Summary

19–1 Bacteria

The smallest and most common microorganisms are prokaryotes, which are single-celled organisms that lack a nucleus. Prokaryotes are divided into two kingdoms: eubacteria and archaebacteria. Eubacteria live almost everywhere. Eubacteria are usually surrounded by a cell wall, which contains a carbohydrate called peptidoglycan. Inside the cell wall is a cell membrane that surrounds the cytoplasm. Archaebacteria look very similar to eubacteria. Archaebacteria lack the peptidoglycan of eubacteria and have different membrane lipids. Also, the DNA sequences of key archaebacterial genes are more like those of eukaryotes than those of eubacteria. Archaebacteria may be the ancestors of eukaryotes.

Prokaryotes are identified by characteristics such as shape, the chemical nature of their cell walls, the way they move, and the way they obtain energy. Three differently shaped prokaryotes are bacilli, cocci, and spirilla. Two different types of cell walls are found in prokaryotes. A method called Gram staining is used to tell them apart. Gram-positive bacteria appear violet when stained, while Gram-negative bacteria appear pink. Prokaryotes move in a variety of ways.

Most prokaryotes are heterotrophs, organisms that obtain energy by consuming food. Other prokaryotes are autotrophs, organisms that can make their own food. Heterotrophic prokaroyotes include chemoheterotrophs and photoheterotrophs. Autotrophic prokaryotes include photoautotrophs and chemoautotrophs. Prokaryotes release energy by both cellular respiration and fermentation. Organisms that require a constant supply of oxygen to live are called obligate aerobes. Organisms that do not require oxygen are called obligate anaerobes. Organisms that can survive with or without oxygen are called facultative anaerobes.

When a bacterium has grown so that it has nearly doubled, it replicates its DNA and divides in half, producing two identical "daughter" cells. This asexual reproduction is called binary fission. Bacteria are also able to exchange genetic information by a process called conjugation. Many bacteria can form an endospore when conditions are bad.

Bacteria are vital to maintaining the living world. Some are producers that carry out photosynthesis. Others are decomposers that break down dead matter. Some soil bacteria convert natural nitrogen gas into a form plants can use through a process called nitrogen fixation. Humans use bacteria in industry, food production, and other ways.

19–2 Viruses

Viruses are particles of nucleic acid, protein, and, in some cases, lipids. All viruses have one thing in common: They enter living cells and, once inside, use the machinery of the infected cell to produce more viruses. A typical virus is composed of a core of DNA or RNA surrounded by a protein coat. A virus's protein coat is called its capsid. Viruses that infect bacteria are called bacteriophages.

Once the virus is inside a host cell, two different processes may occur. In a lytic infection, a virus enters a cell, makes copies of itself, and causes the cell to burst, releasing new virus particles that can attack other cells. The virus uses the materials of the host cell to make copies of its own DNA molecule. In a lysogenic infection, a virus integrates its DNA into the DNA of the host cell, and the viral genetic information replicates along with the host cell's DNA. The viral DNA that is embedded in the host's DNA is called a prophage. The prophage may remain part of the DNA of the host cell for many generations. Eventually, the prophage will remove itself from the host cell DNA and make new virus particles.

Some viruses, called retroviruses, contain RNA as their genetic information. The virus that causes the disease AIDS is a retrovirus.

Viruses must infect a living cell in order to reproduce. Viruses are parasites. Because viruses are not made up of cells and cannot live independently, viruses are not considered to be living things.

19–3 Diseases Caused by Bacteria and Viruses

Disease-causing agents are known as pathogens. Pathogens include bacteria and viruses that cause disease. Not all bacteria are pathogens. Some live in and on the human body and help the body perform essential functions. Other bacteria can produce human diseases such as tuberculosis, strep throat, and tooth decay. Bacteria produce disease in one of two general ways. Some bacteria damage the cells and tissues of the infected organism directly by breaking down the cells for food. Other bacteria release toxins (poisons) that travel throughout the body interfering with the normal activity of the host.

Many bacterial diseases can be prevented by using a vaccine. A vaccine is a preparation of weakened or killed pathogens. A vaccine can prompt the body to produce immunity to the disease. Immunity is the body's natural way of killing pathogens. When a bacterial infection does occur, antibiotics can be used to fight the disease. Antibiotics are compounds that block the growth and reproduction of bacteria. Animals also suffer from bacterial diseases.

There are various methods to control bacterial growth, including sterilization, disinfectants, and food storage and food processing. Disinfectants include soaps and cleaning solutions. Food storage includes using a refrigerator.

Viruses produce disease by disrupting the body's normal equilibrium. In many viral infections, viruses attack and destroy certain body cells, causing the symptoms of the disease. Viral diseases in humans include the common cold, influenza, AIDS, chickenpox, and measles. Viruses produce other serious diseases in both animals and in plants.

Two other viruslike particles can cause disease. Viroids are single-stranded RNA molecules that have no surrounding capsids. Viroids cause disease in plants. Prions are particles that contain only protein—there is no DNA or RNA. Prions cause disease in animals, including humans.