

# Microcosm

## What are Microbes?

Microbes (short for microorganisms) are microscopic single- or multi-cellular organisms that are too small to be seen with the naked eye. The term 'germ' is used for microbes that cause disease.

## Who are these microbes?

Microbes include bacteria, archaea, fungi, viruses (although they are considered non-living), algae and protozoa (tiny animals).

## Where do Microbes live?

They live everywhere on Earth - in the air, in water, soil, rocks, ice, our homes, plants, animals, in the food we eat, and in us humans. They can live in really extreme environments like hot springs, in frozen soil, under high pressure in the deep sea, in the vacuum of space, in places with high radiation, and in brines. If life exists on other planets- it is most likely microbial.

## In a single teaspoon of soil

A teaspoon of healthy soil contains more microbes than there are people on Earth (7 billion) and represents 10,000- 50,000 species. The same teaspoon can contain miles of fungal hyphae.

## How old are Microbes?

Microbes are the oldest form of life on Earth. They evolved about 3-4 billion years ago and remained the only life forms for most of Earth's history.

## How do Microbes live?

Some microbes (bacteria and algae) make their own food from sun light- like plants, others absorb food from the material they live in and on: such as dead plants and animals, human foods, iron, sulfur, oil, toxic wastes. With that they recycle nutrients. Some live together with larger hosts (plant, animals and fungi). This relationship can be beneficial, parasitic and pathogenic. A beneficial relationship is the mycorrhizal symbiosis in which fungi live in plant roots. The fungi provide nutrients and water to the plant and the plant provides sugars to the fungus. Over 90 % of all plants on Earth have this relationship.

## Famous microbes

### Fungi

*Penicillium*: produces antibiotics  
*Saccharomyces cerevisiae* (yeast): makes bread rise, brew beer, make wine.  
*Penicillium roquefortii*: Blue cheeses  
*Trichophyton mentagrophytes*: athlete foot  
*Phytophthora infestans*: potato blight (Irish famine)

### Bacteria

*Yersinia pestis* (Black Death): the deadliest bacteria in the 14th Century  
*Mycobacterium tuberculosis*: Tuberculosis  
*Lactobacillus acidophilus*: turns milk into yoghurt  
*Pseudomonas putida*: clean waste from sewage water in water treatment plants  
*Rhizobium*: fix nitrogen in legumes  
*Escherichia coli*: help digest food in your digestive system

### Protozoa

*Plasmodium falciparum*: Malaria

### Archaea

Methanogens: produces methane

### Virus

Influenza: Flu  
HIV: AIDS  
Zaire ebolavirus: Ebola

### Algae

Phytoplankton produce 70 % of atmospheric oxygen

## When were Microbes discovered?

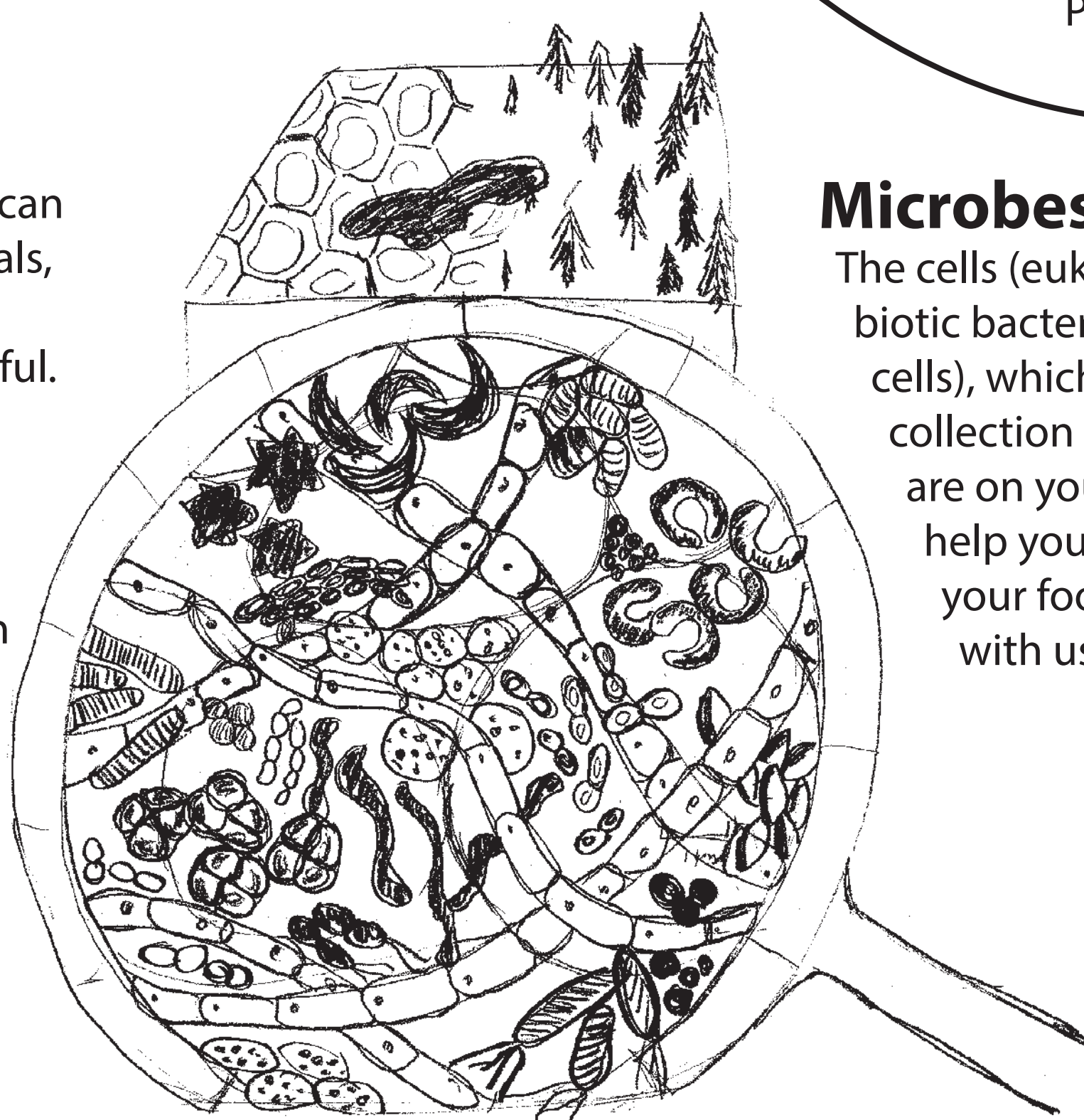
The Dutch businessman and scientist Antonie Van Leeuwenhoek invented the microscope, which allowed him to be the first to observe microbes in 1673. However, the possible existence of microbes was discussed since the 6th century BC- i.e. 2300 years before their discovery.

## Are Microbes foe or friend?

While some microbes can make you, other animals, and plants really sick, most of them are helpful.

## Why does soil smell earthy?

You dig in your garden and suddenly you notice that earthy smell. That smell is caused by geosmin a chemical that is produced by bacteria called Actinomycetes.



## Microbes are your life!

The cells (eukaryotic cells) that make up your body contain originally symbiotic bacteria. These are the mitochondria (the 'powerhouses' of the cells), which still have their own genetic code. A healthy human has a collection of bacteria, fungi, archaea, and viruses. Billions of microbes are on your skin, and swimming in your mouth and belly. Mostly they help you keep other harmful microbes at bay and help you to digest your food and make vitamins. We carry about 4lbs of microbes with us at all times.

## About this sculpture:

This ice sculpture shows a cross section through a landscape with patterned ground in the Arctic and Taiga/ Boreal forest above ground and a close-up view of the soil ecosystem with soil grains surrounded by bacteria, Archaea and fungal hyphae. The area shown is approximately the width of a human hair. Soils are considered one of the most species rich habitats for microbes. Different ecosystems have different microbial communities.

