

## Video Guide: Life in the Soil

### *Life in the Soil*

1. Describe how the soil web contributes to the carbon cycle.

The carbon cycle “starts” with plants capturing atmospheric carbon dioxide and turning it into organic carbon. Decomposers eat the dead plant tissue and mostly return the carbon to the atmosphere through respiration. Other species, such as primary and secondary consumers, essentially do the same by consuming carbon that ultimately came from plants and respirating out the carbon as carbon dioxide.

2. Briefly describe the structure and functions of the following organisms:

- a. **Bacteria** – Bacteria are single-celled prokaryotic organisms, meaning they have no nuclei or membrane-bound organelles. They can grow in the wild as colonies between or on soil particles, especially in grasslands and plowed soils that aren't too acidic. Aerobic and anaerobic bacteria exist, and some eat decaying organic matter while others are parasitic. Bacteria digest sugar and cellulose by producing enzymes to break them down.
- b. **Fungi** – Fungi are characterized by their filamentous vegetative body called mycelium. The mycelium consists of long tangled cells called hyphae. Fungi also produce fruiting bodies for the purpose of spreading spores. Fungi do well in acidic soils, like those you would find in a forest. Fungi are strong decomposers, and can decompose certain materials that are otherwise slow to degrade naturally. Some fungi are parasitic and harmful to plants, while others can support plant development.
- c. **Actinomycetes** – Actinomycetes are bacteria that look like fungi due to their hyphae networks. They produce chemicals that prevent the growth of other kinds of microorganisms, so they act as a natural control for soil bacteria.
- d. **Algae** – Soil algae are typically single-celled photosynthetic organisms. These algae can be either cyanobacteria or protists. Algae are an important part of soil development, as the lichens that break rocks down by producing acid are made of algae and fungi. Blue-green algae also capture nitrogen and deposit it into the soil.
- e. **Protozoa** – Protozoa are single-celled organisms that are more similar to animals. They live in soil water films and prey on bacteria. They release excess nitrogen from consuming bacteria as ammonium ions, which are useful to plants.
- f. **Nematodes** – Nematodes are microscopic worms without body segments that live in larger water-filled pores. Nematodes populations are higher in areas where the soil isn't disturbed, and in forests or grasslands. Different species of nematodes have different diets – some eat plants, some eat bacteria, some eat fungi, and some are predatory and eat other nematodes or protozoa.

- g. **Arthropods** – **Arthropods have jointed legs and an exoskeleton. Similar to nematodes, this group has species with a variety of different diets with different species eating plants, soil fauna, or other organic material. These arthropods make their homes in surface litter, or by tunneling underground which has the side effect of aerating the soil. Tilling soil leads to lower arthropod populations.**
- h. **Earthworms** – **Earthworms are segmented worms that eat organic matter and release waste that is high in plant nutrients. Their tunneling behavior increases soil aeration and they are typically a sign of healthy soil. Earthworms can live in surface litter, shallow soil, or deep soil, and their populations grow with practices such as crop rotation and an increase in organic matter.**
- i. **Mammals** – **Mammals burrow through the soil, mixing and aerating it. Mammals can produce a deep A horizon over a B horizon.**

### ***Benefits and Management of Soil Organisms***

1. Define rhizosphere.  
**The rhizosphere is the area of biological activity that surrounds plant roots. The rhizosphere is the result of the organic matter roots introduce to the soil.**
2. Describe the parts of the nitrogen cycle, focusing on the beginning and end product it produces.
  - a. **Mineralization** – **Soil microorganisms break down organic nutrients so they can form ionic bonds and become inorganic compounds.**
  - b. **Nitrogen Fixation** – **Nitrogen Fixation is the process of soil bacteria converting atmospheric nitrogen into ammonium ions that plants can consume.**
  - c. **Nitrification** – **Oxidation of ammonia to form nitrite and hydrogen ions.**
  - d. **Denitrification** – **Nitrate ions are converted into nitrogen gas, which leaves the soil.**
3. Identify a biological process in the soil that can contribute to climate change.  
**Denitrification can contribute to climate change by the formation of nitrogen gas which escapes into the atmosphere, leading to an increase in greenhouse gases.**
4. Differentiate between Rhizobia and Mycorrhizae.  
**Rhizobia are rhizobacteria that produce plant hormones and vitamins. Mycorrhizae are fungi that essentially extend a plant's root system.**

5. Describe the benefits of mycorrhizae.

**Mycorrhizae act as an extension of the plant's root system, adding countless fibrous roots to the system. This leads to increased micronutrient uptake, water absorption, rootlet lifespan, and protects roots from diseases and toxic metals.**

6. Describe ways to manage soil organisms.

**Soils are purposely inoculated with helpful organisms, such as rhizobium and mycorrhizae. Constantly adding organic matter to feed microorganisms is an important step to take in increasing soil organism populations. Reducing tillage, pesticide use, compacting, and fallow can help. Crop rotation, cover cropping, intercropping, and crop diversification can also improve soil organism health.**

**In terms of managing harmful organisms, sterilization is an extreme but effective measure in which the soil is completely sterilized. Heat is a common way to do this, whether with fire or solarization. Rotating crops can help by removing the habitat for organisms dependent on a specific plant. Growing cultivars resistant to prevalent pathogens is an effective measure in reducing plant disease as a result of harmful soil organisms.**