

1. (8 points total) You have discovered a new gram-positive bacterium. You feed it mice, they die at a dose of 10^6 cells because of destruction of the intestinal epithelium resulting in diarrhea and bleeding, but they live with 10^5 cells, getting sick and then recovering. You perform the following experiment. You feed the mice 10^5 bacterial cells. One month later you obtain serum, CD4+ T cells, and CD8+ T cells from the survivors. Serum, CD4+ T cells, and CD8+ T cells are injected into 10 naive mice each. Note – the serum has no cells, and the T cell preparations are pure. Another set of 10 naive mice receives no treatment. The mice in each group are infected with 10^6 cells of the bacterium with the following results. Note that these are mice of the same strain, so they consider the transferred materials as self.

Survival of mice			
Treatment			
None	Serum	CD4+ T cells	CD8+ T cells
0/10	0/10	0/10	10/10

A. (3 points) What do the results of this experiment suggest to you about the relationship of this bacterium to host cells? Be sure and differentiate your answer with regard to phagocytes and non-phagocytes, as appropriate. Be as specific as you can in discussing the cellular relationships.

B. (3 points) Explain what happened with the three "immune" treatments in terms of altered mortality from the control or not. Propose a mechanism by which the treatment worked or explain why it did not work. (Extra credit – 1 point – could antibody have protected? How?)

C. (2 points) **List** two completely different mechanisms by which bacteria cause destruction of intestinal epithelial cells. Hint – one of these answers is related to your answer in part A.

2. (5 points) List the 7 steps of infectious diseases. Circle the number of any that are not essential for pathogens during infection. Put an X by any steps that are never performed by normal flora.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

3. Two ways that bacteria evade antibodies are antigenic variation and antigenic variety.

A. (4 points) Define antigenic variation and antigenic variety, being sure to delineate how they are different from each other and why they enable evasion of antibody responses.

B. (2 points) Which of these two virulence factors would be easiest to overcome with an antibody response by vaccination? In your answer, be sure to include why you feel the other is not the easiest.

4. (4 points) Using a cytokine and complement, explain the **two** general ways that viruses evade innate/early induced host defenses. Provide an example of each (that is, an example for evading complement for one of the mechanisms and an example for evading a cytokine for the other mechanism).

5. (6 points) Complete this table to explain the different roles of polymorphonuclear leukocytes (PMNs), macrophages, and dendritic cells in fighting infectious agents.

	PMN	Macrophage	Dendritic Cell
Mechanism(s) of direct antimicrobial function (if any):			
Mechanism(s) of regulation of immune response (if any):			

6. (5 points) In no more than a few sentences in the space provided, explain how for endotoxin and superantigens the structures are so different but the end effects are similar. You should include the way that these toxins cause their effects. In terms of bacterial classification by structure, what limitations would you expect in terms of which types of bacteria would make endotoxin and superantigens?