

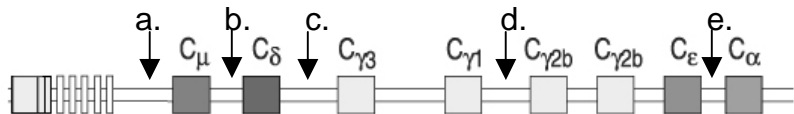
- N-nucleotides and N-additions are names for the same thing. What are N-nucleotides?
  - they are the nucleotides modified by somatic hypermutation
  - they are nucleotides encoded in the D gene segments of Ig and TCR genetic loci
  - they are random nucleotides inserted between rearranged gene segments in B or T cells
  - they are nucleotides that code the recombination switch sequences
  - they are the codons for the three hypervariable regions in Ig variable region genes
- Which of the following does not occur in the bone marrow in developing (pre) B cells?
  - vj and vdj gene rearrangements
  - the generation of junctional diversity
  - surface expressin of IgM on B cells
  - somatic hypermutation
  - none of the above (all of the above occur in developing pre-B cells)
- What is the beneficial result of somatic hypermutation in B cells?
  - some B cells will improve their binding affinity for the stimulating antigen
  - some B cells will improve their binding specificity for the stimulating antigen
  - it allows B cells to change the class of the response (e.g., from IgM to IgA)
  - it is the mechanism to inactivate certain genes and to thus promote allelic exclusion
  - dumb question since there is no somatic hypermutation in B cells
- What is the beneficial result of somatic hypermutation in T cells?
  - some T cells will improve their binding affinity for the MHC plus peptide
  - some T cells will improve their binding specificity for MHC plus peptide
  - it allows T cells to change their restriction specificity without changing peptide specificity
  - it is the mechanism to inactivate certain genes and to thus promote allelic exclusion
  - dumb question since there is no somatic hypermutation in T cells

- What is symbolized by the DNA pictured to the right?



- rearranged TCR  $\alpha$  chain
- rearranged light chain
- it could be either a or b
- TCR  $\beta$  chain (either rearrange or not rearranged)
- germline light chain

- In the picture to the right, which arrow could not be pointing to a switch sequence?

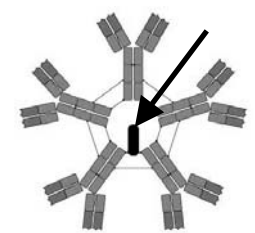


- If the DNA shown in the figure above remained in its current configuration, which of the following antibody isotypes could be made by the B cell?
 

a. IgA	d. all of the above
b. IgD	e. none of the above
c. IgG3	
- Two kinds of gene rearrangements occur in the heavy chain locus: DNA rearrangements that result in production of Ig variable regions and rearrangements that result in Ig isotype (class) switching. With regard to these two type of rearrangements, which of the follow is true?
  - rearrangements in both are usually productive
  - they use similar switch sequences
  - they are both the result of antigen stimulation
  - which exons are used is regulated and is not due to random rearrangements
  - none of the above are true for both isotype switching and vj, vdj rearrangements

9. Some Ig molecules are free to float around the body (secreted Ig) and some are on the surface of B cells (transmembrane Ig). Which of the following is true for these Ig molecules?
- the transmembrane form is a different isotype than the secreted form
  - the transmembrane form binds to an Ig receptor on the cell surface; that sticks it to the surface
  - the secreted form starts as a transmembrane molecules and the end of the molecule that is in the membrane is clipped off to release the secreted form
  - the transmembrane form has hydrophobic amino acids in the Fc region that allow it to transverse the membrane, the secreted form does not have these amino acids
  - no differences except their location

10. The molecule pictured to the right is made up of many protein chains that are linked together. The arrow points to one of the protein chains. On what other molecule are you likely to find this exact same protein (i.e., the protein marked by the arrow)?



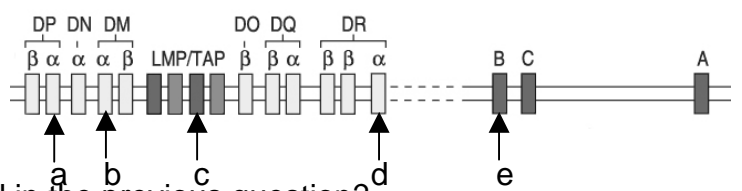
- IgA
- IgD
- TCR
- that protein is part of all immunoglobulins
- that protein is part of all transmembrane immunoglobulins

11. I sequenced the amino acids in the constant region of my IgG3 and found that the IgG3 constant region I inherited from my mother differed by 2 amino acids from the IgG3 constant region I inherited from my father. These differences are
- idiotypic differences
  - isotypic differences
  - allotypic differences
  - atypic differences
  - bad question because, if they differ, they cannot both be IgG3

12. What do a proteasome do?
- they help synthesize proteins
  - they degrade proteins into peptides
  - they are vesicles that fuse with phagosomes
  - they are carbohydrates that contain some protein
  - the are proteins that interact with DNA to regulate gene expression

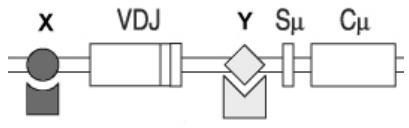
13. Why is it that MHC class II does not get loaded with peptides when it is in the endoplasmic reticulum (ER)?
- MHC class II does not pass through the ER
  - the MHC class II  $\alpha$  and  $\beta$  chains are not assembled until they leave the ER
  - peptides with the proper motifs are not present in the ER
  - there is an invariant chain blocking the peptide binding site while MHC class II is in the ER
  - the premise of the question is wrong. MHC class II is loaded with peptide in the ER

14. In the gene complex pictured to the right, which gene codes for an  $\alpha$  chain of MHC class I?  
note: MHC class I



15. What is the name of the gene complex pictured in the previous question?
- HLA
  - DBCA
  - H-2
  - HIG
  - Dave

16. A MHC<sup>a</sup> mouse is infected with a vaccinia virus and it makes an effective CTL response that clears the virus. T cells from that animal are isolated and tested in tissue culture for their ability to kill a variety of target cells. Which of the following is likely to be killed by these CTLs?
- MHC<sup>a</sup> cells infected with the virus
  - (MHC<sup>a</sup>XMHC<sup>b</sup>)F<sub>1</sub> cells infected with the virus
  - MHC<sup>a</sup> cell with no virus
  - a and b above
  - a, b and c above
17. What do we call molecules that can bind certain TCR chains (with no regard to the antigen binding specificity of the TCR) and bind MHC such that the T cell gets stimulated as if it had bound MHC in an antigen-specific, MHC restricted way?
- polyclonal stimulators
  - protoantigens
  - superantigens
  - psudeoantigen
  - antigen surrogates
18. Where would you most likely find Ig $\alpha$  and Ig $\beta$  molecules?
- they are part of an IgA molecule
  - they are cytokines made by dendritic cells
  - they are transmembrane protein found on B cells along with Ig
  - they are immunoglobulins
  - nowhere, there is no such thing as Ig $\alpha$  and Ig $\beta$
19. What is the function of CD3?
- it transduces a signal into a T cell when the TCR appropriately engages peptide plus MHC
  - it provides co-stimulation to activate T cells
  - it is a macrophage receptor that binds to bacterial lipopolysaccharide
  - it is an adhesion molecule
  - it is the third CD in the collection "The Best of Pink Floyd"
20. Not all T cells in the thymus (i.e., thymocytes) survive to become mature T cells. About what percentage of thymocytes die in the thymus?
- 99.99%
  - 96%
  - 70%
  - 50%
  - 10%
21. A T cell is referred to as "double positive" if on its surface it has
- two different TCRs
  - TCR and CD4 or TCR and CD8
  - TCR and CD3
  - CD8 and CD3
  - CD8 and CD4
22. A B cell makes a productive heavy chain rearrangement. What is the very next thing it does?
- stops rearrangements at the heavy chain locus and divides
  - keep rearranging heavy chains to see if it can go two for two
  - rearranges at kappa and lambda
  - makes the self/non self discrimination
  - waits for T cell help
23. What proportion of the kappa chain rearrangements that have random nucleotides inserted between v and j end up with j in frame?
- 1/2
  - 1/3
  - 1/4
  - 1/9
  - all of them

24. Every B cell has 2 gene loci encoding heavy chains and, in an individual, antibody is made equally from both loci. However, any one B cell uses only one of the loci. This is called
- class switching
  - clonal selection
  - dominant suppression
  - recessive suppression
  - allelic exclusion
25. In the picture to the right, the element marked with a Y causes high levels of transcription of the heavy chain. What is that element called?
- initiator
  - promoter
  - origin
  - enhancer
  - transcription augmenter
- 
26. Assume a heavy chain locus has 50 v gene segments, 25 d segments and 6 j segments. It rearranges the segments but the vdj rearrangement is non-productive. Two questions: can it try again at this locus? And, if yes, what is the theoretical maximum number of tries before all the possibilities are exhausted?
- No, it cannot try again at this locus, it must try the other allele
  - Yes, at best, it can try 50 times
  - Yes, at best, it can try 25 times
  - Yes, at best, it can try 6 times
  - Yes, at best, it can try 125 times
27. In the bone marrow, an immature B cell has a functional antigen receptor on it's surface. What must happen next if that B cell is to leave the bone marrow and become a mature naïve B cell?
- it must bind a multivalent antigen
  - it must bind a soluble antigen
  - it must weakly bind a self antigen
  - any of the above will suffice to let the cell complete its maturation
  - nothing, it should not engage its antigen receptor if it is to become mature B cell
28. A  $MHC^a \rightarrow MHC^a X MHC^b$  bone marrow chimera [ $MHC^a$  bone marrow into a  $(MHC^a X MHC^b)F_1$  host] is immunized to antigen-X.  $T_H2$  cells from the chimera are tested for their ability to help B cells expressing various MHC haplotypes. Which B cell could be helped to make an anti-antigen-X response with these T helper cells?
- $MHC^a$
  - $MHC^b$
  - $MHC^a X MHC^b$
  - all of the above
  - none of the above (this chimera cannot make functional  $T_H2$  cells)
29. A cell that is negatively selected will
- become anergic
  - become an effector cell
  - die
  - divide
  - do nothing and just wait for a positive signal
30. In the thymus, thymocytes that can only bind weakly to self MHC with self peptide
- rearrange the  $TCR\alpha$  chain again to see if they can improve binding
  - leave the thymus as mature T cells
  - die
  - become anergic
  - either c or d above

Answers					
1	6	11	16	21	26
CDAEC	BBEDA	CBDEA	DCCAB	EABED	AEDCB