

Introduction to Microbiology

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Microbiology is an important discipline for all physicians. Microbes have the ability to thrive in many extreme conditions. Microorganisms exist in every habitat on Earth and even within the human body. Many microorganisms are beneficial and perform multiple functions, including decomposition. However, some microscopic species have the ability to cause disease. Physicians need to understand which microbes cause disease, how they infect cells and the means to treat them.



Definition of Microbiology

Microbiology is the discipline that deals with the study of microorganisms. The organisms are broadly classified as:

- Acellular
- Unicellular
- Multicellular

Microbiology can also be classified based on the type of organism that is studied, including:

- Bacteriology
- Parasitology

- Virology
- Mycology

Microbes are organisms that are visible only under a microscope. The field study of microbes is called microbiology. Bacteria, archaea, fungi, and protozoa are all different types of microbes.

Bacteria

Bacteria are prokaryotes, which means they lack nuclei and membrane-bound organelles. They are classified broadly into gram-positive, gram-negative, and atypical bacteria and exist in a variety of shapes, such as cocci, bacilli, and spirals. There are about 5×10^{30} (five million trillion trillion) bacteria in the world today. Bacteria are found in all of the environments on Earth.

Archaea

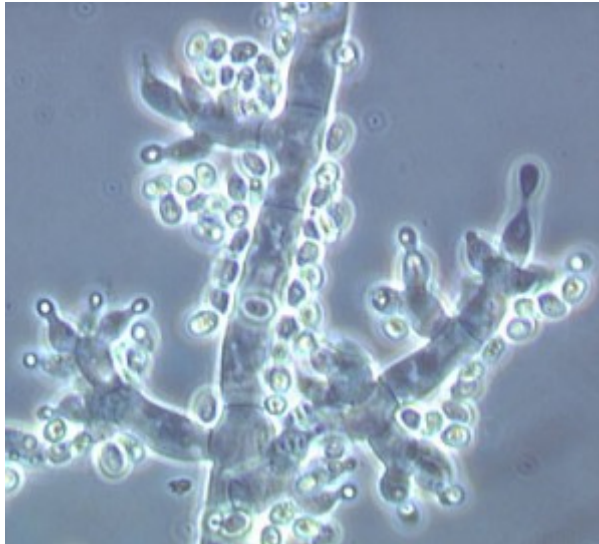


[Image](#): "Cluster of cells of Halobacterium sp. strain NRC-1" by NASA. License: [Public Domain](#)

- Developmentally closer to eukaryote cells than bacteria, but they also lack nuclei and membrane-bound organelles like prokaryotes
- Found in extreme environments, like hot springs
- Archaea can also be found in soils, marshlands, and oceans

Fungi

- Are eukaryotes, similar to human cells
- are heterotrophs - they obtain energy from organic substances
- are significant for having chitin in their cell walls, which is unique to this species
- Have sterols in their cell membrane, like humans
- Can exist in two forms: a filamentous form, with hyphae and mycelia, and yeasts, which are unicellular organisms



[Image](#): "Conidiophores of *Trichoderma* fertile with vase-shaped phialides and newly formed conidia on their ends (bright points)" by Strobilomyces. License: [Public Domain](#)

Protozoa

- Are a type of eukaryote cell (with a nucleus and cell membrane)
- Consist of a diverse group of unicellular organisms



[Image](#): "*Colpoda inflata*" by Dr. Eugen Lehle. License: [CC BY-SA 3.0](#)

- Can be further divided into flagellates, amoebas, ciliates, and apicomplexans
- Can act as pathogens

The Concept of Microorganisms

Compared to other branches of science, like physics, microbiology is a relatively recent field of research, originating in the mid-17th century. There were three major discoveries that created the field of microbiology.

Antonie Van Leeuwenhoek, a Dutch lensmaker, built his own microscope and was able to see microbes in the late 17th century.



Image: "Albert Edelfelt - Louis Pasteur - 1885" by Ondra Havala. License: [Public Domain](#)

Later, **Ferdinand Cohn** described the bacteria bacillus and later developed a taxonomic classification of bacteria.

Before the 19th century, scientists postulated that microorganisms were generated spontaneously. In the mid-1800s, **Louis Pasteur's** experiments with broth disproved this theory by showing that microorganisms could be grown.

Similarly, **Robert Koch** discovered that some microbes can cause diseases in humans, leading to the germ theory of disease that stated that a specific microorganism caused each disease.

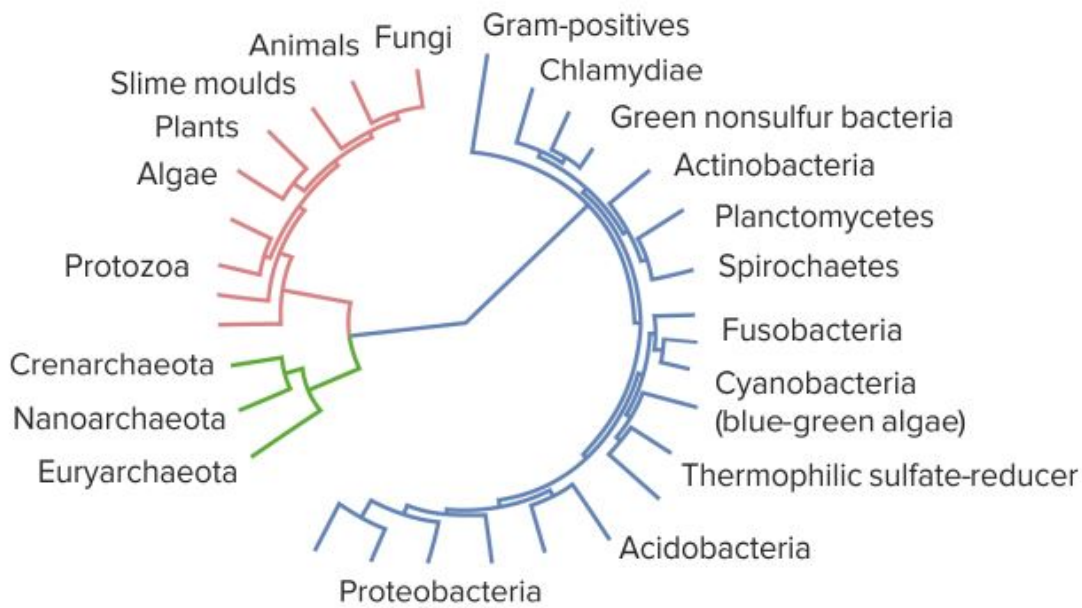
Surviving the Extremes of Life

- Unlike many cells, microbes can live in the most extreme conditions on Earth
- Scientists can grow microbes at pH ranging from 0 to 11.4
- Microbes have been documented living at temperatures from -15 to 121 °C
- Bacteria have survived exposure to 5 megarads of radiation
- The microorganism can sustain life at pressures of 117,000 pounds per square inch, which would destroy many [human cells](#)

Metabolism

Because of the wide range of environments in which microbes can thrive, they can produce significant quantities of energy. Some organisms can use light to make energy (photosynthesis). Others can derive energy from inorganic compounds, like hydrogen, iron, and sulfides. Microorganisms play an important role in maintaining life on Earth.

Half of all the oxygen in the atmosphere is produced by bacteria. Almost 100% of natural nitrogen is made by microbes. Microorganisms help break down plants and organic matter.



"Microbes on the Tree of Life" Image created by Lecturio

Why Do Doctors Care about Microbes?

Why do physicians need to know about microbes? Since **many microbes make humans sick**, it is essential that doctors know about microbial morphology, virulence factors, and treatment methods. Bacteria, like streptococcus and staphylococcus, cause [pneumonia](#) and skin infections.

Protozoa, such as **Giardia**, can enter the intestine and cause massive [diarrhea](#). Fungi can cause systemic infections in the immunocompromised, and viruses are responsible for many diseases and conditions, like [AIDS](#).

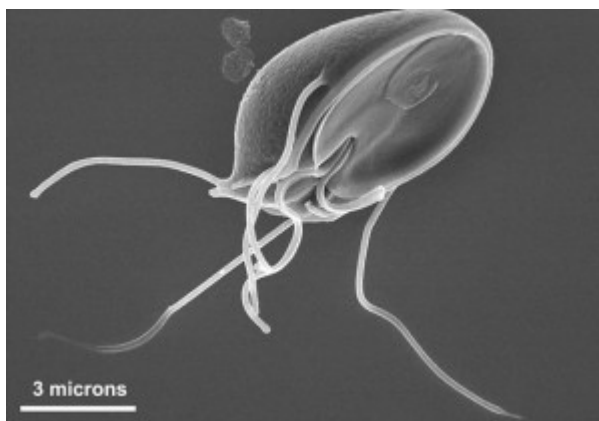


Image: "This scanning electron micrograph (SEM) clearly showed the ventral surface of a Giardia Muris trophozoite" by CDC/ Dr. Stan Erlandsen. License: [Public Domain](#)

Microbes are all around us and are part of our everyday lives. While many organisms cause diseases, there are thousands of microbes that live in a close relationship with another organism.

If both parties benefit from the relationships, they are called **mutual symbiotic relationships**. Humans have many symbiotic relationships with microorganisms. A good example is the human intestinal tract, which has millions of bacteria in it that help digest

food. They also prevent pathogenic bacteria from colonizing the intestinal lumen by crowding it out of space.

References

Carrol, K.C., et al., Medical Microbiology. 27th ed. New York: McGraw-Hill. 2013. Print

Ryan, K.J., Ray, C.G. Sherris Medical Microbiology. 6th ed. New York: Mcgraw-Hill, 2014. Print

Gladwin, M., Trattler, B. Clinical Microbiology made Rediculously Simple. 5th ed. Miami: MedMaster 2011. Print.

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