English for Microbiologist

Introduction to Microbiology

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Objectives

- 1. Define Microbiology
- 2. Explain the important of microbiology in daily life
- 3. List the contribution of the following scientists in the field of microbiology.
  - A.V. Leeunvenhork
  - F. Redi
  - L. Pasteur
  - R. Koch

- 4. Distinguish between eukaryotic and prokaryotic cell.
- 5. Define Fields of Microbiology

WHAT IS MICROBIOLOGY?

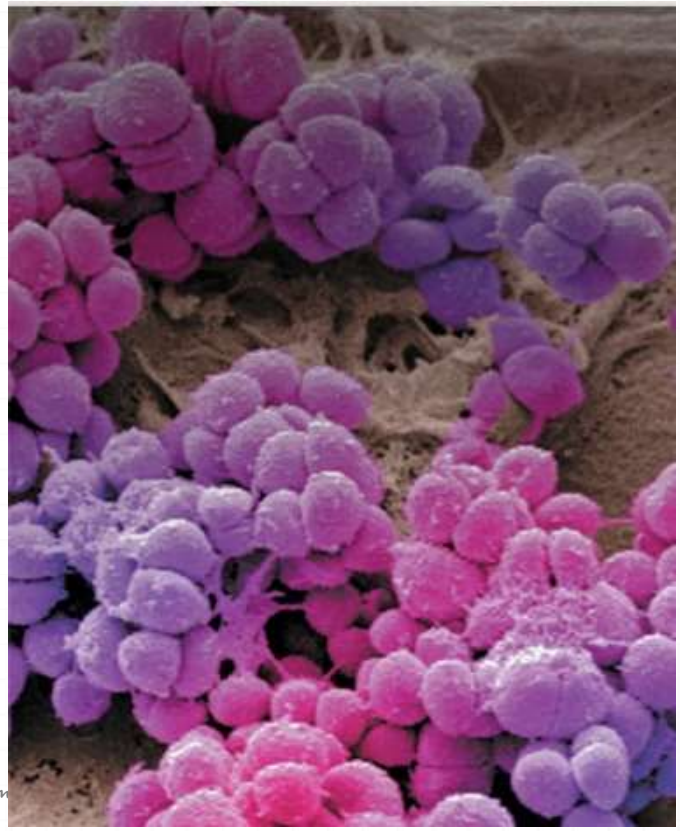
- Microbiology is the study of all living organisms that are too small to be visible with the naked eye. This includes bacteria, archaea, viruses, fungi, prions, protozoa and algae, collectively known as 'microbes'.

10 Importance of Microbiology in Everyday Life

1. Importance of Microbiology:
    - 1.1. 1 .Importance of Microbiology in Food Industry:
    - 1.2. 2. Importance of Microbiology in Medical Science.
    - 1.3. 3. Importance of Microbiology in the pharmaceutical industry.
    - 1.4. 4. Importance of Microbiology in nursing
    - 1.5. 5. Importance of Microbiology in Biotechnology
    - 1.6. 6. Importance of Microbiology in Chemical products
    - 1.7. 7. Importance of Microbiology in fuel:
    - 1.8. 8. Importance of Microbiology in aquaculture/fisheries:
    - 1.9. 9. Importance of Microbiology in Agriculture:
    - 1.10. 10. Importance of Microbiology in Environmental Science/ Sewage System:

Microbes are Beautiful

Figure 1.1 Several types of bacteria found as part of the normal microbiota in an infant's intestine.



Human Use of Microorganisms

- **Biotechnology**: Production of foods, drugs, and vaccines using living organisms

- **Genetic engineering**: Manipulating the genes of organisms to make new products

- **Bioremediation:** Using living organisms to remedy an environmental problem

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Scientists in the Field of Microbiology

Robert Hooke
(1635-1703)

Antonie van Leeuwenhoek
(1632-1723)

Louis Pasteur
(1822-1895)

Robert Koch
(1843-1910)

Lord Joseph Lister
(1827-1912)

Edward Jenner
(1749-1823)

Paul Ehrlich
(1854-1915)

Alexander Fleming
(1881-1955)

and
many
others ...

Designed By
Sagar Aryal

Van Leeuwenhoek (24 October 1632 – 26 August 1723)

- He is commonly known as "**The Father of Microbiology**", and one of the **first microbiologists.**
- Van Leeuwenhoek is best known for his pioneering work in microscopy.

Spontaneous Generation

- **Spontaneous Generation** is an early belief that some forms of life could arise from vital forces present in nonliving or decomposing matter (flies from manure, etc.)

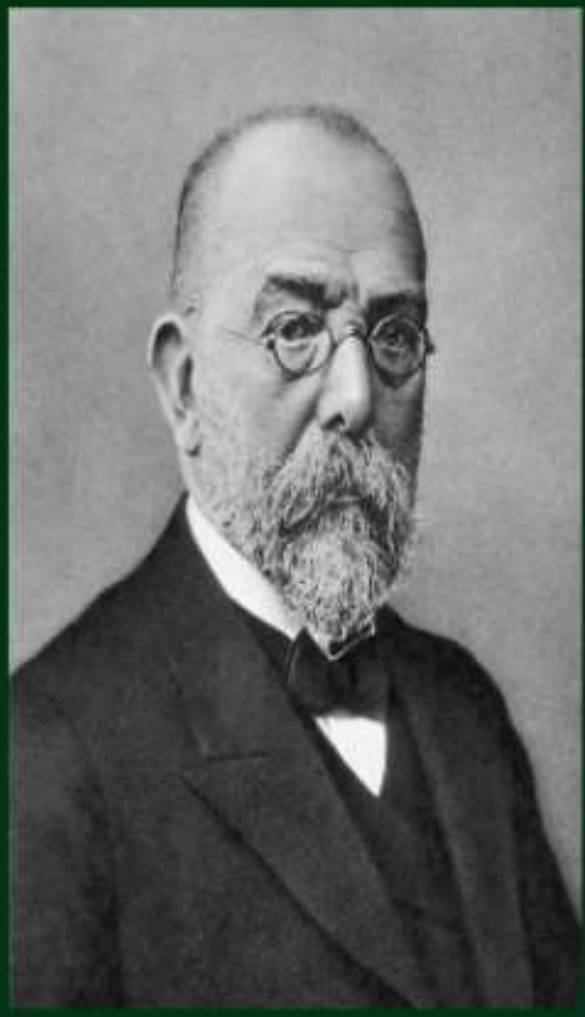
- Louis Pasteur eventually disproved spontaneous generation and proved the **Theory of Biogenesis** - the idea that living things can only arise from ot living things

Louis Pasteur

- French chemist and microbiologist renowned for his discoveries of the principles of vaccination, microbial fermentation, and pasteurization.
- He is regarded as one of the founders of modern bacteriology and has been honored as the **"Father of bacteriology"**

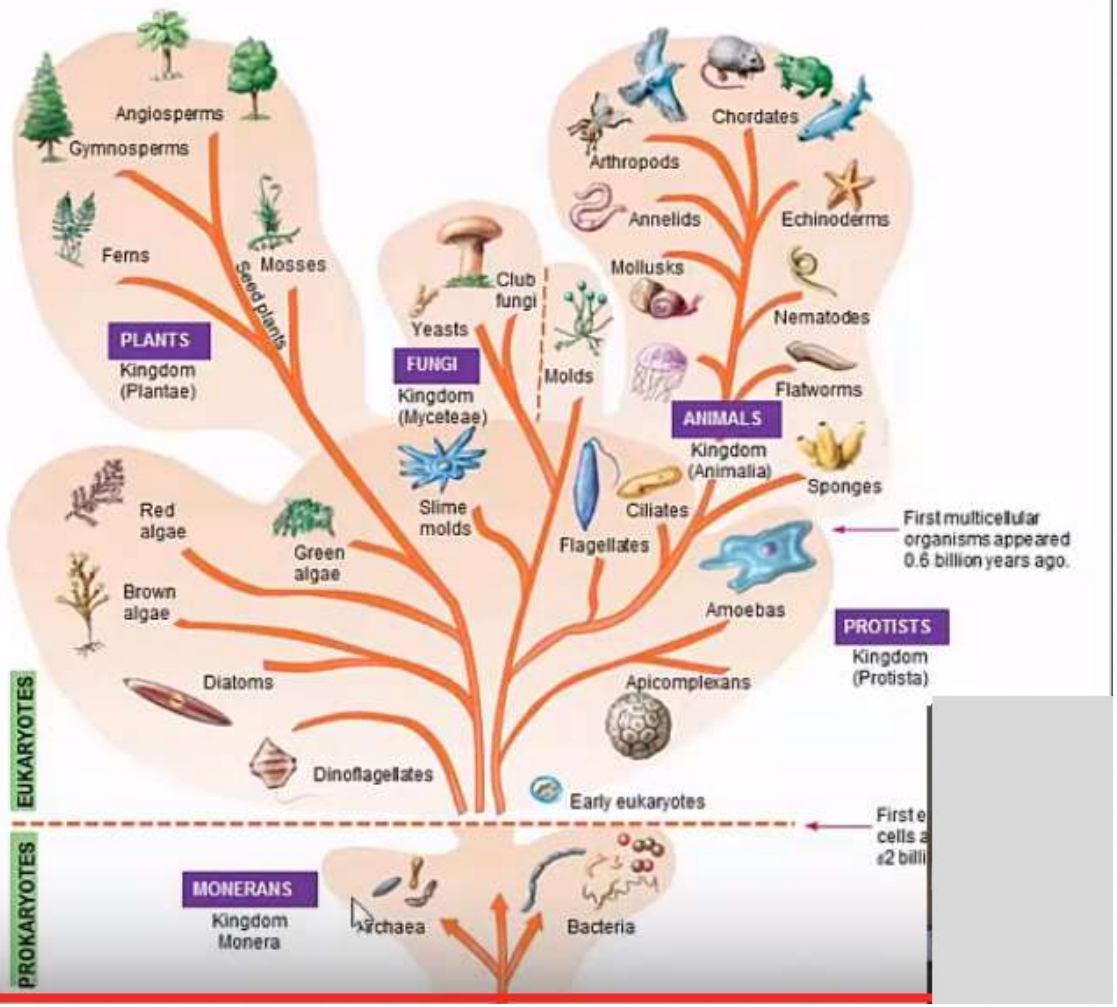
Robert Koch

- German physician and microbio logist. As the discoverer of the specific causative agents of deadly infectious diseases including tuberculosis, cholera, and anthrax.
- He is regarded as one of the main "**founders of modern bacteriology**".



Three Domains of Life

- **Bacteria** - true bacteria
- **Archaea** - odd bacteria that live in extreme environments, high salt, heat, etc.
- **Eukarya** - have a nucleus and organelles



Distinguish between eukaryotic and prokaryotic cell.

Prokaryotic

- Nucleus Absent.
- Cell Type Usually unicellular.
- True Membrane bound Nucleus absent.
- **Example:** Bacteria and Archaea.

Eukaryotic

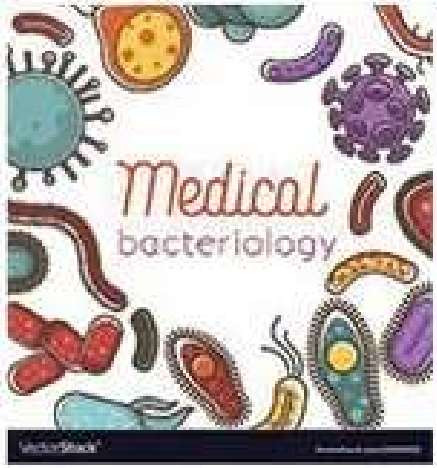
- Nucleus present.
- Cell Type usually multicellular
- True Membrane bound Nucleus present
- **Example:** Animals and Plants.

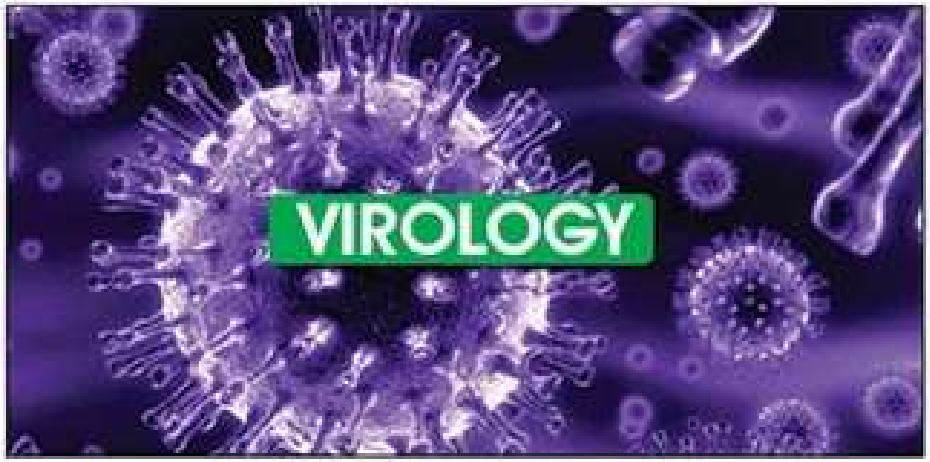
Summary

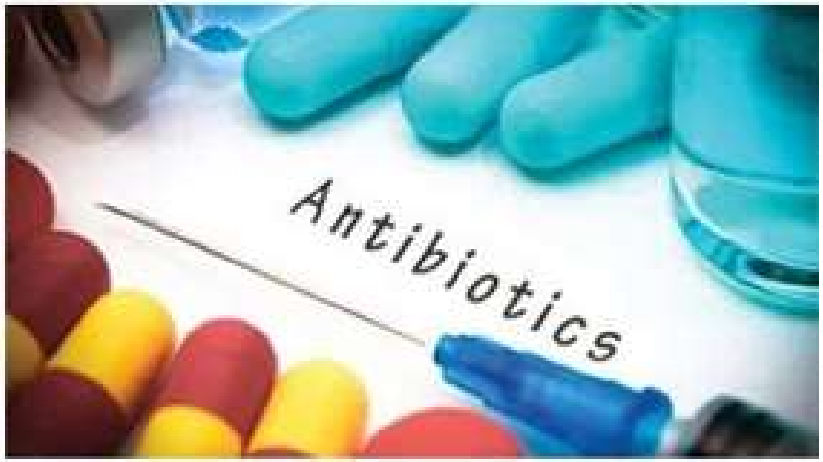
- Microbiology – study of life smaller than seen with the naked eye
  - Viruses, Bacteria, Protist, Fungi and Worms
  - Industrial Applications and Disease awareness

- History of Microbiology
  - Microscope – Antonie van Leeuwenhoek
  - The Germ Theory
  - Louis Pasteur and Robert Koch

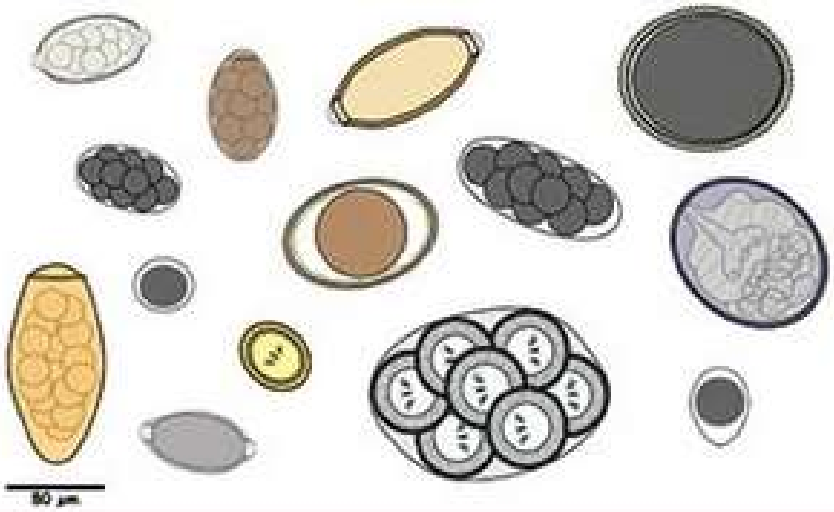
- Classify microorganisms
  - 3 Domains: Eukarya, Bacteria and Archaea
  - Genus and species







Fields of Microbiology



Major Fields of Pure Sciences

- **Bacteriology:** Study of bacteria
- **Mycology:** Study of fungi (achlorophyllous, heterotrophic, eukaryotic with a rigid cell wall containing chitin/cellulose)
- **Protozoology:** Study of protozoans (animal like single celled eukaryotic organisms).
- **Virology:** Study of viruses and viral diseases.
- **Algology or Phycology:** Study of algae.
- **Parasitology:** Study of parasitism and parasites (include pathogenic protozoa, helminthes worms and certain insects).
- **Microbial ecology:** Study of interrelationships between microbes and environment.
- **Microbial morphology:** Study of detailed structure of microorganism.
- **Microbial taxonomy:** Concerned with classification, naming and identification of microorganism.
- **Microbial Physiology:** Study of metabolism of microbes at cellular and molecular levels.
- **Microbial genetics and Molecular Biology:** Study of genetic material, structure and function and biochemical reactions of microbial cells involved in metabolism and growth.

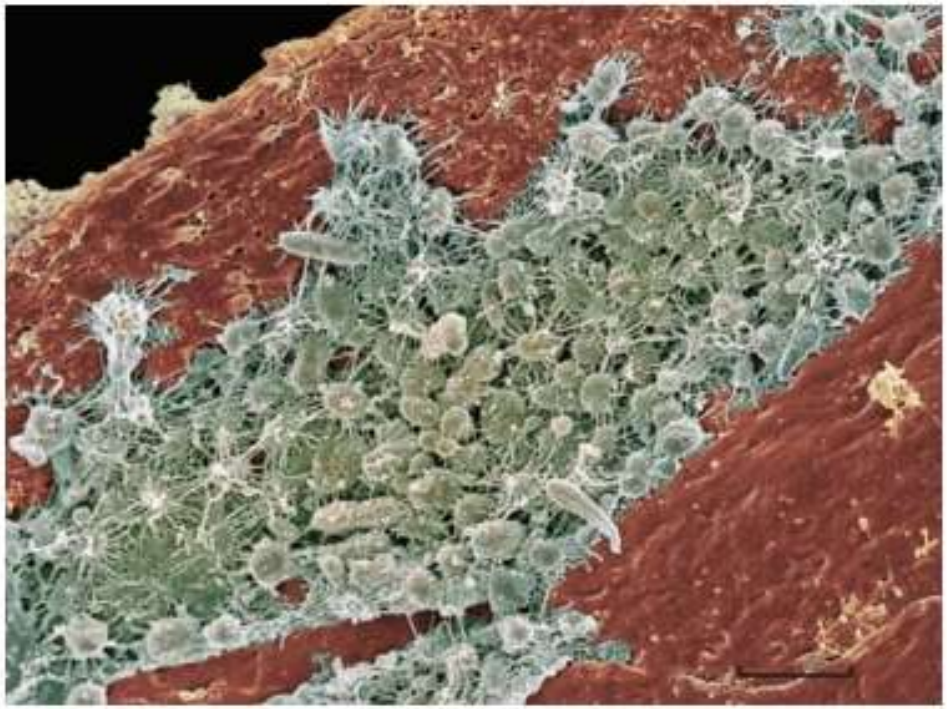
Major Fields of Applied Microbiology

- **Industrial Microbiology:** Concerned with industrial uses of microbes in production of alcoholic beverages, vitamins, NH2-acids, enzymes, antibiotics and other drugs.
- **Agricultural Microbiology:** Study of relationships of microbes and crops and on control of plant diseases and improvement of yields.
- **Food Microbiology:** Deals with interaction of microorganisms and food in relation to food' processing, food spoilage, food borne disease and their prevention
- **Dairy Microbiology:** Deals with production and maintenance in quality control of dairy products.
- **Aquatic Microbiology:** Study of microorganisms found in fresh estuarine and marine waters.
- **Air Microbiology:** Deals with the role of aerospora in contamination and spoilage of food and dissemination of plant and animal diseases through air.

Major Fields of Applied Microbiology (cont.)

- **Exomicrobiology:** Deals with exploration for microbial life in outer space.
- **Medical Microbiology:** Causative agents of disease, diagnostic procedure for identification of causative agents, preventive measures.
- **Immunology:** Deals with the immune system that protects against infection and to study serology reactions.
- **Public Health Microbiology:** Concerns with monitoring, control and spread of diseases in communities.
- **Biotechnology:** Scientific manipulation of living organisms especially at molecular and genetic level to produce useful products.

Choose these interesting figures

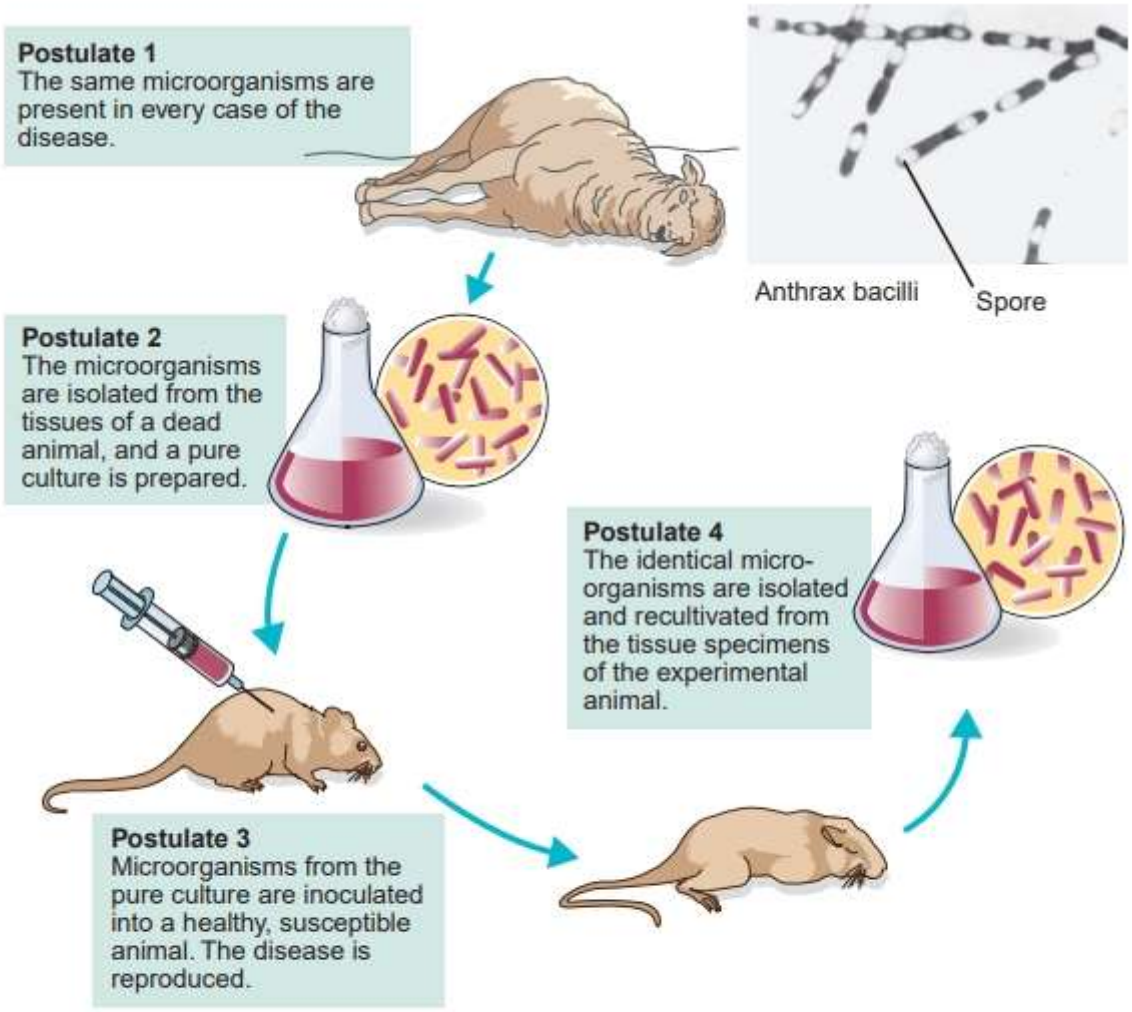


(A)

(B)

FIGURE 1.1 Microbes Are Key to Health and Illness. (**A**) Large numbers of bacteria are found on and in parts of the human body. On the tongue, most are harmless or even beneficial, while a few in our mouth can cause throat infections or lead to tooth decay. (Bar = 5 μm.) (**B**) During the 2009 pandemic of swine flu, people in affected areas such as Mexico wore masks in an attempt to avoid being infected with the virus.

(A)

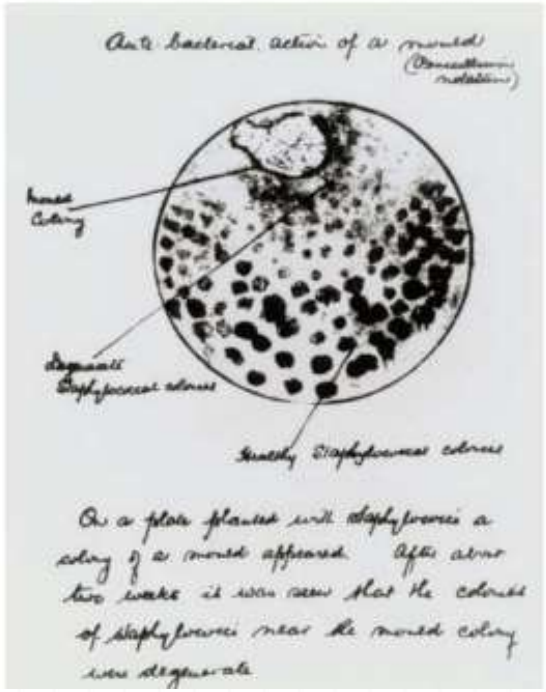


(B)

FIGURE 1.9 **A Demonstration of Koch's Postulates.** Robert Koch (**A**) developed what became known as Koch's postulates (**B**) that were used to relate a single microorganism to a single disease. The insert (in the upper right) is a photo of the rod-shaped anthrax bacteria. Many rods are swollen with spores (white ovals).

FIGURE 1.13 False Color Images of Eukaryotic and Prokaryotic Cells. (**A**) A scanning electron microscope image of a eukaryotic cell. All eukaryotes, including the protozoa, algae, and fungi, have their DNA (pink) enclosed in a cell nucleus with a membrane envelope. (Bar = 3 µm.) (**B**) A false-color transmission electron microscope image of a dividing *Escherichia coli* cell. The DNA (orange) is not surrounded by a membrane. (Bar = 0.5 µm.)

(A)



(C)

FIGURE 1.14 Fleming and Penicillin. (**A**) Fleming in his laboratory. (**B**) Fleming's notes on the inhibition of bacterial growth by the fungus *Penicillium*. (**C**) A World War II poster touting the benefits of penicillin and illustrating the great enthusiasm in the United States for treating infectious diseases in war casualties.

(B)

FIGURE 1.17 Microbial Ecology—Biofilms and Bioremediation. (**A**) The slimy, and often smelly, film seen in a flower vase is an example of a biofilm. (**B**) Microbes can be used to clean up toxic spills. A shoreline coated with oil from an oil spill can be sprayed with microorganisms that, along with other measures, help degrade oil.

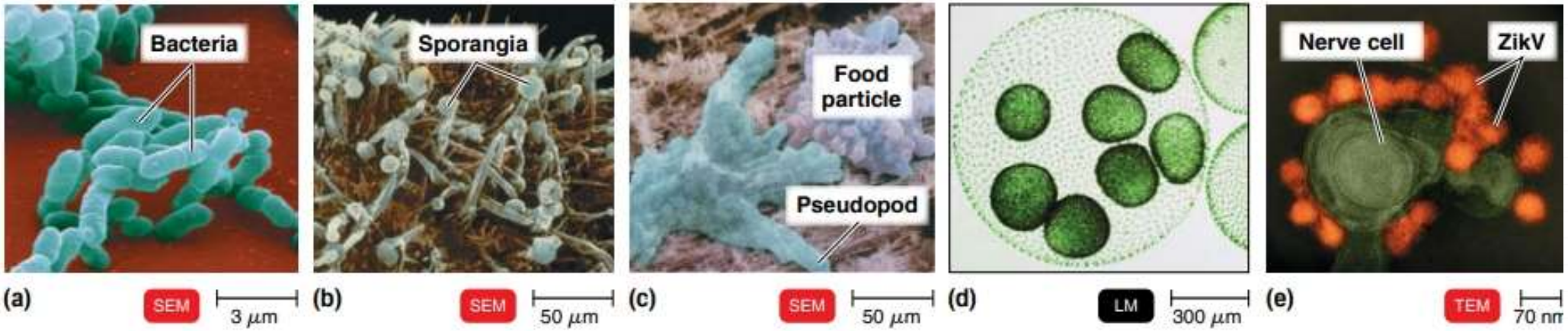
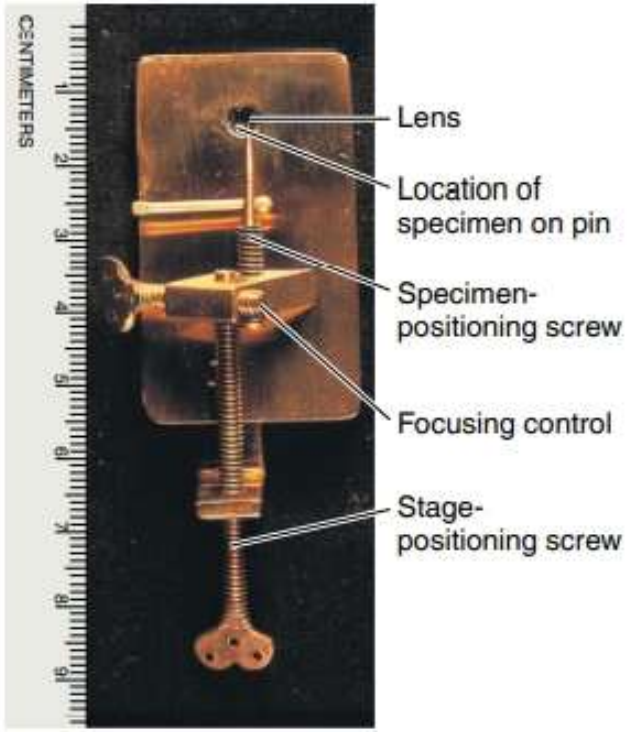


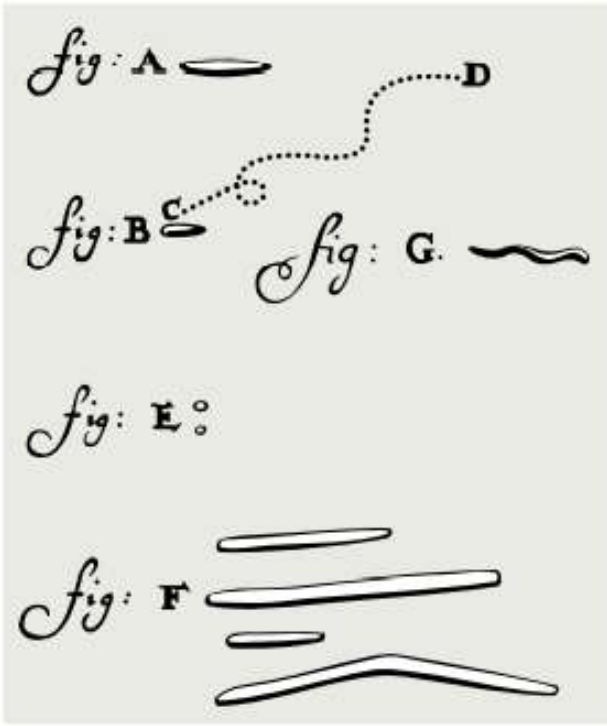
Figure 1.2 Types of microorganisms. **(a)** The rod-shaped bacterium *Haemophilus influenzae*, one of the bacterial causes of pneumonia. **(b)** *Mucor*, a common bread mold, is a type of fungus. When released from sporangia, spores that land on a favorable surface germinate into a network of hyphae (filaments) that absorb nutrients. **(c)** An ameba, a type of protozoan, approaching a food particle. **(d)** The pond alga *Volvox*. **(e)** Zika virus (ZikV). *NOTE:* Throughout the book, a red icon under a micrograph indicates that the micrograph has been artificially colored. SEM (scanning electron microscope) and LM (light microscope) are discussed in detail in Chapter 3.

Q How are bacteria, archaea, fungi, protozoa, algae, and viruses distinguished on the basis of structure?

(a) Van Leeuwenhoek using his microscope



(b) Microscope replica



(c) Drawings of bacteria

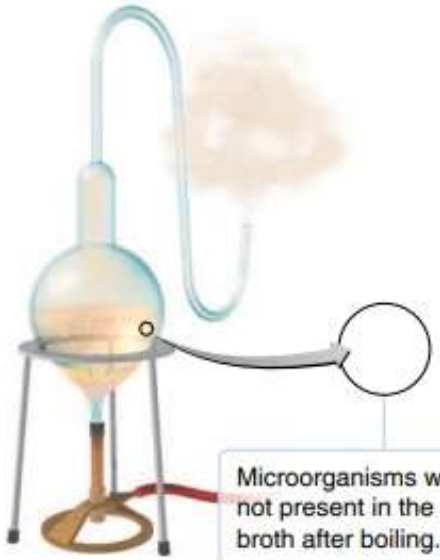
Figure 1.3 Anton van Leeuwenhoek's microscopic observations. **(a)** By holding his brass microscope toward a source of light, van Leeuwenhoek was able to observe living organisms too small to be seen with the unaided eye. **(b)** The specimen was placed on the tip of the adjustable point and viewed from the other side through the tiny, nearly spherical lens. The highest magnification possible with his microscopes was about 300× (times). **(c)** Some of van Leeuwenhoek's drawings of bacteria, made in 1683. The letters represent various shapes of bacteria. C–D represents a path of motion he observed.

According to the hypothesis of spontaneous generation, life can arise spontaneously from nonliving matter, such as dead corpses and soil. Pasteur's experiment, described below, demonstrated that microbes are present in nonliving matter—air, liquids, and solids.

1 Pasteur first poured beef broth into a long-necked flask.

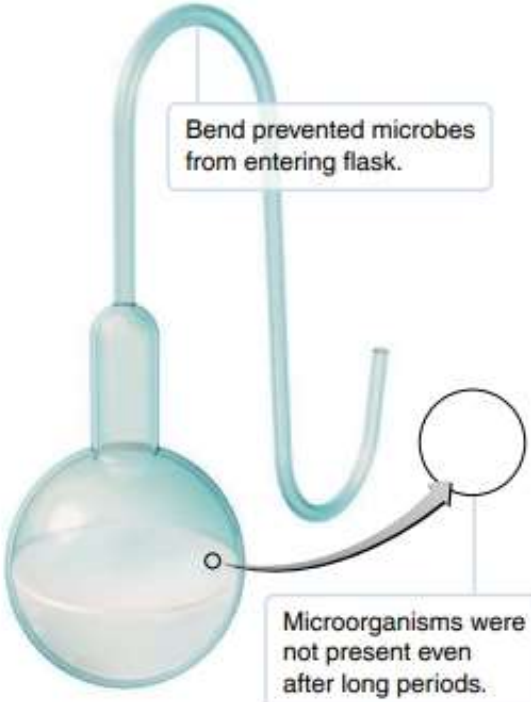
Microorganisms were present in the broth.

2 Next he heated the neck of the flask and bent it into an S-shape; then he boiled the broth for several minutes.



Microorganisms were not present in the broth after boiling.

3 Microorganisms did not appear in the cooled solution, even after long periods.



Bend prevented microbes from entering flask.

Microorganisms were not present even after long periods.

KEY CONCEPTS

- Pasteur demonstrated that microbes are responsible for food spoilage, leading researchers to the connection between microbes and disease.
- His experiments and observations provided the basis of aseptic techniques, which are used to prevent microbial contamination, as shown in the photo at right.

Some of these original vessels are still on display at the Pasteur Institute in Paris. They have been sealed but show no sign of contamination more than 100 years later.