

NAME _____ TA _____

7.013 Problem Set 7 FRIDAY April 16th 2004

Problem sets will NOT be accepted late.

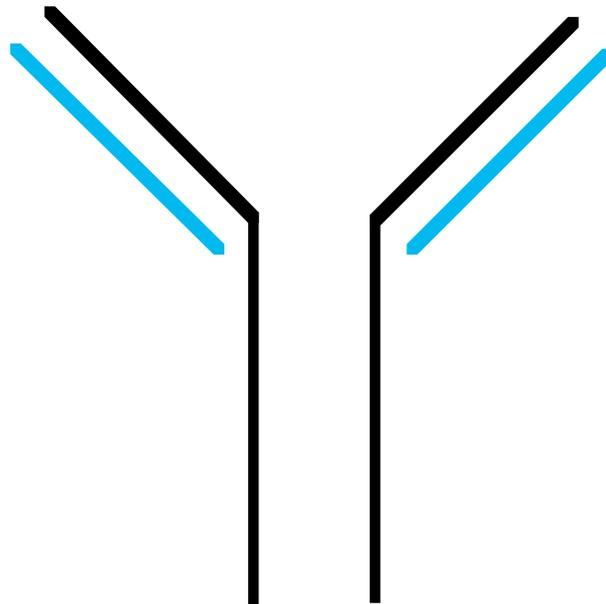
Problem 1

a) What are the four features of the adaptive immune system discussed in *Purves et al.* that allow it to effectively fight a multitude of possible infections? Why is each necessary?

b) How do the jawless fishes and invertebrates survive without an adaptive immune system?

Problem 2

Shown below is a schematic representation of an antibody made in B cells.



a) i) On the diagram above label the following structures on the antibody diagram.

the heavy chains

the light chains

the variable regions

the antigen binding sites

the constant regions

ii) If this were a secreted antibody, indicate on the diagram the region of the antibody that would interact with phagocytic cells.

iii) If this were a membrane-bound antibody, indicate on the diagram the membrane-spanning region of the antibody.

b) What are the interactions between the light and heavy chains that make them associate with each other?

c) What are four ways in which variation is introduced into T- and B-cell receptors during T- and B-cell development?

d) How does the immune system increase receptor avidity after T- and B- cell development?

e) How are the various antibody classes different? What are the advantages of changing an antibody class?

f) How does the body select effective, non-self T cells?

g) Why do T- and B-cells recombine their DNA? Why not just use alternative splicing to create diversity? (Hint: Think about the impact on descendant cells and their ability to fight an infection.)

Problem 3

The Nasal-Spray Flu Vaccine (Live Attenuated Influenza Vaccine [LAIV]) was recently introduced under the name FluMist as an alternative to the traditional flu shot.

a) Besides the route of inoculation, how is FluMist fundamentally different from a flu shot?

b) Why may FluMist be more effective than a flu shot?

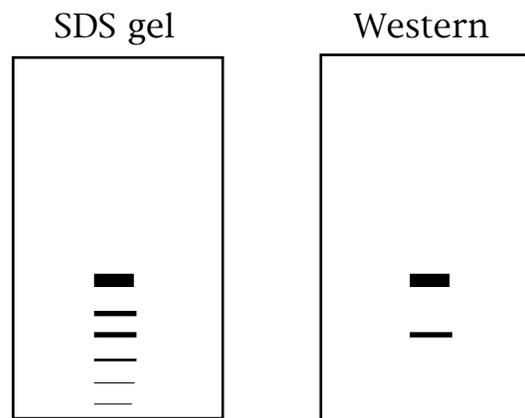
c) Why should people who are allergic to eggs not get a flu vaccine?

d) What is a possible drawback of using a live, attenuated virus vaccine not shared with using the traditional flu shot? How does FluMist reduce the possibility of such a drawback? (Hint: Go online to find more information about the vaccine. Extra Hint: Not at flumist.com)

Problem 4

A researcher is trying to purify a protein he is interested in studying. He performs SDS polyacrylamide electrophoresis, which separates proteins by size, on what he believes to be his purified sample. When he stains the gel with Coomassie blue (a dye that stains all proteins), he sees not only a band corresponding to the molecular weight of the protein he is interested in, but also a few other bands of lower molecular weight.

The researcher thinks these might be proteolytic fragments of the protein he has purified, perhaps caused by an undetectable contaminating protease (i.e., cannot be seen on the gel). To test this hypothesis, he decides to do a Western blot of his gel using a monoclonal antibody to the protein. The only bands that show up on the blot are the one corresponding to the protein of interest and one of the lower bands. See below.



Since the antibody only bound to one lower band, can the researcher conclude that the other bands correspond to different contaminating proteins? Why or why not? If not, what other reagent(s) could make this a more informative experiment?

Problem 5

a) When an organ is transplanted, the patient must take immunosuppressant drugs for the rest of his or her life. Why is that?

b) The exception to this is bone marrow transplants. What makes bone marrow different from, say, a kidney that the patient does not require immunosuppressants to live?

c) What is a complication of bone marrow transplants that is generally not a concern in other transplants, and how is it obviated?

d) Explain why, after a bone marrow transplant, the patient must often get an entire complement of vaccinations.