Archaebacteria

Archaebacteria are the **oldest organisms** living on the Earth. They are unicellular prokaryotes and belong to the kingdom, Archaea. They were first discovered in 1977 and classified as bacteria. Most archaebacteria appear like bacteria, when observed under the microscope. However, they are quite different from bacteria and eukaryotic organisms.

Archaebacteria are found in very harsh conditions such as in the volcanic vents or at the bottom of the sea. They can easily survive in such extreme environment as sea vents releasing sulfide-rich gases, hot springs, or boiling mud around volcanoes.

Archaebacteria Groups

Under the kingdom Archaea, archebacteria are classified into the following phyla:

Phylum Euryarchaeota: This is the most studied division of archaea, and mostly includes methanogens and halophiles.
Phylum Crenarchaeota: It includes thermophiles, hyperthermophiles and thermoacidophiles. These archebacteria are mostly found in the marine environment.
Phylum Korarchaeota: This division consists of hyperthermophiles found in high temperature hydrothermal environment.
Phylum Thaumarchaeota: This phylum includes ammonia-oxidizing archaea, as well as those with unknown energy metablolism.
Phylum Nanoarchaeota: This phylum has a single representative member named Nanoarchaeum equitans. This unusual archebacterium is an obligate symbiont of another archaea belonging to the genus Ignicoccus.

Methanogens harvest energy by converting H_2 and CO_2 into methane gas. They are found in the intestinal tracts of humans and some animals such as cows, and in marshes.
Halophiles survive in a high-salt atmosphere. Hence, they are found in the Great Salt Lake, Dead Sea and other areas with a high salt concentration.
Thermoacidophiles are found in the areas with very high temperatures and extremely acidic conditions. They can be found in hydrothermal and volcanic vents.

Characteristics

1. Archaebacteria are **obligate anaerobes** and they survive only in oxygen-free environments.

2. They are known as **extremophiles,** as they are able to live in a variety of environment. Some species can live in the temperatures above boiling point at 100 degree Celsius or

212 degree Fahrenheit. They can also survive in acidic, alkaline or saline aquatic environment. Some can withstand a pressure of more than 200 atmospheres.

3. The size of archaebacteria ranges from one-tenth of a micrometer to more than 15 micrometers. Some of archaebacteria have flagella.

4. Like all prokaryotes, archaebacteria don't possess the membrane-bound organelles. They don't have nuclei, endoplasmic reticula, Golgi complexes, mitochondria, chloroplasts, or lysosomes. The cells consist of a thick cytoplasm that contains all the compounds and molecules required for metabolism and nutrition. Their **cell wall doesn't contain peptidoglycan**. The rigid cell wall supports the cell and allows an archaebacterium to maintain its shape. It also protects the cell from bursting when present in a hypotonic environment.

5. Archaebacteria have lipids in their cell membranes. They are composed of branched hydrocarbon chains, connected to glycerol by ether linkages.

6. Since these organisms don't have nuclei, the genetic material floats freely in the cytoplasm. They consist of ribosomal RNA (rRNA). Their DNA contains a single, circular molecule, which is compact and tightly wound. No protein is associated with DNA.

7. The archaebacterial cell may contain plasmids, which are small, circular pieces of DNA. They can duplicate independent of a larger, genomic DNA circle. Plasmids often code for antibiotic resistance or particular enzymes.

8. Archaebacteria have been found to be **indifferent to all major antibiotics**. However, they have been observed to be sensitive towards those chemicals/drugs that obstruct the lipid cycle involved in wall polymer biosynthesis.

9. Archaebacteria reproduce by an asexual process known as binary fission. During this process, the bacterial DNA replicates. The cell wall pinches off in the center, due to which the organism is divided into two new cells. Each cell consists of a copy of circular DNA. Some species can multiply from one cell into two in as less time as 20 minutes.

10. During transformation, DNA fragments released by one archaebacterium are taken up by another. In the process of transduction, a bacteriophage (a virus infecting bacterial cells) transfers genetic material from one organism to another. In the process of conjugation, genetic material is exchanged between two bacteria. These mechanisms lead to genetic recombination, causing the continued evolution of archaebacteria.

11. The interactions between archaebacteria and other life forms are **either symbiotic or commensal** as archaea are **not known to pose pathogenic hazard to other organisms**.

12. A characteristic unique to archaea is the composition of their cell walls. The

archaebacteria cell wall is made of **pseudomurein,** which is made up of a **combination of N-acetyltalosaminuronic acid and N-acetylglucosamine.** This kind of cell wall makes archaebacteria **immune to the effects of Lysozyme,** which is an enzyme produced by a host's immune system to attack and disable cell walls of pathogenic bacteria.

The discovery and study of archaebacteria has opened up a whole new possibility of finding life in the most extreme of environments - places where till now, it was thought, life could not exist. Doesn't that take us a step closer to the possibility of finding life in the extreme environment of outer space? Think about it!