Burton’s Microbiology for the Health Sciences

Chapter 1. Microbiology - The Science

- Chapter 1 Outline
- Introduction
- What is microbiology?
- Why study microbiology?
- First microorganisms on Earth
- Earliest known infectious diseases
- Pioneers in the science of microbiology
- Careers in microbiology
- What is Microbiology?
- Biology is the study of living organisms
- Microbiology is an advanced biology course
- Microbiology is the study of microbes, which are extremely small (microscopic) living organisms and certain non-living entities
- Living microbes are known as cellular microbes or microorganisms; examples include bacteria, archaea, some algae, protozoa, and some fungi
- Non-living microbes are known as acellular microbes or infectious particles; examples include viroids, prions, and viruses
- Microorganisms are ubiquitous (they are found virtually everywhere)
- Acellular and Cellular Microbes
- What is Microbiology?
- The microbes that cause disease are sometimes referred to as “germs”
- The scientific term for disease-causing microbes is pathogens
- Microbes that do not cause disease are called nonpathogens; the vast majority of microbes are nonpathogens
- What is Microbiology?
- Microbes that live on and in our bodies are referred to as our indigenous microflora
- Some members of our indigenous microflora are opportunistic pathogens
- Opportunistic pathogens are microbes that can cause disease, but usually do not; they can be thought of as microbes that are awaiting the opportunity to cause disease
- Pathogens cause two categories of diseases: infectious diseases and microbial intoxications
- Categories of Diseases Caused by Pathogens
- Why Study Microbiology?
- Microorganisms play significant roles in our lives; they are essential for life on this planet
- Photosynthetic algae and bacteria (such as cyanobacteria) produce much of the oxygen in our atmosphere
- Microorganisms are involved in the decomposition of dead organisms and waste products
- Saprophytes are organisms that live on dead and/or decaying organic matter
- The use of microbes to clean up toxic wastes and other industrial waste products is known as bioremediation
- Microbes as Saprophytes
- Why Study Microbiology?
- Many microbes play essential roles in various elemental cycles; e.g., the carbon, nitrogen, oxygen, sulfur, and phosphorous cycles
- Algae and bacteria serve as food for tiny animals; they are important links in food chains
- Microbes that live in the intestinal tracts of animals aid in the digestion of food and produce beneficial substances
- For many years, microorganisms have been used as “cell models”; the more that scientists learned about microbial cells, the more they learned about cells in general
- Microbes and Nitrogen Fixation
- Why Study Microbiology?
- Microbes are used in many industries; e.g., food, beverage, chemical, and antibiotic industries and in genetic engineering
- In genetic engineering, a gene or genes from one organism is/are inserted into a bacterial or yeast cell; the cell that receives the new gene(s) is then capable of producing the gene product(s) coded for by the new gene(s)
- The use of living organisms or their derivatives to make or modify useful products or processes is called biotechnology
- First Microorganisms on Earth
- Fossils of primitive microorganisms date back about 3.5 billion years ago.
- Candidates for the first microorganisms on Earth are archaea and cyanobacteria.
- Infectious diseases of humans and animals have existed for as long as humans and animals have inhabited the planet.
- Earliest known account of pestilence occurred in Egypt in about 3180 BC.
- Pioneers in the Science of Microbiology

Anton van Leeuwenhoek (1632-1723)
- “Father of Microbiology”
- Not a trained scientist!
- Made many simple single-lens microscopes
- Observed “animalcules” (bacteria and protozoa)
- Pioneers in the Science of Microbiology
Louis Pasteur (1822-1895)
- French chemist who made numerous contributions to microbiology
- Investigated different fermentation products
- Developed the pasteurization process
- Discovered life forms that could exist without oxygen (anaerobes)
- Developed several vaccines, including rabies and anthrax vaccines

Robert Koch (1843-1910)
- German physician who made numerous contributions to microbiology
- Made significant contributions to the germ theory of disease
- Discovered that *Bacillus anthracis* produced spores
- Developed methods of fixing and staining bacteria
- Developed methods to cultivate bacteria

- **Pioneers in the Science of Microbiology**

- **Koch’s Postulates**
  1. A particular microbe must be found in all cases of the disease and must not be present in healthy animals or humans.
  2. The microbe must be isolated from the diseased animal or human and grown in pure culture in the laboratory.
  3. The same disease must be produced when microbes from the pure culture are inoculated into healthy susceptible laboratory animals.
  4. The same microbe must be recovered from the experimentally infected animals and grown again in pure culture.

- **Medical Microbiology**
  - Involves the study of pathogens, the disease they cause and the body’s defenses against disease.
  - Concerned with epidemiology, transmission of pathogens, disease prevention measures, aseptic techniques, treatment of infectious diseases, immunology, and production of vaccines.

- **Careers in Microbiology**
  - A *microbiologist* is a scientist who studies microbes.
  - There are many career fields within the science of microbiology (e.g., bacteriology, phycology, protozoology, mycology, parasitology, and virology).