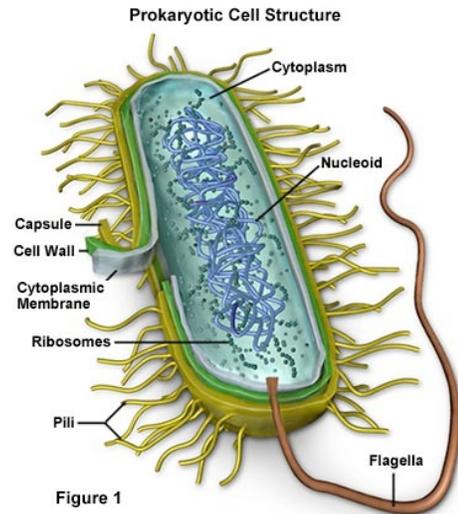


Bacteria Cell Structure

They are as unrelated to human beings as living things can be, but bacteria are essential to human life and life on planet Earth. Although they are notorious for their role in causing human diseases, from tooth decay to the Black Plague, there are beneficial species that are essential to good health.

Bacteria are prokaryotes, lacking a nucleus and organelles. Although they do not have a nucleus, they still have DNA, or genetic material, like eukaryotes. The DNA of bacteria is found in the shape of a circle. Bacteria come in many shapes and sizes, from minute spheres, cylinders and spiral threads, to rods with flagella, and filamentous chains. They are found practically everywhere on Earth and live in some of the most unusual and unlikely of places.



Evidence shows that bacteria were in existence as long as 3.5 billion years ago, making them one of the oldest living organisms on the Earth. There is still debate in the scientific community as to if bacteria or their prokaryotic relative, the archaeans, are older. Many scientists now believe that the archaea and bacteria developed separately from a common ancestor nearly four billion years ago. Millions of years later, the ancestors of today's eukaryotes split off from the archaea. Despite a similar resemblance to bacteria, biochemically and genetically, the archaea are as different from bacteria as bacteria are from humans.

Bacteria that have to consume and break down other organisms are heterotrophs. This includes species that are found in decaying material as well as those that utilize fermentation or respiration. Bacteria that create their own food from sunlight are autotrophs.

- **Capsule** - Some species of bacteria have a third protective covering called a capsule. A capsule is made of complex carbohydrates. Capsules play a number of roles, but the most important are to keep the bacterium from drying out and to protect it from phagocytosis (engulfing/endocytosis) by other microorganisms.
- **Cell Membrane** - The cell membrane surrounds the interior of a bacterium, controlling the flow of materials in and out of the cell. This is a structural trait bacteria share with all other living cells; a barrier that allows them to selectively interact with their environment.
- **Cell Wall** - Each bacterium is enclosed by a rigid cell wall. The wall gives the cell its shape and is found around the cell membrane. The cell wall protects the cell from the environment. It also helps to anchor appendages like the pili and flagella,

which start in the cell membrane and go through the cell wall to the outside. The strength of the wall is responsible for keeping the cell from bursting when placed into a hypotonic environment.

- **Cytoplasm** - The cytoplasm, or protoplasm, of bacterial cells is where the activities for cell growth, basic life requirements, and replication are carried out. In the cytoplasm is water, enzymes, nutrients, wastes, and gases and contains cell parts such as ribosomes, a chromosome, and plasmids. The DNA of the bacteria is found, but is not contained, in an area of the cell called the nucleoid. All the other cellular components are scattered throughout the cytoplasm.
- **Flagella** - Flagella (singular, flagellum) are whiplike structures that provide a means of movement for those bacteria that have them. They can be found at either or both ends of a bacterium or all over its surface. The flagella beat in a propeller-like motion to help the bacterium move toward nutrients; away from toxic chemicals; or, in the case of the autotrophic bacteria, towards sunlight.
- **Nucleoid** - The nucleoid is a region of cytoplasm where the chromosomal DNA is located. It is not surrounded by a membrane, as we've seen in a nucleus, but simply an area of the cytoplasm where the strands of DNA are found. Most bacteria have a single, circular chromosome that is responsible for replication, although a few species do have two or more. Smaller circular DNA strands, called plasmids, are also found in the cytoplasm.
- **Pili** - Many species of bacteria have pili (singular, pilus), small hairlike projections emerging from the outside cell surface. These outgrowths assist the bacteria in attaching to other cells and surfaces, such as teeth, intestines, and rocks. Without pili, many disease-causing bacteria lose their ability to infect because they're unable to attach to host tissue. Specialized pili are used for conjugation, during which two bacteria exchange fragments of plasmid DNA.
- **Plasmid**. Like the chromosome, plasmids are made of a circular piece of DNA. Unlike the chromosome, they are not involved in reproduction. Plasmids contain extra information that may be helpful to the bacterial cell. For example, plasmids have been shown to contain information such as antibiotic drug resistance, resistance to heavy metals, and virulence factors necessary for infection of animal or plant hosts. Scientists can add plasmids to bacteria, genetically modifying them for certain purposes.
- **Ribosomes** - Ribosomes are microscopic "factories" found in all cells, including bacteria. They make proteins. Proteins are the molecules that perform all the functions of cells and living organisms. Bacterial ribosomes are similar to those of eukaryotes, but are smaller and have a slightly different composition and molecular structure.