
APBI200
SOIL BIOLOGY & NUTRIENTS

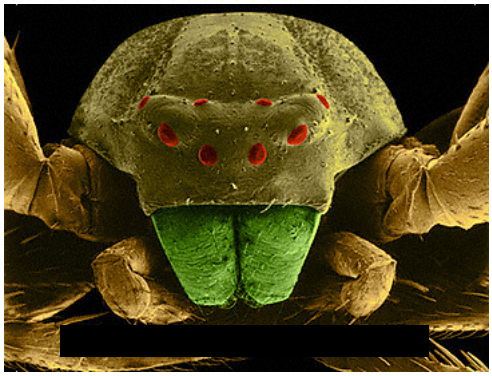

Soil Biology -
SOIL ORGANISMS
Part 1

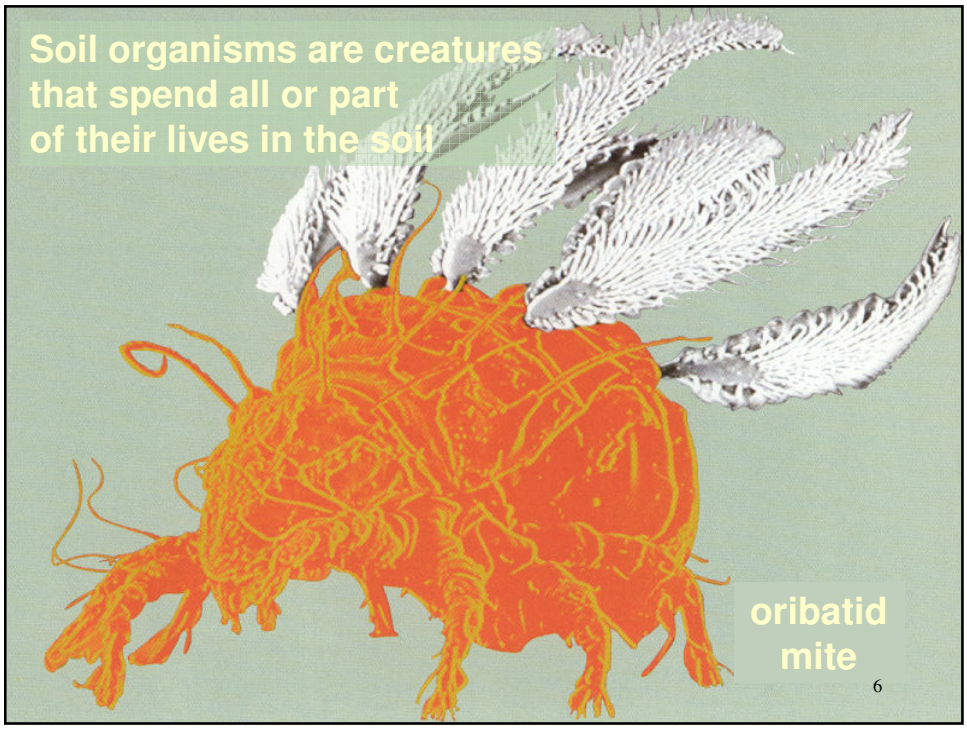
Soil biology is the branch of soil science that deals with organisms and their impacts on soil properties

Lecture outline

- Major groups of soil organisms
  - -size
  - -ecological function(s)
- Soil Flora:
  - -plants
  - -algae
  - -fungi
  - -bacteria

Real? Or not?




Soil organisms are creatures that spend all or part of their lives in the soil
oribatid mite

Importance:

- SOM decomposition / transformations
- Conversion of nutrients from organic to inorganic (plant available forms)
- Plant nutrient retention and release (CEC)
- C cycling
- N cycling
- Soil structure (burrowing, mixing, fecal pellets, cementing agents)

Simplified classification of soil organisms based on:

- **Size of organisms**

  Macro- > 2 mm in width

  Meso- 0.2-2 mm in width

  Micro- < 0.2 mm in width

- **Ecological function**

  (i.e. what they eat)

Ecological functions of soil organisms

- **Herbivores** (subsist on living plants)
- **Detritivores** (eat dead plant debris)
- **Fungivores** (eat fungi)
- **Bacterivores** (eat bacteria)

- **Predators** (consume animals)
- **Parasites** (live off other organisms)

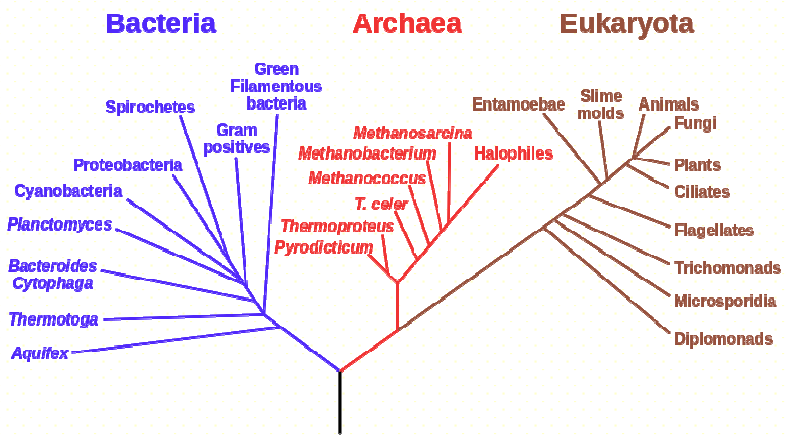
Carbon source:

- **Heterotrophs** (use organic compounds as a source of carbon)
- **Autotrophs** (use CO_2 as carbon source)

Energy source:

- **Phototrophs** (get energy from sunlight i.e. photosynthesis)
- **Chemotrophs** (get energy from chemical oxidation)

Phylogenetic Tree of Life



Classification of soil plants

Plants (flora)

Macroflora: Largely autotrophs

Vascular plants	Feeder roots
Bryophytes	Mosses

Microflora: Largely autotrophs

Vascular plants	Root hairs
Algae	Greens, yellow-greens, diatoms

Largely heterotrophs, aerobic

Fungi	Yeasts, mildews, molds, rusts, mushrooms
Actinomycetes†	Many kinds of actinomycetes

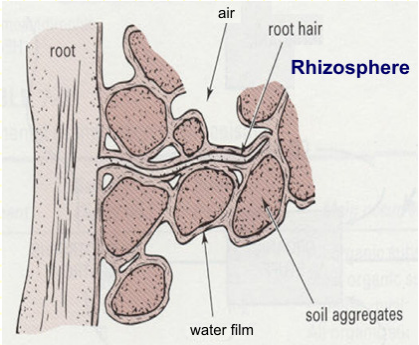
Autotrophs and heterotrophs

Bacteria† (& Archea)	Aerobes, anaerobes
Cyanobacteria†	Blue-green algae

Plants provide large quantities of organic residues though roots and litterfall

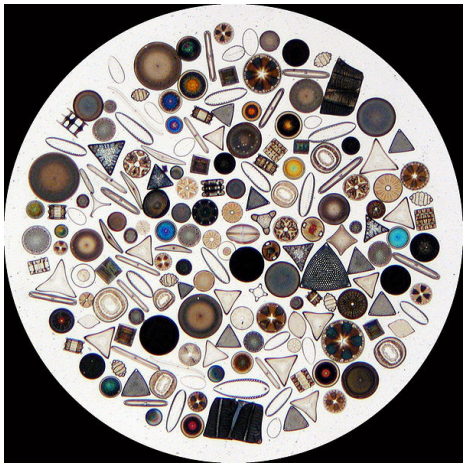
Plants

Rhizosphere



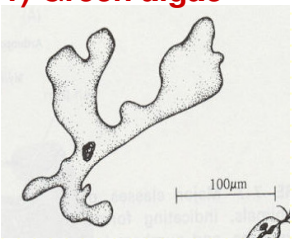
- Zone of soil influenced by living roots & associated soil microorganisms
- These microorganisms usually feed on the proteins and sugars (called exudates) released by roots and on sloughed-off root cells
- Usually extends 1–2 mm out of root surface

Algae have chlorophyll and perform photosynthesis; live at or close to the soil surface



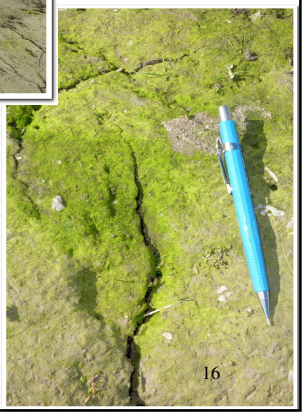
2) Diatoms

1) Green algae



3) Yellow-green algae

Photos: Maja Krzic (UBC)

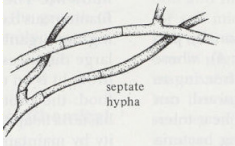


Fungi - heterotropic (mainly) aerobic organisms

Responsible for:
- decomposition of organic matter (convert dead OM to fungal biomass and immobilize nutrients in soil, help accumulation of humic-acid rich organic matter)
- colonization of plant roots (mycorrhizal fungi)
- killing plants (pathogens)
- biocontrol (help control diseases)

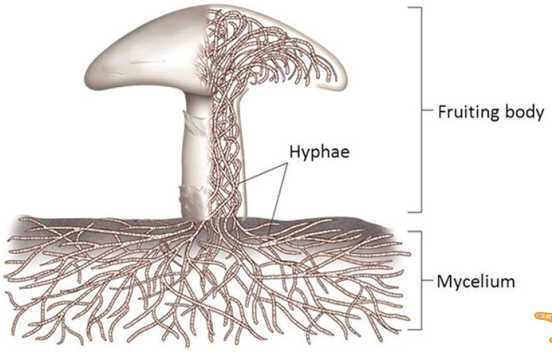
1) Yeast

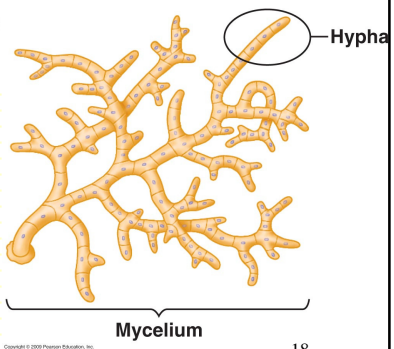
2) Molds



3) Mushroom fungi

Structure of a Typical Fungus





Hyphae: long threadlike filaments

Mycelium: a network of hyphae

Pathogenic fungus

***Armillaria* root rot**

Photos: Dr. Shannon Berch

Litter decomposer fungus (*Mycena*)

Wood decomposer fungus (sulphur shelf)

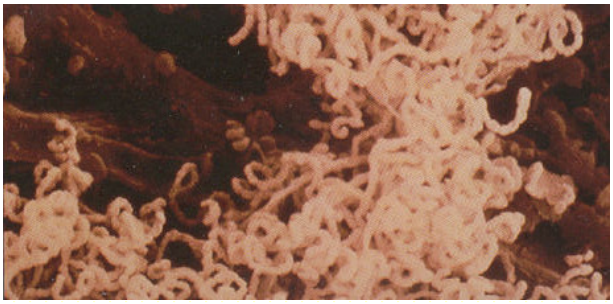
Bacteria the most diverse & abundant group of soil organisms

- N-fixing: form symbiotic associations with roots of legumes & trees (e.g. alder) → atmospheric N available to plants
- decompose organic matter & release nutrients in plant available form (e.g. N-cycle)
- convert soil N to gaseous forms (e.g. N_2O) → N losses from soil

Actinobacteria (formerly known as actinomycetes) are "filamentous bacteria" that:

- decompose soil organic compounds (chitin & cellulose);
- produce antibiotics

https://www.facebook.com/exploristscience/videos/1172282529536608/



Cyanobacteria (formerly known as blue-green algae)

- Have chlorophyll and perform photosynthesis
- Some can fix atmospheric N (*Anabaena* sp.)
- Some are symbionts with lichens, protozoa, diatoms, algae

Cyanobacteria

Archaea

- Single-celled micro-organisms
- No cell nucleus (prokaryotes)
- Previously classed with bacteria (archaebacteria)
- Initially seen in harsh environments (e.g. hotsprings); since found in broad range of habitats

hotspring

acid mine drainage

- Important in C and N cycling