MLAB 1235 Immunology/Serology
Course Objectives and Course Outline
Fall 2003

I. Nature of the Immune System

1. Define “immunology” and “immunity”.
2. Describe the process and purpose of vaccination.
3. Define “attenuated” as it relates to vaccine.
4. Describe how cellular immunity differs from humoral immunity.
5. Define “serology”.

II. Natural (nonspecific, Innate) Immunity

6. Describe the non-specific pathway and 4 defense mechanisms involved.
7. Describe the following external defense mechanisms and list examples of each: physical barriers, physiological factors and factors which modify external defense mechanisms.
8. List the 4 classic signs of the inflammatory response.
9. Describe the process involved in inflammation.
10. Describe 3 mechanisms by which bacteria or organisms which further invade the body are destroyed.
11. Describe each of the following steps involved in phagocytosis: initiation, chemotaxis, adherence, engulfment, and digestion.
12. List 3 soluble tissue and serum substances which help to suppress the growth or kill microorganisms.

III. Specific Immunity

13. Describe the purpose of the “humoral” immune system.
14. State the cell involved in the humoral immune system including: name of cell involved and name of cell which produces protective substances.

15. State two names for the proteins produced by plasma cells.

16. State the cell involved in cell mediated immunity.

17. State the type of infections which are prevented by humoral and cellular immune responses.

18. List the cells involved in non-specific immunity and specific immunity.

19. Describe the origin of immune cells.

20. List the cells involved in non-specific immunity and specific immunity.

21. State the origin of immune cells, specifically where are they produced and what they are called.

22. State the 2 groups of cell lines and the specific cells produced by “committed stem cells”.

23. List and describe the function of the cells involved in non-specific immunity.

24. Define the term “acute phase reactant”.

25. List and describe 3 acute phase reactants.

26. List and describe the function of the cells involved in specific immunity: B lymphocytes, plasma cells, and T lymphocytes.

27. List the components involved in specific immunity.

28. Describe the main function of the primary lymphoid organs: the bone marrow and thymus

29. Describe the function of the secondary lymphoid organs: spleen and lymph nodes.

30. List 3 examples of secondary lymphoid tissue or organs.
IV. The Immune Response

31. Define Antigen

32. List and describe the 5 factors which influence antigenicity.

33. Describe the term “antigenic determinant”.

34. Describe antigen-antibody binding in very simple terms.

35. Compare and contrast antibody production as it relates to: length of time to produce antibody after exposure to antigen and antibody class produced.

36. Illustrate comparing primary and secondary responses by drawing a chart.

37. Describe the cellular events which occur in antibody production.

38. Describe the importance of the cellular immune response.

39. Draw a basic antibody molecule and be able to identify the following parts:
   - Heavy chains
   - Light chains
   - Fab portion
   - Fc portion
   - Antigen binding site
   - Disulfide bridges

40. Name and describe the functions of the pieces formed when antibody is treated with papain and pepsin.

41. List and describe the characteristics and functions of the five classes of antibodies.

42. State the types of infections which the cellular immune response provides protection from.

43. Describe the function of the different types of T cells involved in the cellular immune response: helper, suppressor and cytotoxic.

44. Describe the end result of the function of lymphokines.

A. Antigens and Antigen/Antibody Binding

B. The Humoral Immune System

C. Basic Structure of Immunoglobulins

D. The Cellular Immune Response

E. The Cellular Immune Response
45. Describe the genetic and cellular controls involved in the cellular immune response.

46. Define hypersensitivity

47. Describe the mechanism involved in the four types of hypersensitivity and give examples of each.

48. List and describe three types of immunodeficiency and give an example of each.

49. List and describe the three functional aspects of the immune response.

50. Compare and contrast active and passive immunity and give an example of each.

V. Complement

51. Briefly describe the function of the complement cascade.

52. List the complement component units of the recognition unit, activation unit, and membrane attack unit.

53. Compare and contrast the “classic” and “alternate” methods of complement activation.

54. List the activation sequence of the complement components in both the classical and properdin pathways.

55. List 2 modulating mechanisms by which complement activation is controlled.

2. Basic Immunologic Procedures

I. Introduction

56. Define “sensitization” and “lattice formation”.

57. List 4 factors which can be altered to affect antigen/antibody reactions.

58. List and describe the three classifications of antigen/antibody reactions: primary, secondary and tertiary phenomena.
59. Define the following terms:
   Precipitation
   Agglutination
   Complement fixation
   Affinity
   Avidity
   Law of Mass Action
   Prozone
   Postzone
   Zone of Equivalence

60. State the affect that prozone and postzone will have on the results of serological testing of patient samples.

61. Define “turbidity” and describe how turbidity due to antigen-antibody reactions occurs.

62. Briefly describe the principle of “turbidimetry”.

63. Describe the principle of “nephelometry”.

64. Compare and contrast “endpoint” versus “kinetic” reactions.

65. Describe the basic principle of immunodiffusion.

66. List 4 factors which affect the rate of diffusion in the immunodiffusion procedure.

67. List and describe the 4 types of immunodiffusion reactions.

68. Describe the principle of the Oudin single diffusion technique.

69. Describe the principle of the RID procedure and include type of dimension and diffusion and whether the procedure is qualitative or quantitative.
70. Define the following terms:
   - control
   - standard
   - standard curve

71. List 4 technical errors which may negatively impact the RID procedure.

72. Given a standard curve for an RID procedure and ring diameters of the precipitate obtained read the value off the standard curve.

73. Describe the principle of the Ouchterlony gel diffusion technique.

74. Draw and label a picture which illustrates the three reaction patterns obtained in an Ouchterlony gel diffusion: identity, non-identity, partial identity.

75. Describe the principle of immunoelectrophoresis.

76. Compare and contrast the following immunoelectrophoretic procedures:
   - Rocket Immunoelectrophoresis (IEP)
   - Immunofixation (IFE)

77. Describe the principle of the Western Blot test as it applies to testing for HIV antibodies.

78. List 4 technical errors which may occur when performing immunoelectrophoretic techniques.

79. Define “agglutination”.

80. List 3 particles which can be used in an agglutination test.

81. Describe the process of agglutination.
82. Contrast agglutination with precipitation.

83. Describe 5 physiologic conditions that can be altered to enhance agglutination reactions.

84. Discuss how IgM and IgG differ in ability to participate in agglutination reactions.

85. List 3 advantages in performing agglutination reactions.

86. Describe the principle of each of the following agglutination reactions, including the appearance of a positive reaction: direct agglutination, passive agglutination, reverse passive agglutination, agglutination inhibition and coagglutination.

C. Types of Agglutination Reactions
   1. Introduction
   2. Direct Agglutination
   3. Passive Agglutination
   4. Reverse Passive Agglutination
   5. Agglutination Inhibition
   6. Coagglutination

6. Coagglutination

VI. Labeled Immunoassays

87. Define the following terms as they apply to labeled immunoassays:
   - ligand
   - receptor
   - standard
   - calibrator
   - precipitation
   - solid phase
   - blank
   - control
   - competitive assay
   - non-competitive assay
   - heterogenous assay
   - homogeneous assay
   - sandwich or capture assay

88. Describe the principle of the sandwich technique.

89. List 4 substances which may be used as labels in labeled assays.

90. List 4 methods which can be used to separate bound from unbound analytes once a reaction has occurred and how the labeled analyte is detected.
91. Explain the principle of “competitive binding”.

92. Compare and contrast a radioimmunoassay assay with a immunoradiometric assay.

93. List 4 advantages and disadvantages of Radioimmunoassay procedures.

94. List 4 advantages of enzyme immunoassay procedures.

95. List 4 criteria which aid in the selection of the appropriate enzyme to be used as a label.

96. List 3 enzymes used as labels and indicate which one is the most popular.

97. Distinguish between heterogenous and homogeneous enzyme immunoassay.

98. Compare and contrast the following heterogenous enzyme immunoassays: competitive and non-competitive ELISA, immunoenzymometric assay, and sandwich assays.

99. Describe the principle of the homogeneous enzyme immunoassay.

100. List 2 advantages and disadvantages of enzyme immunoassays.

101. List 2 terms used for fluorescent compounds.

102. Describe how fluorescent compounds act in a fluorescent test procedure as a marker.

103. List 2 compounds used as fluorescent markers including the color exhibited.

104. Compare and contrast the direct and indirect immunofluorescent assays.

105. Compare and contrast the heterogenous and homogeneous fluorescent immunoassays.
106. Describe the fluorescence polarization immunoassay.

107. List 2 advantages and disadvantages of fluorescent techniques.

108. Define “chemiluminescence”.

109. List 2 substances which may be used in chemiluminescent immunoassays.

110. State the principle of the chemiluminescent immunoassay.

111. List 2 advantages and 2 disadvantages of chemiluminescent assays.

112. Define:
   - autoantibodies
   - autoimmune response
   - autoimmune disease

113. Describe the following mechanisms of autoimmune disease:
   - Forbidden Clone Theory
   - Altered Antigen Theory
   - Sequestered Antigen Theory
   - Immunologic Deficiency Theory

114. List 3 factors which may contribute to autoimmunity.

115. Distinguish organ-specific and systemic autoimmune diseases, giving an example of each.

116. Describe the effects of systemic lupus erythematosus (SLE) on the body.

117. Describe the immunologic mechanisms known for SLE.

118. State the principle of the anti-nuclear antibody test (ANA) and describe the 4 patterns seen in the test.
119. Differentiate the screening tests from antibody-specific tests for SLE.

120. Discuss the key symptoms of rheumatoid arthritis (RA).

121. Describe characteristics of the key antibody found in RA.

122. Discuss screening tests for rheumatoid factor (RF), explaining the limitations of current testing procedures.

123. Differentiate Hashimoto’s thyroiditis and Grave’s disease on the basis of clinical signs, laboratory findings and immune mechanisms.

124. Explain the immunologic mechanisms known to cause destruction of cells in the pancreas.

125. Discuss the immunologic mechanisms of the following diseases: multiple sclerosis, myasthenia gravis, Goodpasture’s syndrome; Sjogren’s syndrome and Scleroderma.

126. Define “monoclonal gammopathy” as it relates to abnormal B cell proliferation.

127. Differentiate between Multiple Myeloma and Waldenstrom’s Macroglobulinemia so far as abnormal substance produced, clinical signs and tests used to diagnose.

128. Describe the morphological characteristics of spirochetes.

129. Describe the disease affects that Spirochete diseases have in common.

III. Rheumatoid Arthritis

IV. Hashimoto’s Thyroiditis

V. Grave’s Disease

VI. Insulin Dependent Diabetes Mellitus

VII. Other Diseases

A. Multiple Sclerosis
B. Myasthenia Gravis
C. Goodpasture’s Syndrome
D. Sjogren’s Syndrome
E. Scleroderma

VIII. Immunoproliferative Disease

A. Introduction

B. Plasma Cell Dyscrasias
C. Multiple Myeloma
D. Waldenstrom’s Macroglobulinemia

4. Serological Diagnosis of Infectious Diseases

I. Spirochete Diseases
II. Syphilis

130. Describe the prevalence of syphilis in comparison with other spirochete diseases.

131. State the genus and species of Spirochete which causes syphilis.

132. List 4 other pathogenic Treponemes stating the transmission and the disease they cause.

133. State 4 modes of transmission of spirochete which causes Syphilis.

134. Discuss the different stages of syphilis, including length of each stage and signs/symptoms which may be present.

135. Discuss the signs and symptoms associated with congenital syphilis.

136. List three key elements involved in diagnosing Syphilis.

137. Define reagin.

138. Distinguish treponemal tests from nontreponemal (reagin).

139. Describe the principle of the following tests for syphilis: Venereal Disease Research Laboratory (VDRL), rapid plasma reagin (RPR), Treponema Pallidum Immobilization test (TPI), Fluorescent Treponemal Antibody Absorption Test (FTA_ABS) and ELISA.

140. Define “Biologic False Positive” as it relates to screening tests for Syphilis.

141. State three causes of BFP and false negative reactions in reagin test results.

142. Discuss limitations of cerebrospinal fluid (CSF) testing and testing for congenital syphilis.
143. State the genus and species of Spirochete which causes Lyme’s disease.

144. State the genus and species of tick which is the vector involved in this disease as well as animals which are natural reservoirs of the organism.

145. Describe the early and late manifestations of Lyme’s disease.

146. Relate various aspects of the immune response to Lyme’s disease to disease stages.

147. Compare immunofluorescence assay (IFA), EIA, and immunoblot testing for Lyme’s disease as to sensitivity and ease of performance.

148. Discuss causes of false positive and negative results in serologic testing for Lyme’s disease.

III. Lyme’s Disease
   A. Characteristic of the Organism
   B. Stages of the Disease
   C. Immune Response
   D. Laboratory Diagnosis
   E. Treatment

IV. Streptococcal Serology
   A. Introduction
   B. Characteristics of Group A Streptococcal Infections

149. Describe the morphologic characteristics of Streptococci.

150. Describe how Streptococci are divided into groupings.

151. State the genus and species of the Streptococcal organism which frequently causes disease in humans.

152. List 5 exoantigens which are produced and excreted by Streptococci.

153. Distinguish suppurative from nonsuppurative complications of streptococcal infections and give 2 examples of each.

154. List the two major sites of infection for Group A Strep.
155. Describe the immunologic mechanism that is thought to be the cause of Rheumatic Fever.

156. Describe the immunologic mechanism that is thought to cause the pathogenesis which occurs in glomerulonephritis.

157. State the most reliable test for diagnosing a Streptococcal infection.

158. State the advantages and disadvantages of the rapid tests used for screening purposes for Streptococcal infections.

159. Discuss reasons for performing antibody rather than antigen testing for sequelae of streptococcal infections.

160. Describe the characteristics of streptolysin O (SLO) and streptolysin (S).

161. State the principle of the antistreptolysin O (ASO) titer including the purpose of tubes 13, 14 and the Standard.

162. List causes for false negative results in an ASO titer.

163. State the principle of the Streptozyme test.

164. Compare the sensitivity of the Streptozyme test to other tests for streptococcal antibodies.

165. Differentiate between the different hepatitis viruses and their modes of transmission.

166. Correlate the various serologic markers of hepatitis with their diagnostic significance.

167. Indicate the laboratory methods that are most commonly used to screen for or confirm hepatitis virus infections.

V. Serology of Viral Infections

A. Hepatitis
168. Associate the Epstein-Barr virus (EBV) with the specific diseases it causes.

169. Define the following terms: heterophile antigen, heterophile antibody, Forssman antigen and Forssman antibody.

170. Describe the transmission, signs and symptoms associated with infectious mononucleosis.

171. Describe the cell known as the “Downey cell”.


173. Properly interpret the results of a Davidson Differential test.

174. State the principle of the slide test for infectious mononucleosis including the species of red blood cell used.

175. List the EBV antigens and the timing of appearance of antigens as markers for the disease.

176. Discuss the clinical significance of cytomegalovirus (CMV).

177. Compare and contrast the transmission, signs and symptoms of herpes simplex virus 1 (HSV1) and 2 (HSV2).

178. List the diseases associated with varicella zoster virus, rubella virus, rubeola virus, and mumps virus.

179. Correlate viral IgM and IgG antibodies with their clinical significance in terms of detecting current infections, congenital infections, or immunity to infection.

180. State the most common serology method used to detect antibodies to these viruses.
VI. Human Immunodeficiency Virus (HIV)

181. Describe the makeup of the HIV particle.

182. Differentiate the three main structural genes of HIV and their products.

183. Describe replication of the HIV virus.

184. Explain conditions under which transmission of HIV can occur.

185. Describe the effects of HIV on the immune system.

186. Describe the three stages of HIV infection including CD4 counts.

187. Describe the immune response to HIV infection including the antibodies produced in response to specific HIV antigens.

188. Describe retroviral treatments and the impact they have had on HIV infection.

189. State the reason that ELISA tests for HIV continue to be the screening test of choice.

190. Describe the Western blot test.

191. State the specific bands which must be present in order for a Western blot test to be interpreted as positive.

192. Define “indeterminate result” as it relates to the Western blot test for HIV.

193. List three causes of an indeterminate Western blot test.

194. Discuss the advantages and disadvantages of the p24 antigen test.

195. Describe the polymerase chain reaction (PCR) test for HIV.
196. List the clinical samples which may be submitted for HIV viral growth and isolation.

197. Discuss the clinical utility of HIV viral load testing.

198. State the difficulty encountered when testing neonates for HIV infection.