

MICROBIOLOGY AND IMMUNOLOGY
VMS I, 2009

“TOP 30 QUESTIONS IN MICROBIOLOGY AND IMMUNOLOGY”

The faculty have assembled 30 questions that are meant to focus your study on important concepts in microbiology and immunology. Any resource, including textbooks, the internet, other students, faculty or residents can be used to answer these questions. However, you cannot exchange written answers to these questions with other students or ask the course faculty to edit your answers. Your answers should be complete, yet concise (no more than one-half page in length). **Ten** of these questions will appear on the final comprehensive exam.

1. MHC molecules and lymphocyte antigen receptors each constitute an antigen recognition system. What accounts for diversity in each system, and how are the systems different?
2. Some bacterial diseases are principally caused by bacterial toxins. Describe the structure, mode of action and the physical symptoms caused by three distinct bacterial toxins that fit this description.
3. Using three examples of different diseases, describe how the availability of recombinant forms of human cytokines might be used during therapy. Include a rationale.
4. Describe two mechanisms used by viruses to gain entry into host cells. List a single example for each mechanism.
5. In bacterial pathogenesis, what is meant by “quorum sensing”? Provide two examples of bacteria that are capable of quorum sensing and how it influences their pathogenesis and the diseases they cause.
6. Antibiotics have diverse modes of action. Provide four examples, using four antibiotics with a distinct mode of action. Provide the main groups of organisms that are targeted by each antibiotic.
7. How does *Mycobacterium tuberculosis* cause TB?
8. How does *Plasmodium falciparum* cause malaria?
9. In individuals with a congenital immune deficiency, the particular pathogens responsible for recurrent infections provide important clues to the type of host-defense defect. Utilizing three specific immune deficiencies, list pathogens that are

responsible for recurrent infections, and how the specific immune defect explains the host's susceptibility to these infections.

10. Some pathogens have a remarkable tendency to cause disease in specific organ systems. Provide an explanation for this finding, using three different pathogens that cause disease in three distinct organ systems.
11. Why do some viruses cause more serious disease in children and others cause more serious disease in adults? Give an example of each type of virus (one that causes more serious disease in children and one that causes more serious disease in adults) and provide explanations.
12. Describe the different steps that lead to the production of IgE antibodies in response to an allergen. The pathway you describe should include discussion of the cellular interactions, antigen-specific receptors, co-stimulatory molecules and cytokines that are involved.
13. Compare and contrast the diseases caused by four agents of systemic mycoses.
14. How does one design antiviral compounds? Pick any virus for which we lack effective antiviral therapy and postulate two potential targets for antiviral drug development. Describe the step in viral replication that would be blocked by your new antiviral drugs.
15. As a consultant to the World Health Organization, you are asked to identify a bacterial pathogen, a viral pathogen and a parasite for global eradication. Provide a rationale for your choice.
16. Provide three common causes of gastrointestinal infection. Compare and contrast the diseases they cause.
17. Provide three common arthropod-acquired infections, the etiological agents involved, and the main clinical manifestations.
18. Describe the life cycle of your favorite helminthic parasite.
19. Some pathogens can cause cancer. Provide an example of a bacterial pathogen and a viral pathogen that can cause cancer. Describe the mechanism of carcinogenesis involved.
20. How does the immune system defend against infection by a "typical" extracellular bacterium and a "typical" intracellular bacterium?
21. What enzymatic activity do alphaviruses encode that influenza viruses lack? Why must alphaviruses encode this activity?

22. What are the nature, function and specificity of natural killer cells? How do these cells recognize susceptible targets?
23. Viruses have evolved strategies to evade host immune defenses. Pick two viruses that evade innate immunity and describe the evasion mechanisms of each.
24. Viruses have evolved strategies to evade host immune defenses. Pick two viruses that evade adaptive immunity and describe the evasion mechanisms of each.
25. In your studies aimed at developing a vaccine against an encapsulated bacterium, you consider a vaccine strategy based on the main capsular polysaccharide. You have purified this polysaccharide from cultures of heat-inactivated bacteria. How would you develop an effective vaccine using this purified material? Provide a rationale for your strategy. Which immune effector functions do you hope to elicit?
26. What are superantigens and how do they contribute to disease? Provide two examples of superantigens and the pathogens that contain them.
27. Antibiotic resistance is caused both by mutation within bacterial cells and transfer of antibiotic resistance plasmids (R-factors) from one bacterium to another bacterium. Why does the latter cause the biggest problem in regard to proliferation of antibiotic resistance?
28. Why is it necessary to receive an influenza vaccination every year?
29. How would you prove that a newly identified pathogen (virus, bacterium, fungus, or parasite - pick one) causes a newly recognized pandemic of human disease?
30. How do you predict global warming will affect the types of infectious diseases in North America?