



## What is in our soil?

Soil is essential to life. Healthy soil has food, air and water to help plants grow. In turn animals feed on the crops and humans feed on both plants and animals.

As we've seen, soil is made up of many different components – organic matter from living and decaying plant material, minerals, water, and gases, such as carbon dioxide.

### Soil Organic Matter

Soil organic matter comprises all of the material present within that soil that was once part of a living organism, whether a plant or a soil organism, but that are now dead. It is a very important component of soils as it acts as a source of nutrients for plants and soil organisms, such as earthworms, plants, microbes.

#### \* Did You Know \*

The nutrients are made up of minerals from the earth, ground down from rocks into tiny particles over time. Other nutrients come from dead plants and animals, also broken down over time by the insects and bugs which live in the soil

## What lives in our soil?

A living soil is teeming with life, from earthworms, centipedes and beetles to fungi and bacteria, bugs so tiny you need a microscope to see them. Plants cannot directly use most of the minerals and other essential elements in the soil, so they have to be converted to a useable form by these creatures. The plants in turn help these organisms by secreting sugars and enzymes back into the soil.

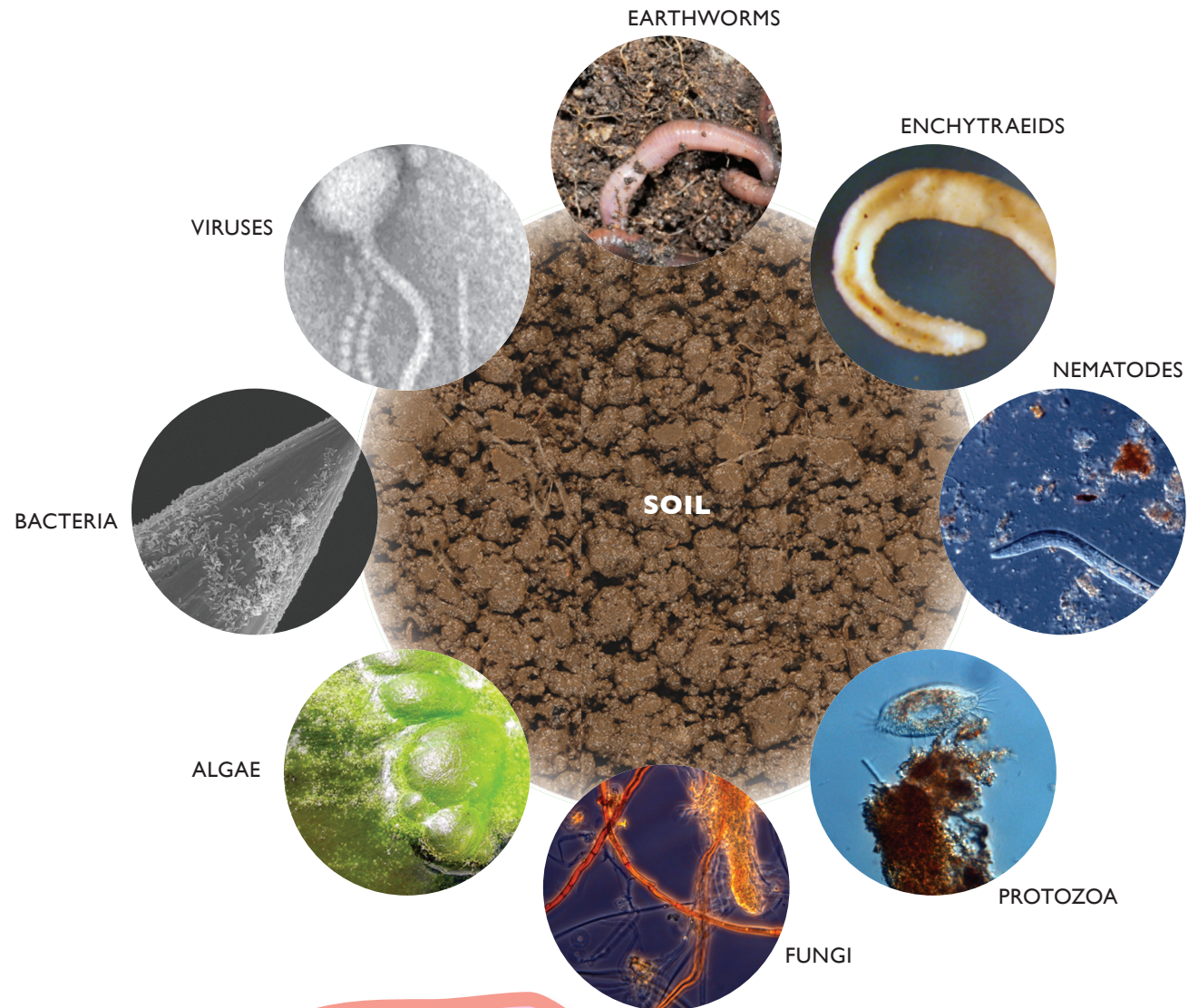
Many different organisms live in the soil.

- From large organisms, e.g. earthworms or beetles, which are called **megaflora**
- To the very small organisms, even smaller than we can see with our naked eyes, e.g. bacteria, protozoa, which are called **microflora**

The types of organisms found within a soil are influenced by the type of soil, e.g. the soil pH (how acid or alkali it is), or its salinity (how salty it is).

How we manage a soil can also affect the type of organisms found within it. For example, does the soil have a lot of organic matter added to it e.g. manure, or straw, or does the soil have lots of man-made fertiliser added.

## Soil Organisms





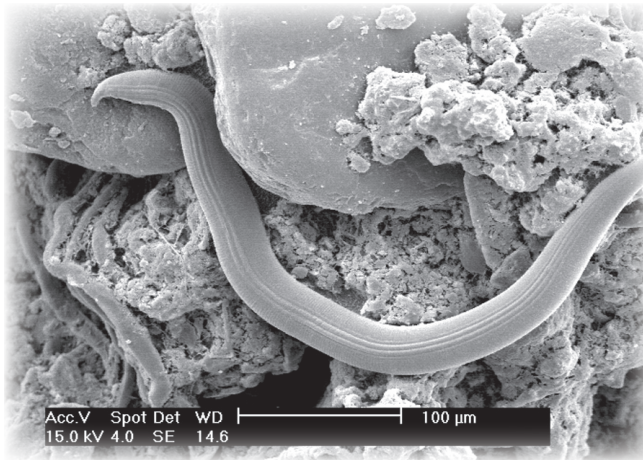
Enchytraeid (length 2cm)

## Enchytraeids

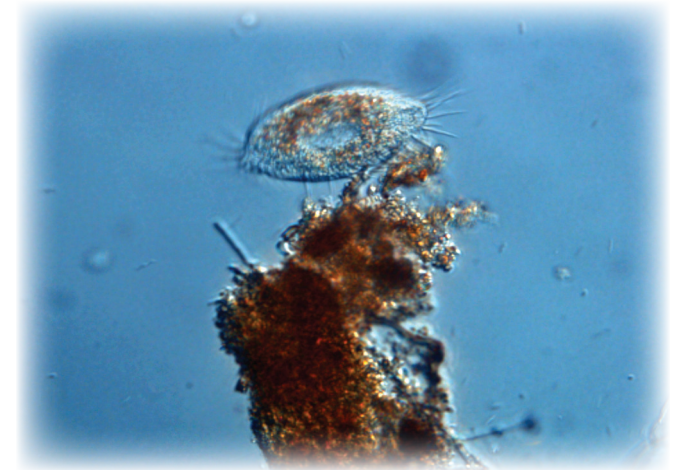
Enchytraeids are similar to earthworms. There are about 600 species and they range from approximately 100  $\mu\text{m}$  to several cms in length. They feed on decomposing organic matter and microbes and thus help recycle nutrients within the soil. They are found in a range of soils but often in 'Heather' or even 'Pete' where organic matter is available.

## Nematodes

Nematodes are roundworms and are one of the most diverse of all animals. There are over 28,000 species of nematodes in the world. They are small, typically 1 mm in length, and swim through soil water feeding on the organic matter, bacteria and algae. They are sensitive to soil pH, preferring a pH of 6. They can cause plant disease such as eelworm disease in potato roots. Some species can even be parasites that affect animals, including man. Many are found in soils like 'Claude' (gley).



Nematode swimming in a water film with soil particles



Light microscope image of protozoa called Euplodes

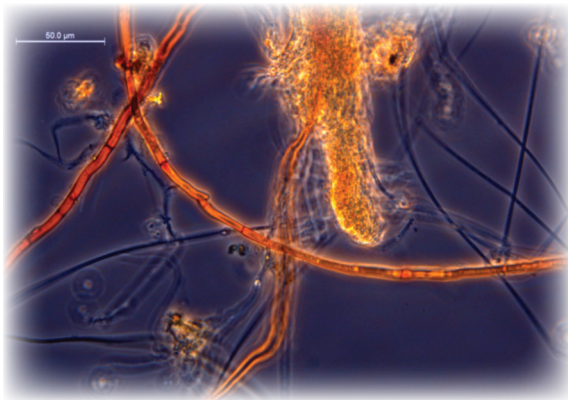
## Protozoa

Protozoa are micro-organisms made up of single cells – they are the smallest of all animals (amoeba are protozoa). They are typically found in the top 15–20cm of soil, and being larger than bacteria or fungi they tend to inhabit the spaces around soil pores. They feed on bacteria and fungi; thus they are important in cycling nutrients that bacteria and fungi originally obtain from the soil organic matter. Protozoa often have little hairs, called 'cilia'. These hairs enable some protozoa to swim through water in their search for bacteria to feed upon.

## Fungi

Fungi is the name given to groups of living things that includes mushrooms, toadstools etc. Fungi cannot produce their own food, so they absorb what they need from their surroundings. Fungi love damp areas and are often found in acidic soils, e.g. within woodlands. There are 100,000 identified species of fungi, although it is estimated that there might be 1.5 million species in total.

Fungi help recycle nutrients within soil as they can break down complex molecules, e.g. cellulose and lignin, into smaller molecules, which can be used as a food source by other organisms, e.g. bacteria. Fungi reproduce by producing 'spores' which are similar to plant seeds. Fungi predominate in soils under woodland, such as in 'Heather' (podzol).



Fungal hyphae



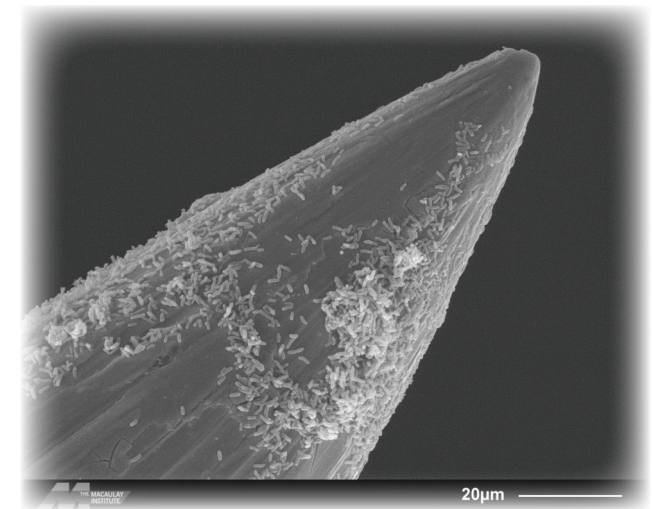
Green algae

## Algae

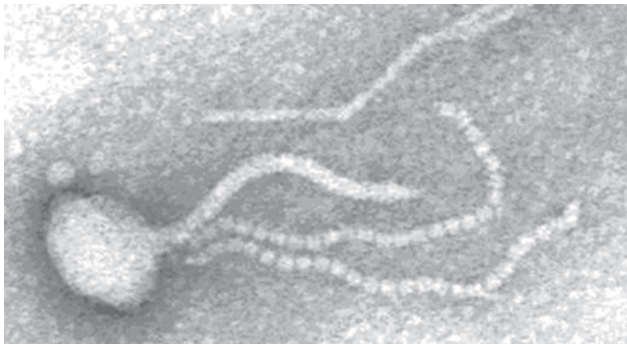
Algae are classed as plants, using photosynthesis to derive their energy and occur as either single cells or in large chains of organisms. They can only live where there is sufficient light; thus they tend to be found on the surface of soils. They often grow on bare rock (such as 'Rocky'... i.e. shallow soils) and therefore help form new soil, as they produce sugar molecules called 'polysaccharides' which help bind soil particles together and act as a food source for other organisms, e.g. bacteria.

## Bacteria

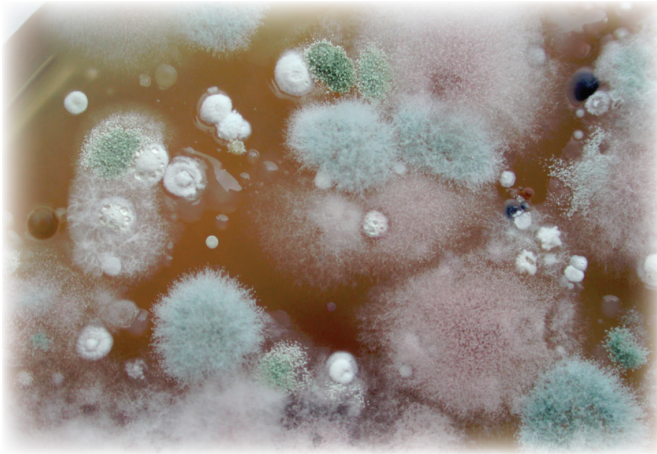
Bacteria are very tiny and about 1–2 micrometres (µm) in length (there are 1000µm in 1mm). The species of bacteria present within the soil is dependent upon the soil conditions such as soil pH and salinity (the amount of salt in the soil). Bacteria are very important in soils as they can 'feed' on the dead organic matter within the soil and thus they can recycle and release the soil nutrients. Bacteria are found in all soils types but dominate in arable soils such as 'Rusty' (brown earth).



Bacteria on the tip of a sewing needle



*Siphoviridae*



*Streptomyces*

## Viruses

Viruses are infectious agents that can replicate only inside the living cells of organisms. They are extremely small and some can live in soil. Some viruses cause plant diseases such as potato leaf roll.

Plant components too are often seen under a microscope in the form of pollen grains and fine roots. Fungi are often in abundance either as hyphae (branches of a fungus) or as spores (the reproductive part). The number and type of these organisms are often determined by the type of soil (e.g. clay, sandy), the temperature, water, pH, salinity.



Nodules on clover roots; the nodules are about 4-5 mm in length

### \* Did You Know \*

Many of the smells from soil are produced from bacteria as a by-product. The typical earthy odour is due to a chemical called geosmin which is produced by bacteria called *Streptomyces*