PROKARYOTES AND EUKARYOTES

PROKARYOTES

- They are the oldest living beings in our world having simpler cells, structures and reproduction types. They are so small that they can not be seen without the usage of a microscope. There are billions of microorganisms in our surroundings. In a pinch of garden soil, approximately 2 billions of microorganisms are found. Microorganisms are usually associated with plants; some are beneficial and some are harmful. Some microorganisms provide various ecological benefits.

- Prokaryotes are described as organisms with simple cell structures. Prokaryotic cells do not contain nucleus and organelles contrary to eukaryotes. Sexual reproduction is not present in prokaryotes; however they can change their genetic material by other methods.
- Prokaryotes can obtain DNA fragments from their environment – this process is called **transformation** and is beneficial in genetic engineering.

- Prokaryotes may also gain DNA with virus infections – this process is called **transduction**.
- Another DNA transfer method among prokaryotes is **conjugation**. Bacteria performing conjugation are tied to each other with thin tubes called pilus and DNA is transferred to a bacterium from another one by passing through these tubes.

Description of prokaryotes is mostly performed by examining some of their DNA regions. In addition, some biochemical tests and examination of their structures and reproduction types also serve for the purpose of identification.

Prokaryote cells are usually round (coccus), cylindrical rod (basil) or like a cork puller (spiral).

Prokaryotes may be single celled or they may form small clusters called colony or may be linearly arranged (filament).

Prokaryotes have one or more flagella. These are thread-like extensions that enable them to swim in fluid environment. In other words, it is a whip-like structure that allows a cell to move.

They are found in all three domains of the living world: bacteria, archaea and eukaryota. While all three types of flagella are used for locomotion, they are structurally very different.

Prokaryote flagella is simpler compared to eukaryote flagella and it enables swimming via a different mechanism: They turn like a fan, however eukaryote flagellae undulate. They move as a response to different stimuli like light, food or magnetic field.

Most of the prokaryotes produce polysaccharides that cover their surfaces forming cell coat. These cell coats maybe named as a capsule, mucilaginous envelope or adhesive coat.

This capsule layer prevents the type of bacteria from being recognized and be killed by the defense systems of the host. Prokaryotes may also adhere to other surfaces of other living beings with the help of their mucilaginous envelopes. The layer that bacteria adhering to the surface form with their mucilaginous secretions is called a **biofilm**.

All prokaryotes (with a few exceptions) have a hard and durable cell wall that surrounds their cell membrane and the cytoplasm within. This cell wall is found inside the capsule if present. Cell wall prevents the explosion of the cell when extracellular water is intense. It also prevents viral infections. However some viruses may leave their contagious genetic material through the cell wall.

Peptidoglycan is found in cell walls of bacteria at least to a small extent. This substance is a mixture of protein and carbohydrate and is important in respect to the biology of bacteria and also in respect to medicine since the quantity of this substance determines the antibiotic susceptibility. Penicillin and some other antibiotics show activity by preventing peptidoglycan synthesis of bacteria. These antibiotics do not effect eukaryotic cells (except for those having antibiotic allergy).

Main components of prokaryotic cell is nucleic acids (DNA and RNA), enzymes, other proteins, ribosomes and inner membrane.

DNA molecules of prokaryotes are found as a couple of DNA rings. Prokaryote DNA is called **genophore** or **chromosome**. Genophore is a long double strand of DNA, usually in one large circle. It includes most of the genetic material of the organism. They also contains **plasmids** (small continuous loops of DNA)

Plasmids produce toxins or carry genes that lead to antibiotic or heavy metal resistivity. Bacteria may transfer their plasmids to each other, and by this way various genes are distributed within a bacterial population in a short time. This is important in respect to the development of antibiotic resistance.

For example, fire blight disease is caused by *Erwinia* species on fruit trees. Farmers administer streptomycin to control the disease, however the plasmid that carries the streptomycin resistance gene is distributed and thus the disease can not be controlled.

Prokaryote enzymes determine the metabolism type of the cell. For example, *Anabaena* (a cynanobacterium) cells have the necessary enzymes that enable them to perform photosynthesis. However *Erwinia* sp. does not have these photosynthesis.

Other components that are present in prokaryote cells depend on the organism. For example, *Anabaena* and other cyanobacteria have thylakoids in their cells; *Bacillus* sp. produce a toxic protein crystal.

Prokaryotes reproduce by binary fission which is a simple procedure compared to eukaryotes.

Most prokaryotes can produce thick walled cells that are called **spores**. These are especially produced when these organisms are under environmental pressure (stress) like lack of food or low temperature. They can survive in dormant state for a long time and when the conditions become favorable again, they germinate and turn into typical cells again.

Endospore is another cell type that tolerates pressure (stress). Endospores are produced within the bacterium cell and passes into the environment after the cells in which they are produced die. The main reason for widespread bacterial infections and bacterium originated food contamination is these endospores.

For example, *Bacillus anthracis* bacterium that produces endospores lead to anthrax (charbon) disease that is generally the subject of bioterrorism. This bacterium has gained attention as a potential biological war agent. Spores of this bacterium enter into human body through wounds, and lead to skin infections that can be easily treated with antibiotics.

However, sometimes bacterium spores may reach the lungs via respiratory system; may reach the gastrointestinal system via consumption of infected and unbaked meat and result in lung or gastrointestinal infections. These type of internal infections are hard to treat since the toxins that *Bacillus anthracis* produces continue to harm the, internal organs even after the bacteria are killed by the antibodies.

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Another bacterium that contaminates food is *Clostridium botulinum*. This bacterium produces spores that can resist pasteurization temperatures (10 min. At 80^0C. Spores germinate following pasteurization, becoem typical cells and start to produce neurotoxins (nerve toxins). The neurotoxins that the bacteria produce lead to a type of paralysis called **botulism**.

Consumers and people making their own canned foods at home are warned not to eat canned foods having swelled caps. The gas that leads to this swelling indicated that *Clostridium botulinum* may have proliferated inside the can.

Another *Clostridium* species called *C. tetani* leads to the formation of tetanus. This bacterium is usually found in the soil and when its spores enter into the body through cuts and wounds, tetanus infection starts.