Chapter 3 Study Guide

1 Somatic recombination happens during maturation of the cell in the variable region genes (V and D or V, D and J segments) of the BCR or TCR genes.

2 During the first encounter with an antigen you have no antibodies for that specific antigen or memory cells for that antigen.

3 Membrane IGs and BCRs are the same thing.

4 BCRs are bound because of a hydrophobic tail; Antibodies are secreted because of a hydrophilic tail. They have the same binding sites. The choice of it being secreted or not is made in the RNA using RNA splicing/ alternative splicing/ RNA processing (all the same thing). This process edits the membrane-binding domain out.
Difference between membrane-bound and secreted antibody lies in the Carboxy-terminus of H-chain

5 BCRs and TCRs are both rearranged using somatic recombination but different genes are rearranged.

6 In mature T and B cells you would see rearranged V, D, and J segments; in the macrophages you would see a germline configuration.

7 TCRs need to have antigens presented to it via MHC molecules unlike BCRs which can detect an antigen itself.

8 Clonal selection selects cells that don't recognize the host's antigens (negative selection) but does recognize foreign antigens (positive selection). Clonal expansion is the proliferation of a lymphocyte after it has sensed a pathogen.

9 Dendritic cells meet antigen at the wound, then they migrate to the lymph nodes where they present the antigen via MHC molecules to the T cell region of the lymph nodes.

10 Lymphocytes: T cells, B cells, NK cells
T cells: either CD4 (TH1 or TH2) or CD8 cytotoxic cells. TH1 activates macrophages, TH2 activates B cells
B cells: have BCRs on surface; secrete antibodies when they become plasma cells
NK cells: innate immune system

11 CD8 (cytotoxic) T cells bind to MHC type I, while CD4 T cells bind to MHC class II
CD8 T cells aka cytotoxic T cells
CD4 T cells aka TH1 and TH2

12 Negative selection is selecting T cells that do not recognize the host's own antigens, while positive selection is selecting T cells that recognize foreign antigens. Only T cells truly undergo both of these processes. (happens in thymus)

13 Secondary immune responses use memory cells

14 Antibodies can neutralize a pathogen, or opsonize it (either directly by the antibody, or indirectly by complement). The goal of most vaccinations is to get our immune system to produce memory cells to a virus.

15 A mature naïve B cell expresses both IgM and IgD on its surface. The first isotype secreted is IgM.

16 Affinity of the antibody binding to the antigen gets better over the course of an infection by somatic hypermutation resulting in affinity maturation. Somatic hypermutation affects the CDR regions of the variable regions of the light and heavy chains the most (CDR3 of heavy chain, CDR 1 of the light chain). This process takes place after a B cell has been activated. It takes place in the DNA of B cells, so it is irreversible.

17 Isotype switching Involves a further DNA recombination event that places the original V-region with other heavy C-regions. Switching is accomplished by recombination within a cluster of C genes, excising the previous C genes and joining a new C gene with previously assembled V-region. Antigen specificity thus remains the same but the isotype of the antibody changes. This happens in the DNA so it is irreversible.

18 CD4 bind to MHC class II molecules and secrete cytokines to activate either macrophages (TH1) or B cells (TH2). CD8 cells bind to MHC class II molecules and kill virally infected cells.

19 The 5 isotypes of antibodies are GAMED (IgG, IgA, IgM, IgE, IgD)
IgM = very good for activating complement (classical pathway), first antibody produced, low affinity, high avidity
IgG = can cross placenta, strong antigen binding site (higher affinity), 2 IgGs can activate complement, highest concentration antibody found in blood
IgA = most secreted antibody, dimeric version found on mucosal surfaces, monomeric found in circulation, found in breast milk and other secretions
IgE = binds to high affinity receptor on mast cells, Ag binding provokes a strong inflammatory reaction, involved in expulsion of worms and other parasites, triggers allergic reactions

20 Plasma cells secrete antibodies.

21 MHC class I presents peptide from intracellular origins while MHC class II presents peptide from extracellular origins. Almost all cells in the body can present

via MHC class I, while dendritic cells, macrophages, and B cells can present via MHC class II.

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22 In all cells except mature B cells, the immunoglobulin variable region genes are in a fragmented form that cannot be expressed. The TCR genes in all cells except mature T cells are also in a fragmented form that isn't expressed.

23 For the B cell heavy chain, the D and J segments come together first, and then the V joins the D and J segments. For the B cell light chain, only V and J join together because there is no D segment.

24 The heavy chain has 5 isotypes (G, A, M, E, D- these confer constant region which determines antibody isotype), while the light chain has 2 isotypes (either kappa or lambda).

25 The constant region of the heavy chain determines the antibody isotype.

26 see number 19

27 The constant domains for the antibodies confer effector function.

28 CDRs= Complementarity determining regions
HVs= hypervariable regions
These areas lie in loops at the end of the V region domain. Three CDRs/ HVs make up the V region of both the heavy and light chain. Therefore each antigen binding site has a total of 6 CDRs/ HVs.

29 The V segments provide diversity for CDR1 and CDR2. In the heavy chain, CDR3 diversity comes from D segments, the V/D junction, and the D/J junction. In the light chain, CDR3 diversity comes from the V/J junction. The CDR3 of the heavy chain has the greatest diversity.

30 see #19
Antibody described in IgG.

31 Junctional diversity happens in DNA so this is irreversible. JD happens during maturation.
P nucleotides = RAG binding to RSS and cleaving results in palindromic nucleotides
N nucleotides = random nucleotide additions by TdT

32 a. T and B cells use RAG1 and RAG2
b. Recombination Signal Sequences are useful in T and B cells