

Soil Biology: The Life Below

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What is Soil?

- Physical properties
 - Structure, texture
- Chemical properties
 - Nutrients, water
- **Biological properties**



Soil Biology Overview

- Agroecology
- Soil Food Web
- Soil Organisms
- Nutrient Cycling
- Healthy Farm Soils



Agroecology

Farm Systems

- Resilient
- Low-Input
- Habitat
- Non-toxic
- Biodiverse



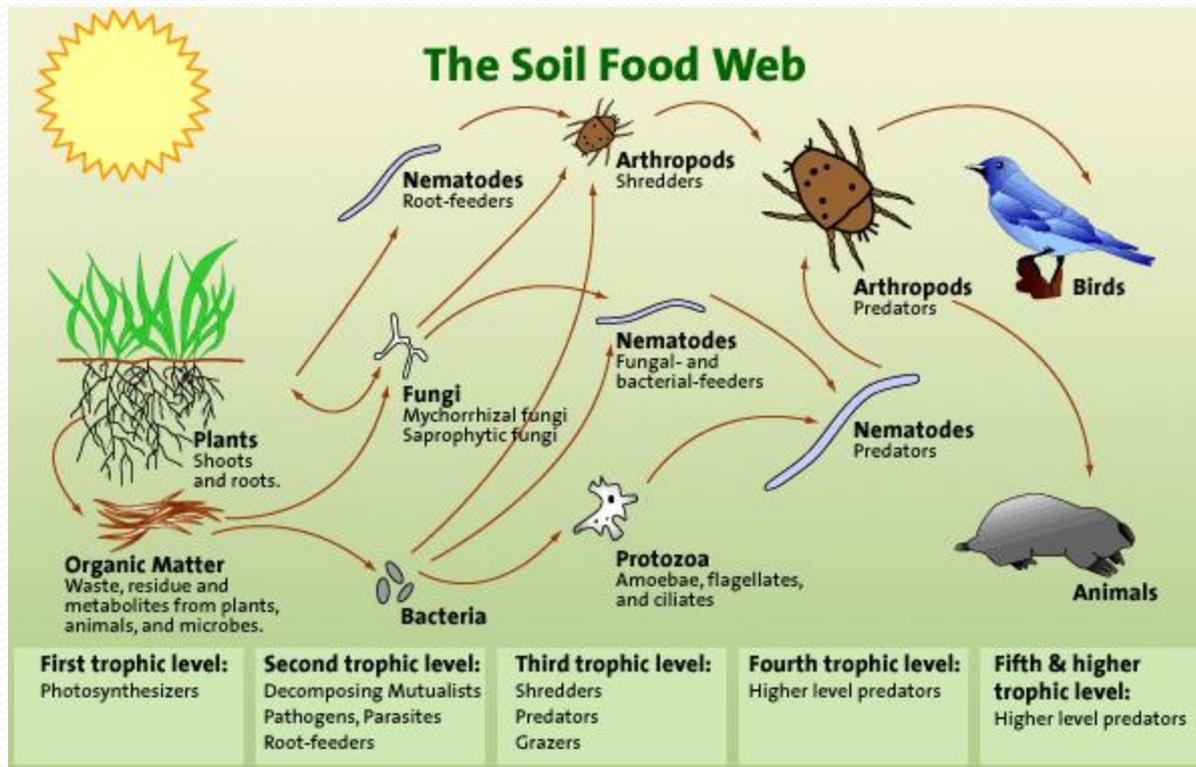
Jean-Francois Millet

Soil is Alive!



- The soil is an ecosystem
- A diversity of organisms live in soil or on plant roots exclusively
- Organic matter in soil feeds soil organisms

Soil Food Web



Soil Food Web

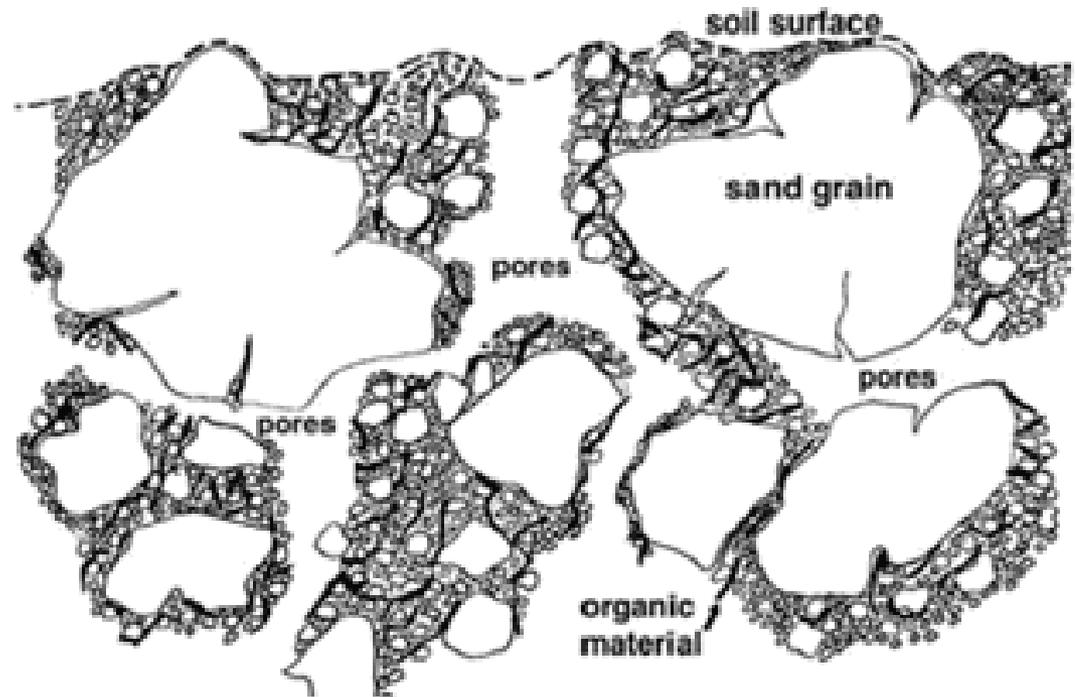
- Web of organisms that live in soil
- Will vary by location and throughout soil profile
- Organisms feed off of organic matter



Clean Samish, WA Dept Ecology

Soil Organism Habitat

- Roots
- Litter
- Humus
- Soil particles
- Pore space



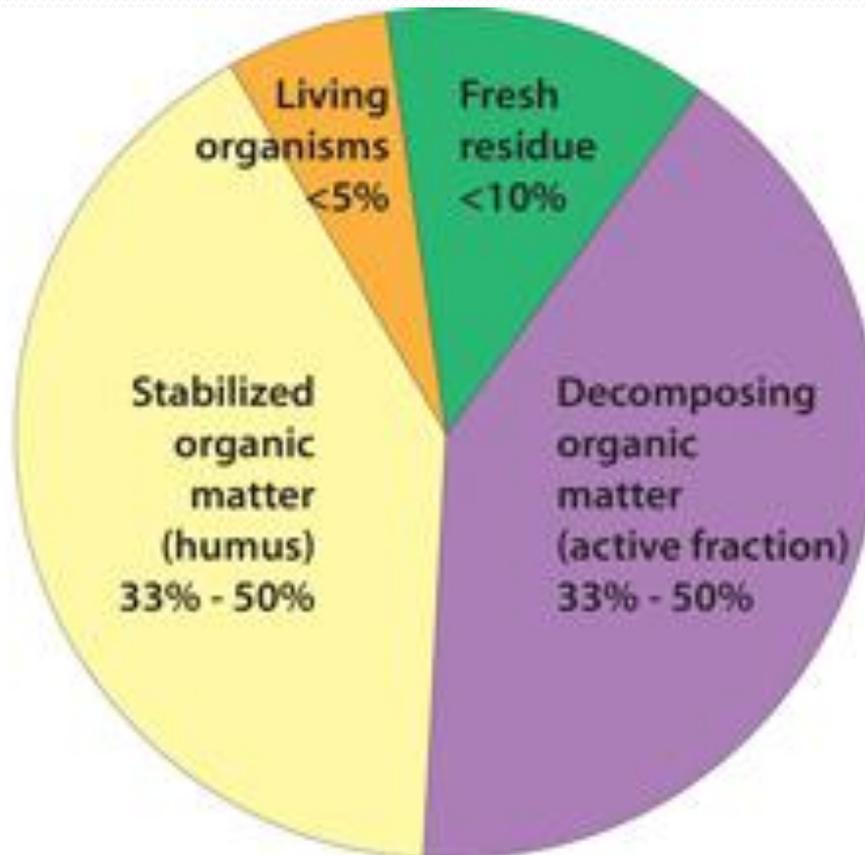
http://vro.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/soilhealth_soil_structure

Food Sources

- Root exudates
- Fresh/dead plants
- Active organic matter
- Labile organic matter
- Other organisms

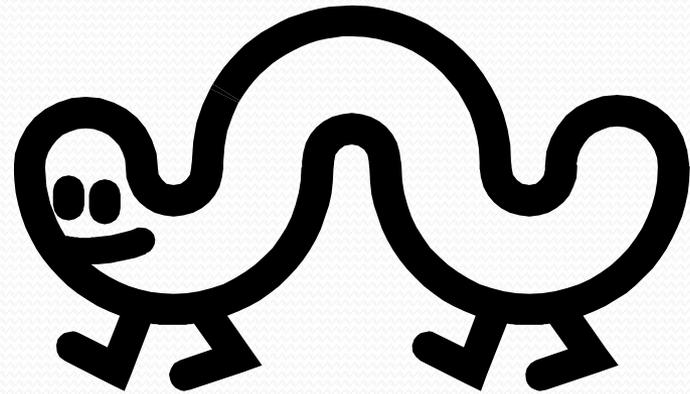


Complex Organic Matter



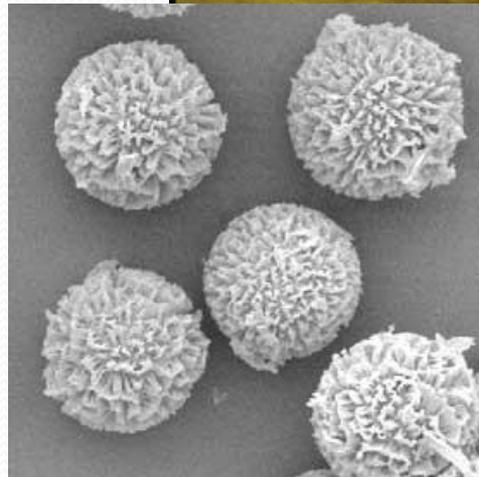
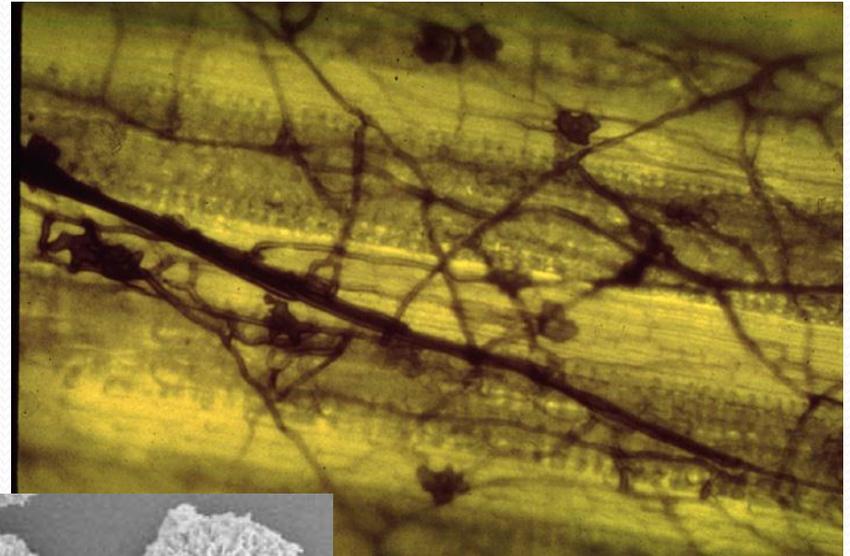
Soil Organisms?

- Fungi
- Bacteria
- Nematodes
- Arthropods
- Earthworms



Fungi

- Multicellular organisms
- Hyphae = micrometers
- Kingdom Fungi
- Mycelium and spores



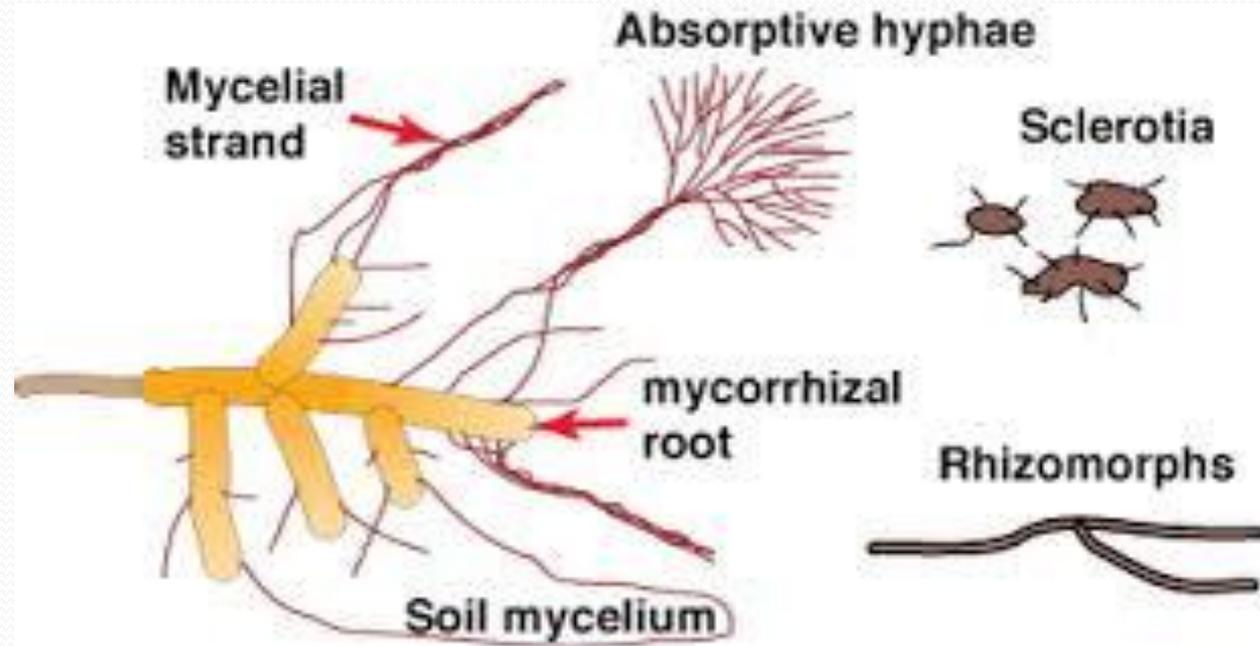
<http://soils.usda.gov/sqi/>

Photo: B. Frey

Fungi

Role in Soil:

- Decomposer
- Mutualists
- Pathogens



Bacteria

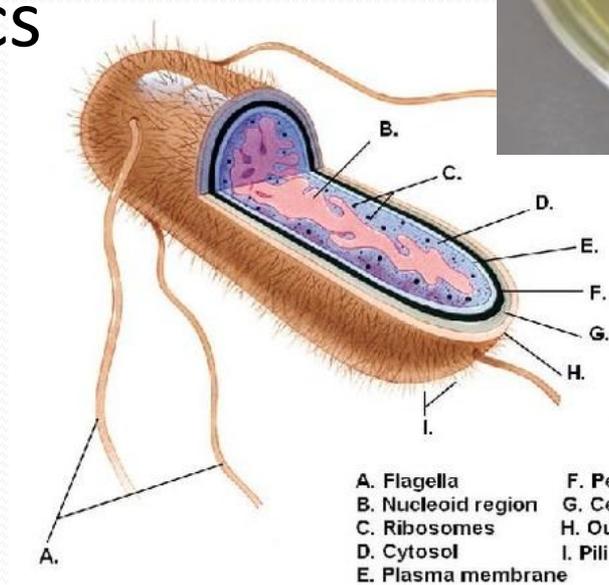
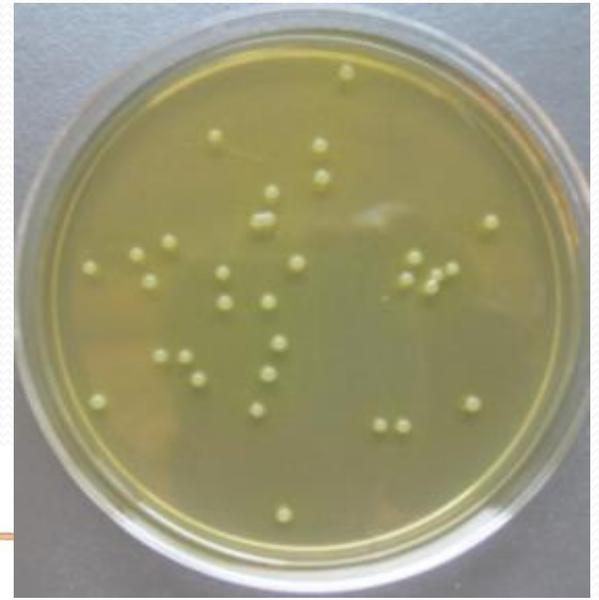
- Single celled organisms
- 4/100,000 of an inch wide
- Prokaryotes
- Rod-shaped with various forms



Bacteria

Role in Soil:

- Nutrient cycling
- Disease suppression
- Water dynamics



A. Flagella
B. Nucleoid region
C. Ribosomes
D. Cytosol
E. Plasma membrane
F. Periplasmic space
G. Cell wall
H. Outer membrane
I. Pili

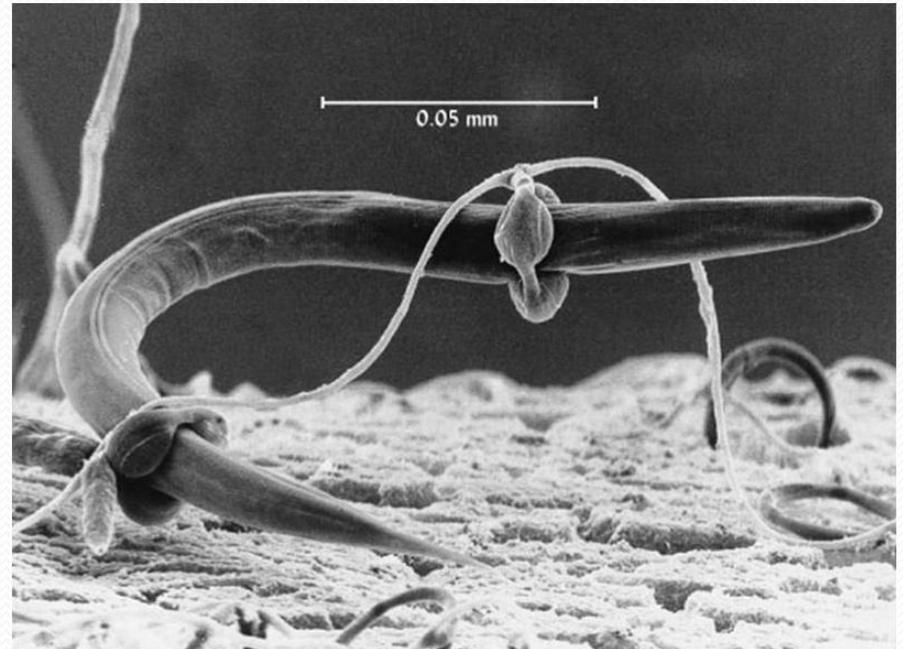
Nematodes

- Microscopic round worms
- 1/500 of an inch
- Various food sources
- Identified by mouth shape



Nematodes

- Nutrient cycling
- Grazing
- Feed on various food sources
 - Bacterial feeders, fungal feeder, omnivores, predatory



http://faculty.yc.edu/ycfaculty/ags105/week10/soil_organisms/soil_organisms4.html

Arthropods

- Many different types of bugs”
 - Millipedes
 - Centipedes
 - Beetles
 - Springtails
 - Mites
 - Symphylan



Earthworms

- 23 families
- Primary decomposers

Role in soil:

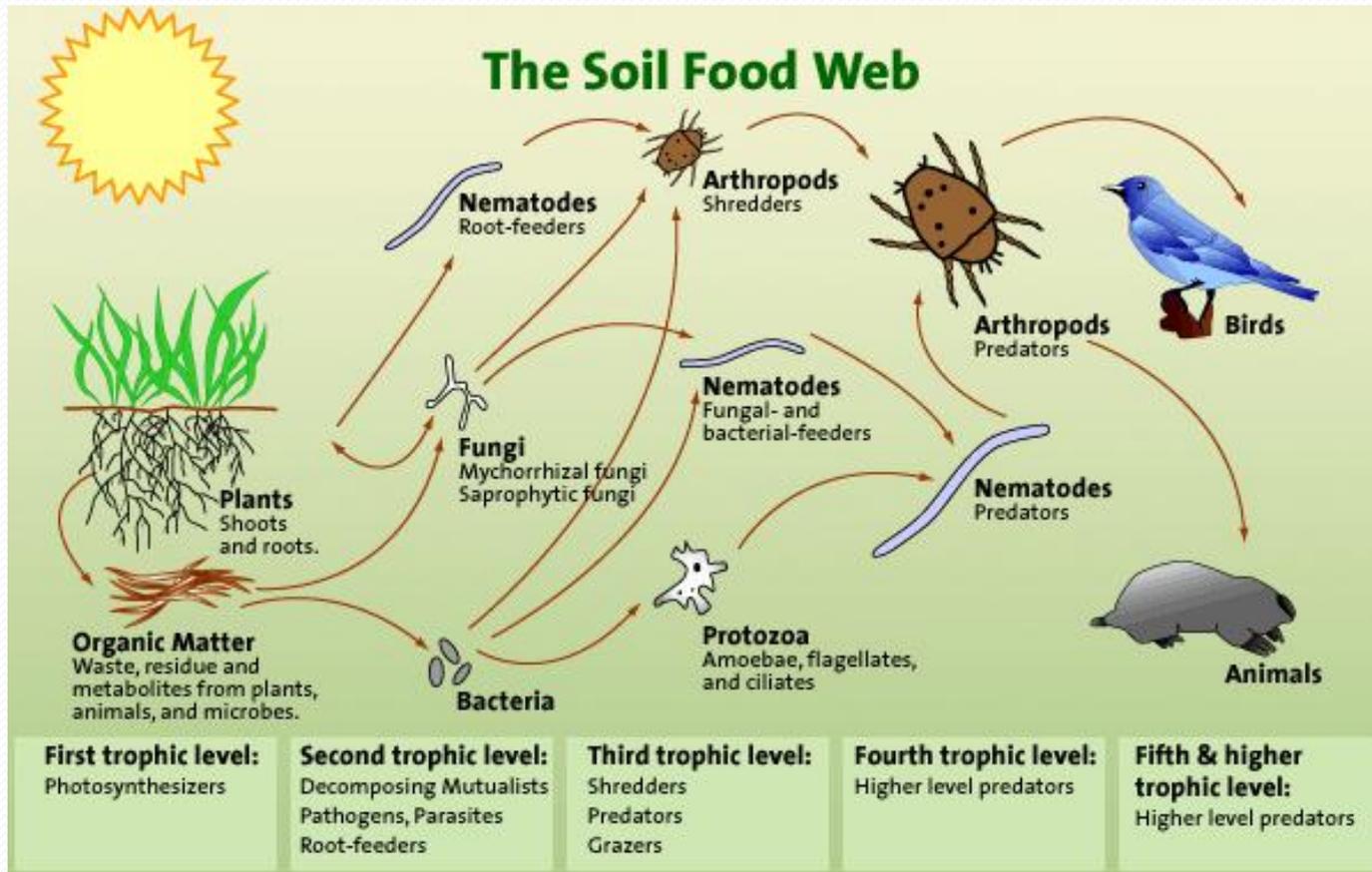
- Create soil structure
- Aggregate soil
- Nutrient cycling
- Shred plant roots



www.wiggleworld.org



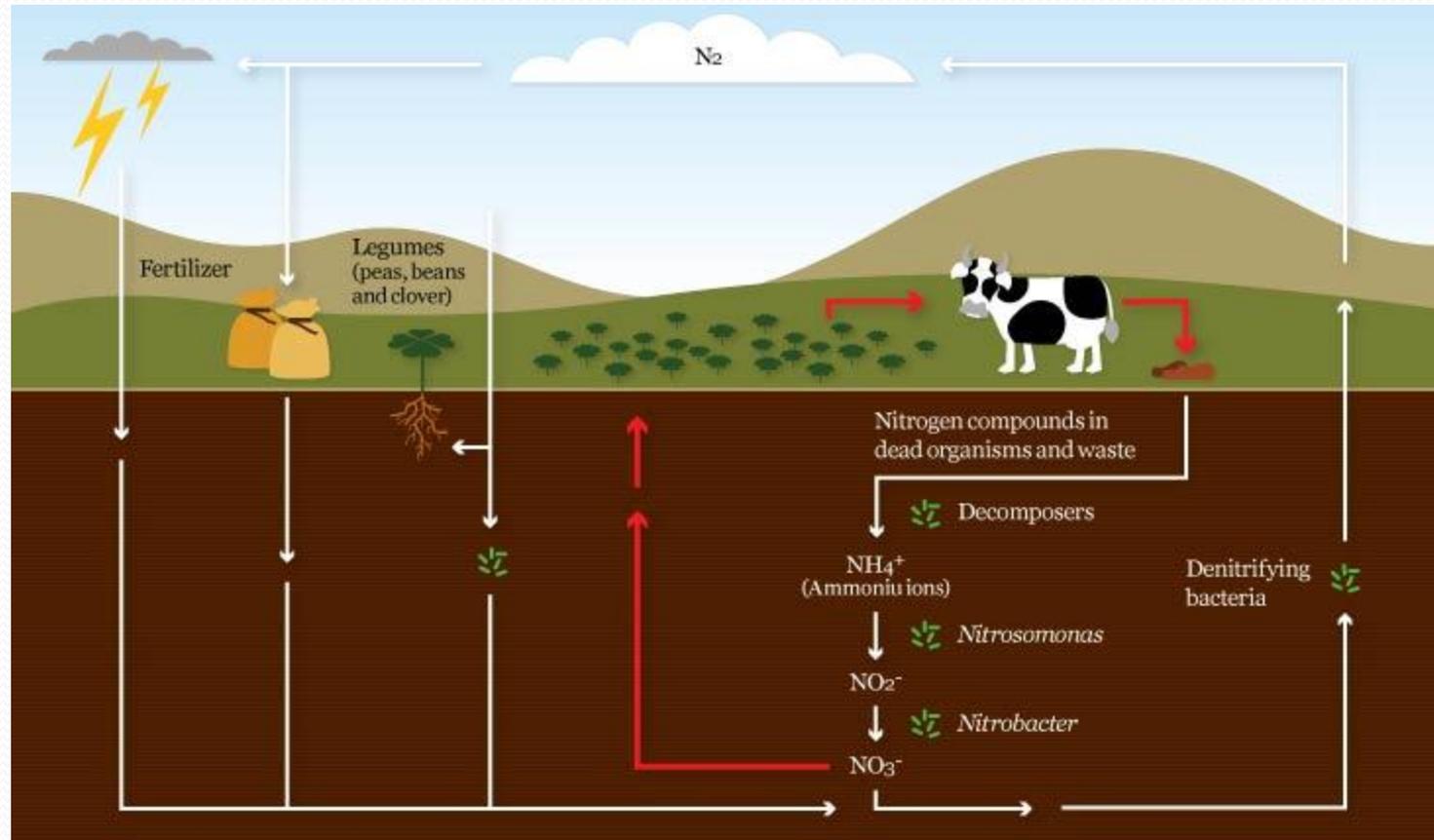
Soil Food Web



What are soil organisms doing?

- Transferring energy
- Ingesting nutrients
- Making nutrients available
- Creating soil structure

Nitrogen Cycle



Determine soil quality

- High in organic matter
- Diversity of microorganisms
- Slow release of nutrients over time
- Needs organic matter inputs
- Reduced cultivation is ideal

Soil Organic Matter

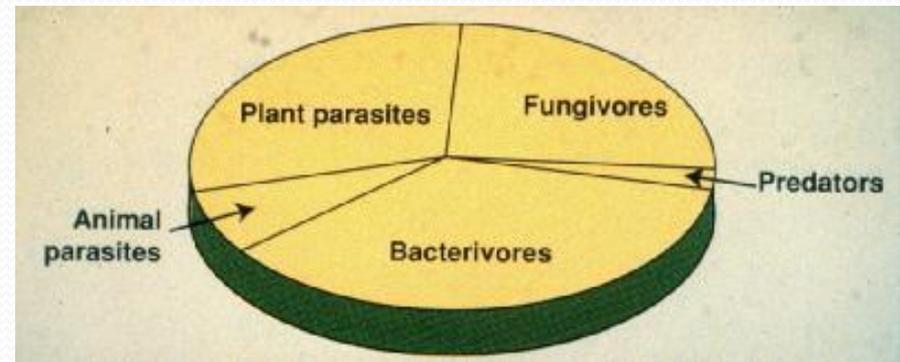
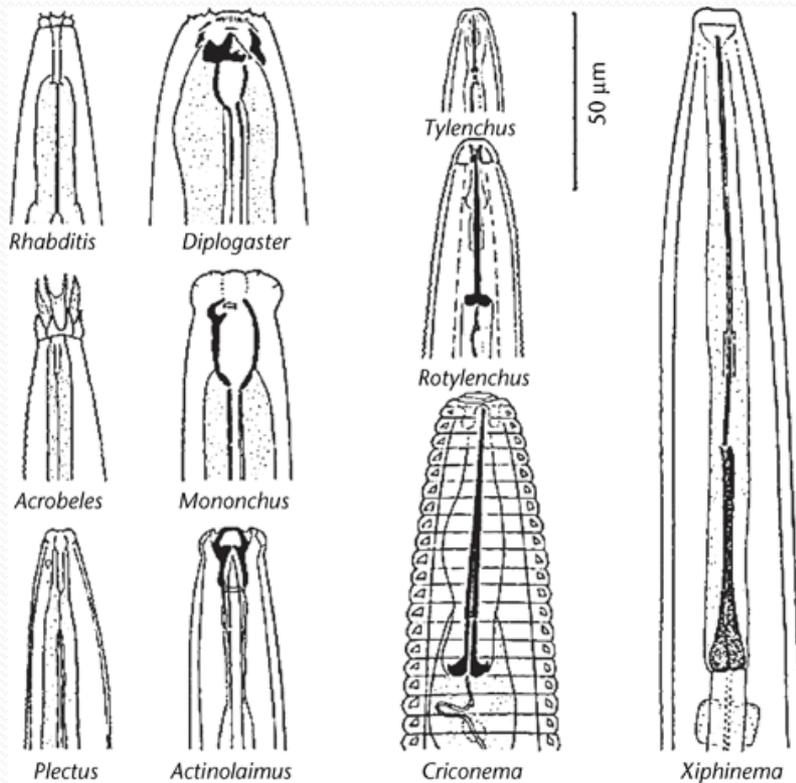
- Soil organisms
- Soil type
- Organic matter inputs
- Tillage
- Crop rotation



Case Study: Communities

- Nematode communities → indicator
- Various food sources available
- Rapid and easy monitoring compared to fungi and bacteria
- Shift in community can indicate soil health changes

Nematode Community Research



www.els.net, left; www.unl.edu, right

Case Study: Pathogens

- Pathogen → agent of disease
- Bacteria and Fungi
- Not all soil organisms are good
- Make sure you are not encouraging pathogens



Root rot

- Complex of soil pathogens
- Influenced by host genetics
- Environment/soil condition affect disease
- Create a “disease suppressive” soil



Developing a disease suppressive soil

Pathogen
biology and
ecology



Biocontrol
mechanisms

Antagonism

Predation

Exploitation

Resistance



Integrated
soil
management

Healthy Farm Soils

- Unique and productive food web
- Control of soil pathogens and food pathogens
- Meets fertility needs



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Soil biology review

- Soil Food Web
- Soil Organisms
- Nutrient Cycling
- Healthy Farm Soils



Questions?

