

Cell Structure and Organizing

The basic unit of all living things is **the cell**.

The cell theory is one of the fundamental concepts of biology; it states that: all organisms are made up of cells, and that all cells derive from other, pre-existing cells.

An organism may comprise just a single cell (***unicellular***), a collection of cells that are not morphologically or functionally differentiated (***colonial***), or several distinct cell types with specialized functions (***multicellular***).

Among microorganisms, all bacteria and protozoans are unicellular; fungi may be unicellular or multicellular.

The most fundamental difference between prokaryotic and eukaryotic cells is reflected in their names; ***Eukaryotic cells*** possess a true nucleus, and several other distinct subcellular organelles that are bounded by a membrane. ***Prokaryotes*** have no such organelles.

Types of microorganisms

The present classification of microbes might read as follows:

1. Prokaryotes:

- A. Archaea
- B. Bacteria (*Cyanobacteria*, *mycoplasma*, Gram-positive bacteria, and Gram-negative bacteria).

2. Eukaryotes

- A. Algae
- B. Protozoa
- C. Fungi
- D. Slime molds

Note: viruses are also classed as microorganisms, but they are shapely differentiated from all cellular forms of life by their dependence upon a host for replication.

Classification of Microbes

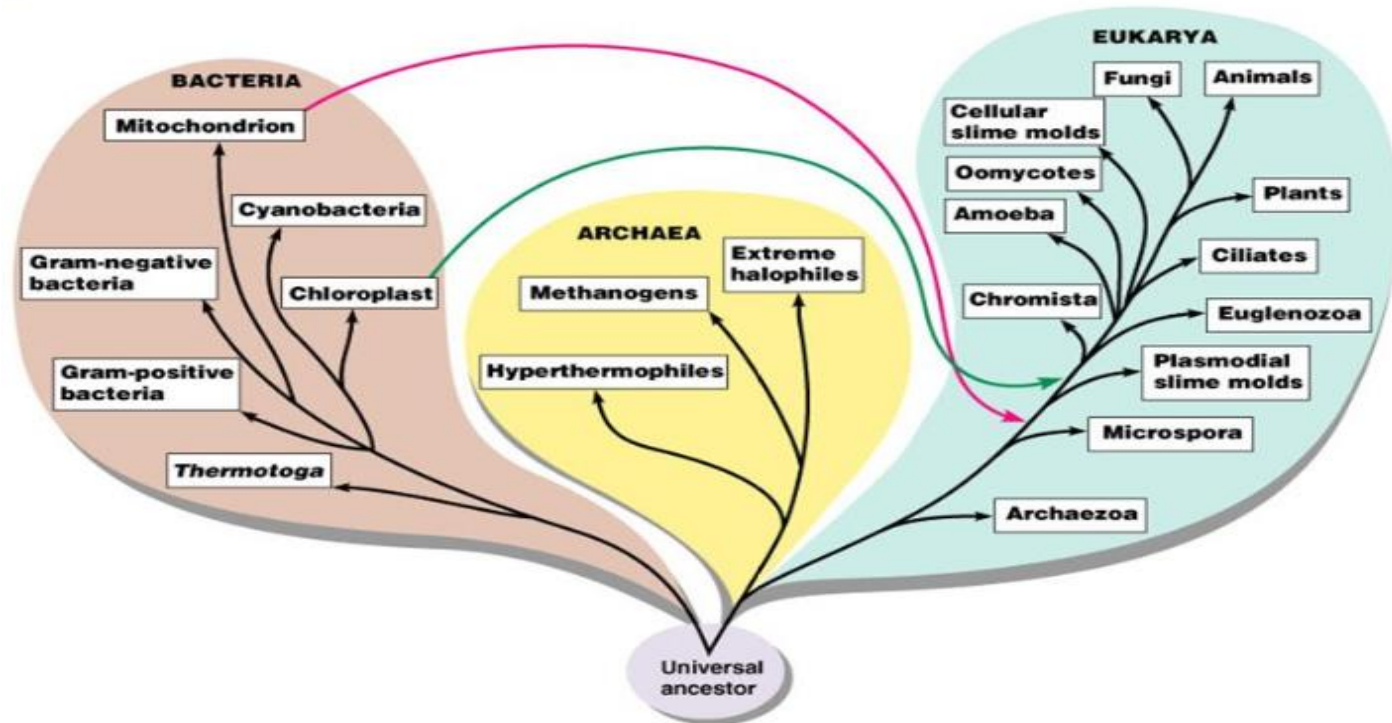


Figure 1: Classification of microbes

The differences between prokaryotes and eukaryotes:

	Prokaryotes	Eukaryotes
DNA	DNA is naked (no histones)	DNA associated with histones
	DNA is circular	DNA is linear
	Genes do not contain introns	Genes may contain introns
	DNA found in cytoplasm (nucleoid)	DNA found in nucleus
Internal Structures	No membrane-bound organelles	Have membrane-bound organelles
Ribosomes	Have 70S ribosomes	Have 80S ribosomes
Reproduction	Asexual (binary fission)	Asexual (mitosis) or sexual (meiosis)
	DNA is singular (haploid)	DNA is usually paired (diploid or more)
Average Size	Smaller ($\approx 1 - 5 \mu\text{m}$)	Larger ($\approx 10 - 100 \mu\text{m}$)

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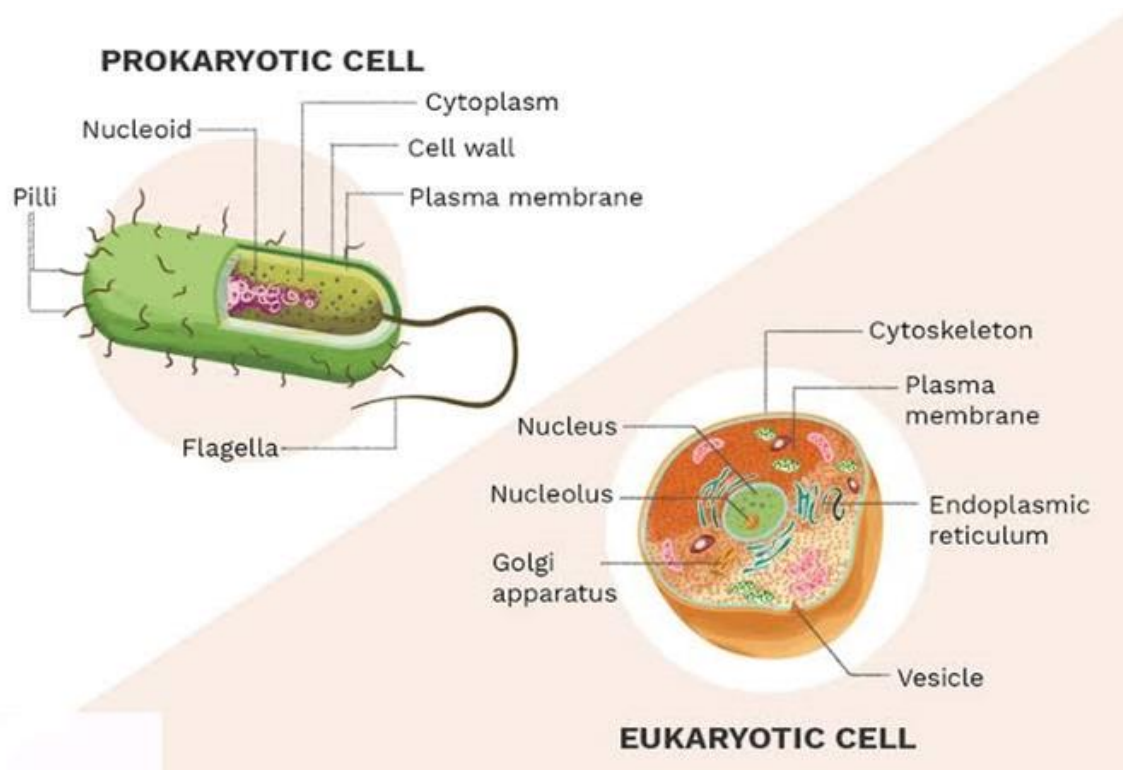


Figure 2: Prokaryotes vs Eukaryotes

Archaea (archaebacteria):

Archaea or Archaebacteria (singular archaeon, the word archaea means “ancient things”):

The Archaea possess the following characteristics:

- Archaea are prokaryotic cells, single-celled microorganisms looking very similar in size and shape to bacteria.
- Unlike the bacteria and the Eukarya, the Archaea have membranes composed of branched hydrocarbon chains (many also containing rings within the hydrocarbon chains) attached to glycerol by ether linkages.
- The cell walls of Archaea contain no peptidoglycan.

- Archaea are not sensitive to some antibiotics that affect the bacteria, but are sensitive to some antibiotics that affect the Eukarya.
- Archaea contain ribosomal RNA (rRNA) that is unique to the Archaea as indicated by the presence molecular regions distinctly different from the rRNA of bacteria and Eukarya.
- Archaea often live in extreme environments and include methanogens, extreme halophiles, and hyperthermophiles. One reason for this is that the ether-containing linkages in the Archaea membranes is more stable than the ester-containing linkages in the bacteria and Eukarya and are better able to withstand higher temperatures and stronger acid concentrations.

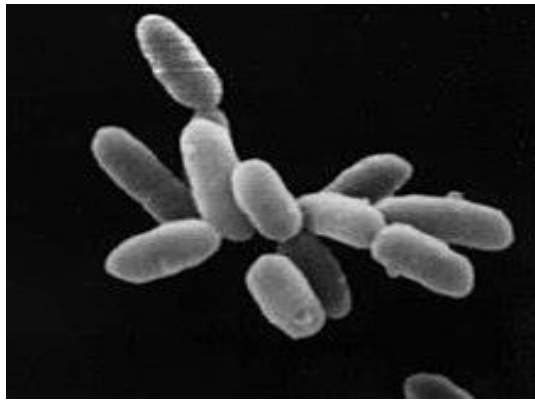


Figure 3: Halobacterium sp.

The bacteria (Eubacteria):

Bacteria (also known as eubacteria or "true bacteria"): are prokaryotic cells that are common in human daily life. Eubacteria can be found almost everywhere and kill thousands of people each year, but also serve as antibiotics producers and food digesters in our stomachs. The bacteria possess the following.

Characteristics of bacteria:

1- Bacteria are prokaryotic cells (have no membrane bounded nucleus).

- 2- Generally small size (the size range between 0.5-5 micrometers).
- 3- Have single chromosome as genetic material.
- 4- Except for ribosomes, there are no cytoplasmic organelles (mitochondria, chloroplasts, and the other organelles present in eukaryotic cells, such as the Golgi apparatus and endoplasmic reticulum).
- 5- Enclosed in a rigid cell wall made up of peptidoglycan. Cell wall may be surrounded by a capsule.
- 6- Reproduce by amitosis (binary-fission / asexual form of reproduction).
- 7- Many bacteria form spores.
- 8- May have flagella for movement.

Cyanobacteria: are aquatic bacteria, and are some of the oldest living organisms on Earth. Because these water-dwelling bacteria photosynthesize, they are also referred to as “blue-green algae.” Cyanobacteria can be found in many different environments, including freshwater and marine ecosystems and that can have major effects on the water quality and functioning of aquatic ecosystems.



Figure 4: Cyanobacteria