1. (1 pt) Who was the first person to observe bacteria using a microscope?
   a. Lister  
   b. van Leeuwenhoek  
   c. Pasteur  
   d. Koch

2. (2 pts) Which **two** of the following contribute to the opportunistic and infectious nature of bacteria?
   a. flagella  
   b. ability to persist in unfavorable environments  
   c. selectively permeable membranes  
   d. fast growth  
   e. ability to sense chemical gradients  
   f. peptidoglycan

3. (1 pt) Capsules, sheaths, and slime layers generally aid with
   a. nutrient transport  
   b. cell attachment  
   c. chemotaxis  
   d. heat resistance

4. (1 pt) Penicillin controls bacterial growth by:
   a. preventing synthesis of the lipopolysaccharide layer  
   b. inhibiting protein synthesis  
   c. preventing cross-link formation in peptidoglycan  
   d. preventing generation of the proton motive force

5. (1 pt) The endosymbiont theory refers to the idea that:
   a. human intestinal function depends upon populations of bacteria in the intestinal tract  
   b. the plant chloroplast evolved from a symbiosis between a photosynthetic prokaryote and a eukaryotic organism  
   c. plasmids that encode for “non-essential” functions in bacteria can readily be transmitted between cells  
   d. termites depend upon a bacterial symbiosis to digest cellulose

6. (1 pt) Proponents of spontaneous generation believed that bacteria originated from:
   a. the air  
   b. chemical breakdown of matter  
   c. pre-existing cells  
   d. maggots

7. (1 pt) In response to experiments showing that spontaneous generation did not occur in broth that was sealed and sterilized, proponents of spontaneous generation argued that __________ was/were necessary for spontaneous generation to occur.
   a. bacteria  
   b. air  
   c. cells  
   d. disease

8. (1 pt) How did Louis Pasteur counter this argument and disprove spontaneous generation?
   a. He sealed and sterilized his experimental flasks  
   b. He cultured anaerobic organisms  
   c. He allowed free exchange of air in his sterilized flasks  
   d. He isolated bacteria from diseased organisms
9. (2 pts) Even after the discovery of bacteria, what **two** things hindered the realization that bacteria caused disease?
   a. belief in spontaneous generation       b. lack of sterile technique and solid media
   c. limitations of culturing techniques  d. lack of understanding of contagion
   e. endospore formation                   f. lack of understanding of enrichment technique

10. (1 pt) When the plague devastated the population of Europe in the Middle Ages, why did people catch the disease even if they didn't come into contact with infected people or dead bodies?
   a. The infectious organism washed out of bodies into the public water supply
   b. The infectious organism produced endospores that persisted in houses and public places
   c. The infectious organism persisted on nearly any surface in a state of non-growth activity and was readily picked up by unsuspecting people
   d. The infectious organism was transmitted from bodies to rats, then to fleas, and from fleas to people

11. (8 pts) What are Koch's Postulates
   i. Bacteria are present in a diseased animal but not in healthy animals
   ii. Bacteria can be isolated from the diseased animal and grown in pure culture
   iii. Inoculation of another healthy animal with cultured bacteria causes the same disease
   iv. The same bacteria can again be isolated from the inoculated, diseased, animal.

12. (1 pt) The use of sterile techniques and agar media enabled early microbiologists to:
   a. study pure cultures                  b. demonstrate the nature of infectious disease
   c. study mixed cultures                d. study agar-metabolizing cultures
   e. disprove spontaneous generation

13. (1 pt) In a gram-negative organism, how do small molecules move into the periplasm from outside of the cell?
   a. they diffuse freely through the peptidoglycan layer    b. they pass through porins
   c. they are transported by lipid A                      d. via binary fission

14. (1 pt) Recently (the last 30 years), the use of evolutionary chronometers has allowed biologists to:
   a. classify prokaryotes according to morphology
   b. infer evolutionary relationships among prokaryotes
   c. study the metabolic pathways of a diversity of prokaryotes
   d. study microorganisms in pure culture

15. (1 pt) In chemotaxis, a prokaryote cell eventually gets where it wants to by:
   a. steering it's movement towards a desired substance
   b. tumbling in random directions and eventually reaching a desired substance by chance
   c. tumbling in directions that are determined by a concentration gradient of a desired substance
   d. tumbling in random directions and tumbling only when concentrations of desired substance are not increasing.
16. (1 pt) The size of prokaryote cells relative to water molecules:
   a. increases rates of prokaryote growth
   b. means that water must be transported through the prokaryote cell membrane
   c. necessitates expenditure of considerable energy by prokaryotes
   d. determines the directions in which prokaryotes move in the random walk

17. (1 pt) Peptidoglycan:
   a. consists of lipids and proteins
   b. regulates entry and exit of the cell via transport proteins
   c. consists of repeating units of N-acetyl glucosamine and N-acetyl muramic acid
   d. is found only in gram positive bacteria

18. (1 pt) Who was one of the first people to suspect bacteria as the cause of infection and use
   an antiseptic to prevent infection?
   a. Lister
   b. van Leeuwenhoek
   c. Pasteur
   d. Koch

19. (1 pt) What structure(s) are active in the uptake of nutrients?
   a. porins
   b. transport proteins
   c. lipid A
   d. peptidoglycan

20. (6 pts) Fill in the following table of features that distinguish Archaea from Bacteria (one
    feature per box)

<table>
<thead>
<tr>
<th>Cell Structure</th>
<th>Archaea</th>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membranes</td>
<td>Can be a lipid monolayer</td>
<td>Always a lipid bilayer</td>
</tr>
<tr>
<td></td>
<td>Isoprenoid side chains</td>
<td>Fatty acid side chains</td>
</tr>
<tr>
<td></td>
<td>Ether link to side chains</td>
<td>Ester link to side chains</td>
</tr>
<tr>
<td>Cell Wall</td>
<td>Psuedopeptidoglycan and others</td>
<td>Peptidoglycan</td>
</tr>
</tbody>
</table>

21. (1 pt) Cells must ___________________________ to take up sufficient nutrients
   a. expend energy
   b. utilize diffusion processes
   c. grow rapidly
   d. have a lipopolysaccharide layer

22. (1 pt) Reproduction via binary fission leads to what type of growth under optimal
    conditions:
   a. linear
   b. mixed
   c. exponential
   d. uptake-limited

23. (2 pts) Which two genera are capable of producing endospores?
   a. *Streptomyces*
   b. *Clostridium*
   c. *Escherichia*
   d. *Bacillus*
   e. *Yersinia*
   f. *Staphylococcus*
24. (6 pts) Match each of the following descriptions with the appropriate organism/group of organisms.

_A___ Bacillus thuringiensis   a.  produces parasporal bodies
_C___ Streptomyces            b.  invades lymph nodes or lungs
_B___ Yersinia pestis         c.  produces conidiospores
_D___ Mycoplasma pneumoniae  d.  cannot synthesize own amino acids

25. (4 pts) Identify the following structures for the cell to the right, which has recently depleted all available nutrients in its environment and is entering a dormant state:

A. ___ endospore
B. ___ spore coat, or exosporium
C. ___ cortex
D. ___ core

26. (2 pts) In the glyoxylate bypass, what 2-C compound is added to glyoxylate in order to replenish an important precursor metabolite? ____Acetyl CoA___

What precursor is replenished? ___OAA___________

27. (1 pt) What precursor metabolite is essential for the production of fatty acids?
__ Acetyl CoA ______

28. (1 pt) What is one precursor metabolite that is used for amino acid synthesis, including synthesis of amino acids that are subsequently used for nucleic acid synthesis?
___OAA, alpha-ketoglutarate_______________
29. (7 pts) Identify each of the labeled structures in the above diagram

A. lipid A
B. porin
C. N-acetyl glucosamine (NAG)
D. N-acetyl muramic acid (NAM)
E. glycerol
F. fatty acids
G. transport protein

30. (1 pt) Which of the above structures can cause toxic effects in a host (such as you)?  **A**

31. (2 pts) Which of the above structures is most hydrophobic?  **F**
   is hydrophilic?  **E**

32. (1 pt) A cell with the above envelope structure would stain gram ___ negative.

33. (1 pt) The whole structure composed of E, F, and G:
   a. regulates entry to and exit from the cell
   b. maintains the cell's structure
   c. is highly resistant to osmotic pressure
   d. varies in molecular composition among groups of Bacteria
Carbon sources:
34. carbohydrates
35. proteins
36. organic acids, many others
37. fatty acids
38. sugars
39. amino acids
40. nucleic acids
41. lipids
42. peptidoglycan
43. proteins
44. DNA
45. Ribosomes
46. envelope
47. RNA

48. (1 pt) Cell constituents (nucleic acids, proteins, lipids) are made in proportion to one another in the ____________ phase of growth in batch culture
a. death  b. stationary  c. exponential  d. lag

49. (1 pt) The pattern of cell numbers over time in the stationary phase is most likely due to:
a. death of all cells  b. concurrent growth and death of cells
c. exponential growth of cells  d. constant inputs of fresh nutrients to the system

50. (1 pt) Production of antibiotics is most likely to take place in the ____________ phase
a. death  b. stationary  c. exponential  d. lag

51. (1 pt) In batch culture one reason the exponential phase comes to an end is:
a. organisms run out of space  b. uptake enzymes become saturated
c. $K_s$ is exceeded  d. nutrients are used up
52. (8 pts) Draw and label the growth curve in batch culture.
- Be sure to label both axes, as well as each phase of the growth curve.

53. (10 pts) Explain the functions of the cell membrane and wall and how these functions are essential to the growth and persistence of prokaryotes. Be sure to explain the necessity of active processes in the cell membrane, and how this relates to the necessity of having a cell wall.

The cell membrane functions to regulate entry to and exit from the cell (2 pts). It is described as selectively permeable, meaning that the membrane functions to select what can enter a cell (1 pt). This is possible because very little -- water and only a few other very small molecules -- can diffuse through the lipid bilayer (1 pt). Any other transport across the membrane requires assistance by transport proteins (1 pt). Selective permeability also means that the cell can create charge gradients across the membrane, essential for energy transformations, by actively pumping protons across the membrane (1 pt).

Bacterial cells often exist in relatively dilute liquids (1 pt). Therefore, they must rely on active transport processes to concentrate essential nutrients inside the cell (1 pt). This can result in considerable osmotic pressure within the cell, as the tendency of water is to move to a higher concentration of solutes (ie, inside the cell) (1 pt). The cell wall provides the necessary structure to resist this osmotic pressure and prevent cell lysis (1 pt).