Table 3-1 Comparison of Structures in Bacterial, Archaeal, and Eukaryotic Cells

Structure	Function	Bacterial Cells	Archaeal Cells	Eukaryotic Cells				
				Fungi	Algae	Protozoa	Plants	Animals
Cytoplasmic membrane	Semipermeable barrier; regulation of substances moving into and out of cell	+	+	+	+	+	+	+
Cell wall (with peptidoglycan)[a]	Protects cell against osmotic shock	+	−	−	−	−	−	−
Cell wall (without peptidoglycan)	Protects cell against osmotic shock or physical damage	−	+	+	+	−	+	−
Flagella (with microtubules, 9+2 arrangement)	Cell movement	−	−	+	+	+	+[b]	+[c]
Flagella (without microtubules)	Cell movement	+	+	−	−	−	−	−
Cilia	Cell movement; movement of materials	−	−	−	−	+	−	+
Nucleoid	Region of DNA concentration; heredity control	+	+	−	−	−	−	−
Nucleus	Membrane-bound organelle containing DNA; region of heredity control	−	−	+	+	+	+	+
Nucleolus	Formation of ribosomal subunits	−	−	+	+	+	+	+
Archaeal chromosome	Circular molecule that contains genome (hereditary information); histone-like proteins occur in association with DNA and play a role in maintaining archaeal chromosome structure and gene expression	−	+	−	−	−	−	−
Bacterial chromosome	Circular molecule in most cases, although linear in some bacterial cells; contains genome (hereditary information); histone-like proteins generally are absent but DNA binding proteins are present and play a role in expression of genome	+	−	−	−	−	−	−
Chromosomes	Linear molecules that contain genomes; DNA stores the hereditary information; protein establishes structure of the chromosome essential for gene expression	−	−	+	+	+	+	+
Ribosome	Translation of genetic information carried by mRNA into proteins; protein synthesis	+	+	+	+	+	+	+
Endoplasmic reticulum	Processing and transport of proteins and other substances through cell; communication of chemicals and coordination of functions within cell	−	−	+	+	+	+	+
Golgi body	Processing and transport of proteins and other substances through cell; communication of chemicals and coordination of functions within cell	−	−	+	+	+	+	+
Lysosome	Containment of digestive enzymes; controlled degradation of substances	−	−	+	+	+	+	+
Cytoskeleton	Organization and support of organelles within cell	−	−	+	+	+	+	+
Mitochondrion	Respiratory chemiosmotic generation of ATP	−	−	+	+	+[d]	+	+
Chloroplast	Photosynthetic chemiosmotic generation of ATP	−	−	−	+	−	+	−
Endospore[e]	Survival; heat resistance	+	−	−	−	−	−	−

[a] Lacking in some bacteria.
[b] Reproductive cells of some lower plants have flagella.
[c] Reproductive cells of some animals, e.g., sperm cells, have flagella.
[d] Some protozoa such as *Giardia* and *Veramorpha* lack mitochondria.
[e] Present in only a few bacteria.

Table 3-3 Comparison of Cytoplasmic Membranes of Bacterial, Archaeal, and Eukaryotic Cells

Characteristic	Bacteria	Archaea	Eukaryotic
Protein content	High	High	Low
Lipid composition	Phospholipid	Sulfolipids, glycolipids, nonpolar isoprenoid lipids, phospholipids	Phospholipid
Lipid structure	Straight chain	Branched	Straight chain
Lipid linkage	Ester linked*	Ether linked (diethers and tetraethers)	Ester linked
Sterols	Absent†	Absent	Present

*The bacteria *Aquiflex pyrophilus* contains phospholipids and ether linked lipids.
†Some bacteria in the genus *Mycoplasma* contain sterols in their cytoplasmic membranes.

Table 3-5 Comparison of Gram-positive and Gram-negative Bacterial Cell Walls

	Gram-positive Wall	Gram-negative Wall
Peptidoglygan	Always present; occurs as a thick layer	Always present; occurs as a thin layer
Peptidoglycan tetrapeptide	Most contain lysine	All contain diamino-pimelic acid
Peptidoglycan cross linkage	Generally pentapeptide, for example, entirely glycine	Direct bonding of diamino-pimelic acid of one chain to the terminal D-alanine of another chain
Teichoic acid	Present	Absent
Teichuronic acid	Present	Absent
Lipoproteins	Absent	Present
LPS (lipopolysaccharide–endotoxin)	Absent	Present
Outer membrane	Absent	Present
Periplasmic space	Absent	Present