Allergy and Immunology Review Corner: Chapter 7 (Part 1, pages 139-159) of *Cellular and Molecular Immunology* (Seventh Edition), by Abul K. Abbas, Andrew H. Lichtman and Shiv Pillai.

Chapter 7 (Part 1, pages 139-159): Immune Receptors and Signal Transduction

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1. What is the principal co-stimulatory receptor on T cells for delivering second signals for T cell activation?
   A. CD2
   B. CD28
   C. LFA-1
   D. ICAM-1

2. Which of the following is not a component of the CD3 receptor?
   A. γ
   B. α
   C. ε
   D. δ

3. Which of the following is not part of the TCR complex?
   A. TCR
   B. ζ-chain
   C. CD3
   D. CD4

4. What is the Src family tyrosine kinase that mediates signal transduction events after T-cell recognition of peptide-MHC complexes on antigen presenting cells?
   A. AID
   B. Lck
   C. BTK
   D. RAG

5. Which chain contains a fourth CDR region?
   A. α
   B. β
   C. CD3
   D. ζ

6. Which pathway results in ERK activation?
   A. c-Jun
   B. Rac
   C. Ras
   D. PLCγ1
7. Which pathway results in c-Jun activation?
A. PLCγ1  
B. ERK  
C. Ras  
D. Rac

8. The region of physical contact between the immune cell and the APC is referred to as which of the following?
A. TCR complex  
B. MHC  
C. SMAC  
D. SAP

9. Which of the following transcription factors does cyclosporine block?
A. AP-1  
B. NFAT  
C. c-Jun  
D. NF-κB

10. Which inhibitory phosphatase is specific for an inositol phospholipid?
A. SHIP  
B. DAG  
C. ERK  
D. JNK

Answers
1. B, page 158
The CD28 molecule on T cells is the principal costimulatory receptor for delivery of second signals for T cell activation.

2. B, page 146
The alpha chain is part of the TCR. The remainder of the chains makes up the CD3 complex.

3. D, page 146
The antigen receptor of … T cells is a heterodimer consisting of two transmembrane polypeptide chains, designated TCR α and β, covalently linked to each other by a disulfide bridge between extracellular cysteine residues…the CD3 and ζ proteins are noncovalently associated with the TCR αβ heterodimer.

4. B, page 149
The CD4 and CD8 coreceptors greatly facility the activation process by bringing Lck (which is loosely associated with the tail of the coreceptor proteins) close to the CD3 and ζ ITAMs.
5. B, page 146
The β chain V domain contains a fourth hypervariable region that does not appear to participate in antigen recognition but is the binding site for microbial products called superantigens.

6. C, page 153
The Ras pathway is activated in T cells after TCR ligation, leading to the activation of the extracellular receptor-activated kinase (ERK), a prominent member of the MAP kinase family, and eventually to the activation of downstream transcription factors.

7. D, pages 153-154
The Rac-GTP…initiates a parallel MAP kinase cascade, resulting in the activation of a distinct MAP kinase called c-Jun N-terminal kinase (JNK).

8. C, page 151
The region of physical contact between the T cell and the APC forms a bull’s-eye like structure that is called an immunologic synapse or a supramolecular activation cluster (SMAC).

9. B, page 156
Cyclosporine binds to a cytosolic protein called cyclophilin, and FK506-binding binds to a protein called FK506-binding protein (FKBP). Cyclosporine-cyclophilin complexes and FK506-FKBP complexes bind to and inhibit calcineurin and thereby block translocation of NFAT into the nucleus.

10. A, page 158
Another inhibitory phosphatase that does not act on phosphoproteins but rather is specific for an inositol phospholipid is called SHIP (SH2 domain-containing inositol phosphatase).

Allergy and Immunology Review Corner: Chapter 7 (Part 2, pages 159-170) of *Cellular and Molecular Immunology* (Seventh Edition), by Abul K. Abbas, Andrew H. Lichtman and Shiv Pillai.

Chapter 7 (Part 2, pages 159-170): Immune Receptors and Signal Transduction

*Prepared by Meagan W. Shepherd, MD, Ohio State University*

1. What binds to the B cell complement receptor?
A. C2a
B. C3a
C. C3d
D. C3b
2. Which of the following is not part of the B cell coreceptor complex?
   A. CR2
   B. CD19
   C. CD81
   D. CD5

3. What is the name of the kinase that is associated with the B cell coreceptors?
   A. Lyn
   B. Lck
   C. Fyn
   D. Blk

4. To which of the following molecules does PLCγ2 bind which causes it to become active?
   A. Lyn
   B. Btk
   C. DAG
   D. BLNK

5. What is the prototypical inhibitory receptor of the CD28 family?
   A. PD-1
   B. Ubiquitin
   C. CTLA-4
   D. ZAP-70

6. Which of the following type I cytokine receptors does not share a common β chain with the others?
   A. IL-3 receptor
   B. IL-4 receptor
   C. IL-5 receptor
   D. GM-CSF receptor

7. Which cytokine receptor family uses the JAK-STAT pathways?
   A. IL-1 receptor family
   B. G-protein
   C. TNF receptor family
   D. Type II cytokine receptor family

8. Which of the following receptors does not use the gp130 signaling component?
   A. IL-6 receptor
   B. IL-10 receptor
   C. IL-11 receptor
   D. IL-27 receptor

9. Which of the following domains is common to all NF-κB proteins?
A. SH2  
B. IKK  
C. Rel  
D. TLR

10. Which of the following is not included in the IκB kinase (IKK) complex?  
A. NEMO  
B. IKKα  
C. IKKβ  
D. IκBα

Answers  
1. C, page 161  
B lymphocytes express a receptor for C3d that is called the type 2 complement receptor (CR2, or CD21).

2. D, page 161  
The CR2-CD19-CD81 complex is often called the B cell coreceptor complex because CR2 binds to antigens through attached C3d at the same time that membrane Ig binds directly to the antigen.

3. A, page 161  
Phosphorylation of the tail of CD19 results in the efficient recruitment of Lyn, a Src family kinase that can amplify BCR signaling by greatly enhancing the phosphorylation of ITAM tyrosines in Igα and Igβ.

4. D, page 162  
PLCγ2 becomes active when it binds to BLNK and is phosphorylated by Syk and Btk.

5. C, page 163  
The prototypical inhibitory receptor of the CD28 family, CTLA-4 (also called CD152), has the ability to inhibit T cell responses induced on activated T cells and has a higher affinity than CD28 for B7 proteins.

6. B, page 166  
A distinct subgroup of type I receptors includes receptors that share a common β chain (CD131) subunit. This subgroup includes the receptors for IL-3, IL-5, and GM-CSF.

7. D, page 166  
All type II cytokine receptors, like the type I receptors, engage JAK-STAT signaling pathways.

8. B, page 166  
Another subgroup of [type I cytokine] receptors uses the gp130 signaling component, and this includes the receptors for IL-6, IL-11, and IL-27.
9. C, page 168
   There are five NF-κB proteins. The domain that is common to all NF-κB proteins is a DNA-binding domain called a Rel homology domain.

10. D, page 168
    Upstream signaling leads to the activation of a unique type of ubiquitin E3 ligase that can add a lysine-63 type of ubiquitin chain to a protein called NEMO or IKKγ that is a noncatalytic subunit of a trimeric enzyme complex called the IκB kinase (IKK) complex. This complex contains two other subunits called IKKα and IKKβ.