Biology 205 Microbiology, Midterm I Learning Objectives

Chapter One Learning Objectives

1. What types of "organisms" are studied in microbiology? Which of these are considered non-living?
2. How are scientific names correctly written?
3. Six specific microbiological breakthroughs from the "Golden Age of Microbiology" were discussed in class. For each, you should commit to memory the sequence of events, researcher and contribution to the field of microbiology.
4. Discuss the four major experiments explained in class that led to the refutation of Spontaneous Generation and the acceptance of the Theory of Biogenesis. For each leading up to the work of Louis Pasteur, why did the scientific community as a whole remain unconvinced of the Theory of Biogenesis.
5. Understand how microorganisms can play both a beneficial and a detrimental role in their interactions with people. Include normal flora in your discussion.

Chapter Three Learning Objectives

6. Define resolution. How does wavelength relate to resolving power?
7. Understand the mechanism by which light microscopes, scanning electron microscopes, and transmission electron microscope allow you to visualize an image. Commit to memory the resolving power of each.
8. Explain the use of positive/basic stains and negative/acidic stains. How does each work and what part of the cell does each stain?
9. Define differential staining. For each technique discussed in class, understand the mechanism of action and what "positive" and "negative" look like.

Chapter Four Learning Objectives

10. Identify and correctly name the five morphological types, and arrangements of bacterial cells discussed in lecture.
11. Understand the location and function of each of the following prokaryotic structures: glycocalyx (capsule & slime layer), flagella, fimbriae, pili, cell wall, cell membrane, nucleoid region and inclusions.
12. Identify and correctly name the four flagellar arrangements.
13. Discuss the basic mechanism for bacterial motility. Include in your discussion how bacterial flagella differ from eukaryotic flagella in structure and movement and how different bacterial arrangements will affect how bacterial cells move. Include endoflagella/axial filaments in your discussion.
14. Discuss positive and negative chemotaxis and phototaxis. How do bacterial cells respond to attractants and repellants?
15. Why is the cell wall a necessary component of most bacterial cells? How is the cell wall of a bacterium different from plants, fungi, Archaea, and Mycoplasmas?
16. Understand the chemical make-up of Gram positive, Gram negative and Acid Fast cell walls.
17. What are the major structural differences between bacterial and archaeal cell membranes?
18. Provide the name and function of each of the bacterial inclusions discussed in lecture.
19. How does a nucleoid region differ from a nucleus? How is it similar?
20. Discuss the process of sporulation and germination. Why are spores useful? Can all bacteria produce spores?

Chapter Five Learning Objectives

21. Define oxidation and reduction. Why are these always discussed together as redox reactions.
22. Discuss redox reactions in biological systems.
23. Identify the redox partners in aerobic and anaerobic respiration and oxygenic and anoxygenic photosynthesis.
24. How is ATP generated in both substrate level and oxidative phosphorylation?
25. Why is it so important that the electron transport chain is housed in a lipid bilayer membrane? Why is a terminal electron acceptor so important?
26. What happens in a microorganism if the terminal electron acceptor of the ETC is not available? What molecules build up? What is done with these molecules?
27. Discuss the major differences between respiration and fermentation. What are the four basic kinds of fermentation?
28. How is ATP generated in chemosynthesis, photosynthesis and respiration? How is the process different for each and how is it the same?
29. Discuss the redox partners of sulfur and iron oxidizing bacteria.
30. How do non-cyclic and cyclic photosynthesis differ? How does each produce ATP and NADPH/NADH, what are they used for?

31. How is carbon fixed during chemosynthesis and photosynthesis? How are the processes similar and how are they different?
32. How do amphibolism, catabolism and anabolism relate to growth and repair in cells?

Chapter Six Learning Objectives

33. How do most bacterial cells reproduce? Why do bacterial cells have tremendous biotic potential?
34. Discuss what is happening to a bacterial culture during the four phases of population growth. Are they growing, dividing, what is driving the change in population number?
35. Categorize, discuss the pros and cons and understand the mechanism of action for each of the following methods of counting the number of bacterial cells in culture: serial dilution and spread plating, microscopic counts, MPN, and spectrophotometry.
36. How do temperature, osmotic pressure, pH, and oxygen changes affect the growth of a bacterial culture? How are organisms classified according to their needs in regard to these physical aspects of the environment? What adaptations might various bacterial species have in order to live in less than desirable environments?
37. What do the terms "facultative" and "tolerant" mean with respect to the physical aspects of the environment discussed above?
38. Six chemical growth requirements were discussed in lecture. What are these used for in the bacterial cell? How does the availability of these affect the growth of a bacterial culture?
39. How are differential and selective media useful in isolating, identifying and enriching for particular bacterial species?
40. How do complex and chemically defined media differ? When is each useful for the routine culture of bacterial cultures?

Chapter Seven Learning Objectives

41. Define sterilization, commercial sterilization, disinfection, antisepsis, degerming and sanitization. Understand what is meant by
    "-stat," "-lytic" and "-cide".
42. How do the following affect the effectivity of a given microbial control agent: microbial load, exposure length, microbial characteristics, moisture, temperature, organic matter and vegetations/biofilms?
43. How is a biofilm produced? How are the microbes within it so protected from the environment?
44. Why is moist heat better than dry heat at killing microbes?
45. Define thermal death point, thermal death time, and decimal reduction time.
46. Under what circumstances is filtration a useful method of controlling microbial growth?
47. How do ionizing and non-ionizing radiation control microbial growth?
48. What experimental method discussed in class is useful to determine the bactericidal properties of a given chemical? Which would you use if you were only concerned with the bacteriostatic properties?
49. How would you rate the various kinds of microorganisms in terms of their resistance to the chemical control of microbial growth?

Chapter Eight Learning Objectives

50. What did the work of Griffith, Avery, and Hershey & Chase contribute to the field of genetics?
51. How is the bacterial chromosome different from the eukaryotic chromosome? What other molecule contains useful genetic information for prokaryotes? Compare and contrast DNA replication in eukaryotes vs. prokaryotes.
52. Why does the replication of every DNA molecule start with a short segment of RNA?
53. Define: vertical gene transfer, horizontal gene transfer, DNA replication, gene expression, transcription, translation, conjugation, transduction and transformation.
54. How is gene expression in prokaryotes different from eukaryotes, both in the timing of transcription & translation and in how transcription is regulated?
55. How do RecA proteins and transposons enable novel DNA to be integrated and used in a recipient cell? Discuss this for both transformation and transduction.
56. Define F factor, F^+ cell, F^- cell and Hfr cell. Understand what happens when F^+ , F^- & Hfr cells interact during conjugation.
57. Describe the mechanisms of inducible and repressible operons. Include the role of promoters, operators, effectors, inducers, repressors and co-repressors in your answer.
58. Discuss the levels of bacterial control of gene expression, paying particular attention to post-translational and transcriptional control, as discussed in lecture.
59. What is quorum sensing? How does it relate to gene expression, particularly as relates to sporulation, biofilm formation, competence and virulence genes.

60. Define auxotroph. How does the term auxotroph relate to mutant selection?
61. What is the Ames test? How and why does it result in positive mutant selection?

Chapter Nine Learning Objectives

62. Define biotechnology & recombinant DNA technology. What applications were discussed in lecture which utilize this technology?
63. Discuss how recombinant DNA molecules are made using restriction enzymes. What are the steps used in making these recombinant molecules?
64. Define vector. How do both plasmids & viruses play a role in the expression of recombinant DNA molecules?
65. There are 4 essential regions on a plasmid vector. What are they, and what does each do to propagate and identify *in vitro* transformed cells?
66. Describe the process of PCR. How is PCR used to produce an RFLP in order to identify a microbial pathogen?