



Lumbricus terrestris – a common earthworm. This one is about 10 cm in length

Earthworms

There are over three thousand species of earthworms in the world. Most grow slowly, taking 1-2 years to mature and living for up to 4 years.

Earthworms feed on organic matter either within the soil or on the soil surface. They produce burrows in the soil, which aids drainage; they also mix the soil up and transfer organic material and associated nutrients

from the surface deep into the soil. The burrows form when the earthworms feed and they protect the earthworms from temperature variations within the soil, such as when there is a frost. Earthworms prefer a temperature range of 0-35°C and a soil pH range of 5–7.

Peat soils are too acidic for earthworms, even though there is lots of organic matter there for food. Very sandy soils, e.g. in the Machair, tend to be too dry and abrasive for earthworms and very clay rich soils tend to have too little food and not enough oxygen for the earthworms to thrive. Earthworms prefer 'Rusty' (brown earth) to any other soil.

It is important to keep a good balance between air and water to help provide a good environment for most soil organisms.

Redworms, brandling worms, tiger worms and red wiggler worms (*Eisenia fetida*) are species of earthworm adapted specifically to decaying organic material. They thrive in rotting vegetation, compost, and manure.



Eisenia Fetida – the tiger worm



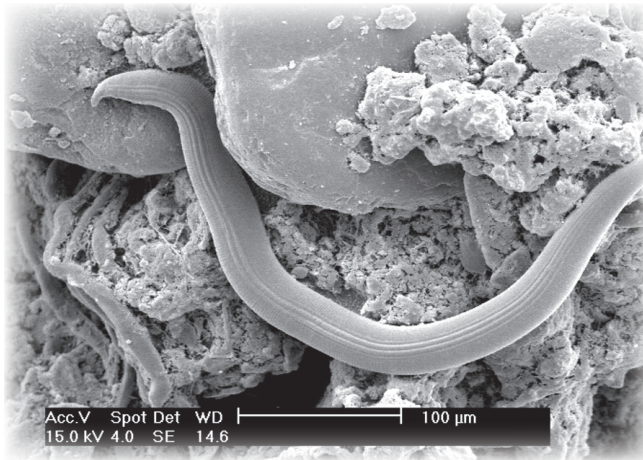
Enchytraeid (length 2cm)

Enchytraeids

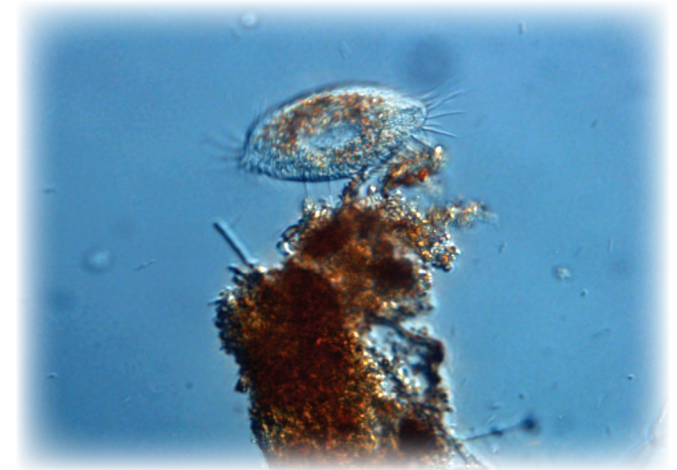
Enchytraeids are similar to earthworms. There are about 600 species and they range from approximately 100 μm to several cms in length. They feed on decomposing organic matter and microbes and thus help recycle nutrients within the soil. They are found in a range of soils but often in 'Heather' or even '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

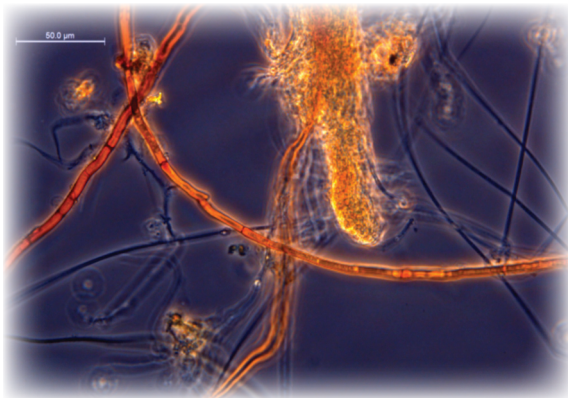
Protozoa

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



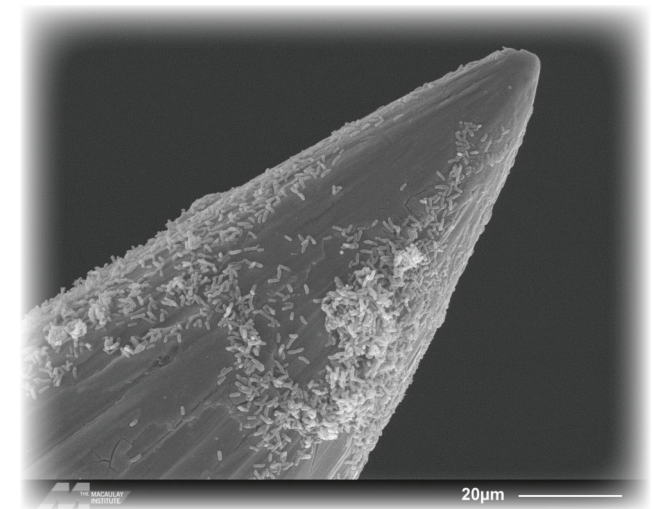
Green algae

Algae

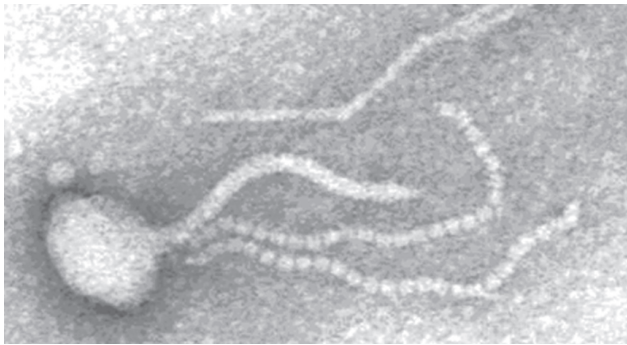
Algae are classed as plants, using photosynthesis to derive their energy and occur as either single cells or in large chains of organisms. They can only live where there is sufficient light; thus they tend to be found on the surface of soils. They often grow on bare rock (such as 'Rocky'... i.e. shallow 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

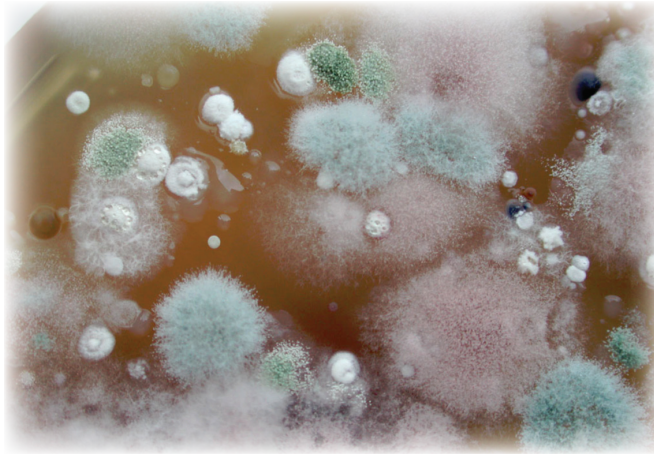
Bacteria are very tiny and about 1–2 micrometres (µm) in length (there are 1000µm in 1mm). The species of bacteria present within the soil is dependent upon the soil conditions such as soil pH and salinity (the amount of salt in the soil). Bacteria are very important in soils as they can 'feed' on the 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*