Welcome to the FIT Board Review Corner, prepared by Timothy Chow, MD, and Christopher Foster, MD, senior and junior representatives of the College's Fellows-In-Training (FITs) to the Board of Regents. The FIT Board Review Corner is an opportunity to help hone your Board preparedness.

Review Questions
Allergy and Immunology Review Corner: Janeway's Immunobiology, 9th edition

Chapter 4: Antigen Recognition by B-cell and T-cell receptor

1. The B cell receptor is made of the following polypeptide chains:
    a) Two γ chains and two δ chains
    b) Two α chains and two β chains
    c) Two heavy and two light chains
    d) Two constant chains and two variable chains

2. Different antibody subtypes are defined by:
    a) The carboxy-terminal domains of two different heavy chains
    b) The carboxy-terminal domains of two identical heavy chains
    c) The amino-terminal domains of two different heavy chains
    d) The amino-terminal domains of two identical heavy chains

3. The antigen-binding site of the antibody is composed of
    a) Three hypervariable loops from each light and heavy chain that are localized to a single site.
    b) Six hypervariable loops from the light chain that are localized to a single site.
    c) Three hypervariable loops from each light and heavy chain that are localized uniformly throughout the antibody structure.
    d) Six hypervariable loops from the light chain that are localized uniformly throughout the antibody structure.

4. The majority of T cell receptors are composed of which of the following heterodimers linked by disulfide bond.
    a) α:β heterodimer
    b) α:γ heterodimer
    c) α:δ heterodimer
    d) β:γ heterodimer
    e) γ:δ heterodimer

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5. B cell receptors and T cell receptors have _____ and ____ antigen recognition sites, respectively.
    a) 1 and 1
    b) 1 and 2
    c) 1 and 3
    d) 2 and 1
    e) 2 and 2
    f) 2 and 3
    g) 3 and 3

6. The MHC class I molecule is composed of an α chain and β2 microglobulin chain which are encoded on chromosomes _____ and _____ respectively in humans.
    a) 3 and 9
    b) 5 and 12
    c) 6 and 15
    d) 11 and 18

7. The MHC class II molecule is composed of two α chains and two β chains. The peptide-binding cleft is located between the α1 and β1 chains, and the membrane-spanning domain is the β2 and α2 chains. The MHC class I molecule is composed of three α chains and one β chain. The peptide-binding cleft is located between the ____ and ____chains, and the membrane-spanning domain is the _____chain.
    a) α1, β2-microglobulin, α2
    b) α1, α2, α3
    c) α2, α3, β2-microglobulin
    d) α2, β2-microglobulin, α3

8. The term MHC restriction refers to the
    a) Unique clusters of conserved residues that bind the two ends of peptide in MHC class I molecules, not found in MHC class II molecules.
    b) T cells recognizing unique set of peptides bound to a specific MHC molecule.
    c) Differential expression of MHC class II molecules on antigen-presenting cells.
    d) Specific binding interactions between CD8 and MHC class I.

9. Which cytokine can increase expression of MHC class I molecules on all types of nucleated cells:
    a) TNF-α
    b) TGF-β
    c) IFN-α
    d) IL-6

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10. γ:δ T cells are similar to α:β T cells in that they both
    a) Recognize antigen presented by MHC class I and II molecules.
    b) Bind non-peptide ligands.
    c) Display specificity through MHC restriction.
    d) Recognize antigen through CDR3 regions.

Answers

1. **C**. Page 141. Fig 4.2. The B cell receptor (membrane-bound immunoglobulin) is made of two heavy chains and two light chains. The heavy and light chains are composed of constant and variable regions.

2. **B**. Page 145. Fig 4.1 The trunk of the Y-shaped immunoglobulin structure is called the Fc fragment and is composed of the carboxy-terminal domains of two identical heavy chains. These domains determine the antibody's isotype.

3. **A**. Page 146-7. Fig 4.7. When the variable domains of the heavy and light chains are paired together, the three hypervariable loops from each domain are brought together, creating a single hypervariable site at the end of each antibody molecule. The framework regions are much less variable and form the β sheets that provide structural framework of the molecule. These six hypervariable loops are commonly termed the complementarity-determining regions.

4. **A**. Page 153. Fig 4.14. The majority of T cell receptors are composed of α:β heterodimers.

5. **D**. Page 153. Fig 4.13. B cell receptors (immunoglobulin) have two antigen binding sites, T cell receptors have 1. Because of this, B cell receptors can bind to discontinuous amino acid sequences that are brought into proximity through protein folding, whereas T cell receptors must bind to continuous amino acid sequences

6. **C**. Page 155. The MCH class I α chain is encoded on chromosome 6; the β2 -microglobulin chain is encoded on chromosome 15

7. **B**. Page 156-7. Fig 4.17, 4.18. The MHC class I molecule's peptide binding cleft is between the α1 and α2 chains; it's only membrane-spanning domain is the α3 chain. Note the differences between the structure of MHC class I and II molecules.

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8. **B**. Page 163-5. Fig 4.27 MHC restriction refers to T cells recognizing unique set of peptides bound to a specific MHC molecule contributing to the dual specificity of T cell responses.

9. **C**. Page 166. Fig 4.30. IFN-α and IFN-β increase the expression of MHC Class I on all types of cells; IFN-γ increases the expression of both MHC class I and II molecules and induce expression of MHC class II molecules on cell types that don't typically express this.

10. **D**. Page 166-7. γ:δ T cells make up a minority of T cells. They have a similar structure to α:β T cells, and both recognize antigen through complementarity-determining regions, such as CDR3. However, γ:δ T cells bind nonpeptide ligands, nonpolymorphic nonclassical MHC molecules and certain lipids. They are not considered to be MHC restricted.

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