Chapter 12 Drugs, Microbes, Host
The Elements of Chemotherapy

Building Your Knowledge

1) In 1900, what percentage of all children in the United States died of infectious disease before age 5?

2) Explain the concept of selective toxicity.

3) Design the perfect antibiotic. Please consider ease of administration, target microbe, distribution throughout the body (if necessary for the targeted microbe) length of activity, host toxicity and potential for the development of antibiotic resistance to the drug.

Does the perfect antibiotic actually exist? Why or why not?

4) Compare and contrast narrow and broad spectrum antibiotics.

If you know what the causative agent of a disease is, which would you want to use?

If a patient is septic (seriously ill) with an unknown organism, which would you recommend?

5) Where do most antibiotics originate, in the lab or from nature?

Why is this the case?

6) Which drugs are most selectively toxic to bacterial cells (in general)?

Which are the least selectively toxic?

Why?

7) Are drugs that target the cell wall more or less selectively toxic than those that target the plasma membrane? Why?

8) Are most penicillin and penicillin-like antibiotics more effective against actively growing cells, or old, dormant cells? Why?

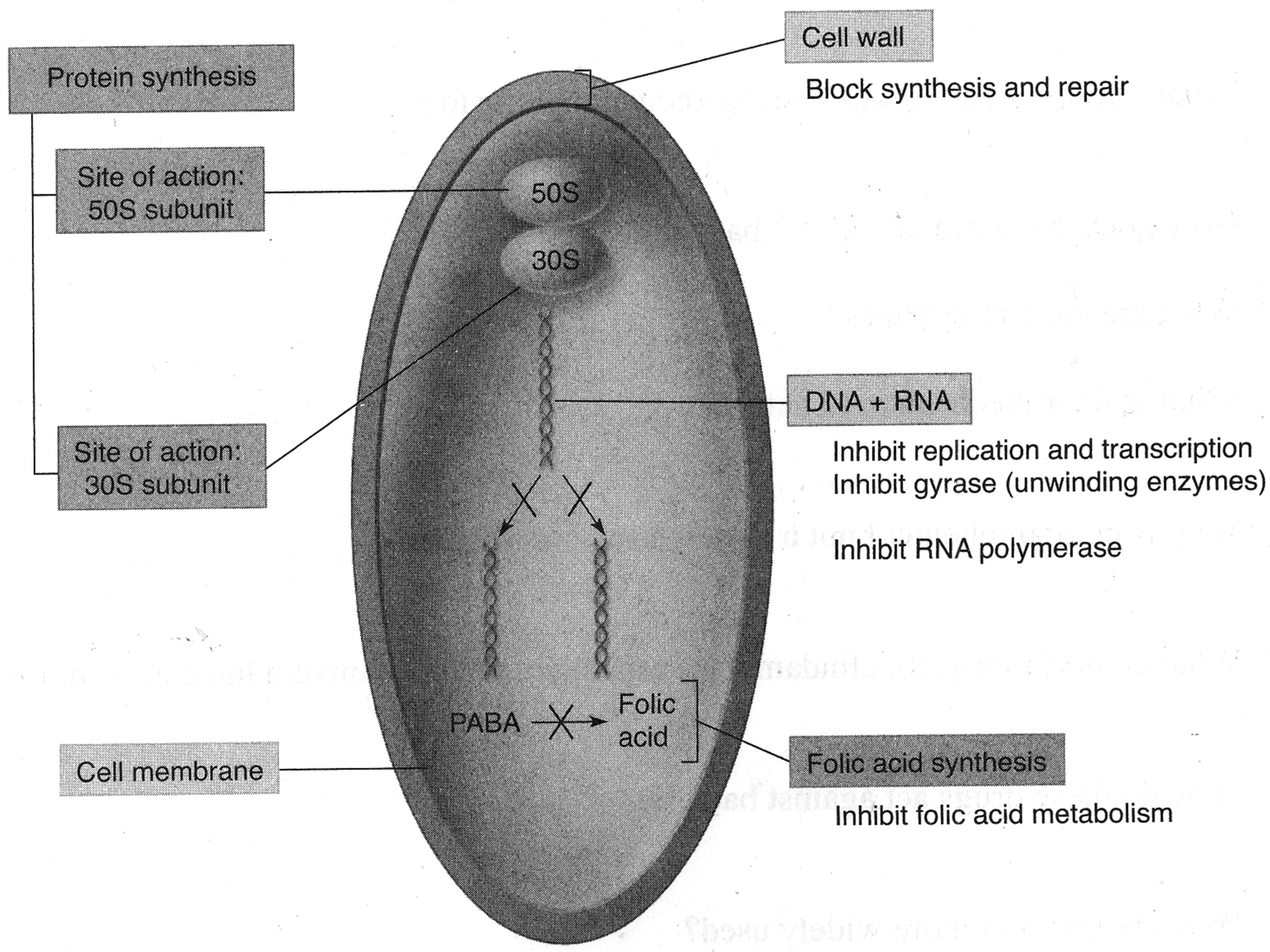
Are they more effective against Gram-positive or Gram-negative cells? Why?

9) What is competitive inhibition and what does it have to do with sulfonamide activity against bacterial cells?

10) Why don't sulfonamides damage host cells as much as they do bacterial cells?

11) Are the membrane-disrupting drugs generally used topically (on body surfaces) or administered internally?

12) Fill in the diagram with several example antibiotics that target each of the following structures or processes in a bacterial cell.



13) How is most penicillin produced?

14) List 3 members of the penicillin family.

a. _____

b. _____

c. _____

15) What is the advantage of using semi-synthetic penicillins, like ampicillin or nafcillin?

16) Why add clavulanic acid to penicillins (e.g., Augmentin)?

17) What are the two major problems that limit the usefulness of the penicillin antimicrobials?

18) What are cephalosporins?

How are they generally administered? Why?

What are the "generations" of cephalosporins based on?

19) What group of antibiotics does aztreonam belong to?

How does this antibiotic affect bacterial cells?

20) What are the tetracyclines?

What is their mechanism of action?

21) Why is chloramphenicol not a widely used antimicrobial?

22) What do erythromycin, clindamycin, vancomycin and rifamycin have in common?

How do these drugs act against bacteria?

Why are they not more widely used?

23) What are the bacillus antibiotics?

What is their mechanism of action?

Why are they generally not given systemically?

24) Describe the new classes of antibiotics recently discovered and approved by the FDA?

25) Where do sulfamides come from?

How does this origin differ from that of penicillins and cephalosporins?

26) What are fosofmycin and synercid?

Why are they not widely used?

27) Why are scientists hopeful that resistance to the oxazolidinones will be slow to develop?

28) Why did the CDC change the recommendation from ciprofloxacin to doxycycline for the treatment of anthrax in 2001?

29) Why are anti-fungals generally more toxic to human tissues than antibacterial agents?

30) List 4 separate antifungals and the conditions they treat.

Antifungal agent	**Condition(s) treated**

31) Why are polyenes effective against fungal cells, but not bacterial cells?

32) Why are there few effective anti-parasite drugs?

What drugs are used to treat malaria?

What drugs are used to treat roundworm?

33) Why is selective toxicity so difficult to achieve in anti-viral therapies?

34) Why are viral diseases like measles and mumps fairly rare in the U.S.?

35) What are 3 basic mechanisms of action of anti-viral agents?

a. _____

b. _____

c. _____

36) Why is the fact HIV is a retrovirus significant when designing anti-viral therapies?

37) How does chromosomal drug resistance originate? Does this type of resistance spread in a population?

38) What is the difference between intrinsic and extrinsic drug resistance? Which is of more concern?

39) What are R factors? Do these spread through a bacterial population?

40) Describe 4 distinct ways bacteria may become resistant to antibiotics they were once sensitive to.

a. _____

b. _____

c. _____

d. _____

41) What are beta-lactamases and what antimicrobial drugs do they confer resistance to?

42) Do pumps generally confer resistance to 1 type of antimicrobial or many? Why?

How do bacteria become resistant to rifampin or streptomycin?

43) How do bacteria become resistant to sulfonamide?

44) Does exposure to an antibiotic increase or decrease the percentage of resistant cells in a population? Explain.

45) Why does combining drug therapies limit the spread of drug resistance?

46) What are prebiotics, probiotics and lantibiotics?

How does each prevent disease?

47) There are 3 major categories of antibiotic side-effects. Name them.

a. _____

b. _____

c. _____

48) Why are the liver and kidneys often damaged by antibiotics?

49) Why are tetracyclines not given to pregnant women or young children?

50) How may antibiotics cause diarrhea? (list 2 ways)

51) If a person takes penicillin once and does not have an allergic reaction to it, does that mean they are not allergic? Explain.

52) What 3 factors do doctors generally consider when choosing antimicrobial therapies?

a. _____

b. _____

c. _____

53) If the causative agent of a disease is unknown, do doctors generally give narrow-spectrum or broad-spectrum antibiotics? Why?

54) What 2 methods are commonly used to tell which antibiotics are most and least effective against a given pathogen?

a. _____

b. _____

Organizing Your Knowledge

Antimicrobial Agent	Mechanism of Action	Commonly Used to Treat
penicillin		
sulfonamide		
chloroquine		
gentamicin		
polymyxins		
nystatin		
rifampicin		
mebendazole		
metronidazole		
ribavirin		
AZT		
amphotericin B		
chloramphenicol		
tetracycline		
vancomycin		

Antimicrobial Drug	Group	Mechanism of Action	Mechanism of Resistance
vancomycin			
tetracycline			
sulfonamide			
rifampicin			
ribavirin			
polymyxins			
penicillin			
nystatin			
metronidazole			
mebendazole			
gentamicin			
chloroquine			
chloramphenicol			
AZT			
amphotericin B			

Practicing Your Knowledge

1. Which of the following is NOT a common target for antibacterial drugs?
   a. cell wall synthesis
   b. nucleic acid structure
   c. protein synthesis
   d. bacterial cell nucleus

2. All of the following antibiotics target procaryotic ribosomes EXCEPT___.
   a. streptomycin
   b. cephalexin
   c. gentamicin
   d. erythromycin

3. Prophylatic antibiotics are given ___
   a. after a person is infected with a virus
   b. to people at increased risk of viral infection
   c. after a person is infected with bacteria
   d. to people at increased risk of bacterial infection

4. An antibiotic with a high therapeutic index (TI) ___.
   a. is a less risky choice than one with a low TI
   b. is generally very toxic
   c. has a high MIC and low toxic dose

5. Which of the following is NOT a characteristic of an ideal antimicrobial drug?

a. not excessive in cost
b. microbistatic, not microbicidal
c. selectively toxic to microbe
d. easy to deliver to site of infection

6. Anti-viral drugs are ___.

a. commonly used to treat head colds.
b. hard to design because the viruses are intracellular parasites
c. generally safer to use than anti-bacterial drugs
d. not subject to anti-viral resistance

7. A MDR pump will confer resistance to ___.

a. a single class of antibiotics (e.g., the penicillins)
b. many different antibiotics from different groups
c. only gram-negative bacteria
d. only gram-positive bacteria

8. _____ is an example of a synthetic antimicrobic drug.

a. polymyxin
b. rifamycin
c. tetracyline
d. sulfonamide

9. When the cause of a disease is unknown, but suspected to be bacterial, a useful course of action would be _____.

a. to start anti-viral therapy
b. to disinfect the patient
c. to start a broad-spectrum antibiotic
d. to start a narrow-spectrum antibiotic

10. Two ways to determine an organism's resistance to antimicrobial drugs are ___ methods.

a. MIC and therapeutic index
b. Kirby-Bauer and therapeutic index
c. MIC and Kirby-Bauer
d. Kirby-Bauer and beta-lactamase

11. An organism becomes resistant to penicillin when it___.

a. produces thymidine kinase
b. acquires its folic acid from the enviroment
c. produces beta lactamase
d. loses its DNA

12. Clavulanic acid is added to the penicillin group of drugs because ___.

a. it inhibits beta-lactamase enzymes
b. it works against Gram-positive bacteria, penicillins don't
c. it lengthens the shelf-life of penicillins
d. it disrupts bacterial cell membranes

13. The major drawbacks to penicillin use are _____.

a. development of resistance and host cell toxicity
b. synergistic effects with anti-viral therapies
c. development of resistance and host allergic responses
d. purine degradation and host allergic responses

14. Antibiotics that disrupt microbial plasma membranes ___.

a. are more toxic than those that disrupt microbial cell walls
b. are commonly given systemically
c. are not toxic to host cells
d. generally have a high therapeutic index

15. _____ is commonly used to treat fungal infections.

a. Tetracycline
b. Vancomycin
c. Amphotericin B
d. Quinine