Prokaryotic Cell Structure and Function

What are the different shapes and arrangements that a prokaryote may have?
(Fig 3.1, 3.2)

Coccus, bacillus, vibrio, spirilla(rigid), spirochete (flexible), Pleomorphic

What is the "typical" size of a prokaryotic cell?
(Fig 3.3)
Exceptions: *Epulopiscium fishelsoni* (p. 45),
Thiomargarita namibiensis (Big bacteria and p.45),
"Nannobacteria" (Minimal Cell genome: PNAS Sep 1996, p 10004-10006)

Nannobacteria: Size of Nannobacteria: 0.03 μm (~ the size of a ribosome)
Theoretical minimum size of a cell: 0.14 μm
Theoretical minimum genome: ~ 315 X 10^3 base pairs;
250 genes (each gene ~1250 base pairs, ~400 amino acids)

Mycoplasmas: Smallest living prokaryotes
(~450 genes, ~ 600-800 kilobasepairs)

What comprises a prokaryotic cell?
What are the functions of the different structures found in a prokaryotic cell?
(Fig 3.4, Table 3.1)

Cell wall, periplasmic space, plasma membrane, cytoplasm, nucleoid region, ribosomes, inclusion bodies, flagella

Cytoplasmic matrix
Inclusion bodies
Ribosomes
Nucleoid

What are the characteristics of the Plasma membrane?

Semipermeable
Proteins and lipids. Amphipathic lipids, (fig 3.5 phospholipid);
Cholesterol and hopanoid (fig 3.6 and box 3.2)
Structure of the plasma membrane Fluid mosaic model (fig 3.7),
Archael lipids and membrane (figs 20.3, 20.4, 20.5)
Transport (Group translocation, active transport: Ch 5, p 100-104)

Read the following article:

Carbohydrate transporters of the bacterial phosphoenolpyruvate: sugar phosphotransferase systems (PTS) (2001) *FEBS* Letters vol 504 pp 104-111

PROKARYOTIC CELL WALL

Cell wall: function

Gram staining (fig 2.14)

Gram positive/Gram negative cell wall (fig 3.15)

Peptidoglycan (murein) subunit composition (fig 3.16, 3.17)

Composition of Archael cell wall (fig 20.1, Pseudomurein fig.20.2)

Peptidoglycan (PG) cross-links (fig 3.18)

Peptidoglycan (PG) structure (fig 3.19)

Gram positive cell wall (fig 3.21, 3.22)
- Teichoic acids

Gram negative cell wall (fig 3.23, 3.24)
- Outer membrane, periplasmic space, PG, Braun's lipoproteins, adhesion sites, porin protein
- Structure of Lipopolysaccharide (fig 3.25)

Mechanism of Gram staining (fig 2.14)

Cell wall and osmotic protection: (fig 3.26)
- Lysis, plasmolysis
- Action of lysozyme and penicillin

Synthesis of Peptidoglycan cell wall (figs 10.28, 10.29)
- Role of uridine diphosphate
- Role of bactoprenol
- Steps in PG synthesis
- Action of cycleserine, penicillin, vancomycin, bacitracin
- Role of autolysins
- Role of Penicillin binding proteins

Patterns of cell wall formation (fig 10.30)

Components external to the cell wall

Capsules
Slime layers
S-layers

Pili and Fimbriae
Sex pili: conjugation

Flagella and motility

Distribution of flagella (fig 3.31)

Flagellar ultrastructure (fig 3.33)

Flagellar synthesis/growth (fig 3.34)

Mechanism of flagellar movement (fig 3.35, 3.36)

Chemotaxis: figs 3.37, 3.38, and 3.39
Mechanism Will be covered with gene expression (Ch 12)

Bacterial endospores:

Location (fig 3.40)

Structure (fig 3.41)

Spore formation (fig 3.43)

Endospore germination (fig 3.44)

Characteristics Table from Brock