

Question 5

You are an immunologist who wants to make the big bucks. You decide to leave the world of science and get a job as a script-consultant on a new medical drama (ER-like) show. You test the writers with a few questions to see just how much they know.

- a) Compare how macrophages and B cells **recognize** antigen.
- b) Compare how macrophages and B cells **present** antigenic peptides (epitopes).
They present epitopes exactly the same way on their MHC II molecules on the surface.
- c) Macrophages and B cells present antigens to _____ -cells. (Fill in blanks.)
- d) Name 2 components of the innate or nonspecific immune system.

Below are short descriptions given to you by the writers of scenarios in the early episodes.

Scenario #1

One of the characters on the show is diagnosed with leukemia, a cancer of the blood system. She is very sick until her boyfriend bravely agrees to donate his bone marrow. The bone marrow transplant is successful and our character lives!

- e) You tell the writers that the bone marrow transplant from the boyfriend is **unlikely** to be successful. Give the reason and the molecular basis for why.

Because of the **different** major histocompatibility molecules the marrow will be rejected.

Scenario #2

The leading doctor gives birth to a baby boy. After some time, the child shows no acquired or specific immune response and is diagnosed with a rare disorder, Severe Combined Immune Deficiency (SCID), and as a result the boy must live in a germ-free environment. Several causes of SCID have been described and are listed below.

- f) For each cause, indicate which of the following branches of immune system are affected. (**Cellular =Cell-Mediated**)

Cause	Cell-Mediated, Humoral or Both
T cells fail to develop	
DNA recombination deficiency	
Absence of MHC class I molecules	
Lack of MHC class II molecules	

Scenario #3

Patients in the hospital are coming down with multiple infections. Lab results show that the sick are infected with a bacterium, *S. aureus*, that secretes "Protein A" which binds the constant region of antibodies.

g) What cell recognizes the constant region of secreted antibodies? _____

h) Why might the effect of Protein A allow **multiple** (non *S. aureus*) infections?

i) What branch of the immune system does *S. aureus* evade using Protein A?

Humoral

Cellular or Cell-Mediated

Both

Scenario #4

Many patients are coming into the emergency room with a disease caused by an unknown pathogen! A doctor studies this pathogen in order to create a vaccine against it.

j) He discovers that the infectious agent is an intracellular bacterium and its cell surface is coated with human-like proteins. Considering the mechanism of the pathogen, the doctor decides to generate a live-attenuated vaccine instead of a heat-killed vaccine.

i) What are the two advantages of using a live-attenuated vaccine vs. a heat killed vaccine in this case?

ii) What is a disadvantage of using a live-attenuated vaccine?

~~Question 6~~

~~a) Shown below is a schematic of the production of a heavy chain polypeptide for an antibody. At the top is the chromosomal arrangement found in an immature B cell, at the bottom is shown the heavy chain polypeptide.~~

~~i) Label the process indicated by each arrow. Choose the one best option for each from:~~

~~protein processing
transcription
translation
transduction~~

~~RNA ligation
RNA splicing
DNA rearrangement
DNA ligation~~

~~ii) Indicate on the diagram below where you would expect to find each of the following components;~~

~~Promoter~~

~~Transcription terminator~~

~~start codon~~

~~stop codon~~

~~iii) Indicate on the diagram below the variable and the constant region of the heavy chain polypeptide.~~

Question 4

a) Cells are in which phase of the cell cycle when incorporating radioactive dTTP into their DNA? (Circle one.) 3 points

~~G₀ phase~~ ~~G₁ phase~~ ~~G₂ phase~~ ~~M phase~~ **S phase** ~~Lunar phase~~

b) Estimate the length of the G₂ phase from the graph. (Circle one.) 3 points

Can't be determined 0 hrs **~2-3 hrs** ~6-7 hrs ~9-10 ~11-12 hrs ~13-14 hrs ~20 hrs ~22 hrs

c) Estimate the length of the S phase from the graph. (Circle one.) 3 points

Can't be determined 0 hrs ~2-3 hrs **~6-7 hrs** ~9-10 ~11-12 hrs ~13-14 hrs ~20 hrs ~22 hrs

d) Estimate the duration of the cell cycle. (Circle one.) 3 points

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e) Estimate the length of the G₁ phase from the graph. (Circle one.) 3 points

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a) Compare how macrophages and B cells **recognize** antigens.

*MØs nonspecifically engulf antigen.
B cells take up antigens that their surface antibodies specifically bind.*

b) Compare how macrophages and B cells **present** antigenic peptides (epitopes).

They present epitopes exactly the same way on their MHC II molecules on the surface.

c) Macrophages and B cells present epitopes to helper T-cells. (Fill in blanks.)

d) Name 2 components of the innate or nonspecific immune system.

Skin, MØs, complement, mucus lining, mucocilliary ladder, lysozyme in tears, sweat, etc.

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Several causes of SCID have been described and are listed below.

f) For each cause, indicate which of the following branches of immune system are affected.

Cause	Cellular/ Cell-Mediated, Humoral or Both
T cells fail to develop	BOTH
DNA recombination deficiency	BOTH
Absence of MHC class I molecules	Cellular or CELL-Mediated
Lack of MHC class II molecules	HUMORAL

Scenario #3

Patients in the hospital are coming down with multiple infections. Lab results show that the sick are infected with a bacterium, *S. aureus*, that secretes "Protein A" which binds the constant region of antibodies.

g) What cell recognizes the constant region of secreted antibodies? MØ

h) Why might the effect of Protein A allow **multiple** (non *S. aureus*) infections?

Protein A sequesters all antibodies to all antigens by binding to the antibody. This will prevent Macrophages from ridding the pathogen and will in fact precipitate out antibodies from the blood.

i) What branch of the immune system does *S. aureus* evade using Protein A?

Humoral

 Cellular or Cell-Mediated

 Both

Scenario #4

j) He discovers that the infectious agent is an intracellular bacterium and its cell surface is coated with human-like proteins. Considering the mechanism of the pathogen, the doctor decides to generate a live-attenuated vaccine instead of a heat-killed vaccine.

i) What are the two advantages of using a live-attenuated vaccine vs. a heat killed vaccine in this case?

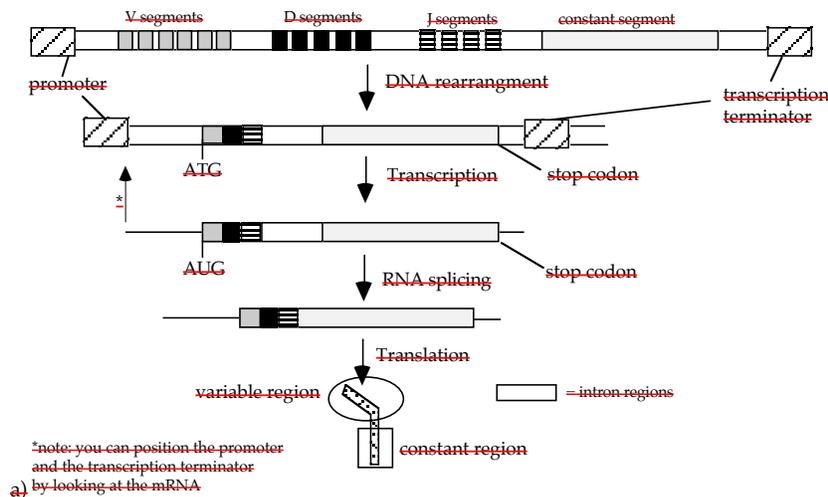
It'll mimic the disease by invading cells, thus it will illicit both a humoral and cellular response.

Surface proteins will not be denatured by heat.

ii) What is a disadvantage of using a live-attenuated vaccine?

Could acquire virulence factors, Need a "cold chain" (expensive refrigeration), it may make people sick.

Question 6



b)

~~i) True.~~

~~ii) False. B cells produce antibodies that bind antigens.~~

~~iii) False. Macrophages present antigen to T helper cells. Only T cells can recognize epitopes in MHC II molecules on macrophages and B cells.~~

~~iv) False. Clonal expansion means that only the B cells that express antibodies that recognize a particular foreign antigen will proliferate when exposed to that particular antigen.~~

~~v) False. The two antigen binding sites of an antibody molecule bind to identical antigenic determinants.~~

~~c) The rabbit protein is recognized as foreign (non-self) by the guinea pig.~~

~~d) B cells, by gene rearrangement of Ab genes (VDJ rearrangement). Also, T cells (by rearrangement of T cell receptor genes).~~