A SUMMARY OF PROKARYOTIC CELL STRUCTURE AND FUNCTION
(Bacteria and Archaea)

CELL PART	STRUCTURE	FUNCTION	COMMENTS
Flagella Long, slender, protein strands that display rotary motion	Made of flagellins; attached to wall and cell membrane; not enclosed by membrane	Move cells through the environment or sweep liquid past fixed cells. May carry receptors.	Arrangement varies (monotrichous, peri-trichous, amphitrichous, etc.)
Fimbriae	Short, hair-like and numerous; made of fimbrin proteins	Attach cells to various surfaces; may aid in pathogenicity	Resemble cilia on eukaryotic cells, but not used for swimming
Pili	Hair-like and longer than fimbriae; usually 1 or 2 per cell	Attach cells to other cells; shorten to bring cells together	Sex pili are involved in gene transfer during conjugation
Glycocalyx	Layer of polysaccharide or protein deposited outside the cell	Protection, attachment, nutrient storage, aids pathogenicity	Dense = capsule Loose = slime layer Matrix of biofilms
Sheaths, stalks & spines	Variable composition	Attachment and sometimes protection	Restricted to only certain types of bacteria
Rigid Cell wall	Peptidoglycan in most Bacteria; composition different in Archaea	Support for cytoplasm and flagella; provides protection & cell shape	Site of action for several antibiotics and lysozyme.
Outer wall layer	Techoic acid or mycolic acid in Gram-pos. cells; resembles cell membrane in Gram-neg.	Protection, attachment, in Gram-neg. cells the lipid A of LPS is highly toxic to mammals	Used for serological typing of Gram-neg. bacteria
Periplasmic space (location variable)	Potential space between wall layers and cell membrane	Storage of enzymes, wall components and nutrients	Contains periplasmic flagella in Spirochetes
Periplasmic flagella	Made of flagellins; in the periplasmic space	Movement of cell through environment	Found within the cell walls of Spirochetes
Cell membrane (Plasma membrane) Bacteria	Lipid and protein in a 40:60 ratio; usually lacks ring-form lipids	Limits cell, controls entry and exit, taxis & signal transduction	Living, dynamic layer; selectively and differentially permeable
Cell membrane (Plasma membrane) Archaea	Unique structure with mirror image glycerol and ether-linked lipids	Limits cell, controls entry and exit, taxis & signal transduction	Living, dynamic layer; selectively and differentially permeable
Mesosomes	Highly folded regions of cell membrane	Not present in living, functioning cells	Artifact of microscopy fixation techniques
Thylakoids	Membrane bound compartments found in cyanobacteria	Contain pigments and enzymes involved in photophosphorylation	Light reactions of photosynthesis occur in these
Cytoplasm	Protoplasm bounded by cell membrane; contains ribosomes & inclusions	Factory area, site of metabolism (synthesis and breakdown)	Bulk of the cell
Ribosomes	Granules of nucleic acid (RNA) and protein in 50S and 30S subunits	Site of protein synthesis	Free in cytoplasm, target for several antimicrobial drugs

Nucleoid (nuclear region)	Contains ccc-DNA; not enclosed by membrane; may contain histones	Controls cellular reproduction and most metabolic activity	Sometimes visible in cells stained with nigrosin
Plasmids	Small, ccc-DNA found outside the chromosome	Carry genes not always used for cell function	Used as cloning vectors in genetic engineering
Carboxysomes	Polyhedral protein shells with enzymes	Fix carbon of CO_2 into monosaccharides	Found in autotrophs (photo and chemo)
PHB granules	Granules made of poly-β-hydroxybutyrate	Nutrient reserves	May be made visible by certain stains
Metachromatic granules	Volutin or linear phosphate polymers	Phosphate reserves	Stain red with some methylene blue preps
Gas vacuoles	Protein-bound vesicles filled with gas	Regulate cell buoyancy in aquatic environments	Refractile with light microscopy
Sulfur granules	Tiny granules of elemental sulfur	Sulfur storage	Refractile with light microscopy
Endospores	Specialized cells with thick keratinized coats, low water content and dipicolinic acid	Dormant structures; allow populations to survive long periods of unfavorable conditions	Visible with several stain techniques; common in *Bacillus*, *Clostridium* & other sp.
Heterocysts	Specialized, thick-walled, anaerobic cells made by cyanobacteria	Carry nitrogenase enzymes for fixing (N_2) into ammonium	Mature heterocysts are unable to divide; are supported by other cells
Akinetes	Specialized, thick-walled cell made by some cyanobacteria	Resting structure; promotes survival of populations	Large cells, often develop near or between heterocysts
Conidia	Chains of small cells formed at filament tips	Reproductive structures	Made by actinobacteria, e.g., *Streptomyces*
Spheroplasts	Gram-negative cell without peptidoglycan	Used as research tools	Similar forms found in nature are L-forms
Protoplasts	Gram-positive cell without peptidoglycan	Used as research tool	Sensitive to osmotic pressure changes