

# Microbiology

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## Introductory article

### Article Contents

- Microbiology and its Historical Roots
- Classification and Basic Characteristics of Microorganisms
- Microbial Ecology
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- Applications in Microbiology

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**Microbiology is the study of microorganisms – biological entities too small to be seen with the unaided eye. Most major advances in microbiology have occurred within the past 150 years, and several important subdisciplines of microbiology have developed during this time, including microbial ecology, molecular biology, immunology, industrial microbiology and biotechnology. Microorganisms of various types exist in all three domains of life (the Bacteria, Archaea and Eukarya), and they are by far the most abundant life forms on Earth. Microscopic biological agents include bacteria, archaea, protists (protozoa and algae), fungi, parasitic worms (helminths) and viruses. Although a small percentage of microorganisms are harmful to certain plants and animals and may cause serious disease in humans, the vast majority of microorganisms provide beneficial services, such as assisting in water purification and the production of certain foods, and many are essential for the proper functioning of Earth's ecosystems.**

## Microbiology and its Historical Roots

Microbiology is the study of microorganisms, microscopic organisms that include in particular the bacteria, a large group of very small cells that have enormous basic and practical significance (Madigan *et al.*, 2015). Microbiology considers all aspects of microbial cells, including their structure, metabolism, diversity, genetics and evolution, ecology and roles in infectious diseases. Microbiology is composed of several subdisciplines, each of which is focused on part of the broader science. Scientists

who study microorganisms, called microbiologists, typically specialise in one or more of these areas (Table 1).

The science of microbiology developed later than other biological sciences, primarily because needed tools, such as the microscope, had to be developed to convincingly prove that microorganisms (also called microbes) exist. Following early microscopic discoveries, methods for the culture and identification of microorganisms were developed, and from these, our understanding of the enormous beneficial and detrimental effects of microbes began to unfold. We review some historical highlights in microbiology now.

## The discovery of microorganisms

The English naturalist Robert Hooke (1635–1703) was an early microscopist and published the first book devoted entirely to microscopic observations of microorganisms. Hooke prepared detailed and quite accurate drawings of moulds (fungi) and many other microbes, and these were the first known description of microorganisms.

The first person to see bacteria, which are typically much smaller than moulds, was the Dutch amateur microscopist Antoni van Leeuwenhoek (1632–1723). van Leeuwenhoek constructed simple microscopes that contained a single lens and used them to examine various natural substances. These microscopes were crude by today's standards, but by careful manipulation and focusing, van Leeuwenhoek was able to see a wide variety of microorganisms, including bacteria. van Leeuwenhoek reported his discoveries in a series of letters to the Royal Society of London, which were then published in the *Philosophical Transactions of the Royal Society*, one of the most prestigious scientific journals of the era and the first in the world exclusively devoted to science. His communications revealed a previously hidden microbial world that existed in water, nutrient solutions, the oral cavity and virtually anywhere one could imagine. van Leeuwenhoek's discoveries also boosted the long held belief that invisible agents of some sort were the cause of infectious diseases, a belief that was not scientifically confirmed until nearly 200 years later. **See also: Leeuwenhoek, Antoni van; Light Microscopy; History of Bacteriology**

## The golden age of microbiology

Major advances in microbiology in the nineteenth and early twentieth centuries surrounded four major scientific questions of that

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**RD Boyd**



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