Environmental microbiology

Soil microbiology

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Soli microbiology

- Soil microbiology is the study of organisms in soil, their functions and how they affect properties of soil or environmental microbiology. Soil structure and interactions among microorganisms (including soil fungi, soil bacteria and species like nematodes) can impact soil biology and biochemistry and other properties of soil.

Soil Composition

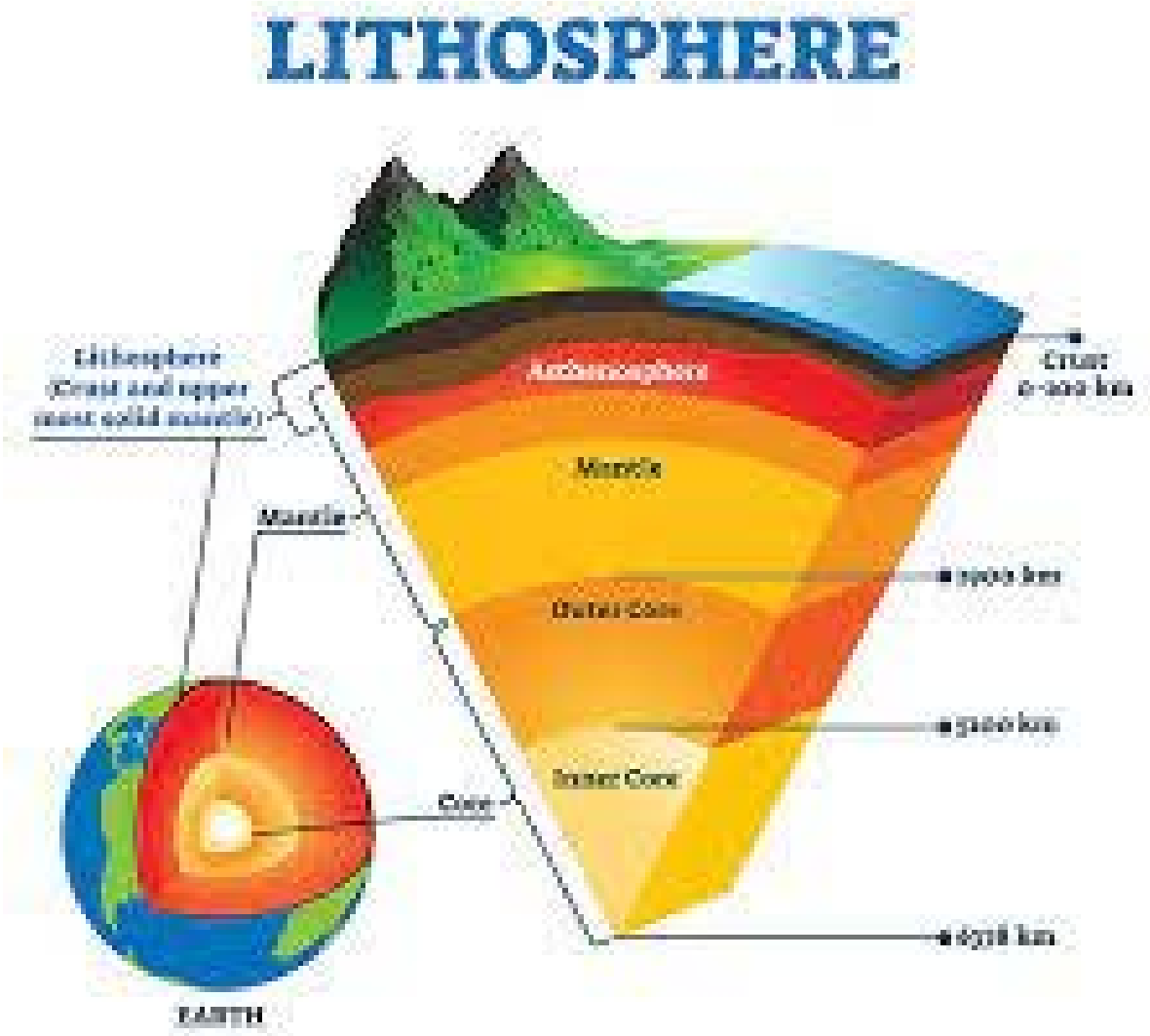
- Soils are made up of four basic components: mineral particles, air, water, and organic matter. Solid materials (organic and inorganic) , which represent around half of soil content and spaces filled with air and water.

  Living organisms present in the soil are grouped into two categories as follows.

1. Soil flora (micro flora) e.g. Bacteria, fungi, Actinomycetes, Algae
2. Soil fauna (micro fauna) animal like eg. Protozoa, Nematodes, earthworms, moles, ants, rodents

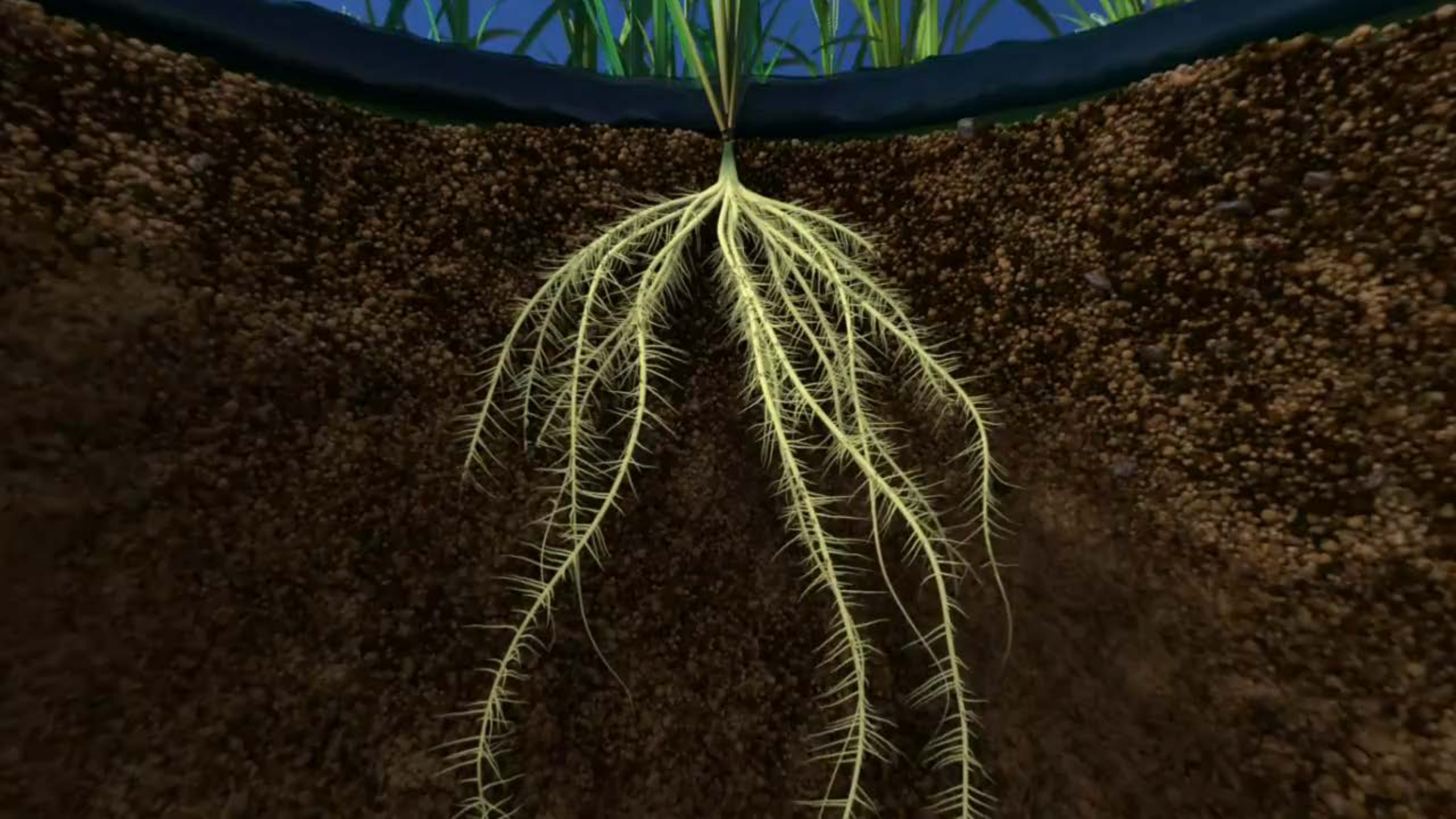
Soil Microbiology: The Composition of the Lithosphere

- **Humus** – rich moist layer of soil containing plant and animal debris being decomposed by microbes
- **Rhizosphere** – zone of soil around plant roots contains associated bacteria, fungi, and protozoa
- **Mycorrhizae** – symbiotic relationship formed between fungi and certain plant roots



Rhizosphere:

- The term ‘rhizosphere’ was introduced in 1904 by the German scientist Hiltner to denote that region of the soil which is modified as a result of the uptake and deposition of substances by a growing root or the root surface (rhizoplane) together with that region of the surrounding soil in which the microbial population is affected, qualitatively and/or quantitatively, by the presence of a root.



Importance Of The Rhizosphere

Balanced and varied soil microbial activity in the rhizosphere performs critical activities, including:

- Nitrogen-fixation
- Nutrient solubilization
- Suppression of pests and pathogens
- Tolerance of plant stress
- Decomposition of organic residue
- Recycling of soil nutrients

Mycorrhizae

- symbiotic associations between fungi and plant roots.
- The fungi involved (e.g. basidiomycetes, ascomycetes, deuteromycetes) are always associated with the primary cortex of the root.

Mycorrhizae – live in or on plant roots

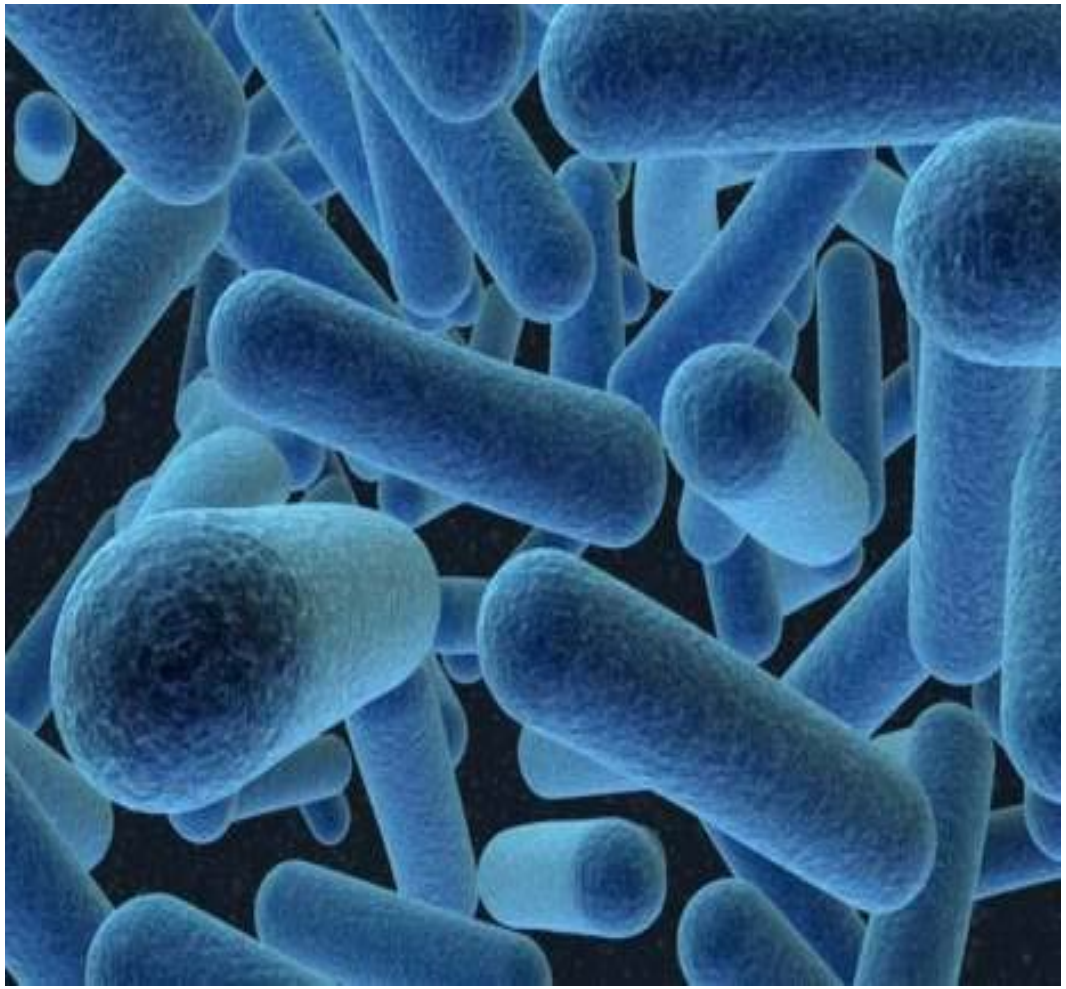
- Increase uptake of water and nutrients by roots.
- Produce hormones and antibiotics that help plant growth and prevent diseases, Help trap nematodes that are harmful to plants.


empathy
the biological choice
What is Mycorrhizal Fungi?
Over 80% of plants live in a symbiotic relationship
with a remarkable organisim called mycorrhizal fungi.

Types of Soil Microorganisms:

1. Bacteria:

- More dominant group of microorganisms in the soil and equal to one half of the microbial biomass in soil. Population 100,000 to several hundred millions for gram of soil. (Common soil bacteria – Arthrobacter, *Bacillus, Clostridium, Micrococcus).*



2. Actinomycetes

Intermediate group between bacteria and fungi. Numerous and widely distributed in soil. Abundance is next to bacteria. 104 – 108/g soil. 70% of soil actinomycetes are Streptomyces. Many of them are known to produce antibiotics. Population increases with depth of soil.

3. Fungi

More numerous in surface layers of well-aerated and cultivated soils-dominant in acid soils. Common genera in soil are Aspergillus, Mucor, Penicillium Trichoderma, Alternaria and Rhizopus. Algae – found in most of the soils in number ranges from 100 to 10,000 per g.

4. Protozoa:

- Unicellular – population ranges from 10,000 to 100,000 per g of soil. Most of the soil forms are flagellates, amoebae or ciliates. Derive their nutrition by devouring soil bacteria. Abundant in upper larger of the soil. They are regulating the biological equilibrium in soil.

5-nematodes

- A few species are harmful to plants, but these are kept in check by predatory nematodes and arthropods.
- The harmless nematodes eat decaying plants, soil microbes and other nematodes and release nutrients from the bodies of their prey.
- This speeds up nutrient recycling.

Importance of Soil Microorganisms

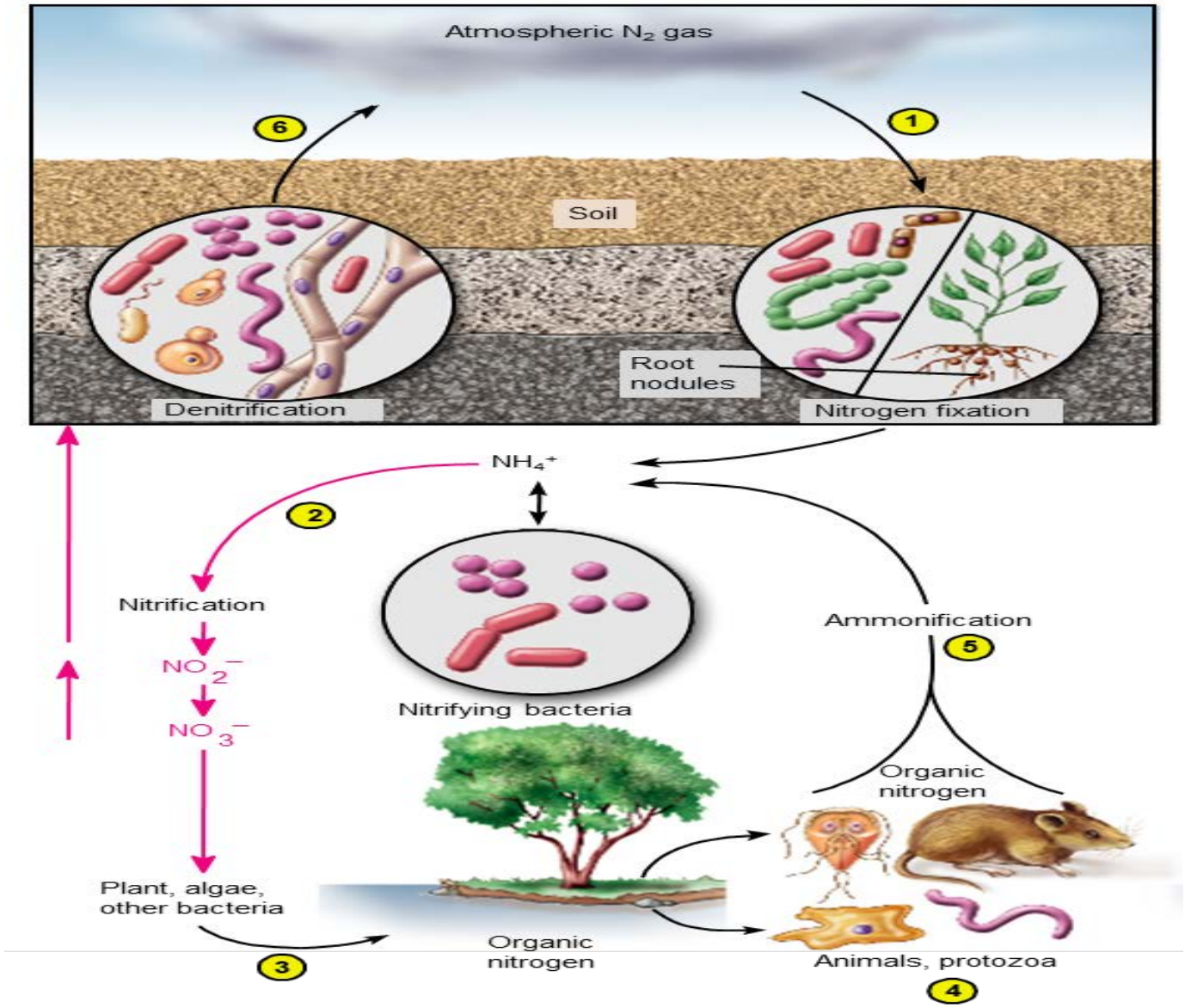
- Importance of Soil Microorganisms:

(Involved in nutrient transformation process)

1. Decomposition of resistant components of plant and animal tissue
2. Role in microbial antagonism
3. Participate in humus formation
4. Predator of nematodes
5. Surface blooming reduces erosion losses

The Nitrogen Cycle

- **Nitrogen fixation** – atmospheric N_2 gas is converted to NH_4 salts; nitrogen-fixing bacteria live free or in symbiotic relationships with plants
- **Ammonification** – bacteria decompose nitrogen-containing organic compounds to ammonia
- **Nitrification** – convert NH_4^+ to NO_2^- and NO_3^-
- **Denitrification** – microbial conversion of NO_3^- back to atmospheric N_2



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