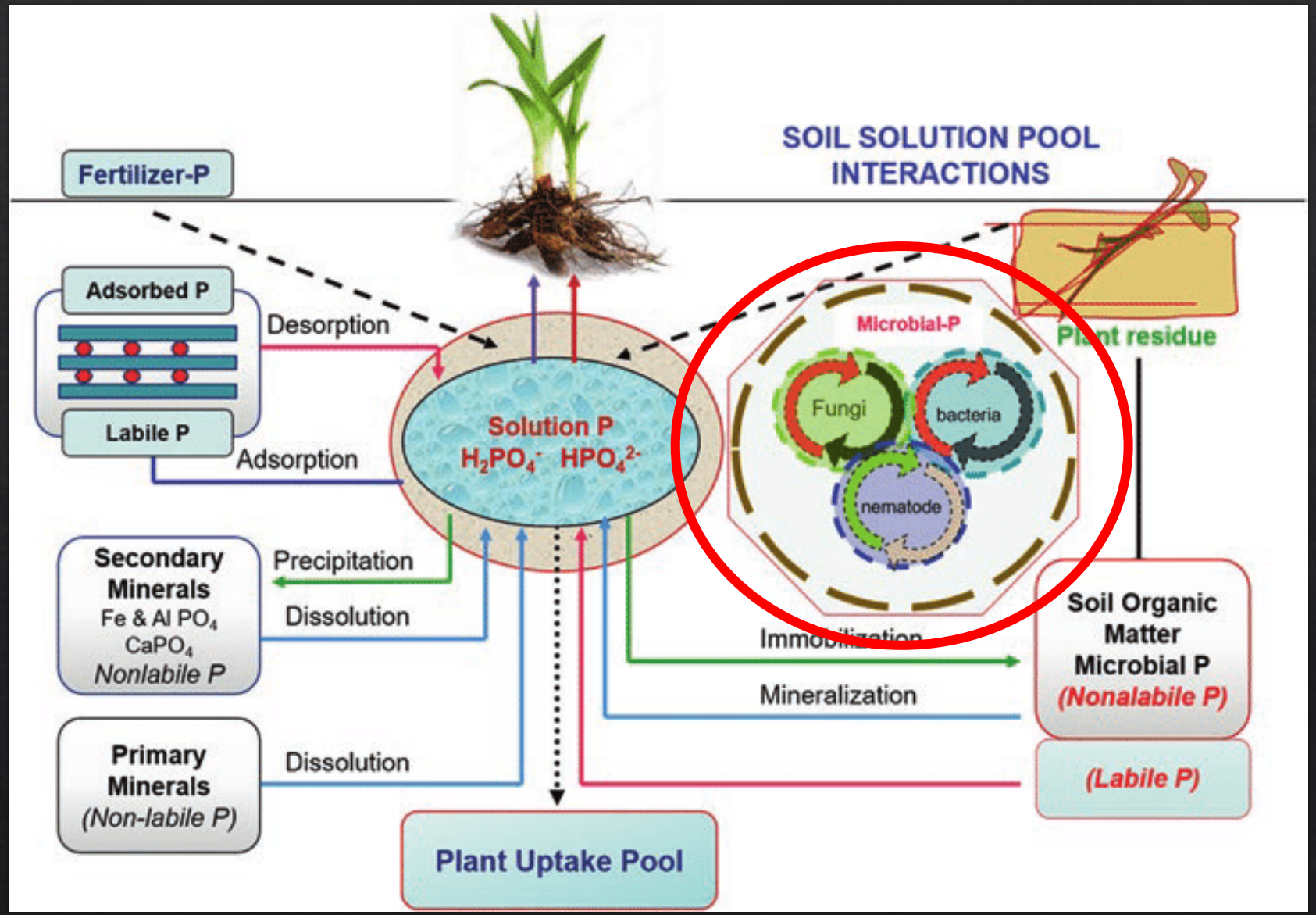
Nitrogen cycle



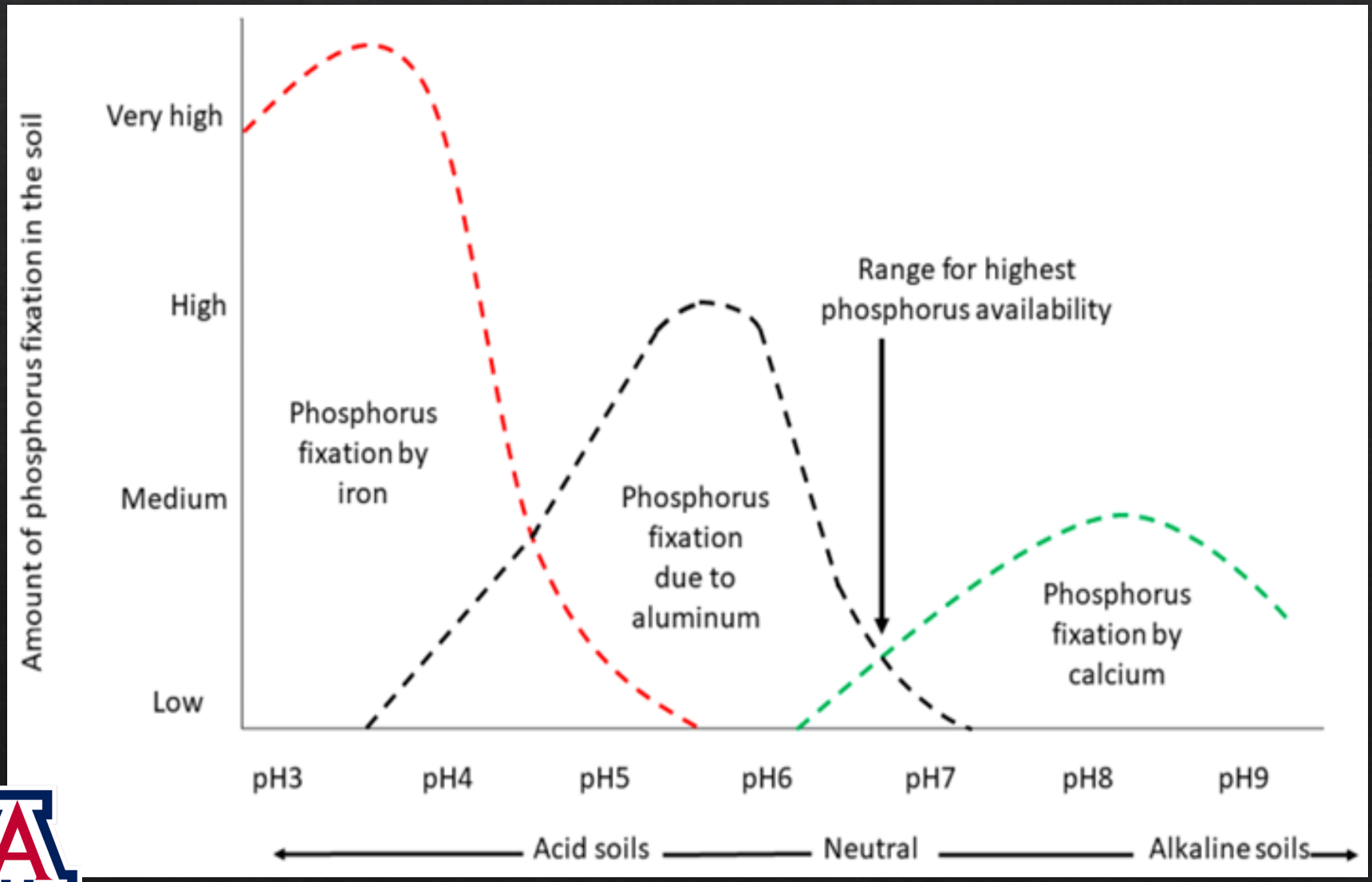
Soil Biology in Nitrogen Cycling

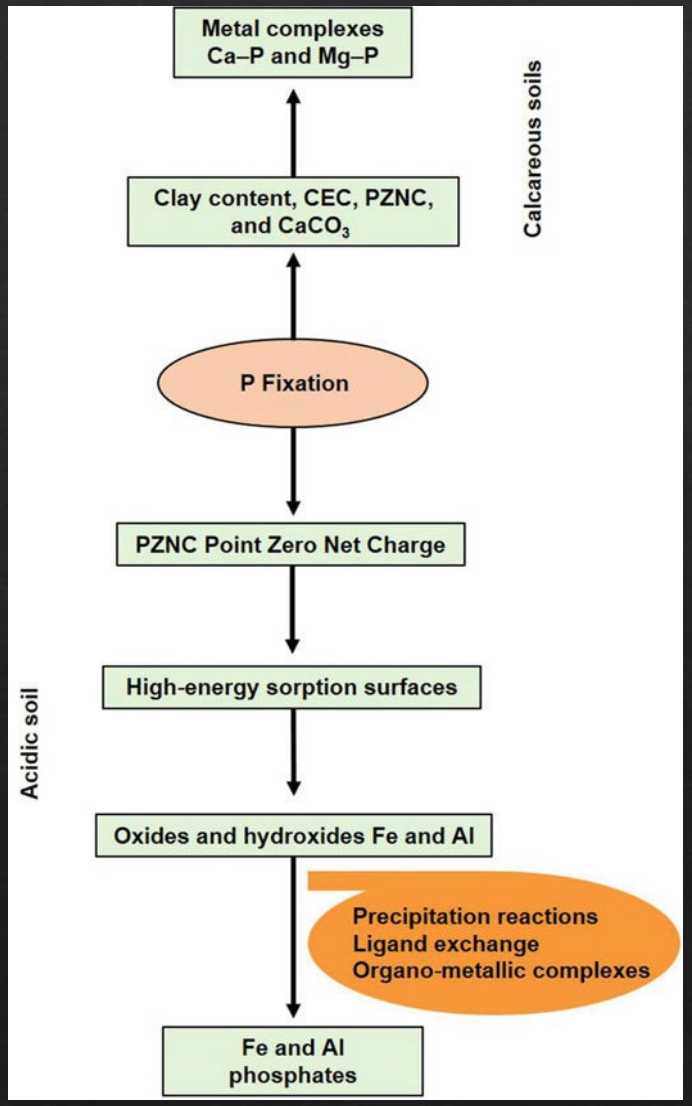


Phosphorus cycle

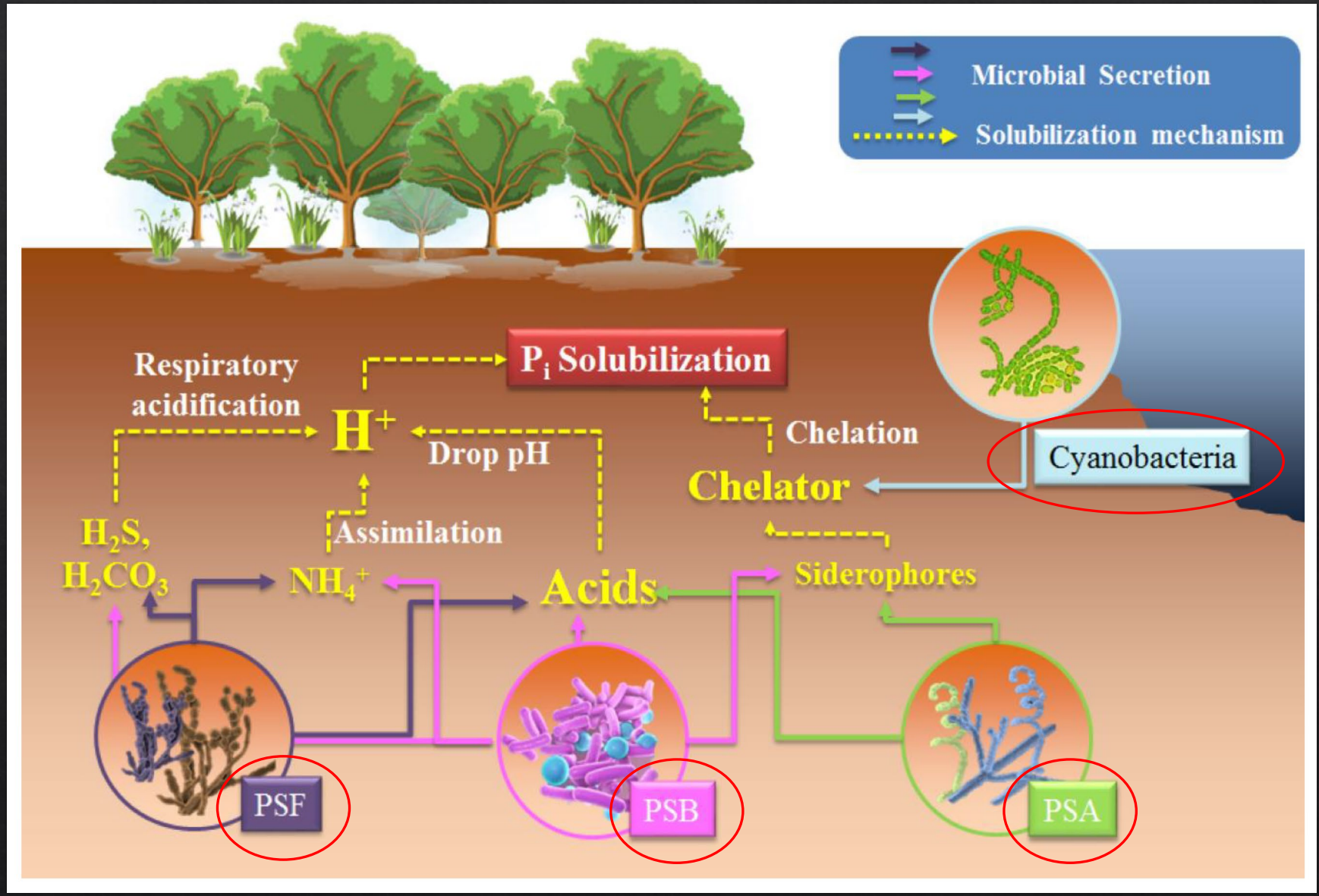


Phosphorus Availability: pH

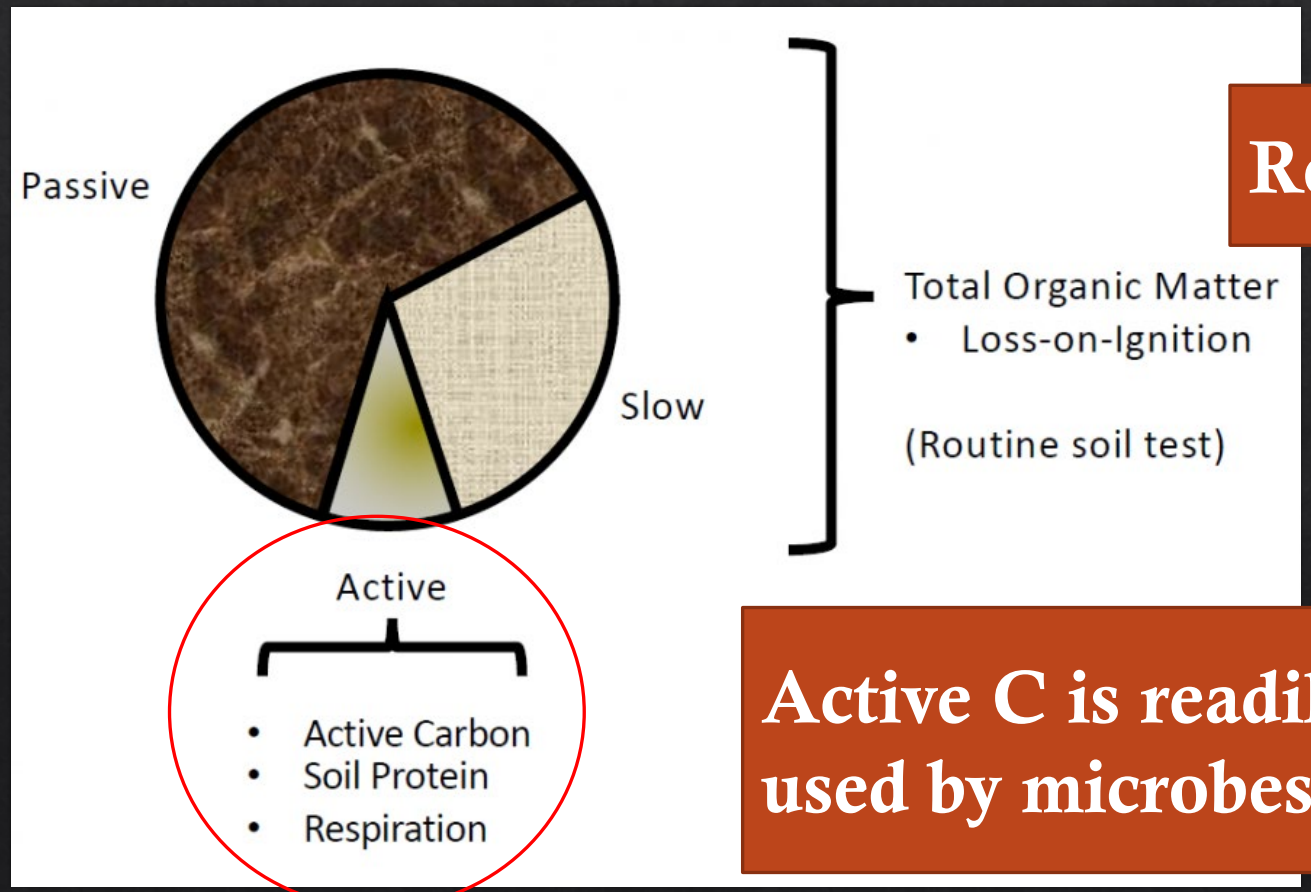




Microbial Solubilization of P

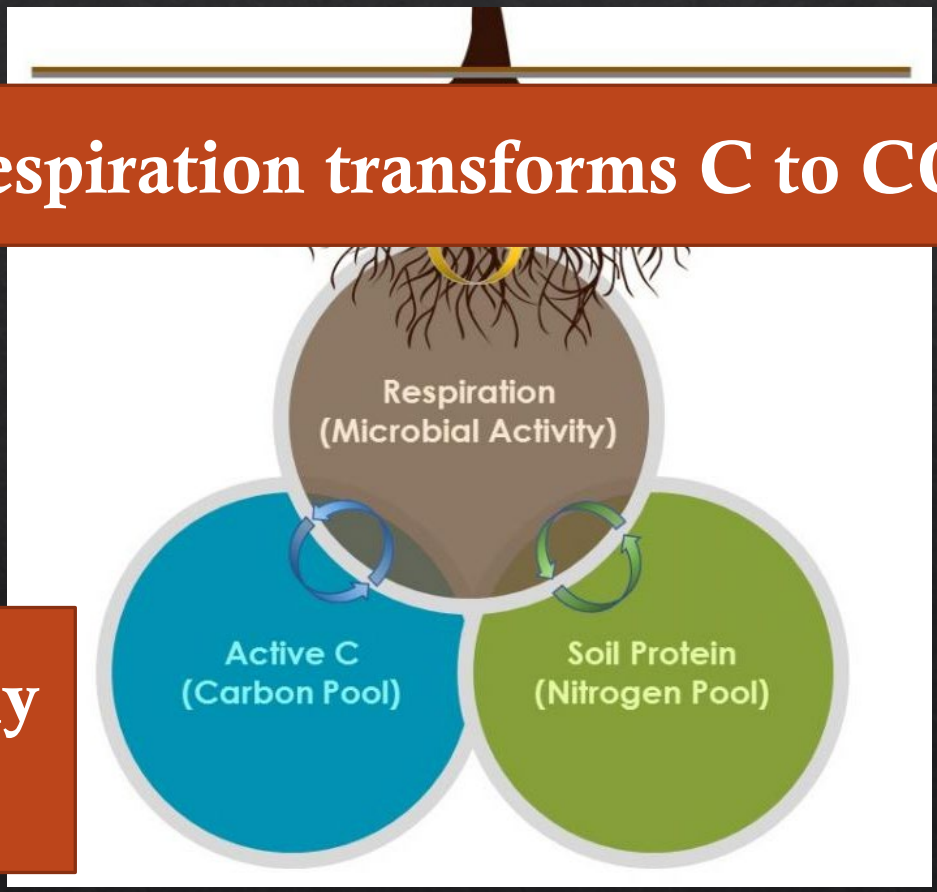


Soil Organic Matter: C and N pools

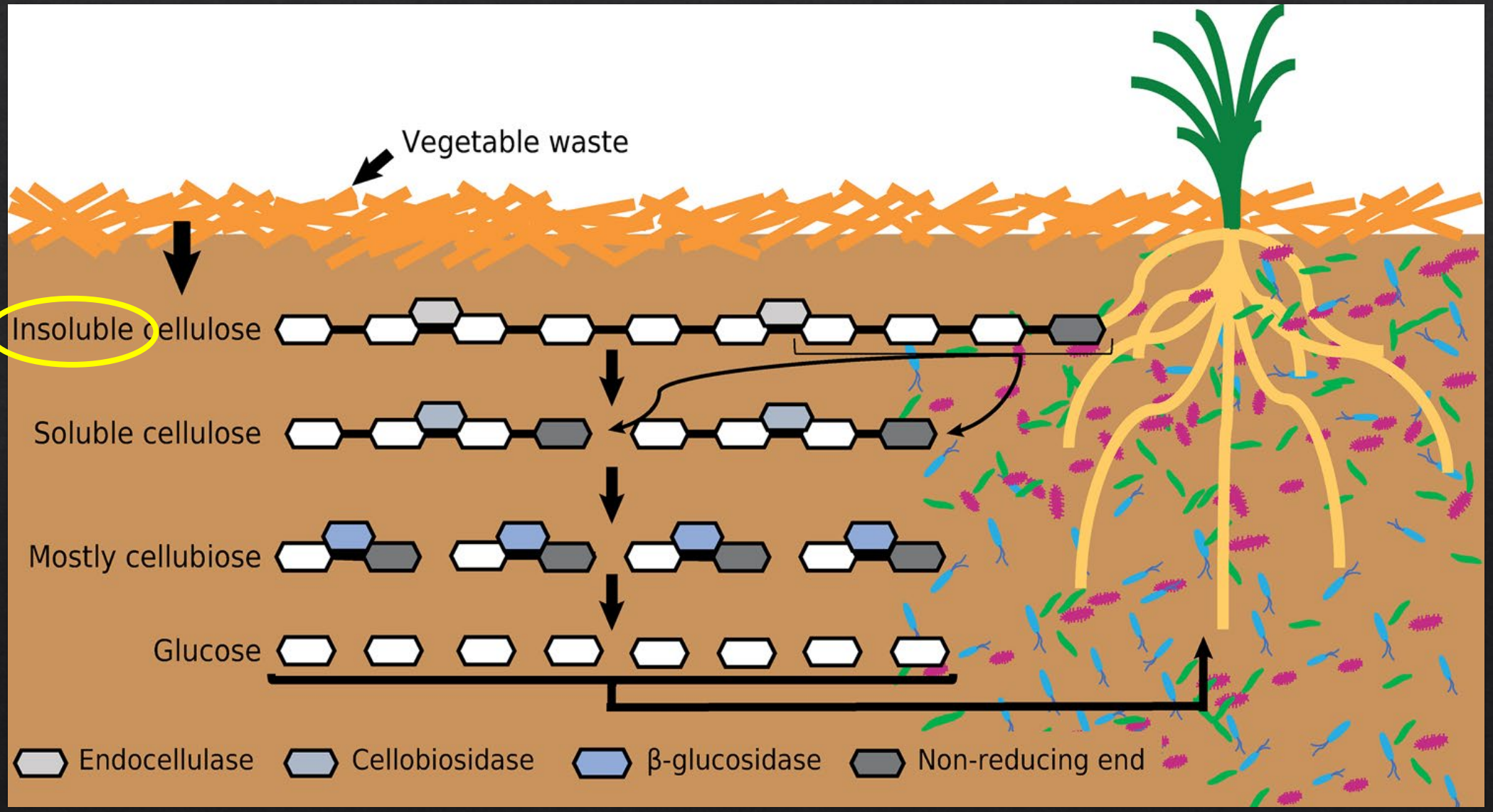


Active C is readily used by microbes

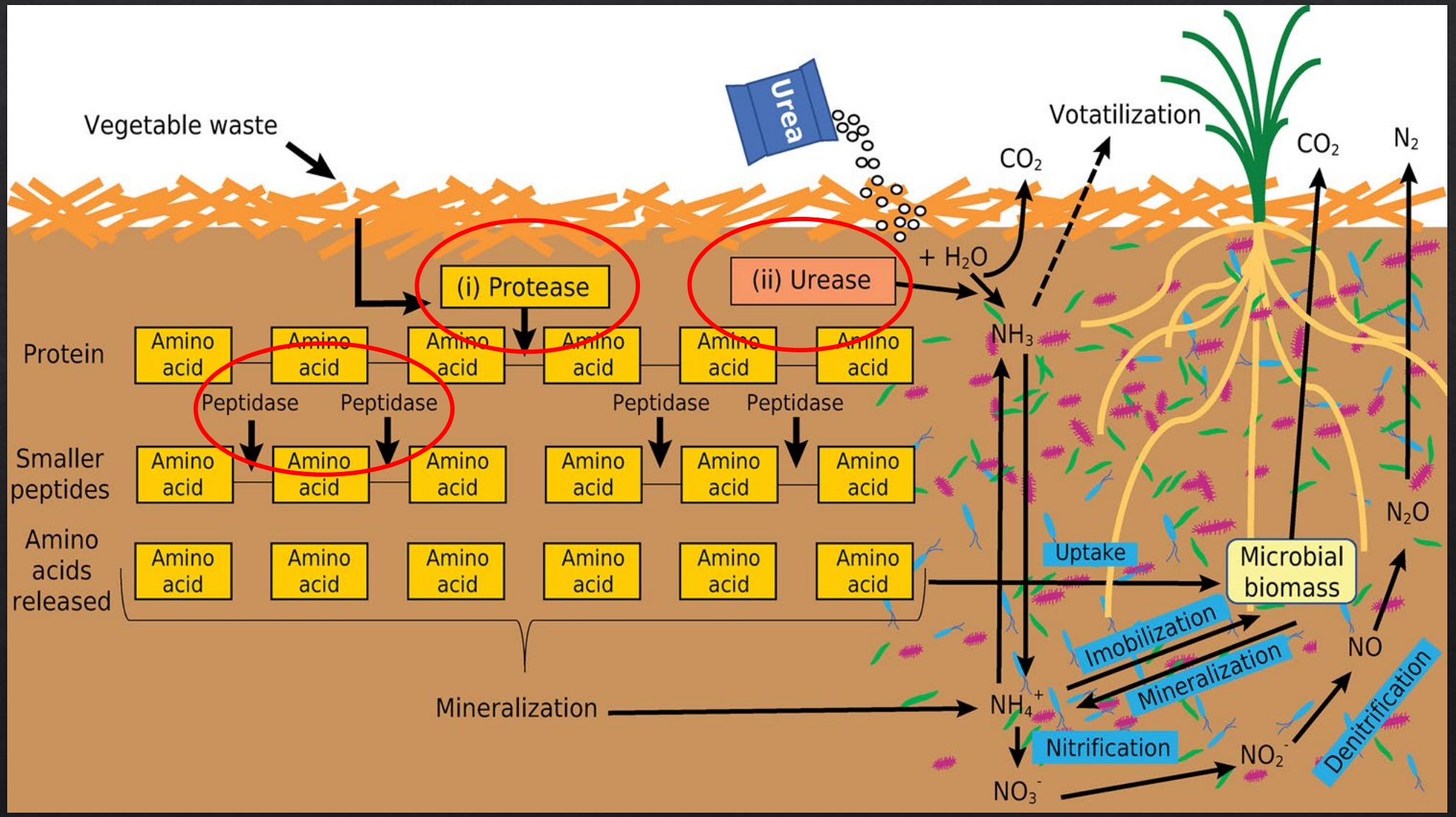
Respiration transforms C to CO_2



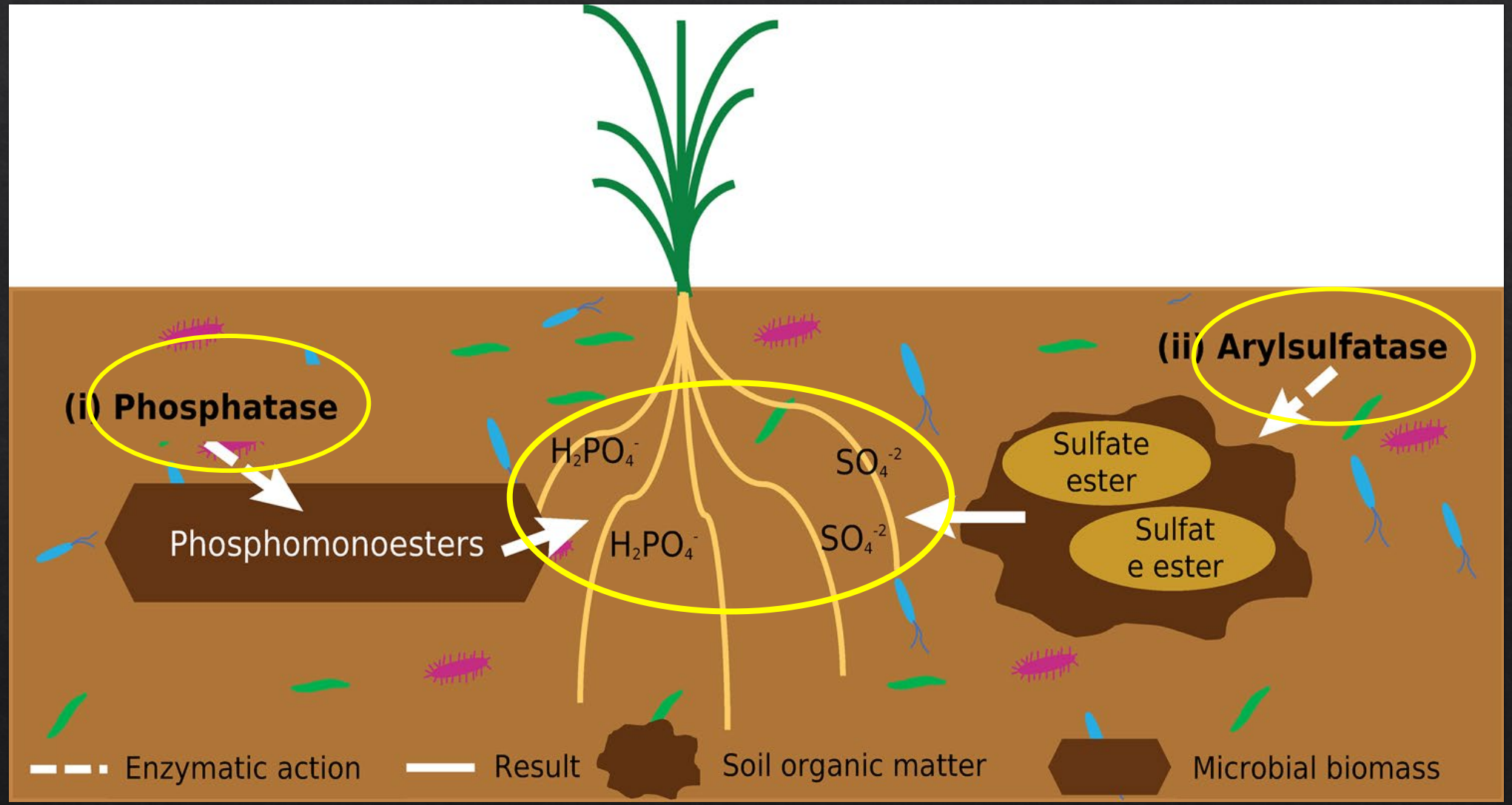
Soil Enzymes: Carbon Cycle



Soil Enzymes: N Cycle



Soil enzymes: P and S Cycle

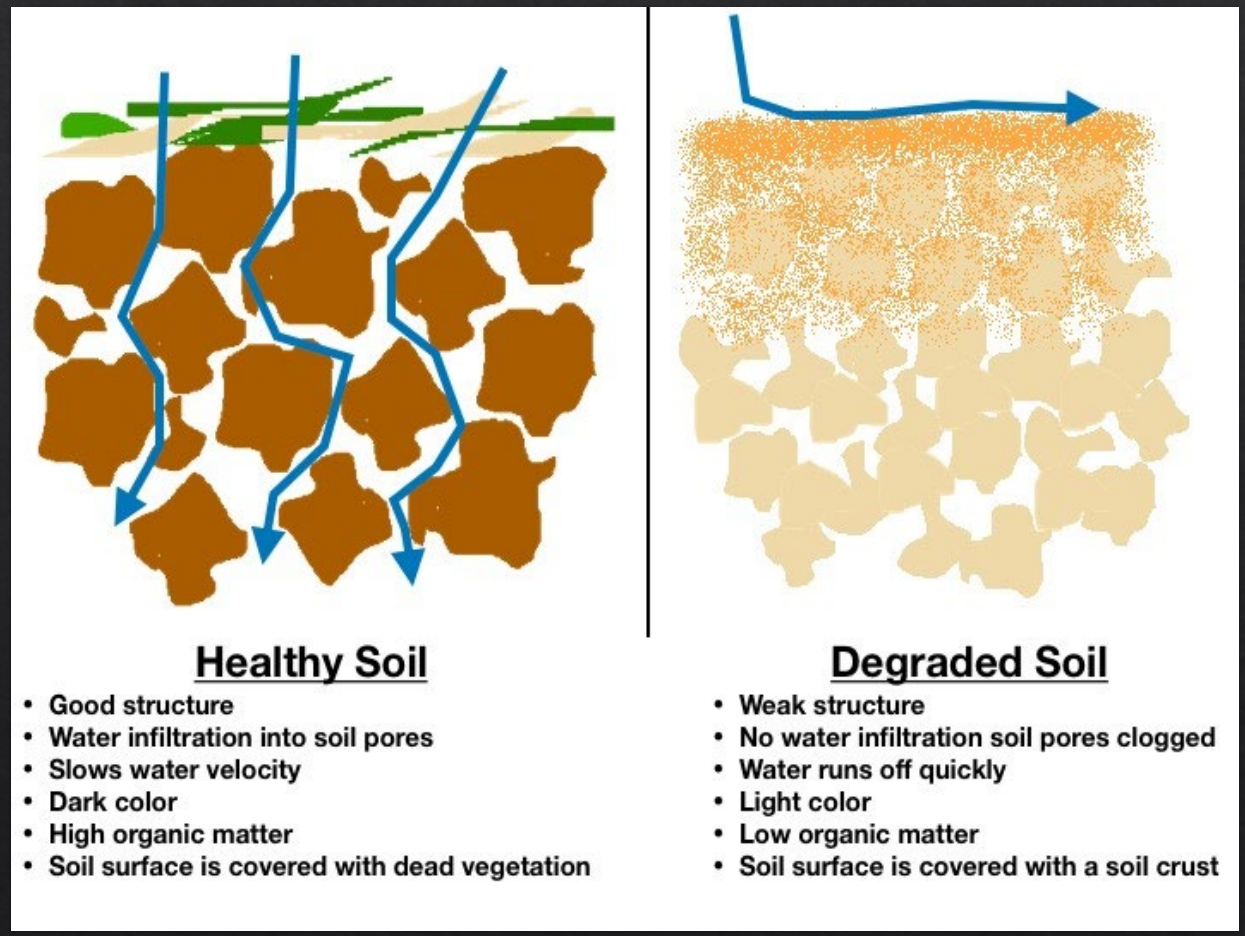


Soil Structure and Aggregation

GOOD CONDITION VS = 2
Soil dominated by friable, fine aggregates with no significant clodding. Aggregates are generally sub-rounded (nutty) and often quite porous

MODERATE CONDITION VS = 1
Soil contains significant proportions (50%) of both coarse clods and friable fine aggregates. The coarse clods are firm, sub-angular or angular in shape and have few or no pores

POOR CONDITION VS = 0
Soil dominated by coarse clods with very few finer aggregates. The coarse clods are very firm, angular or sub-angular in shape and have very few or no pores



Healthy Soil

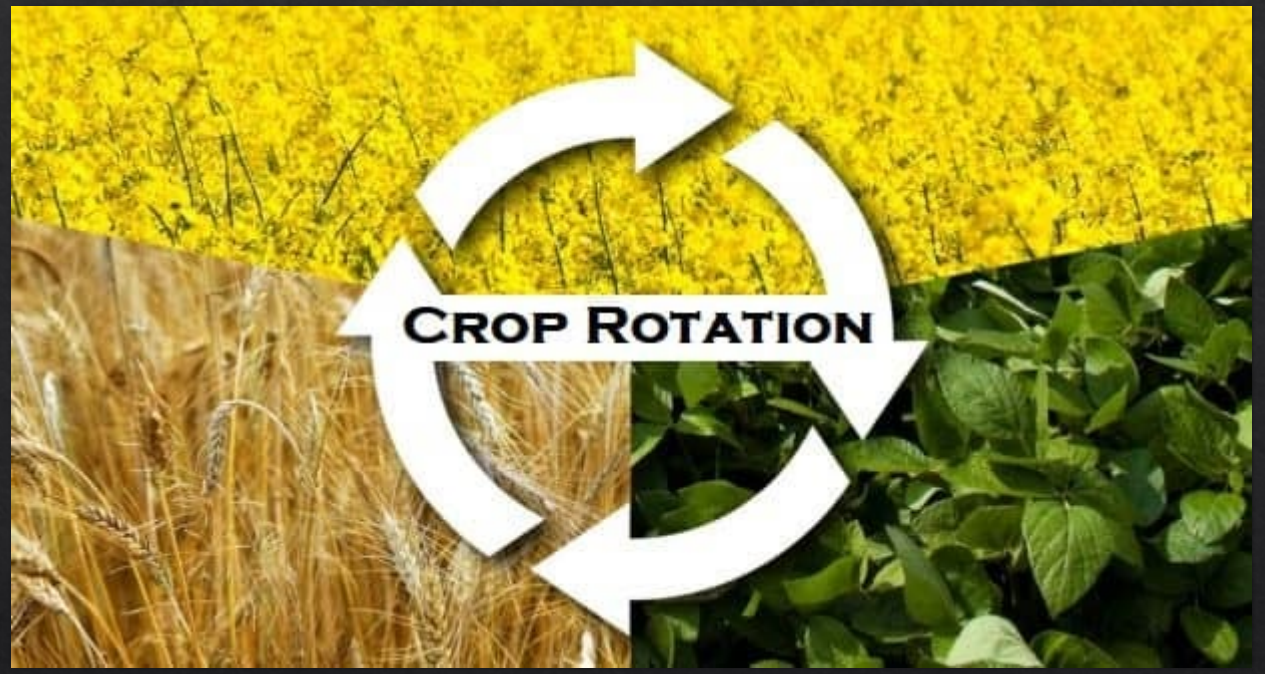
- Good structure
- Water infiltration into soil pores
- Slows water velocity
- Dark color
- High organic matter
- Soil surface is covered with dead vegetation

Degraded Soil

- Weak structure
- No water infiltration soil pores clogged
- Water runs off quickly
- Light color
- Low organic matter
- Soil surface is covered with a soil crust

Soil Health Tools: Boosting Fertility

Residues

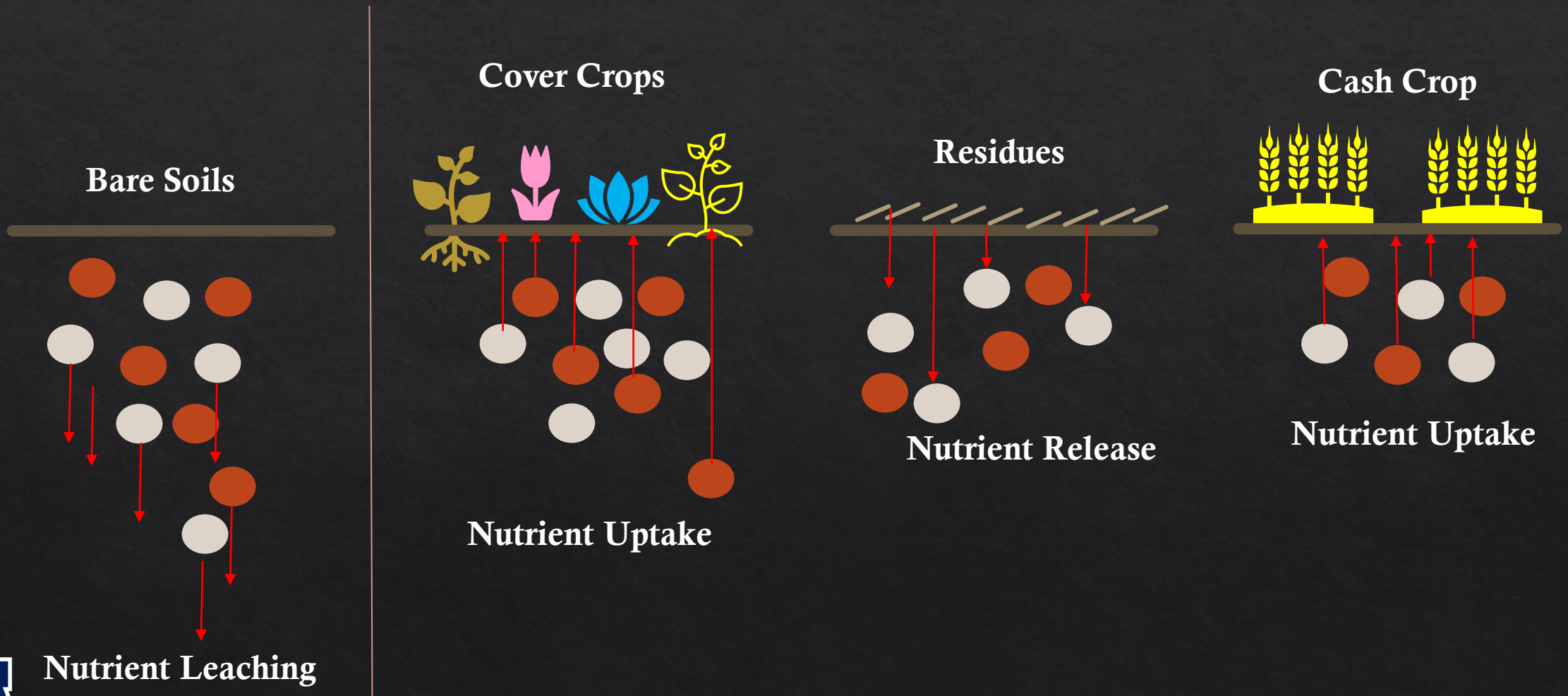


- Soil carbon-nitrogen ratio
- Biodiversity
- Nitrogen fixation

Biology

Why Cover Crops and Soil Fertility

Cover Crops: ‘Catch and Release’



Take Home Message

- Nutrient release and cycling, needs biology
- Soil Carbon improves nutrient storage and retention
- Cover crops can effectively cycle nutrients, preventing losses
- Healthy soils are fertile soils

Thanks!

Please feel free to contact me at:

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