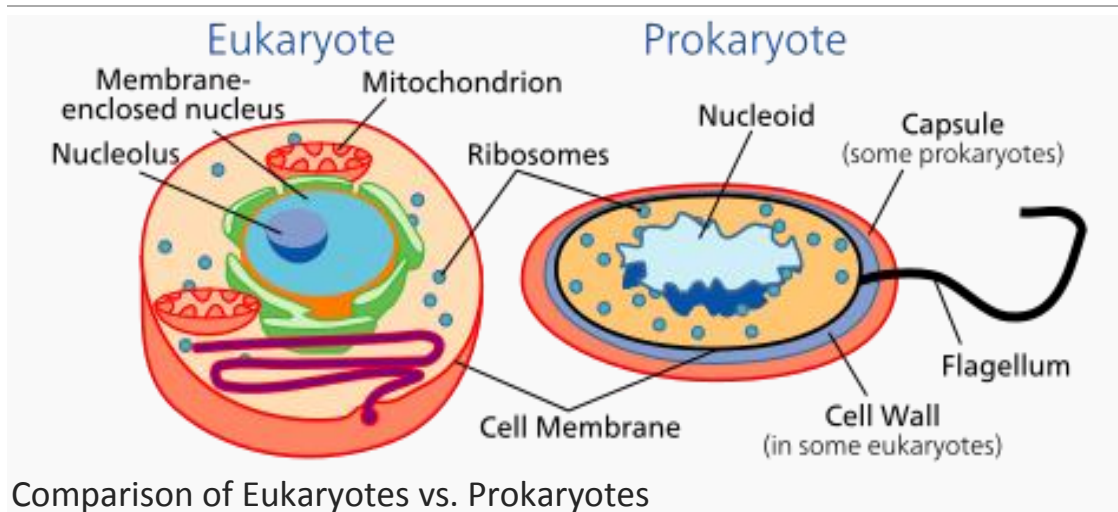


Prokaryotes and Eukaryotes



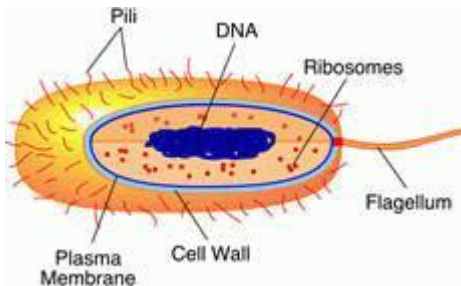
Eukaryotes Originated from Prokaryotes

Similar gene sequences between prokaryotes and eukaryotes suggest that they originated from a universal ancestor and evolved into separate domains billions of years ago. Prokaryote evolved to eukaryote through several stages.

Prokaryotes

Domain

- in the domain Bateria and Archaea.
- Structure:



- Cell membrane: phospholipid bilayer that encloses the cytoplasm, serves as attachment point for the intracellular cytoskeleton and cell wall.
- Cell wall: rigid, outside of the plasma membrane. Its function is to determine the shape of the organism and to act as a vessel pressure, preventing over-expansion when water enters the cell.

- Nucleoid: analog to nucleolus of eukaryotes, nucleoid contains DNA, genetic material of the cell, but it is not enclosed by any membrane.
- Chromosomes: contains genetic information. Chromosomes make up nucleoid. Prokaryotic cells are haploid.
- Flagella: tail-like organelles in charge of movements of cells.
- Pili: shorter and thinner than flagella, used also for motility and adherence.

Morphology of prokaryotic cells

Prokaryotic cells have a variety of shapes. These shapes are to describe, classify and identify micro-organism. Some common shapes are:

- Cocci: spherical shape
- Bacilli: cylindrical or rod shape
- Spirilla: a curves rod long enough to form spirals
- Vibrio: a short curved rod (comma) shaped
- Spirochete: long helical shape

Cell division

- Prokaryotic cells reproduce through asexual reproduction. They usually are divided by binary fissions (breaking in half, forming two identical daughter cells) or budding (daughter cells grow out of the parent and gradually increase in size)
- Prokaryotic cells have their genes passed out completely to their daughter cells through mitosis. Genome is stored in chromosome.

Energy intake

- Bacteria and Archaea are the main branches of prokaryote evolution.

Generally, Bacteria and Archaea are quite similar in size and shape.

• Prokaryotes vs. Eukaryotes Cell

	Eukaryotic Cell	Prokaryotic Cell

Nucleus	Present	Absent (nucleoid)
# of Chromosomes	More than one	One - but not a true chromosome; Plasmids present
Cell Type	Multicellular	Unicellular
True Membrane-bound Nucleus	Present (Lysosomes, Golgi-complex, Endoplasmic Reticulum, Mitochondria, Chloroplasts)	Absent
Telomeres	Present (Linear DNA)	Circular DNA; does not need telomeres
Genetic Recombination	Mitosis, fusion of gametes	Partial, un-directional transfer of DNA
Lysosomes/Peroxisomes	Present	Absent
Microtubules	Present	Absent (rare)
Edoplasmic Reticulum	Present	Absent
Mitochondria	Present	Absent
Cytoskeleton	Present	Possibly Absent

DNA Wrapping on proteins	Yes	No
Ribosomes	Larger (80S); 70S in organelles	Smaller (70S)
Vesicles	Present	Present
Golgi Apparatus	Present	Absent
Mitosis	Yes	No; binary fission
Chloroplasts	Present in plants	Absent; chlorophyll is scattered in the cytoplasm
Cell Size	10-100 μm	1-10 μm
Permeability of Nuclear Membrane	Selective	not present in cell
Cell Wall	Present on Plant and Fungi cells (chitin)	Present (peptidoglycan)
Vacuoles	Present	Present
Flagella	Present; for movement	Present; for propulsion

Eukaryotes

Structure

- **Plasma membrane:** A lipid/protein/carbohydrate complex, providing a barrier and containing transport and signaling systems.
- **Mitochondrion:** Surrounded by a double membrane with a series of folds called cristae. Functions in energy production through metabolism. Contains its own DNA, and is believed to have originated as a captured bacterium.

- **Cytoskeleton**

Microfilaments

Intermediate filaments

Microtubules

- **Nucleus:** double membrane surrounding the chromosomes and the nucleolus. Pores allow specific communication with the cytoplasm. The nucleolus is a site for synthesis of RNA making up the ribosome.
- **Nuclear envelope:** doubled membrane, enclosing the nucleus.
- **Nucleolus**
- **Chromatin:** contains genetic information of cells (DNA)
- **Chromosomes:** only visible during cell divisions.

- **Endoplasmic Reticulum (ER)**

Rough ER: A network of interconnected membranes forming channels within the cell. Covered with ribosomes (causing the "rough" appearance) which are in the process of synthesizing proteins for secretion or localization in membranes.

Smooth ER: A network of interconnected membranes forming channels within the cell. A site for synthesis and metabolism of lipids. Also contains enzymes for detoxifying chemicals including drugs and pesticides.

- **Golgi apparatus:** A series of stacked membranes.
- **Lysosome:** A membrane bound organelle that is responsible for degrading proteins and membranes in the cell, and also helps degrade materials ingested by the cell.
- **Ribosome:** Protein and RNA complex responsible for protein synthesis, cell division and energy intake.