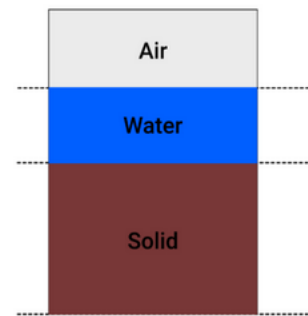


An Overview of Basic Soil Biology

The Basic Components of Soil

Soil is made of four components:

- **air**
- **water**
- **mineral material** (such as clay and silt)
- **organic matter** (such as decaying plant roots, leaves, mulch and animal manure)

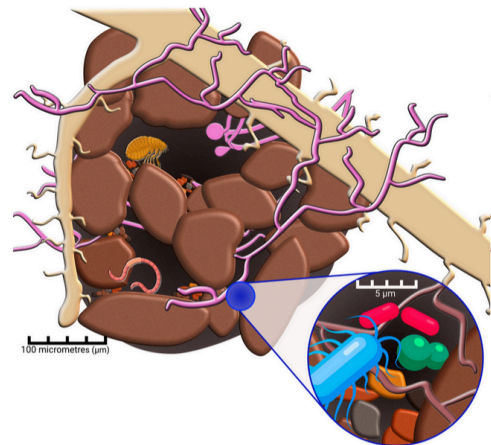


Having gaps, or “pore space” between the solid matter is important for soil health. And the more *connected* the pore space, the healthier the soils will be and the better the soil will be at holding water and air. Pore diameters are tiny – between 1-100 micrometres (µm). This is thinner than a human hair.

Soil Aggregate

A soil aggregate is a naturally formed assembly of silt, sand, clay, organic matter, root hairs, micro-organisms and their secretions and the pores between them.

Aggregates need living roots in order to form. They are destroyed by tillage. When water and air enters a well-aggregated soil, they enable beneficial microbes to thrive and function.



Well aggregated soils have more organic matter. They are better able to hold onto water and maintain a balanced level of nutrients. They are able to self-organise, self- heal and self-regulate themselves resulting in good soil structure, better yields, and more resilience to extreme weather events such as droughts and floods.

Plant Exudates

Plant exudates are fluids emitted through the roots of plants. They consist of substances like sugars, amino acids, organic acids and vitamins¹.

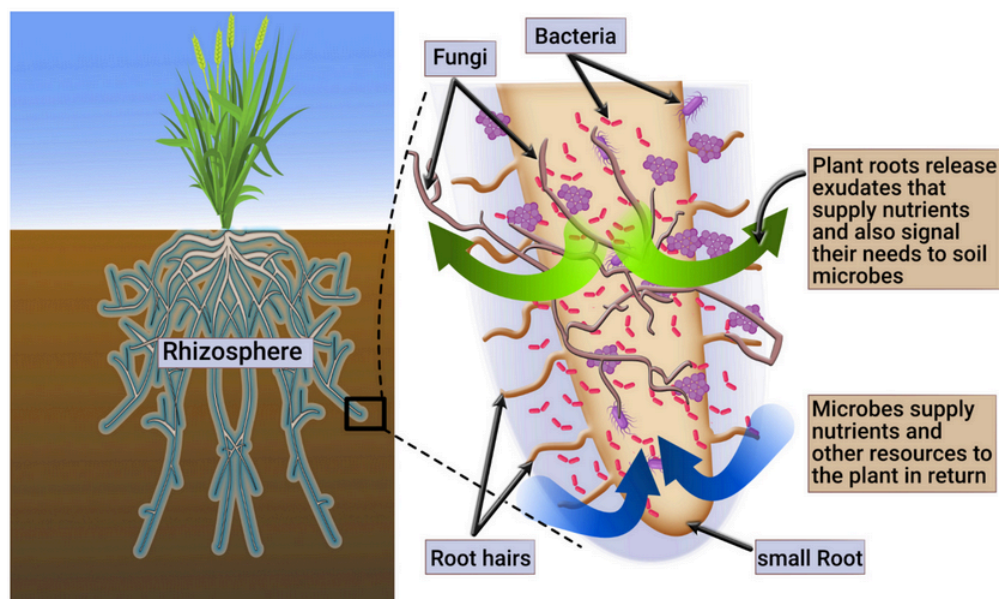
They influence the “rhizosphere” (explored in more detail below) around the roots, and can improve soil moisture, nutrient availability and plant growth. They also help plants to adapt to and gradually change the soil environment ².

¹<https://www.sciencedirect.com/science/article/abs/pii/B9780323998963000035>

²<https://www.sciencedirect.com/science/article/abs/pii/S0065211323000378>

The Rhizosphere

The rhizosphere is a narrow region immediately next to the roots. It is full of bacteria that feed and decompose the exudates (sugars and proteins) released by the plant.



Plants also produce signals that support and encourage growth of bacteria that are beneficial for the plant.

Fungal filaments (hyphae) also respond to the plant exudates. In response to these plant signals, they supply nutrients (e.g nitrogen, phosphorus, micronutrients and water) and help protect the plant from disease and drought. Other beneficial microbes (e.g protozoa) and small arthropods are also very active here.

Soil Microorganisms / Microbes

Microorganisms (also known as microbes) have their own role in soil and plant health through their effect on nutrient cycles and sequestration of soil carbon³. The different types of soil microbes are shown below.

Bacteria	Break down nutrients and release them to roots
Fungi	Help make nutrients available to plants (such as Mycorrhizae shown in more detail below)
Protozoa	Large microbes which help with soil fertility and help regulate bacteria ⁴
Nematodes	Microscopic worms which can secrete nutrients to the plant; some are beneficial and some are predatory ⁵

Carbon Sequestration refers to the process of removing carbon dioxide (CO₂) from the atmosphere and storing it. Storing carbon dioxide in soil (as well as grasslands, forests and oceans) is known as Biological Carbon Sequestration⁶.

³<https://www.sciencedirect.com/science/article/abs/pii/B9780128164839000037>

⁴<https://www.britannica.com/science/protozoan/Ecological-and-industrial-importance-of-protozoans>

⁵<https://www.holganix.com/blog/5-types-of-soil-microbes-and-what-they-do-for-plants>

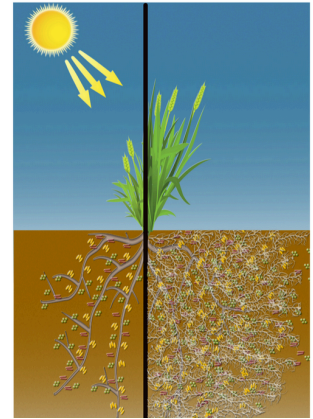
⁶<https://www.energy.gov/science/doe-explainscarbon-sequestration>

Mycorrhizal fungi

Plant roots are not very efficient at absorbing water and nutrients on their own. They need help.

Mycorrhizal fungi collaborate with plant roots and vastly increase the surface area for nutrient absorption.

This can lead to an improvement in soil structure and nutrient cycling.

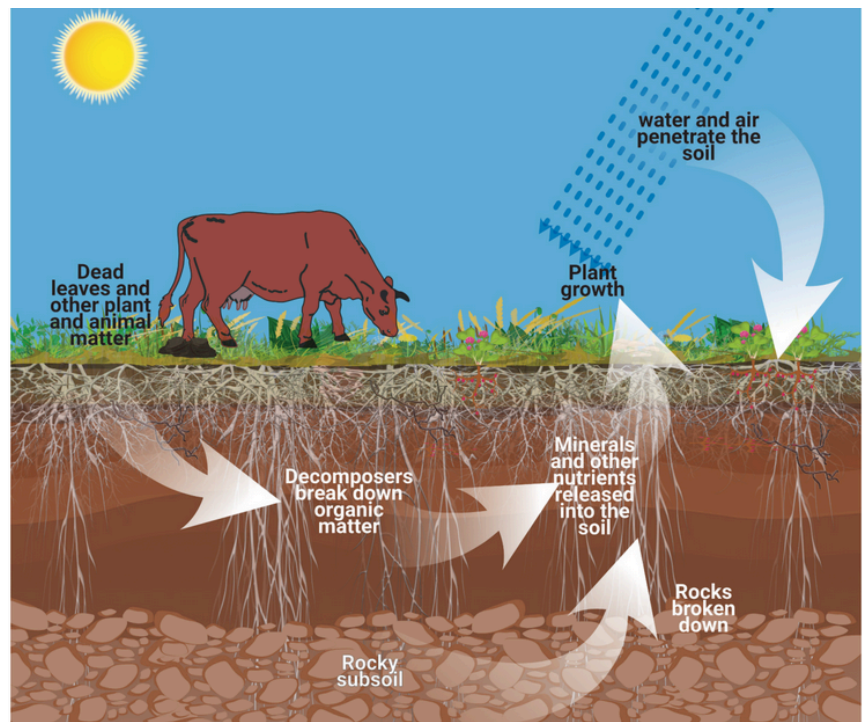


Nutrient Cycling

It is also useful to know about the nutrient cycle when it comes to soil biology.

The nutrient cycle is a system where nutrients are transferred from the physical environment to living organisms and then back again.

Nutrients from the soil such as nitrogen, phosphorus and magnesium are taken up by plants and animals. These are then released back to the environment via death and decomposition.



Further reading and resources

- The Functions of Soil Biology - AHDB ([link here](#))
- 5 Reasons Why Soil Biology Matters on the Farm ([link here](#))
- A Guide to Soil Biology and How To Protect It ([link here](#))
- An Introduction to Soil Health with Nikki Yoxall (Webinar Recording- [link here](#))
- Water, Carbon and Nutrient Cycles on the Farm (Webinar recording- [link here](#))

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