



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

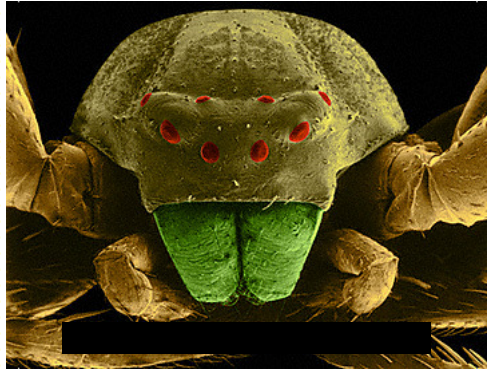
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## Lecture outline

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

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Real? Or not?



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



oribatid mite

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## 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)**

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## 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)

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## 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:

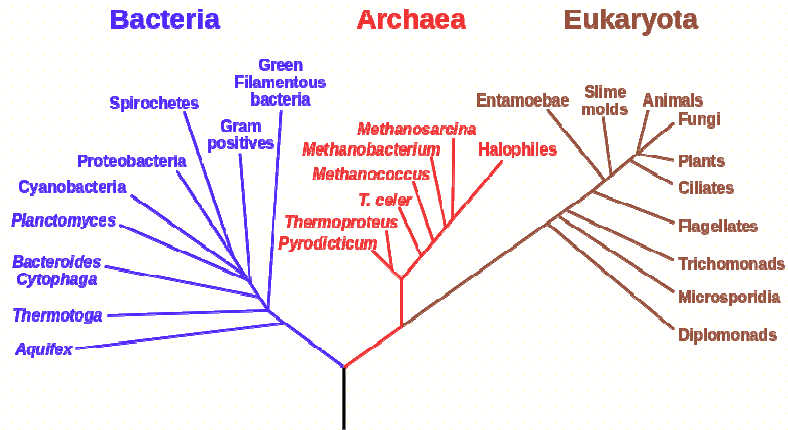
- **Heterotrophs** (use organic compounds as a source of carbon)
- **Autotrophs** (use CO<sub>2</sub> as carbon source)

### Energy source:

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

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## Phylogenetic Tree of Life



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## 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† (& Archaea)	Aerobes, anaerobes
Cyanobacteria†	Blue-green algae

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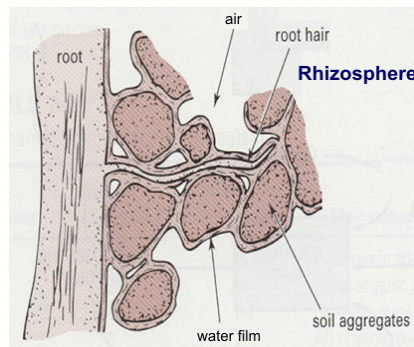
## Plants provide large quantities of organic residues through roots and litterfall



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## Plants

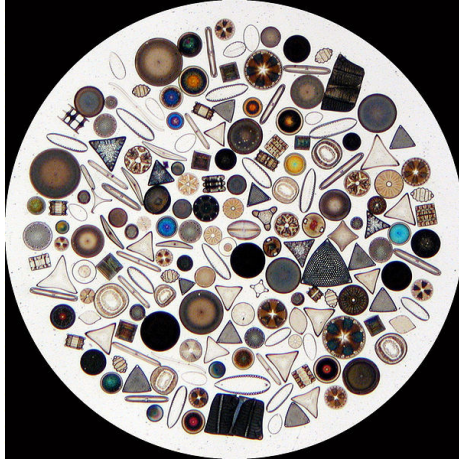
### Rhizosphere



- 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

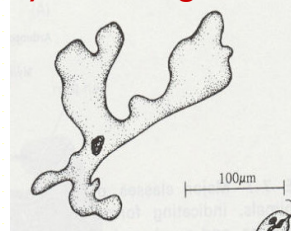
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**Algae** have chlorophyll and perform photosynthesis; live at or close to the soil surface



**2) Diatoms**

**1) Green algae**

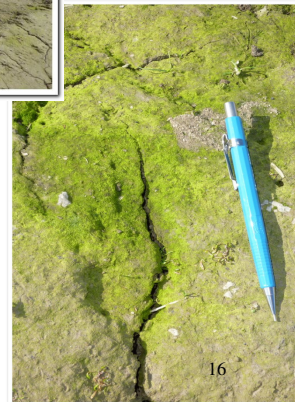


**3) Yellow-green algae**

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Photos: Maja Krzic (UBC)



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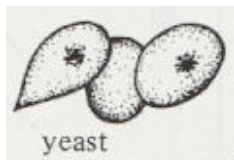


# Fungi - heterotrophic (mainly) aerobic organisms

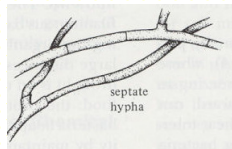
Responsible for:

- 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

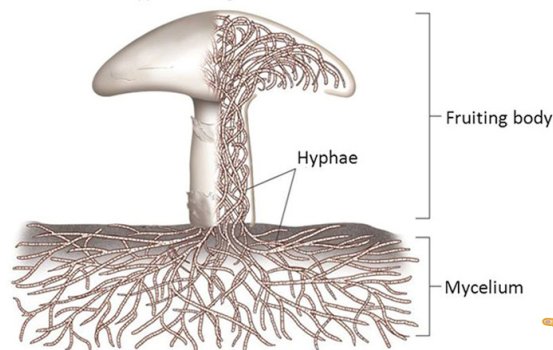


## 3) Mushroom fungi



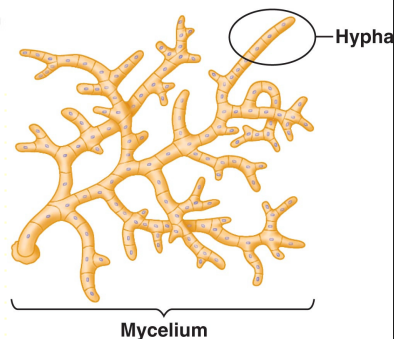
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### Structure of a Typical Fungus



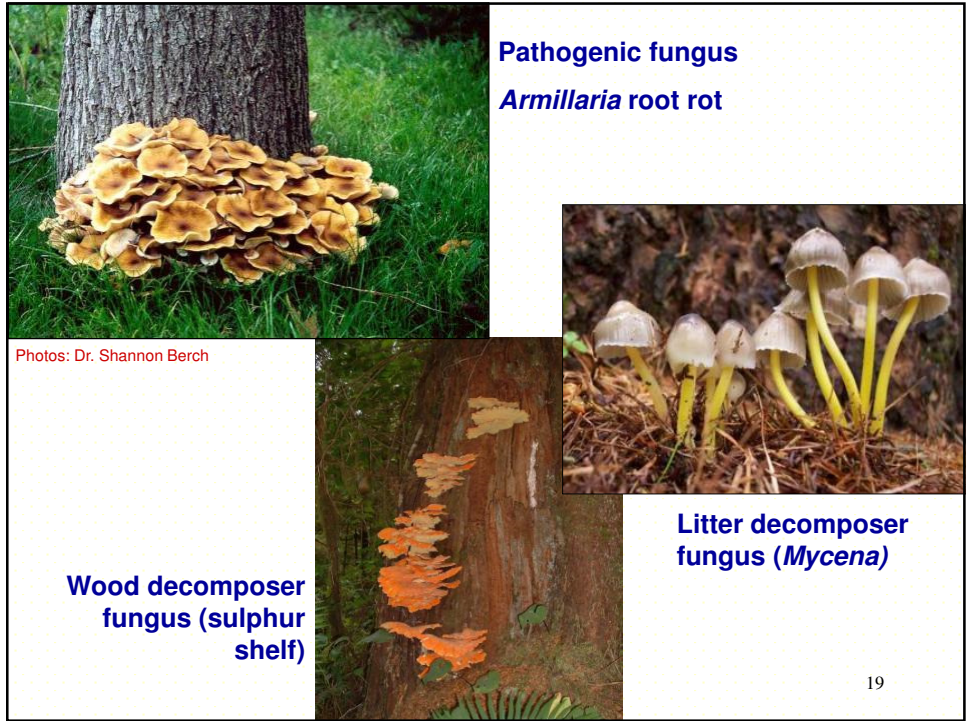
**Hyphae:** long threadlike filaments

**Mycelium:** a network of hyphae



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## **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/>



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**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

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# 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