

# The Science of Carbon Farming & Land-based Climate Solutions

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# What are you hoping to gain in this session?

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Name

An identity (ex: parent, farmer, electrician)

What do you hope to gain from this session?

# This is what we're up against

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Challenges: climate change, food security, land restoration, environmental & climate justice



# The Next 10 Years Will Determine the Next 1000+



## Climate [in]justice & debt

- Climate change is driven by **excessive consumption & energy** use by wealthy people & **wealthy** industrialized nations
- Poorer nations, POC, & Indigenous Peoples who have contributed **least** to cause climate change are bearing **most** of the burden

This is what gives me hope

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## What is Carbon Farming, anyway?

- Storing C in terrestrial ecosystems: More C going into the soil than going out
- Mitigate & Adapt to climate change
- [Ideally/future] Farmers getting compensated for that service

## Carbon Farming has Significant Co-Benefits

- Soil & water conservation
- Climate change resilience
- Increased yields via better soil health, crop synergies & diversified/intensified production
- Better profitability in many systems long term



## BUT: Risks & Challenges

- Carbon farming requires land use and business transition...which means cost, risk, & time for farmers.
- Land access and land justice is central to building out carbon farming.
- Public, private, & philanthropic funding needed for this transition. We need to develop full financing & technical assistance packages for climate retrofits.
- Basic science is well established and understood, but research questions (and some controversies) remain.

It's not \*just\* about the carbon...

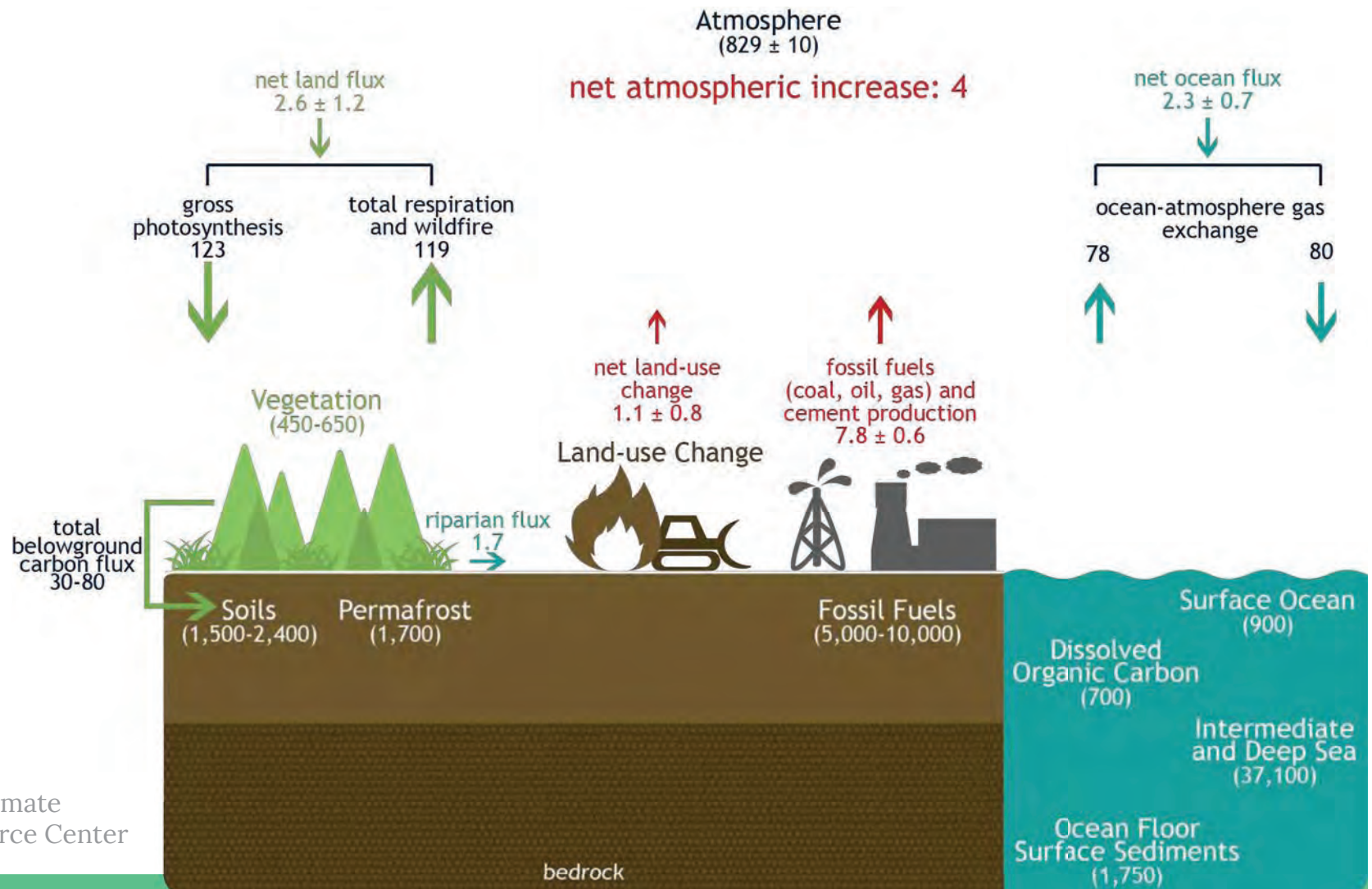
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This is the holiness of “dirt.”

# Carbon

Basic building block of life



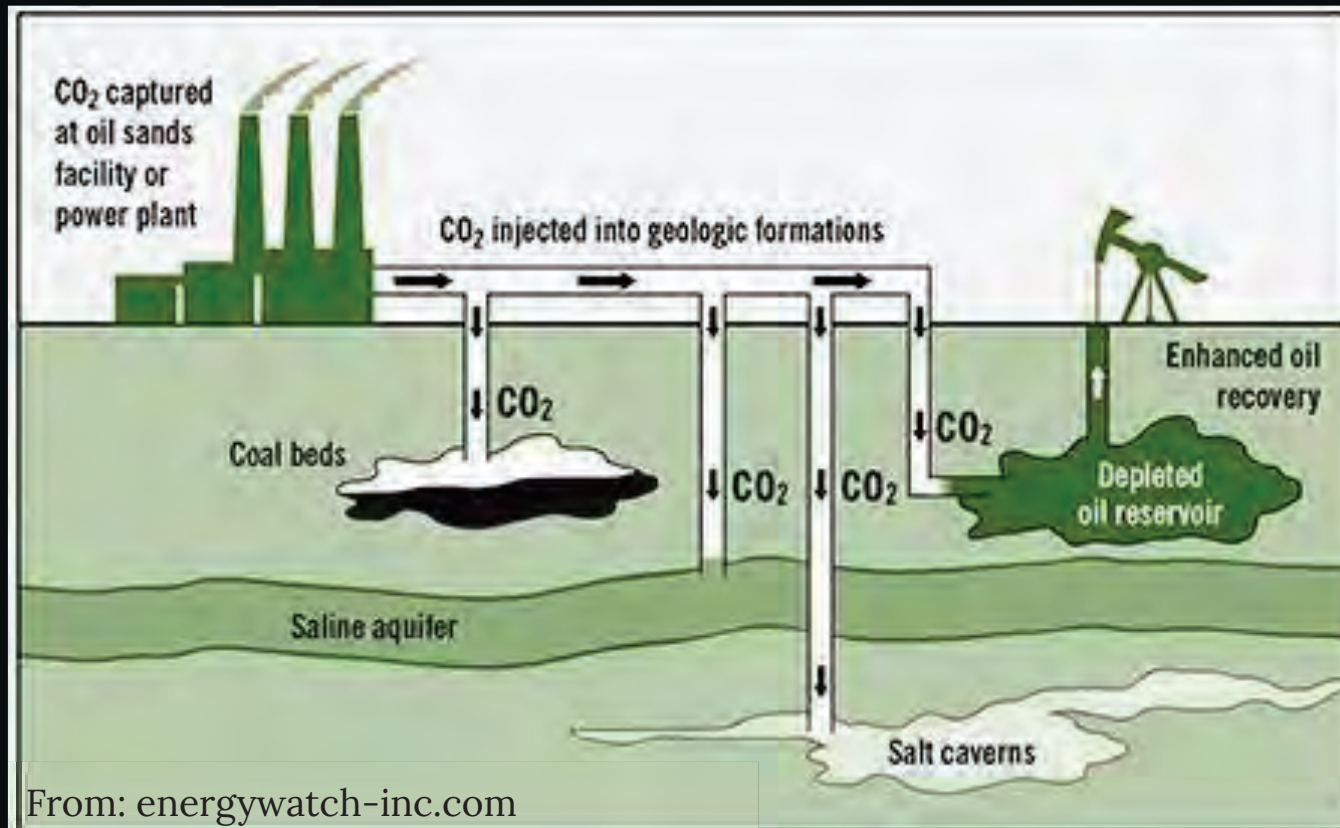


From USFS Climate  
Change Resource Center

# What is C sequestration?

1. Carbon Capture & Storage (CCS)
2. Biological sequestration

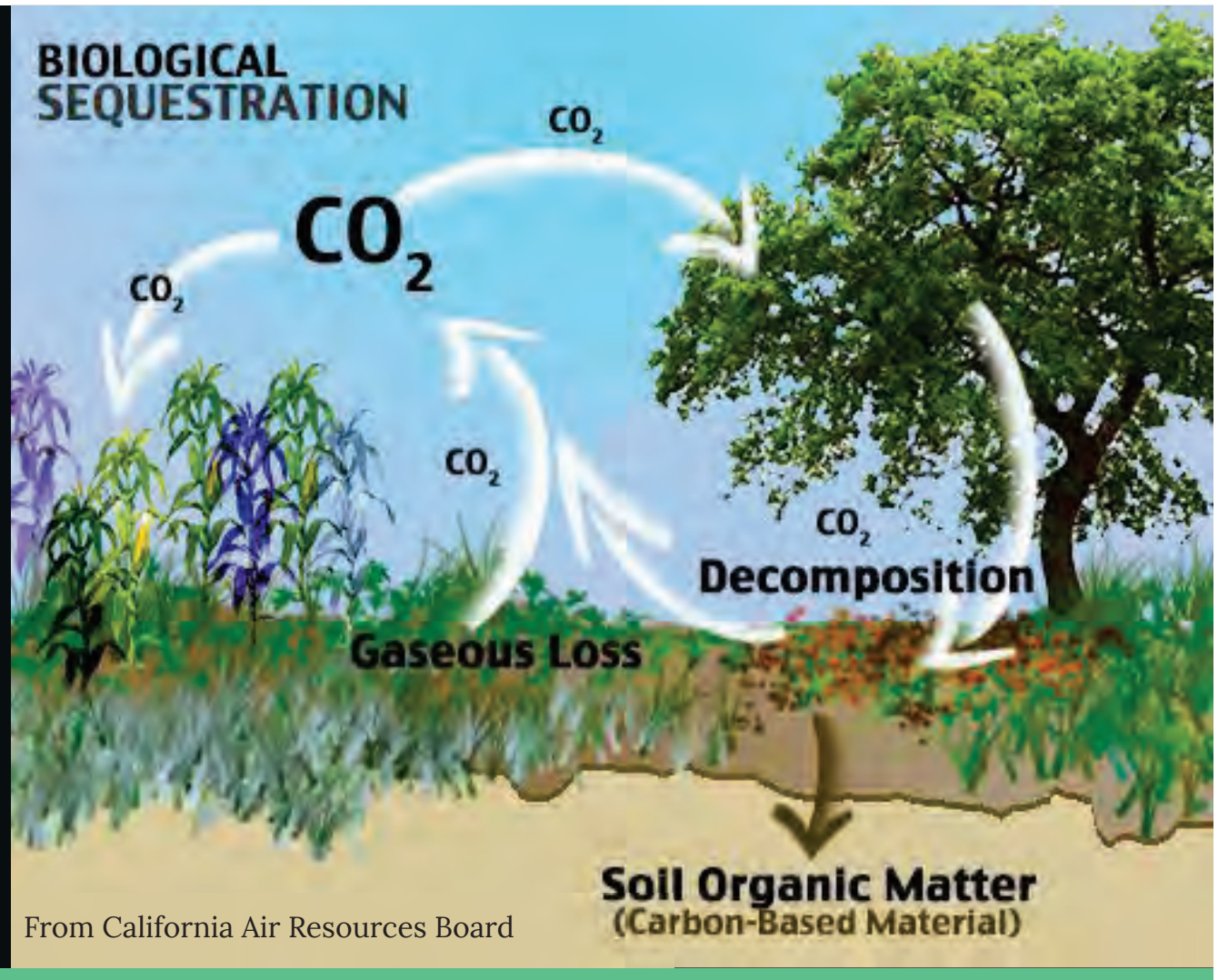
# Geoengineering CCS





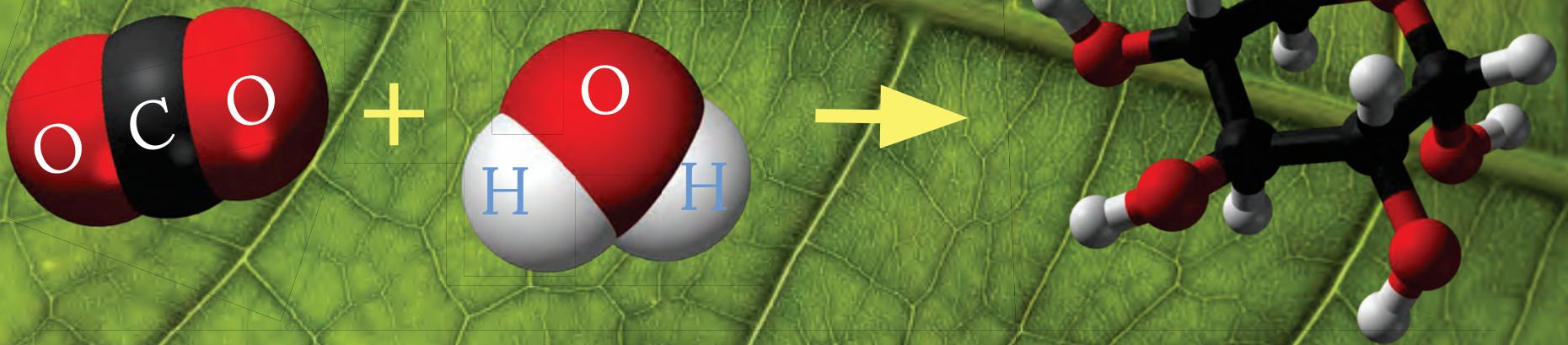
# What is Carbon Sequestration

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# Carbon Sequestration Pathways

## 1. Photosynthesis → plant tissues



Carbon dioxide (CO<sub>2</sub>) + Water (H<sub>2</sub>O) + Sunlight → Carbohydrates (Glucose)



Photosynthesis ... to forests

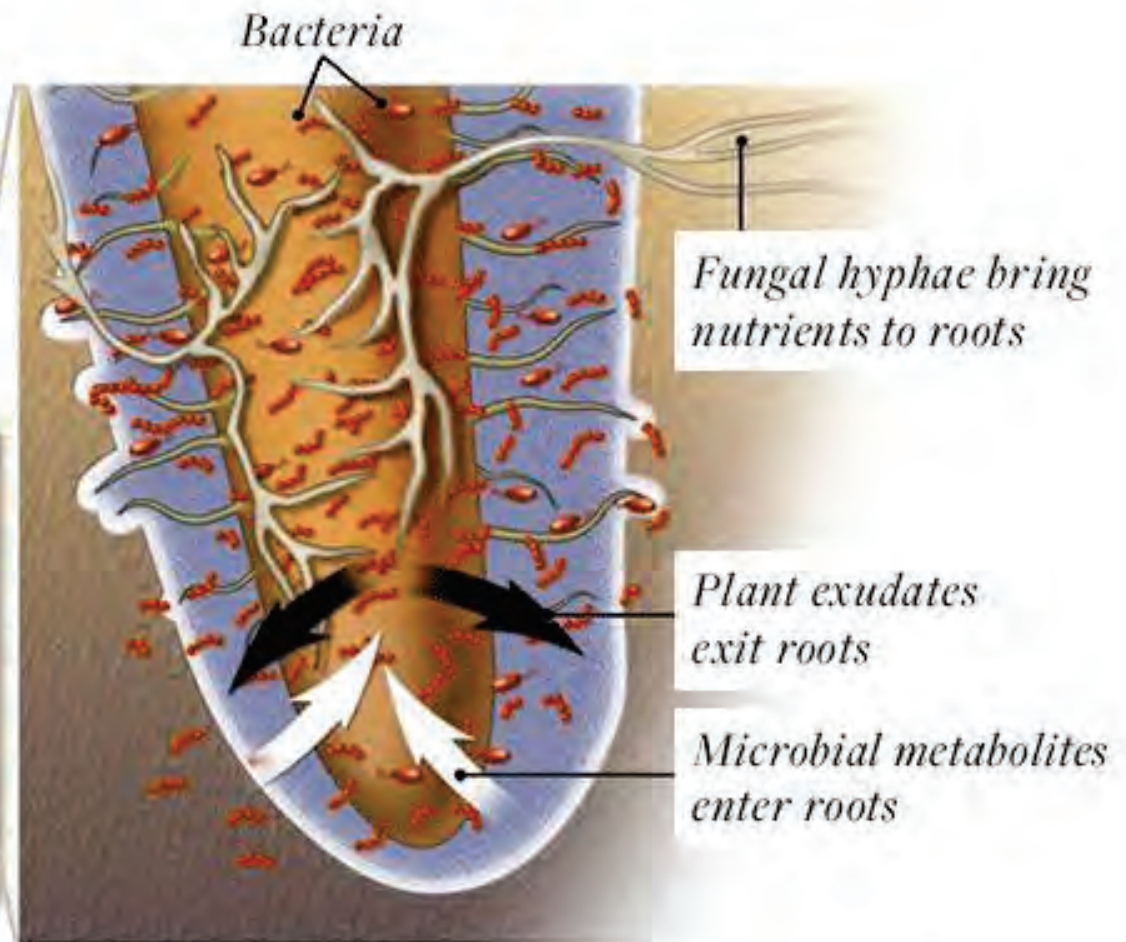
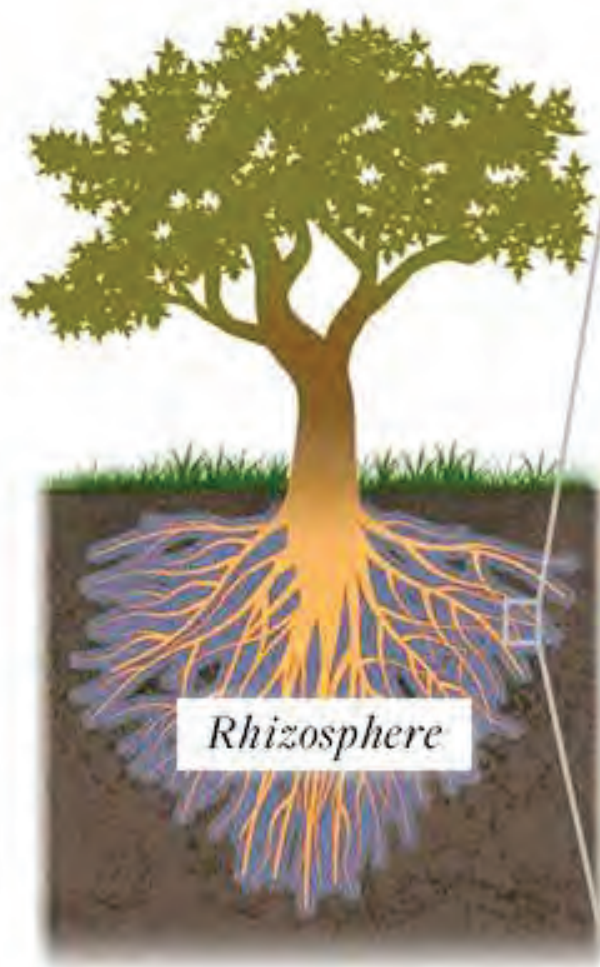


# Carbon sequestration pathways

## 2. Photosynthesis → soil C







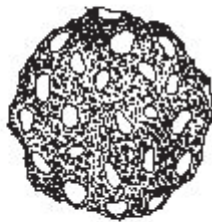
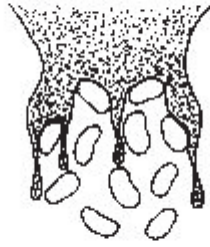
From Biklé & Montgomery (2016) <http://nautil.us>

MICROBIAL AND FUNGAL  
BYPRODUCTS GLUE  
THE PARTICLES TOGETHER

[soilandhealth.org](http://soilandhealth.org)



DISPERSED STATE



AGGREGATED STATE



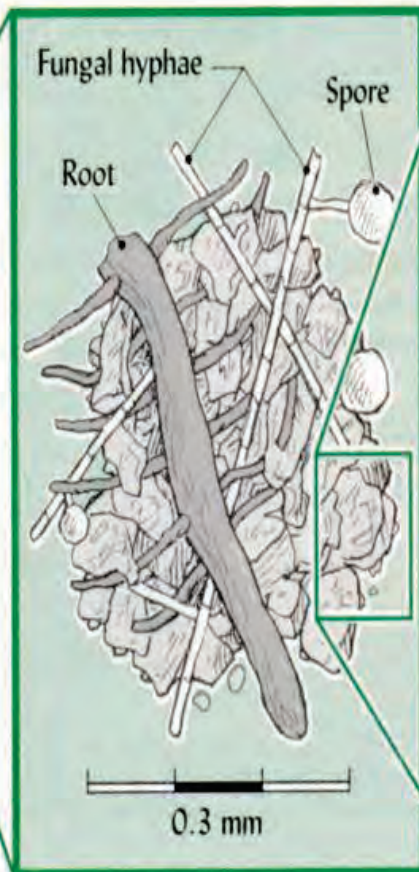
Aggregation and soil structure





#### Macroaggregate

- Roots
- Hyphae



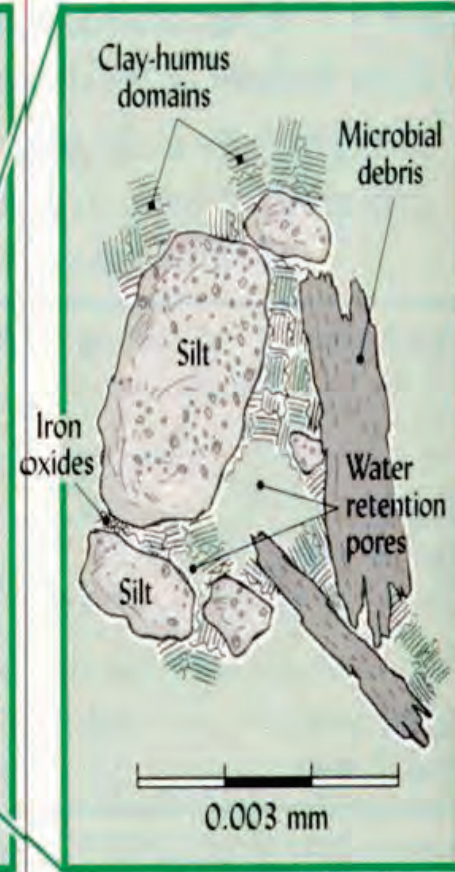
#### Microaggregate

- Root hairs
- Hyphae
- Polysaccharides



#### Submicroaggregate

- Mineral grains encrusted with plant and microbial debris
- Plant debris coated with clay



#### Primary particles

- Clay and clay-humus domains

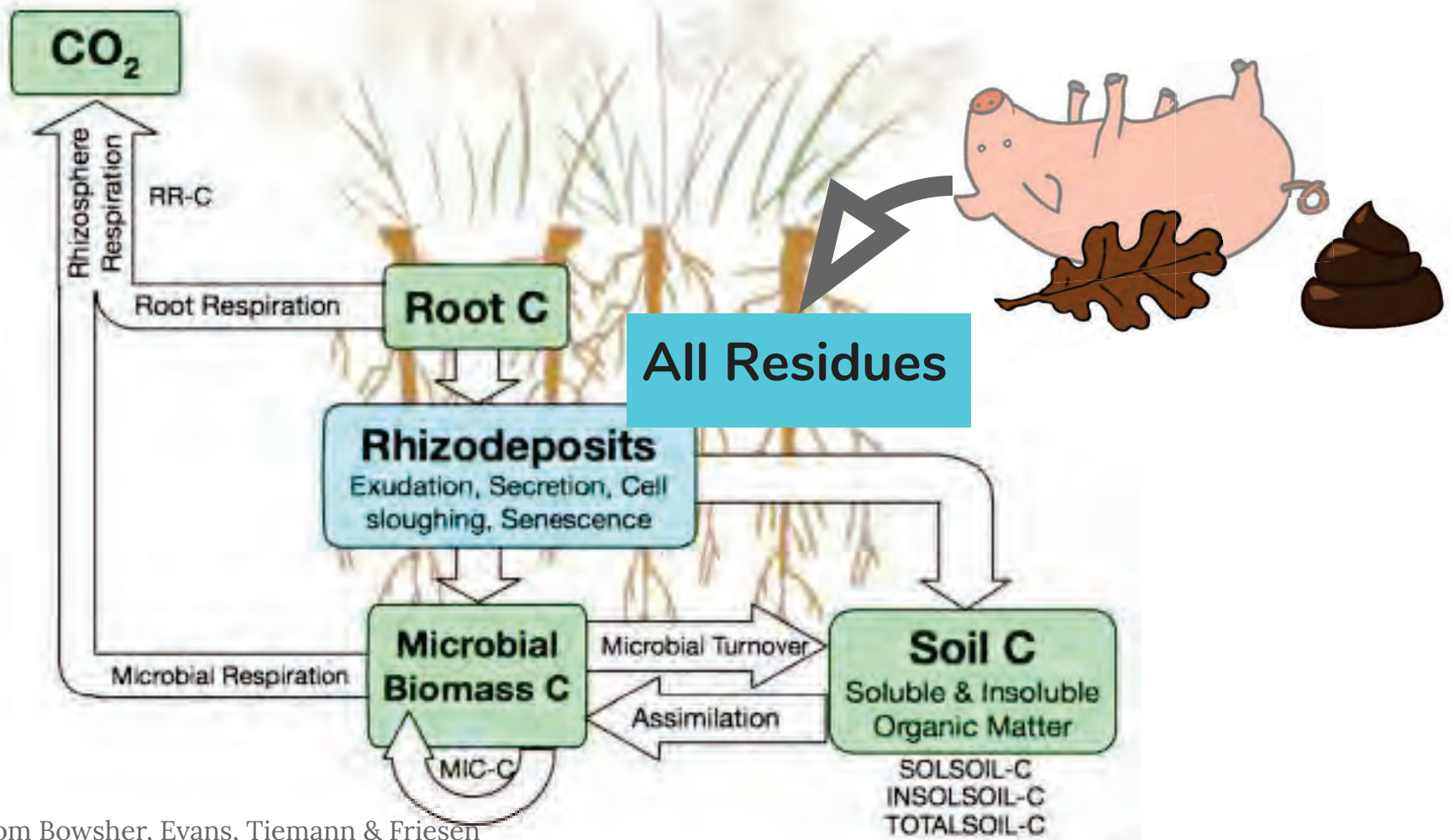
*Tisdall & Oades. 1982*

# Carbon sequestration pathways

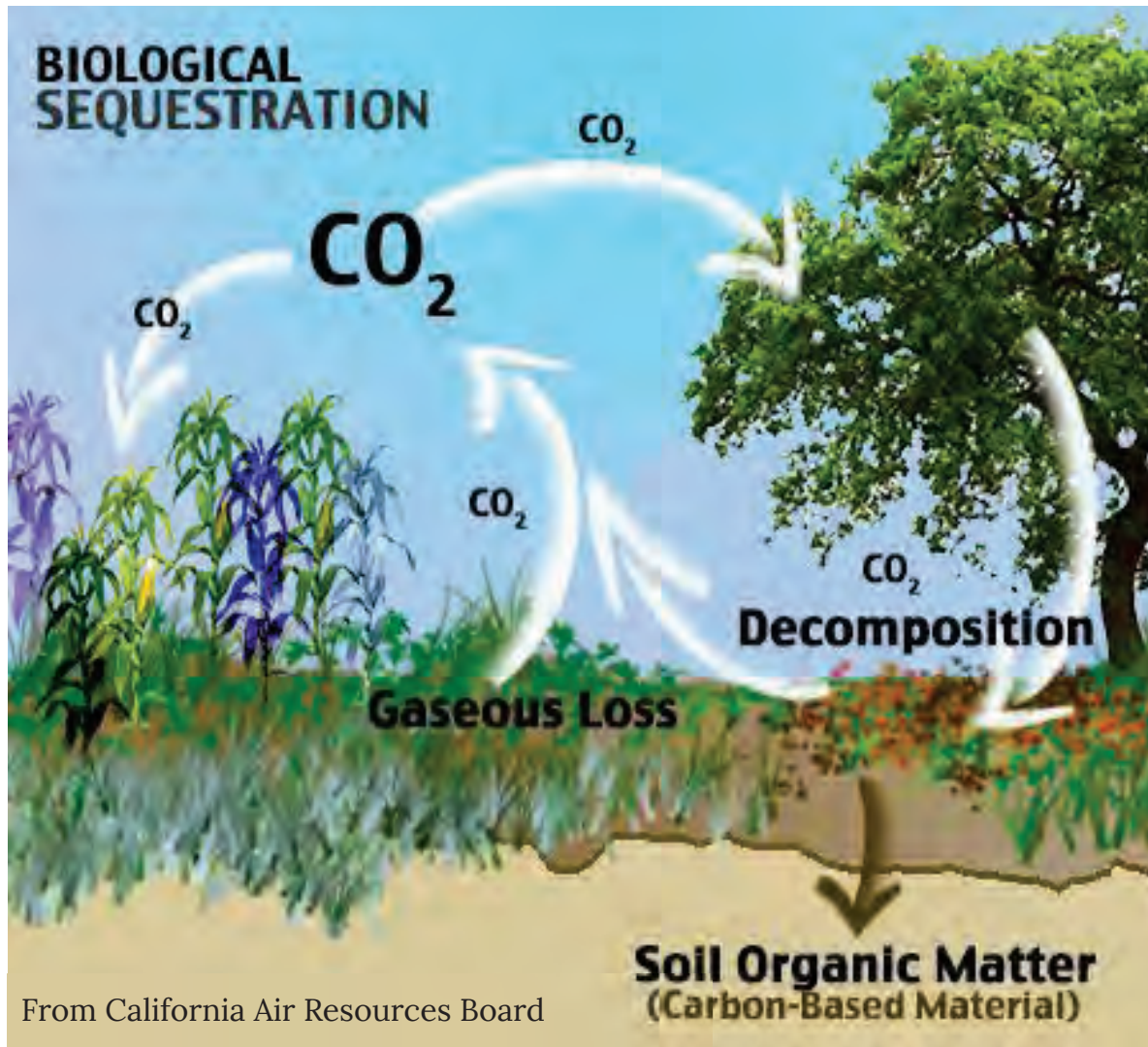
## 3. Decomposition → soil C







Adapted from Bowsher, Evans, Tiemann & Friesen (2012)



# Review

1. Photosynthesis  
→ plants
2. Photosynthesis  
→ Soil C
3. Decomposition  
→ Soil C



## Carbon pools & residence times

1. Active (exudates!) → Fast, 1-5 yrs
2. Particulate organic matter → Slow, 20-50 yrs
3. Humus → Semi-permanent, 100-5,000 yrs