Independent Study Guide - Cell Structure (Chapter 3)

Prokaryotic cell structure (table 3.3; figure 3.23)

I. **Cytoplasmic membrane** (section 3.4; figure 3.24)
   a. Defines boundary of the cell
   b. Semi-permeable; excludes all but water, gases, and some small hydrophobic molecules
   c. Transport proteins function as selective gates (selectively permeable)
   d. Receptors provide a sensor system
   e. Phospholipid bilayer, embedded with proteins
   f. Fluid mosaic model
   g. Electron transport chain (figure 3.26)
      i. Series of proteins that eject protons from the cell, creating an electrochemical gradient
      ii. Proton motive force is used to fuel:
          1. Synthesis of ATP
          2. Rotation of flagella
          3. One form of transport

II. **Directed movement of molecules across the cytoplasmic membrane** (section 3.5)
   a. Transport systems
      i. Facilitated diffusion – no energy expended
      ii. Active transport - energy is expended
iii. Group translocation - chemically modifies a compound during transport

iv. Secretion - General secretory pathway

III. Bacterial cell wall (section 3.6) (table 3.5)
   a. Peptidoglycan – rigid molecule; unique to bacteria
      i. Provides rigidity to the cell (figure 3.25 shows osmosis, which can cause cell that lacks a wall to burst)

   b. Gram-positive cell wall structure
      i. Thick layer of peptidoglycan
      ii. Teichoic acids

   ii. Medical significance of peptidoglycan
      1. Target for selective toxicity; synthesis is targeted by certain antimicrobial medications
      2. Recognized by innate immune system
      3. Target of lysozyme

   Alternating subunits of NAG and NAM form glycan chain
   Glycan chains are connected to each other via peptide chains on the NAM molecules (figure 3.32)
c. Gram-negative cell wall structure
   i. Thin layer of peptidoglycan
   ii. Outer membrane
      1. Porins
   iii. Lipopolysaccharide
      1. additional membrane barrier
      2. porins permit passage
      3. lipopolysaccharide

d. Periplasm

e. Mycoplasma species lack a cell wall

f. Archaea - have a variety of cell wall types

IV. Capsules and slime layers (section 3.7)
   a. Capsules and slime layers (glycocalyx layer) – attachment
   b. Some capsules are involved in pathogenicity

V. Filamentous protein appendages (section 3.8)
   a. Flagella – motility
      i. Flagellin
      ii. Rotates like a propeller
      iii. Proton motive force is used for energy
      iv. Presence/arrangement can be used as an identifying marker
         1. Peritrichous
         2. Polar
   b. Chemotaxis - directed movement towards/away from a chemical
      i. Cell movement is due to a series “runs” and “tumbles”
      ii. Runs are longer when the cell is going in the right direction
   c. Pili – attachment
      i. Common pili (fimbriae)
      ii. Sex pili

VI. Internal structures (section 3.9)
   a. Chromosome - essential genetic information
   b. Plasmids - "Extra" genetic information
      i. Ability to use specific uncommon nutrients
      ii. Ability to destroy specific antibiotics
      iii. Ability to produce toxins or other virulence determinants
      iv. Replicate independently of the chromosome
      v. Can be transferred, spread or lost among population
   c. Ribosomes – protein synthesis
      i. 70S
         1. 30S and 50S subunits
         2. composed of proteins and ribosomal RNA
      ii. target for selective toxicity
      iii. 16S ribosomal RNA is used in determining relatedness

VII. Endospores (figure 3.46)
   a. Resistant to heat, drying, UV light, chemicals
   b. Made by relatively few types of bacteria
      i. Bacillus species
      ii. Clostridium species
   c. NOT a method of reproduction
Eukaryotic Cell Structures

I. Plasma membrane and transport (section 3.10, 3.11)
   a. Transport similar to that of prokaryotes, but...
   b. endocytosis (figure 3.49)
      i. pinocytosis
      ii. phagocytosis
   c. exocytosis

II. Protein structures within the cytoplasm (section 3.12)
   a. ribosomes - 80S
      i. 60S and 40S subunits
      ii. 18S RNA
   b. cytoskeleton (figure 3.50)
   c. flagella and cilia (figure 3.51)

III. Comparison of prokaryotic/eukaryotic cell structure/function - see table 3.7

Study Questions
1. Where is a cell's cytoplasmic membrane relative to the cell wall?
2. What is the role of the cytoplasmic membrane?
3. Describe the structure of the cytoplasmic membrane.
4. What is the fluid mosaic model?
5. Name two roles of proteins found in the cytoplasmic membrane.
6. How is facilitated diffusion different from active transport?
7. What is the difference between the major facilitator superfamily and ABC transport systems?
8. Describe the structure of peptidoglycan.
9. What will happen if you weaken the structure of peptidoglycan?
10. What effect does penicillin have on peptidoglycan?
11. What effect does lysozyme have on peptidoglycan?
12. How is the Gram-negative cell wall different from the Gram-positive cell wall?
13. Where is LPS found?
14. What is the medical significance of LPS?
15. Which cell types have periplasm?
16. What are plasmids?
17. Describe some characteristics that are commonly encoded on plasmids.
18. Describe the general mechanism of chemotaxis.
19. What is an endospore?
20. Name two genera that produce endospores.
21. Use the terms sporulate and germinate in describing the "life-cycle" of a spore-forming bacterium.
22. What traits are used to classify prokaryotes?
23. How is pinocytosis different from phagocytosis?
24. How do prokaryotic ribosomes differ from those of eukaryotic cells?