Bacteriology Exam 1 Name_____
1/31/06

1. (3 pts) What are 3 differences between prokaryotes and eukaryotes? Explain each difference.
i. size: prokaryotes are typically from 1 to 10 μm in diameter, whereas eukaryotes are typically 10 to 100 μm in diameter.

ii. cellular organization: prokaryotes have no membrane-bound organelles, whereas eukaryotes have membrane-bound organelles, including a nucleus.

iii. genetic material: prokaryotes generally have a single, circular chromosome, and often possess circular plasmids which carry accessory genetic material. Eukaryotes generally have multiple, linear chromosomes.

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) Who was the first person to observe bacteria using a microscope?
a. Lister **b. van Leeuvenhoek** c. Pastuer d. Koch

8. (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

9. (1 pt) How did Louis Pasteur counter the argument that air was necessary for 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

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. (4 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. (2 pts) **Two** limitations of culture technique are:
a. inability to study organisms in their native environment
b. inability to manipulate study conditions
c. inability to prevent contamination
d. inability to quantify microbial growth
e. limited ability to verify purity of cultures
f. limited ability to infer evolutionary relationships among all of the prokaryotes

14. (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

15. (1 pt) Which transport system utilizes a periplasmic binding protein?
a. Simple transport b. Group transport c**. ABC transport**

16. (3 pts) Match each membrane transport system with the most appropriate form of energy

2	a. Simple transport	1. phosphorylation
1	b. Group transport	2. proton motive force
3	c. ABC transport	3. ATP

17. (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.

18. (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

19. (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

20. (7 pts) a. Archaea b. Bacteria c. both Archaea and Bacteria

In which of the above groups of prokaryotes do we find:

c	lipid bilayers in the cell membrane?
a	lipid monolayers in the cell membrane?
a	cell walls consisting of protein layers?
b	lipopolysaccharide layers?
b	organisms succeptible to the antibiotic penicillin?
c	transport proteins in the cell membrane?
b	ester links between the fatty acids and glycerol backbone?

21. (1 pt) What effect does lysozyme have on a cell wall?
a. inhibits cross-linking **b. breaks beta 1-4 linkages**
c. breaks peptide bonds d. prevents entry of N-acetyl glucosamine

22. (1 pt) Cells must _____ to take up sufficient nutrients
a. expend energy b. utilize diffusion processes
c. grow rapidly d. have a lipopolysaccharide layer

23. (1 pt) What structure(s) are active in the uptake of nutrients?
a. porins **b. transport proteins** c. lipid A d. peptidoglycan

24. (1 pt) Reproduction via binary fission leads to what type of growth under optimal conditions:
a. linear b. mixed **c. exponential** d. uptake-limited

25. (2 pts) Which **two** genera are capable of producing endospores?

a. *Streptomyces* **b. *Clostridium***

c. *Escherichia* **d. *Bacillus***

e. *Yersinia* f. *Staphylococcus*

26. (5 pts) Match each of the following descriptions with the appropriate organism/group of organisms.

__c___ *Escherichia coli*
__e___ *Streptomyces*
__b___ *Yersinia pestis*
__d___ *Mycoplasma pneumoniae*
__a___ *Bacillus thuringiensis*

a. produces parasporal bodies
b. invades lymph nodes or lungs
c. has highest μmax
d. cannot synthesize own amino acids
e. produces conidiospores

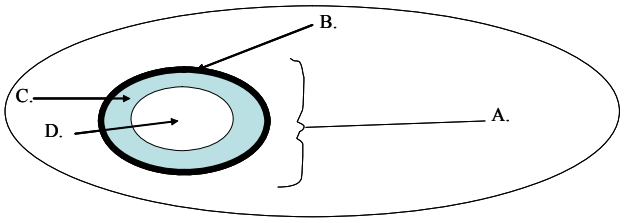
27. (4 pts) Identify the following structures for the cell to the right, which has recently depleted all available nutrients in its environment:

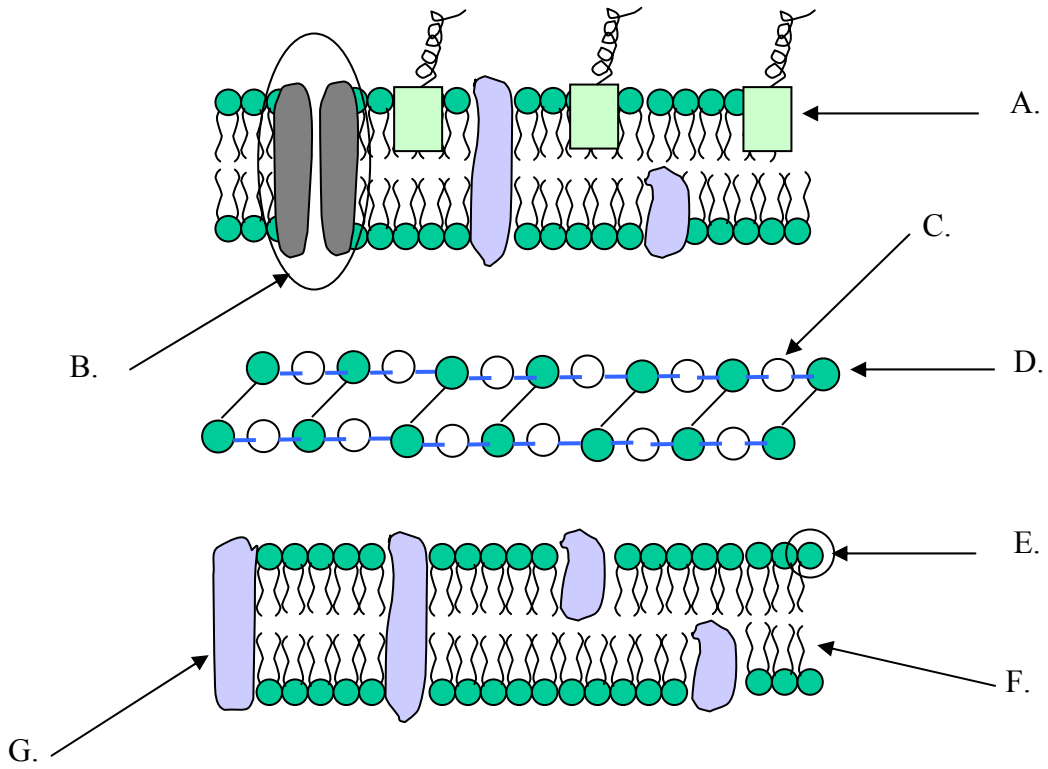
A. endospore

B. spore coat, or exosporium

C. cortical layers

D. core





28. (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**

29. (3 pts) Which of the above structures:

a. can cause toxic effects in a host (such as you)? A

b. is most hydrophobic? F

c. is hydrophilic? A

30. (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

31. (1 pt) A cell with the above envelope structure would stain gram negative.

32. (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? ____Oxaloacetate_____

33. (1 pt) Write an anaplerotic reaction that produces OAA from pyruvate:

Pyruvate + CO2 → OAA

34. (10 pts) Indicate (with arrows) which of the precursors below are used in synthesis of which building blocks, and which building blocks are used in synthesis of each cellular component. Be sure to indicate **all** possibilities.

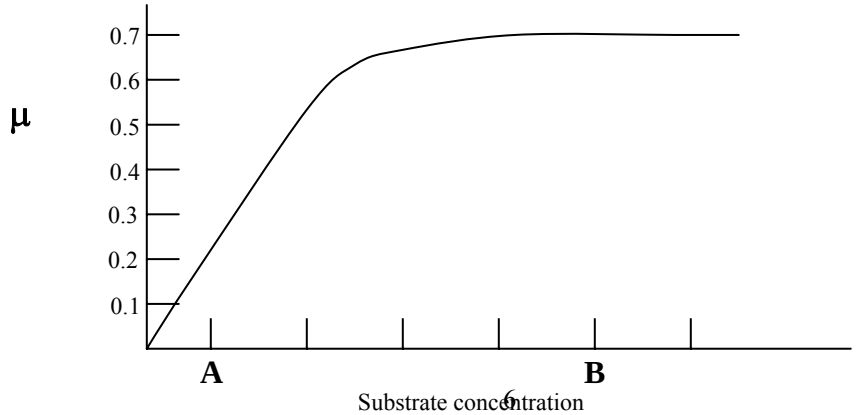
PEP		DNA
	fatty acids	
OAA		RNA
	nucleic acids	
Acetyl CoA		lipid bilayer
	sugars	
α-ketoglutarate		proteins
	amino acids	
Pyruvate		ribosomes

PEP → sugars, nucleic acids (via sugars), amino acids
Pyruvate → sugars, nucleic acids (via sugars), amino acids
OAA → amino acids, nucleic acids (via AA)
α-ketoglutarate → amino acids, nucleic acids (via AA)
Acetyl CoA → fatty acids

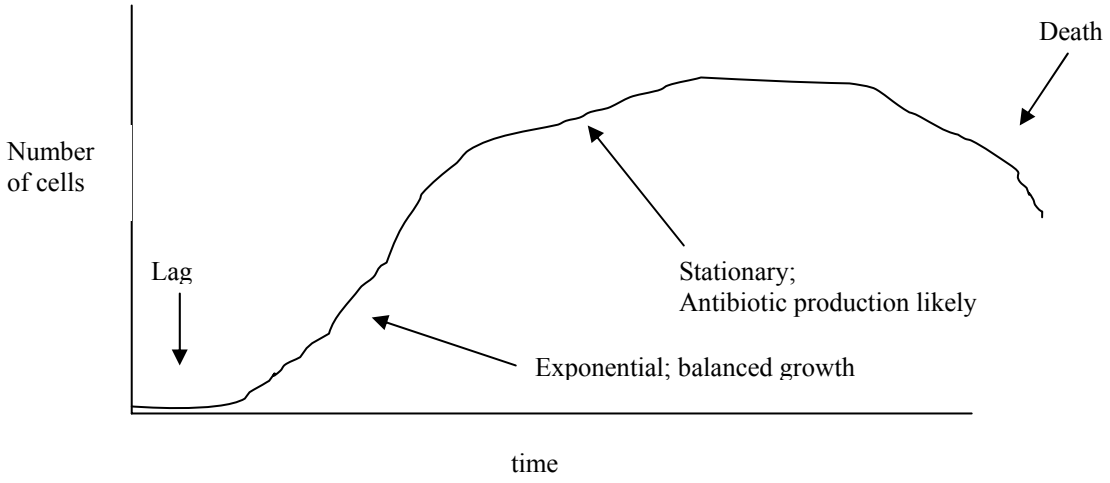
fatty acids → lipid bilayer
nucleic acids → DNA, RNA, ribosomes (via RNA)
sugars →
amino acids → proteins, ribosomes

35. (2 pts) What is μmax on the following graph? __0.7_____

36. (4 pts) Is substrate concentration limiting to growth rates at point A?___yes_____
At point B?__no_



37. (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.
- Indicate where the production of antibiotics would be most likely
- Indicate where balanced growth is most likely



38. (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. It is described as selectively permeable, meaning that the membrane functions to select what can enter a cell. This is possible because very little -- water and only a few other very small molecules -- can diffuse through the lipid bilayer. Any other transport across the membrane requires assistance by transport proteins. 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.

Bacterial cells often exist in relatively dilute liquids. Therefore, they must rely on active transport processes to concentrate essential nutrients inside the cell. 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). The cell wall provides the necessary structure to resist this osmotic pressure and prevent cell lysis.