# Lesson: Bacteria

Bacteria are the most abundant organisms on Earth and are widely distributed in the ocean. Bacteria are microscopic single-celled organisms; they have a relatively thick outer cell wall that surrounds a thin cell membrane. If you examined some bacteria under a microscope, you would observe the three basic bacteria shapes.

There are round bacteria called coccus (plural, cocci), rod-shaped bacteria called bacillus (plural, bacilli), and spiral-shaped bacteria called spirillum (plural, spirilla).

The first organisms that lived on Earth were prokaryotic cells that resembled these present-day bacteria. Since bacteria are structurally different from all other cells and organisms, they are classified in their own kingdom, Monera.

Bacterial cells can reproduce at a rapid rate, some every 20 minutes. All the instructions for reproduction are contained within threadlike structures called chromosomes. Because bacteria are prokaryotic (lack a nuclear membrane), this nuclear, or hereditary, material is dispersed throughout the cell's cytoplasm. The chromosomes are made up of molecules of DNA (deoxyribonucleic acid), which contain all the directions for a cell's structure and function within segments called genes. The total genetic make-up of an organism, that is, all its genes, is known as its genome. Bacteria are often used in modern recombinant DNA technology (genetic engineering) because they reproduce so rapidly.

**Decay Bacteria**

Bacteria play a very important part in the biological world. Bacteria are partly responsible for the decomposition, or breakdown, of dead organic matter. (Fungi also break down dead organic matter.) Dead matter is decomposed by a group of bacteria known as decay bacteria. In the ocean, decay bacteria break down organic matter into smaller molecules that are released into the water. These smaller molecules, such as phosphates, nitrates, and sulfates, are used as nutrients by different bacteria and other organisms. In this way, decay bacteria help recycle dead organic matter. Decay bacteria, and organisms like them, are called decomposers.

As you might suspect, decay bacteria are most abundant in bottom sediments where dead organic matter accumulates. There, the bacteria attach themselves to dead matter and secrete special chemicals that begin to break down organic matter in the sediments into nutrient molecules, some of which are taken in by the bacteria themselves. Feeding on organic matter in this way, the bacteria exhibit the type of nutrition normally found in fungi and animals.

Decay bacteria thrive in an environment that is warm, moist, dark, and rich in food. These conditions can be duplicated in the laboratory, where you can grow, or culture, marine bacteria. The food on which laboratory bacteria feed is a gel called nutrient agar (made from algae), which is put into a clear glass or plastic Petri dish. An inoculating needle is used to transfer bacteria from water or from another sample to the nutrient agar. The inoculating needle is dipped into a sample that contains the bacteria to be cultured and then moved, or streaked, across the agar plate. The petri dish is covered and placed in an incubator (which keeps the dish warm) for a specified amount of time. During incubation, the bacterial cells along the streak will begin to multiply. They reproduce by dividing in two. After 24 hours, a single bacterial cell (bacterium) can grow into a colony, a bacterial population that contains millions of cells. Colonies on the agar may differ in color, form, and texture.

There are more than 5000 species of bacteria. One interesting group of bacteria is the so-called magnetic bacteria, found in some saltwater and freshwater marshes. Magnetic bacteria contain a string of magnetite (iron oxide) crystals that make the cell behave like a magnet. By clinging to the iron deposits in marshes, the magnetic bacteria can feed on dead matter in the sediments. Some species of bacteria supply their energy needs in other ways. For example, the sulfur bacteria that live in marine mud use the compound hydrogen sulfide ($H_2S$), which is produced when organisms decay. (Hydrogen sulfide is the gas that smells like rotten eggs.) Oxidation of hydrogen sulfide provides energy that can be used by bacteria to form sugar from carbon dioxide and water. The hydrothermal vents on the deep ocean floor also contain bacteria that feed on sulfur compounds. The process by which organisms like sulfur bacteria derive energy from chemicals (that is, from inorganic raw materials) is called chemosynthesis.

**Blue-Green Bacteria**

Cyanobacteria, also known as blue-green bacteria (formerly called blue-green algae), is an organism also resembles a bacterium, because it lacks a membrane-bound nucleus. Most biologists classify cyanobacteria in the kingdom Monera with all other bacteria. Since they contain chlorophyll, cyanobacteria are able to make their own food. They are, in fact, the only moneran that is photosynthetic. In addition to chlorophyll, the cyanobacteria contain the blue pigment phycocyanin. The combination of green and blue pigments in the cyanobacteria produces their characteristic blue-green color. Some species of blue-green bacteria, such as the Oscillatoria, also contain the red pigment phycoerythrin. In shallow water, this species can produce a red color when a population bloom occurs. In fact, this cyanobacterium is responsible for periodically producing this effect in the Red Sea and may, in part, be responsible for giving this sea its name.

Cyanobacteria, which are found throughout the oceans, are very hardy organisms and can survive under a wide range of different environmental conditions. Some species of cyanobacteria live attached to rocks in the wave splash zone above the high tide mark. The cells are covered by a jellylike mass around their cell walls that prevents them from drying up when the tide is out. When these cells die, they stain the rocks black, a stain that resembles a recent oil spill. Other species of cyanobacteria secrete toxic chemicals

that can produce a painful rash if they come into contact with skin. Cyanobacteria can also thrive in waters and sediments that are low, or lacking, in oxygen.

Scientists think that the first photosynthetic organisms to inhabit Earth were the cyanobacteria. The earliest cyanobacteria produced reeflike growths called stromatolites. Like coral reefs, the mushroom-shaped stromatolites built by cyanobacteria had a framework of calcium carbonate. Fossil stromatolites more than 3 billion years old have been found.