1 – Basic Concepts and Components of the Immune System

1.1) The ____ immune system uses ____ as well as molecules (e.g. complement components). The ____ immune system uses ____ as well as antigen recognition molecules.

a) Adaptive; Phagocytes; Innate; Lymphocytes
b) Adaptive; Lymphocytes; Innate; Phagocytes
c) Innate; Phagocytes; Adaptive; Lymphocytes
d) Innate; Lymphocytes; Adaptive; Phagocytes

1.2) Phagocytic white cells (leukocytes, e.g. macrophages) congregate within ____ when foreign organisms get through a cut in the skin.

a) Microseconds
b) Seconds
c) Minutes
d) Hours
e) Days

1.3) Which of the following mediates an early response to viral infections by the innate immune system?

a) Complement components
b) Vaccines
c) T and B lymphocytes
d) Cytokines
e) Interferons

1.4) Which of the following is a messenger that mediates the connection between the innate and adaptive immune systems?

a) Complement components
b) Vaccines
c) T and B lymphocytes
d) Cytokines
e) Interferons

1.5) Which of the following immune system components would NOT recognize a macromolecule epitope (binding site)?

a) Phagocyte
b) T lymphocyte
c) B lymphocyte
d) Antibody

1.6) Which of the following is a large genomic region or gene family found in most vertebrates, playing an important role in immunity?

a) Antigen-recognition molecules
b) Major histocompatibility complexes (MHCs)
c) Human leukocyte antigens (HLAs)
d) Immunoglobulin
e) Epitopes

1.7) B-cell antigen receptors can interact directly with antigen, whereas T-cell antigen receptors only recognize antigen when it is presented to them on the surface of another cell.

a) True

b) False

1.8) How are B-cell and T-cell antigen receptors distributed?

a) By size (steric hindrance)
b) By molecular weight
c) By activation (clonal)
d) By location in the body
e) Equally (same number of each receptor)

1.9) A medical student acquired hepatitis B through a needle-stick injury. The student had not received their vaccinations for this virus and eventually experienced liver problems. One of the clinical signs of this disease is jaundice, which turns the skin and sclera what color?

a) Black
b) Red
c) White
d) Yellow
e) Blue

1.10) Monoclonal antibodies (mAb) are antibodies with a wide range of clinically important applications, such as pregnancy tests, cancer diagnosis, and cancer treatment. These antibodies are ____ and come from ____ parent cell(s).

a) Dissimilar; Multiple
b) Dissimilar; A single
c) Identical; Multiple
d) Identical; A single

1.11) Adaptive immune system response typically takes how long/

a) Microseconds
b) Seconds
c) Minutes
d) Hours
e) Days

2 – Basic Concepts

1) Which of the following is NOT true when comparing innate to adaptive immunity?

a) Innate responds quickly and adaptive responds slowly
b) Innate has few pathogen (non-self) recognition mechanisms and adaptive has many
c) Innate has immunologic memory and adaptive does not
d) Innate does not show response improvements over time and adaptive does
e) Innate response is non-specific and adaptive is very specific

2) Phagocytes ingest particular matter into cells for degradation. Which of the following is NOT considered a phagocyte?

a) Macrophage
b) Neutrophil
c) Eosinophil
d) Basophil
e) Lymphocyte

3.1) Which of the following components of the innate immune system involves recognition molecules such as mannan-binding lectin (MBL) for bacteria with mannose on the surface?

a) Natural killer (NK) cells
b) Complement system
c) Oxygen dependent and independent killing
d) Interferons
e) Acute phase proteins

3.2) Which of the following components of the innate immune system involves cytokines produced by macrophages, which are produced during infection?

a) Natural killer (NK) cells
b) Complement system
c) Oxygen dependent and independent killing
d) Interferons
e) Acute phase proteins

3.3) Which of the following components of the innate immune system involves the release of histamine?

a) Neutrophil
b) Eosinophil
c) Macrophage
d) Tissue mast cell
e) Natural killer cell

4.1) Which of the following components of the adaptive immune system secretes immunoglobulin (Ig)?

a) Activated B cell (plasma cell)
b) CD4+ activated T cell
c) CD8+ cytotoxic T cell (CTL)
d) Resting lymphocytes (B cell, CD4+ T cell, CD8+ T cell)
e) B and C

4.2) Which of the following components of the adaptive immune system causes lysis of virally infected cells and the release of cytokines?

a) Activated B cell (plasma cell)
b) CD4+ activated T cell
c) CD8+ cytotoxic T cell (CTL)
d) Resting lymphocytes (B cell, CD4+ T cell, CD8+ T cell)
e) B and C

4.3) Antigen presenting cells (APCs) include macrophages and dendritic cells, which are found in lymphoid tissues and the ____. These are critical in the uptake and presentation of antigen to T cells.

a) Liver
b) Kidney
c) Skin
d) Brain
e) Gallbladder

4.4) Which of the following is NOT a major feature (characteristic) of the adaptive immune system?

a) Specificity
b) Diversity
c) Memory
d) Improvement
e) Speed

5) Humoral immunity is mediated by antibodies from ____ and is involved in the elimination of ____ pathogens. Cell mediated immunity is mediated by ____ and is involved in the elimination of ____ pathogens.
a) B lymphocytes; Intracellular; T lymphocytes; Extracellular
b) B lymphocytes; Extracellular; T lymphocytes; Intracellular
c) T lymphocytes; Intracellular; B lymphocytes; Extracellular
d) T lymphocytes; Extracellular; B lymphocytes; Intracellular

6) How many doses of the Hepatitis B vaccine (5µg HBsAg in 0.5mL intramuscular) are required to reach a protective level of antibody?
a) One
b) Two
c) Three
d) Four
e) Five

Match the following innate immune system cell types with their function:

7.1) Eosinophils
7.2) Macrophages
7.3) Tissue mast cells
7.4) Natural killer cells
7.5) Neutrophils

a) Phagocytosis and bacteriocidal mechanisms, antigen presentation
b) Lysis of some virally infected cells
c) ~~Killing parasites~~
d) Release of histamine and other mediators
e) Phagocytosis and bacteriocidal mechanisms

7.6) In a resting lymphocyte, B cells and T cells can be distinguished from each other via a simple blood smear.
a) True
b) False

7.7) T cells are made in the ____ and complete their differentiation in the ____.
a) Spleen; Thyroid
b) Spleen; Thymus
c) Bone marrow; Thyroid
d) Bone marrow; Thymus
e) Bone marrow; Thalamus

7.8) Which of the following is a transmembrane glycoprotein that serves as a co-receptor for the T cell receptor (TCR), and is also known as a cytotoxic T cell (CTL)?
a) Cluster of differentiation 4 (CD4+)
b) Cluster of differentiation 8 (CD8+)
c) Plasma cells (activated B cells)

7.9) Which of the following produce large amounts of antibodies (Igs) and differentiate upon stimulation from CD4+ cells?
a) Cluster of differentiation 4 (CD4+)
b) Cluster of differentiation 8 (CD8+)
c) Plasma cells (activated B cells)

7.10) Which of the following is a glycoprotein expressed on the surface of T helper cells, regulatory T cells, monocytes, macrophages, and dendritic cells?

a) Cluster of differentiation 4 (CD4+)
b) Cluster of differentiation 8 (CD8+)
c) Plasma cells (activated B cells)

8) An individual is bitten by a dog with rabies and begins to develop antibodies against the rabies. These antibodies are harvested and transferred to unimmunized individuals to confer protection more rapidly for these individuals. This is an example of:

a) Active immunity
b) Passive immunity

Match the stage of an adaptive (acquired) immune response with the description:

9.1) Proliferation of cells with matching receptors
9.2) Eventual elimination of antigen
9.3) Recognition of antigen

a) Cognitive phase
b) Activation phase
c) Effector phase

9.4) What stage of an adaptive immune response involves secretion of antibody from a large plasma cell with extensive endoplasmic reticulum?

a) Cognitive phase
b) Activation phase
c) Effector phase

10.1) Which of the following types of antigen presenting cells (APCs) is critical in uptake and presentation of antigen to T cells?

a) Macrophage
b) Dendritic cell
c) B cell

10.2) Which of the following types of antigen presenting cells (APCs) has immunoglobulin that functions as a receptor, then the antigen is internalized, degraded, and presented to T cells?

a) Macrophage
b) Dendritic cell
c) B cell

10.3) Which of the following types of antigen presenting cells (APCs) is specialized for degradation and presentation of particulate antigens to T cells?

a) Macrophage
b) Dendritic cell
c) B cell

3 – Introduction to Antigen Recognition

1.1) Which of the following is NOT true regarding the complement system?

a) They are serum proteins that form protein cascades, each activated component activating the next to generate a physiologic response
b) They can bind to bacteria, making holes in their membrane
c) They attract phagocytes to both foreign material and self cells
d) Binding of MBLs to a bacterial capsule triggers the complement cascade
e) They help to eliminate immune complexes (antibody-antigen) and prevent them from damaging the body

1.2) Which of the following key components of the complement pathway can be activated by the lectin, classical, and alternative pathways?

a) C1
b) C3
c) C5
d) C7
e) C9

Match the three types of molecules that recognize antigen with their description:

2.1) Recognize antigens bound to MHC — a) B cell receptor (BCR)
2.2) Can create a soluble antigen receptor (antibody) — b) T cell receptor (TCR)
2.3) A cluster of genes that encode proteins — c) Major histocompatibility complex (MHC)

2.4) Which of the following has an immunoglobulin fold?

a) BCRs
b) TCRs
c) MHCs
d) BCRs & TCRs
e) BCRs, TCRs, & MHCs

2.5) The genes encoding which of the following can undergo hypermutation to create receptors that are an even better fit for foreign antigens?

a) BCRs
b) TCRs
c) MHCs
d) BCRs & TCRs
e) BCRs, TCRs, & MHCs

2.6) The genes encoding which of the following are extensively polymorphic (have multiple alleles or forms of the same gene)?

a) BCRs
b) TCRs
c) MHCs
d) BCRs & TCRs
e) BCRs, TCRs, & MHCs

3.1) What types of cell is class I MHC found on?

a) B cells
b) Macrophages
c) Dendritic cells
d) Essentially all cells
e) Mainly on A, B, & C

3.2) What types of cell is class II MHC found on?

a) B cells
b) Macrophages
c) Dendritic cells
d) Essentially all cells
e) Mainly on A, B, & C

3.3) What is the function of major histocompatibility complex (MHC) molecules?

a) Present sugars to T cells
b) Present peptides to T cells

c) Create holes in the membranes of bacteria
d) Lyse foreign antigens
e) Phagocytize foreign antigens

4.1) Unlike B cell receptors (BCRs), T cell receptors (TCRs) can only recognize foreign antigen if it is presented as a complex with a MHC molecule.
a) True
b) False

4.2) If the structure of an individuals MHC molecules makes it impossible for them to recognize and bind any peptide antigen from a given virus, that individual will still be able to activate a T cell response to cells infected with that virus.
a) True
b) False

5.1) Which of the following is NOT true about MHC molecules but true about B and T cells?
a) The genes that encode molecules are the most variable genes we know of in the human genome (polygenic)
b) They are extensively polymorphic (existence of multiple alleles or forms of the same gene)
c) Every cell in each individual expresses the same set of molecules
d) Every cell expresses a different molecule created from multiple gene segments that undergo somatic rearrangement
e) Their diversity exists in the population as a whole, not in the individual

5.2) Given that an individual's parents have completely different HLA genes, that individual will have about ____ different class I and II MHC molecules on the surface of certain of their lymphoid cells.
a) 3
b) 6
c) 9
d) 12
e) 15

4 – Antigen and Antibody Structure

1) Which of the following differentiates an antigen from an immunogen?
a) An antigen is a foreign molecule
b) An antigen can cause the production of antibodies
c) An antigen does not always elicit an immune response
d) Antigens are usually proteins or polysaccharides
e) Antigens are capable of being bound by immunologic receptors

2) Which of the following is NOT true regarding effective immunogens?
a) Foreign to the host
b) Fairly large (molecular weight > 6000)
c) Chemically complex (e.g. proteins made of many nucleotide bases)
d) Requires a carrier-conjugate to cause the generation of antibodies

3) Which of the following best describes penicillin, a hapten?
a) Large in size and can induce an immune response alone
b) Large in size and needs to be coupled to induce an immune response

c) Small in size and can induce an immune response alone
d) Small in size and needs to be coupled to induce an immune response

4) An epitope is generally used to refer to an area on a much larger molecule (e.g., a viral protein) with which an antibody can react.
a) True
b) False

5) Which of the following is NOT true?
a) The term epitope is not synonymous with antigen
b) A viral protein may contain a large number of epitopes that are capable of interacting with many different specific antibodies
c) Immunologic receptors on T cells recognize continuous (linear) epitopes
d) Immunologic receptors on T cells recognize discontinuous (conformational) epitopes
e) Antibodies can recognize both continuous and discontinuous epitopes

6) Which of the following is an agent (e.g. aluminum salts, oil-based, virosomes) often used to modify or augment the effects of a vaccine by stimulating the immune system to respond to the vaccine more vigorously, and thus providing increased immunity to a particular disease?
a) Antigen
b) Epitope
c) Immunogen
d) Stimulant
e) Adjuvant

7.1) What fraction of serum are the antibodies (immunoglobulins) initially found when using lytical techniques (e.g. electrophoresis)?
a) Albumin
b) Gamma (γ) globulin
c) Beta (β) globulin
d) Alpha (α) globulin

7.2) In the electrophoresis of human serum, which of the following is the most electronegative and thus migrates farthest toward the positive electrode?
a) Albumin
b) Gamma (γ) globulin
c) Beta (β) globulin
d) Alpha (α) globulin

7.3) Gamma (γ) globulin serum fraction contains predominantly which immunoglobulin?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

8) On an early morning run near his home, a runner startled a group of dogs being exercised and was bitten on the leg. The runner was later unable to locate the dog and its owner to verify that the dog had an up-to-date rabies vaccination. Given that rabies is always fatal, and despite the very low incidence in domesticated dogs, prudence dictated undergoing treatment. The runner was given human immunoglobulin G-containing

antibodies to rabies virus (anti-rabies immunoglobulin) injected around the site of the wound and at several other intramuscular sites. This antibody preparation confers instant protection from the virus without requiring the body to develop a response. This is an example of:

a) Active immunity
b) Passive immunity

9) The aim of monoclonal antibody production is to produce cells that only secrete immunoglobulin directed against the antigen used in immunization. Which of the following hybridoma production steps is NOT correct?

a) Immunize a mouse with antigen of choice then remove the spleen when the mouse is making an antibody response
b) Fuse the immune spleen cells with a myeloma tumor cell
c) The cells are cultured in a selective medium allowing fused and non-fused cells to survive
d) Cells are grown in individual culture plate wells, and culture supernatants from wells contains growing hybrid cells are screened for presence of desired antibody by an enzyme-linked immunosorbent assay (ELISA)
e) This clone (hybridoma) is an immortal producer of the desired monoclonal antibody

Match the following descriptions with their term:

10.1) Allows for flexibility
10.2) Binds antigen
10.3) Binds to various cellular receptors and to complement
10.4) Only has fragment antigen-binding (Fab) region
10.5) Has an fragment crystallizable (Fc) and Fab region
10.6) Each antibody molecule contains ____ heavy chains and ____ light chains.

a) Light chain
b) Heavy chain
c) Fab region
d) Fc region
e) Hinge region

a) 1; 1
b) 1; 2
c) 2; 1
d) 2; 2
e) 2; 3

Match the immunoglobulin(s) with the functional description:

11.1) Activates the complement system
11.2) Involved in allergic responses
11.3) Predominant in the primary (early) immune response
11.4) Has different subtypes
11.5) Can transfer across the placental (maternal protection)

a) IgG
b) IgE
c) IgM
d) IgG & IgM
e) IgG & IgA

11.6) Pepsin cleaves what region of immunoglobulin?

a) Heavy chain
b) Light chain
c) Hinge region

11.7) Papain cleaves what region of immunoglobulin?

a) Heavy chain
b) Light chain
c) Hinge region

11.8) IgM is structurally characterized as:

a) Monometric
b) Bimetric
c) Trimetric
d) Tetrametric
e) Pentametric

11.9) Which of the following is the main immunoglobulin in the gut and secretions (saliva, milk, tears) and is important in mucosal immunity?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

11.10) Which of the following binds to an Fc receptor on mast cells and basophils?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

11.11) Which of the following is chiefly found on the surface of B cells as a receptor molecule and is involved in cell activation?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

5 – Antibody-Antigen Interactions

1) Which of the following is NOT involved in the antigen-antibody interaction?
a) Electrostatic interactions between charged side-chains
b) Hydrophobic interactions
c) Van der Waals forces
d) Hydrogen bonds
e) Peptide bonds

2.1) Which of the following best describes cross-reactivity?
a) When one antibody can bind with one antigen
b) When one antibody can bind with multiple antigens
c) When multiple antibodies can bind with one antigen
d) When multiple antibodies can bind with multiple antigens

2.2) Penicillin can form a hapten-carrier conjugate with a self-protein that can then act as an immunogen and generate an immunoglobulin ____ antibody, and can cross-react with a number of other antibiotics. This can complicate the treatment of bacterial infections in these patients because they are unable to take the antibiotics necessary to combat the infection.
a) IgA
b) IgD
c) IgE

d) IgG
e) IgM

3.1) Which of the following is used to enumerate and/or separate live cells that express an antigen, sorted by applying an electric charge to the stained cells?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.2) Which of the following is a very sensitive and simple test for antigens, which uses a covalent complex of enzyme linked to antibody, to detect antigen directly or to bind antibody-antigen complex?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.3) Which of the following is used to characterize antigens in complex mixtures biochemically?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.4) Which of the following uses ultraviolet (UV) light for examining specimens?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.5) Which of the following would be used as preliminary screening for the presence of antibodies to HIV proteins in a patient's blood sample?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.6) What color light is emitted when antigens are exposed to UV light after being treated with fluorescein isothiocyte (FITC), such as in the test for *Treponema pallidum* (syphilis) or to dye the Chicago river for a particular holiday (fluorescein)?
a) Blue
b) Purple
c) Red
d) Orange
e) Green

3.7) Which of the following uses the enzyme horseradish peroxidase (HRP)?
a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)
e) ELISA & Western blotting

3.8) Which of the following is used extensively to detect antigens in cells or tissue sections, as well as to screen for auto-antibodies to cell or tissue antigens?

a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

3.9) Which of the following uses protein antigens separated by molecular weight using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE)?

a) ELISA (Enzyme-linked immunosorbent assay)
b) Fluorescent antibody (fluorochromes)
c) FACS (fluorescence-activated cell sorting)
d) Western blotting (immunoblotting)

6 – Antibody Diversity

1.1) Each polypeptide chain (heavy and light) on immunoglobulin has a variable (V) and constant (C) region. Immunoglobulin chains are encoded by _____ that is/are rearranged during ____ development to assemble a functional gene encoding either a heavy or a light chain.

a) A single continuous DNA sequence; B cell
b) A single continuous DNA sequence; T cell
c) Sets of gene segments; B cell
d) Sets of gene segments; T cell

1.2) Which of the following is only contained in heavy chains and not in light chains?

a) Leader (L)
b) Joining (J)
c) Diversity (D)
d) Variable (V)
e) Constant (C)

2.1) During the development of B cells, the Ig gene segments are rearranged and brought next to each other to form a contiguous functional gene (somatic recombination). The complex of enzymes involved in somatic recombination in lymphocytes is called:

a) RAG-1 (Recombination-Activating Gene)
b) RAG-2 (Recombination-Activating Gene)
c) V(D)J-recombinase
d) V(D)J-lyase
e) A & B

2.2) In somatic recombination, the ____ rearranges first. The ____ region of the antibody molecule is generated via somatic recombination as it binds to the antigen and contains both a constant region and a variable region.

a) Heavy chain; Fab
b) Light chain; Fab
c) Heavy chain; Fc
d) Light chain; Fc

2.3) The two types of light chains are:

a) Alpha (a) and beta (b)
b) Sigma (s) and gamma (g)

c) Epsilon (e) and delta (d)
d) Omega (o) and zeta (z)
e) Lambda (l) and kappa (k)

2.4) During the final step of synthesis for heavy and light immunoglobulin chains, which of the following peptides is cleaved?
a) Leader (L)
b) Joining (J)
c) Diversity (D)
d) Variable (V)
e) Constant (C)

3) Which of the following is NOT true regarding the mechanisms of generating antibody diversity?
a) V, D, and J gene segments are present in multiple copies (germline diversity)
b) VJ and VDJ gene segments can recombine in multiple combinations (combinatorial diversity)
c) Different sequences at the joint lead to greater antibody diversity (junctional diversity)
d) A single combination of light and heavy chains
e) Somatic hypermutation after antigenic stimulation

4) Class switching (isotype switching) involves rearrangement of the V(H) exon to associate with a different C(H) exon at different times in the course of an immune response. The ____ region of the antibody molecule is affected (changed) via class switching and, unlike somatic recombination, this process is antigen ____.
a) Fab; Dependent
b) Fab; Independent
c) Fc; Dependent
d) Fc; Independent

5.1) ____ is frequently found on the surface of B cells co-expressed with ____. These two classes are co-expressed not by class switching but by alternative processing of a primary RNA transcript. Both molecules expressed on the single mature B cell have the same binding specificity for antigen.
a) IgA & IgG
b) IgD & IgM
c) IgE & IgA
d) IgG & IgM
e) IgM & IgE

5.2) If alternative processing uses the first polyadenylation site, then what type of heavy chain mRNA is derived?
a) α (alpha)
b) γ (gamma)
c) δ (delta)
d) ε (epsilon)
e) μ (mu)

5.3) If alternative processing uses the second polyadenylation site, then what type of heavy chain mRNA is derived?
a) α (alpha)

b) γ (gamma)
c) δ (delta)
d) ε (epsilon)
e) μ (mu)

6) Production of secreted antibodies (pAs site) involves a ____ chain of amino acids with a stretch of charged (versus non charged) amino acids at the ____ terminus, in comparison to membrane bound antibody production (pAm site).

a) Shorter; NH2
b) Shorter; COOH
c) Longer; NH2
d) Longer; COOH

7) In heterozygous individuals who have, for example, inherited two alternative forms of the constant region gene for IgG_1 (i.e., IgG1m(1) and IgG1m(2)), which of the following is true regarding the Ig expression by a particular B cell, according to allelic exclusion?

a) It will be of the IgG1m(1) type
b) It will be of the IgG1m(2) type
c) It will contain both types
d) It will contain neither type
e) It will contain only one of the types

7 – The T Cell Receptor (TCR)

1.1) Protein and nucleic acid sequence data have been obtained for many TCRs with different specificities. Analyses of these sequences suggest the existence of how many hypervariable (hv) regions within the variable region?

a) 1
b) 2
c) 3
d) 4
e) 5

1.2) The biochemical structure of the T-cell receptor (TCR) of the αβ type (95% of human TCRs) is comparable to a ____ immunoglobulin ____ fragment, having very short cytoplasmic tails.

a) Secreted; Fab
b) Secreted; Fc
c) Membrane-bound; Fab
d) Membrane-bound; Fc

2.1) Where are δγ T cells generally found in the body (location of TCR rearrangement)?

a) Spleen
b) Bone marrow
c) Thyroid
d) Thymus
e) Thalamus

2.2) In comparison to αβ T cells, δγ T cells ____ and are hypothesized to be a ____ line of immune defense.

a) Recognize peptide antigens by MHC; Primary
b) Do not recognize peptide antigens by MHC; Primary

c) Recognize peptide antigens by MHC; Secondary
d) Do not recognize peptide antigens by MHC; Secondary

3.1) Which of the following best describes the location of the delta (δ)-chain locus in human T-cell receptors?
a) Chromosome 7
b) Chromosome 7 within the alpha (α)-locus
c) Chromosome 14
d) Chromosome 14 within the beta (β)-locus
e) Chromosome 14 within the alpha (α)-locus

3.2) Which of the following are located in chromosome 7 within human T-cell receptors?
a) Alpha (α)-locus
b) Beta (β)-locus
c) Gamma (γ)-locus
d) A & B
e) B & C

3.3) Comparing the arrangement of TCR genes and BCR genes, the ____ chain is analogous to the heavy (H) chain and the ____ chain is analogous to the light (L) chain.
a) Alpha (α); Beta (β)
b) Beta (β); Alpha (α)
c) Delta (δ); Gamma (γ)
d) Gamma (γ); Delta (δ)

3.4) Which of the following TCR genetic chains contain D-segments, similar to immunoglobulin heavy chains?
a) Alpha (α); Beta (β)
b) Delta (δ); Gamma (γ)
c) Beta (β); Delta (δ)
d) Gamma (γ); Alpha (α)
e) Alpha (α); Delta (δ)

3.5) Which of the following TCR genetic chains contains V and J segments, similar to genes for immunoglobulin kappa and lambda light chains?
a) Alpha (α); Beta (β)
b) Delta (δ); Gamma (γ)
c) Beta (β); Delta (δ)
d) Gamma (γ); Alpha (α)
e) Alpha (α); Delta (δ)

4) The process used to increase antigen binding affinity is called somatic ____ and occurs in ____ cells but not ____ cells.
a) Cell hybridization; B; T
b) Cell hybridization; T; B
c) Hypermutation; B; T
d) Hypermutation; T; B

5.1) Deficiencies in ____ lead to autosomal-recessive severe combined immunodeficiency disease (SCID).
a) RAG-1
b) RAG-2

c) RAG-1 or RAG-2
d) Both RAG-1 and RAG-2

5.2) If both RAG-1 and RAG-2 mutations occur, which of the following is true?
a) T cells will be absent but B and NK cells will be present
b) T and B cells will be absent but NK cells will be present
c) B cells will be absent but T and NK cells will be present
d) B and NK cells will be present but T cells will be absent
e) B, T, and NK cells will be absent

6.1) If a B cell successfully rearranges the first heavy chain locus, it inhibits the rearrangement of the other heavy chain on the other chromosome. What is this called?
a) Affinity maturation
b) Allelic exclusion
c) Class switching
d) Somatic cell hybridization
e) Somatic hypermutation
f) V(D)J gene rearrangement

6.2) Allelic exclusion is a process by which the protein from only one allele is expressed while other allele(s) are silenced. Allelic exclusion occurs (generally) in which of the following?
a) B cells and TCR beta chains, but not in alpha chains
b) B cells and TCR alpha chains, but not in beta chains
c) TCR beta chains, but not in alpha chains or B cells
d) TCR alpha chains, but not in beta chains or B cells
e) B cells, TCR beta chains, and TCR alpha chains

7.1) Superantigens such as staphylococcal enterotoxins bind to certain TCR ____ chains and to MHC class II molecules. MHC binding does not involve the peptide groove. T cells can then release extremely high levels of cytokines, which lead to toxic shock syndrome (TSS) when they appear in the blood.
a) Alpha (α)
b) Beta (β)
c) Delta (δ)
d) Gamma (γ)

7.2) The TCR binds with ____, and the relatively ____ surface of the TCR interacts with its ligand.
a) MHC only; Flat
b) MHC only; Curved
c) Peptide antigen only; Flat
d) Peptide antigen only; curved
e) Both MHC and peptide antigen; Flat
f) Both MHC and peptide antigen; Curved

7.3) T cells ____ the potential to express an alternative secreted form like the B-cell antigen receptor. Superantigens can activate T cells ____ antigen processing and presentation.
a) Have; Only with
b) Have; Independent of
c) Do not have; Only with

d) Do not have; Independent of

8.1) A TCR complex is comprised of the TCR, CD3 molecules, and which of the following CD3 chains?

a) Delta (δ) chain
b) Gamma (γ) chain
c) Epsilon (ε) chains (two chains)
d) Zeta (ζ) chains (two chains)

8.2) Which of the following molecules is necessary (not accessory) for antigen recognition and T cell activation?

a) CD2
b) CD3
c) CD4
d) CD8
e) CD28
f) CD45R
g) LFA-1

Match the description with the molecules:

9.1) Co-receptor molecule involved in signal transduction — a) TCR
9.2) Adhesion molecule — b) CD3
9.3) Antigen recognition molecule — c) CD4 & CD8
9.4) Involved in signal transduction on different T cells — d) CD11a (LFA-1)
9.5) Genes involved in antigen processing — e) LMP/TAP

9.6) CD4 molecules bind with ____ MHC molecules and are found on (expressed by) ____ cells. CD8 molecules bind with ____ MHC molecules and are found on (expressed by) ____ cells.

a) Class I; Helper T; Class II; Cytotoxic T
b) Class I; Cytotoxic T; Class II; Helper T
c) Class II; Helper T; Class I; Cytotoxic T
d) Class II; Cytotoxic T; Class I; Helper T

9.7) Which of the following is the cellular receptor for HIV attachments to T cells?

a) CD2
b) CD3
c) CD4
d) CD8
e) LFA-1

9.8) CD4 and CD8 enhance the response of specific T cells, both by stabilizing the TCR-peptide-MHC complex and by bringing what type of protein kinase into the proximity of the cytoplasmic tails, thereby facilitating signal transduction and cell activation?

a) Serine
b) Threonine
c) Aspartic acid
d) Histidine
e) Tyrosine

8 – Major Histocompatibility Complex (MHC)

1.1) Class III MHC genes encode for which of the following?

a) CD4+ T cells
b) CD8+ T cells
c) Compliment molecules
d) Cytokine molecules
e) C & D

1.2) MHC class I has three genes (HLA-A, HLA-B, & HLA-C). Which of the following is the correct order from most alleles (most polymorphic) to least alleles?

a) A > B > C
b) A > C > B
c) B > A > C
d) B > C > A
e) C > A > B
f) C > B > A

1.3) How many genes does MHC class II have?

a) 2 (HLA-DP alpha/beta)
b) 2 (HLA-DQ alpha/beta)
c) 4 (HLA-DP alpha/beta, HLA-DQ alpha/beta)
d) 4 (HLA-DQ alpha/beta, HLA-DR alpha/beta)
e) 6 (HLA-DP alpha/beta, HLA-DQ alpha/beta, HLA-DR alpha/beta)

1.4) Which of the following MHC class II genes has the most alleles (most polymorphic)?

a) DPα
b) DPβ
c) DQα
d) DQβ
e) DRα
f) DRβ

1.5) Which of the following MHC class II genes has the lease alleles?

a) DPα
b) DPβ
c) DQα
d) DQβ
e) DRα
f) DRβ

2.1) MHC molecules exhibit ____ and immunoglobulin/TCR molecules exhibit ____.

a) Allelic exclusion; Allelic exclusion
b) Allelic exclusion; Co-dominant expression
c) Co-dominant expression; Co-dominant expression
d) Co-dominant expression; Allelic exclusion

2.2) Because of a lack of genetic recombination in the MHC, blocks of alleles (haplotypes) are inherited together, and they are identical in families. Which of the following is the likely result of this?

a) Family members have identical combinations of HLA alleles, thus tissue transplantation is simple
b) Family members have identical combinations of HLA alleles, thus tissue transplantation is difficult

c) No family members have identical combinations of HLA alleles, thus tissue transplantation is simple
d) No family members have identical combinations of HLA alleles, thus tissue transplantation is difficult

3.1) Class II MHC molecules accommodate ____ peptides and thus ____ be referred to analogously as a "hotdog in a bun", in contrast to class I MHC molecules.
a) Smaller; Would
b) Smaller; Would not
c) Larger; Would
d) Larger; Would not

3.2) Which of the following is NOT a structural chain in class I MHC?
a) β1
b) α1
c) α2
d) α3
e) β-microglobin

3.3) Which of the following is NOT a structural chain in class II MHC?
a) α1
b) α2
c) α3
d) β1
e) β2

4) Evidence is accumulating showing that polymorphism in the MHC may be advantageous. Homozygosity at HLA class I has been shown to be a(n) ____ with respect to HIV/AIDS. Similarly, there is evidence that homozygosity at HLA class II ____ the risk of hepatitis B virus infection persisting.
a) Advantage; Decreases
b) Advantage; Increases
c) Disadvantage; Decrease
d) Disadvantage; Increase

Certain MHC haplotypes are associated with autoimmune disease. Match the disease with the HLA type:

5.1) Ankylosing spondylitis	a) B27
5.2) Insulin-dependent diabetes mellitus	b) DR2
5.3) Pemphigus vulgaris	c) DR3
5.4) Systemic lupus erythematosus	d) DR4
5.5) Good pasture's syndrome	e) DQ2
5.6) Multiple sclerosis	
5.7) Rhematoid arthritis	

9 – Review of Antigen Recognition

1.1) Which of the following is true regarding immunoglobulin and T-cell receptor (TCR) proteins and gene segments?
a) Heavy chain analogous to βδ TCR chain using VDJ gene segment; Light chain analogous to αγ TCR chain using VJ gene segment

b) Light chain analogous to βδ TCR chain using VDJ gene segment; Heavy chain analogous to αγ TCR chain using VJ gene segment
c) Heavy chain analogous to βδ TCR chain using VJ gene segment; Light chain analogous to αγ TCR chain using VDJ gene segment
d) Light chain analogous to βδ TCR chain using VJ gene segment; Heavy chain analogous to αγ TCR chain using VDJ gene segment
e) Heavy chain analogous to αγ TCR chain using VDJ gene segment; Light chain analogous to βδ TCR chain using VJ gene segment
f) Light chain analogous to αγ TCR chain using VDJ gene segment; Heavy chain analogous to βδ TCR chain using VJ gene segment

Match the following structure with its function (recognition of antigen):

a) Immunoglobulin b) TCR αβ c) TCR γδ

1.2) Dual recognition: self MHC + peptide antigen

1.3) Directly: some recognize nonpeptide phosphorylated lipids and carbohydrates; other recognize antigen that have not been processed

1.4) Directly: carbohydrate, protein, lipid, nucleic acid epitopes

1.5) MHC class I has peptides of ____ amino acid residues and is an ____ antigen. MHC class II has peptides of ____ amino acid residues and is an ____ antigen.

a) 8-11; Endogenous; 9-30; Exogenous
b) 9-30; Endogenous; 8-11; Exogenous
c) 8-11; Exogenous; 9-30; Endogenous
d) 9-30; Exogenous; 8-11; Endogenous

1.6) Which of the following is NOT true of T-cell receptors, when compared to immunoglobulin?

a) Prior to exposure to antigen, there are multiple V region gene segments
b) Prior to exposure to antigen, somatic recombination of gene segments occurs
c) Prior to exposure to antigen, there is junctional variability
d) Prior to exposure to antigen, there are multiple combination of chains
e) After exposure to antigen, there is somatic hypermutation and class switching

10 – Antigen Processing and Presentation

1) The ____ T cell-APC interaction is MHC ____-restricted, and the ____ T cell-target cell interaction is MHC ____-restricted.

a) CD4+; Class I; CD8+; Class II
b) CD4+; Class II; CD8+; Class I
c) CD8+; Class I; CD4+; Class II
d) CD8+; Class II; CD4+; Class I

2.1) Which of the following describes where class I MHC is found and not where class II MHC is found?

a) B cells
b) Dendritic cells
c) Macrophages
d) Antigen presenting cells (A, B, & C)
e) All nucleated cells

2.2) Peptides antigens generated in the cytosolic compartment (intracellular infection, e.g. virus) bind to ____ MHC molecules for presentation to ____ T cells. Peptide antigens

generated in vesicles (extracellular infection, e.g. bacteria) bind to ____ MHC molecules for presentation to ____ T cells.

a) Class I; CD4+; Class II; CD8+
b) Class II; CD4+; Class I; CD8+
c) Class I; CD8+; Class II; CD4+
d) Class II; CD8+; Class I; CD4+

3.1) In the processing pathway for extracellular antigens, synthesis of MHC class II and invariant chain (Ii) occurs in the ____.

a) Cytosol
b) Golgi apparatus
c) Endoplasmic reticulum
d) Ribosomes
e) Lysosomes

3.2) The invariant chain ____ the empty peptide-binding groove. After vesicle fusion, the invariant chain is ____ and peptides can enter the MHC class II grove.

a) Activates; Added
b) Activates; Degraded
c) Blocks; Added
d) Blocks; Degraded

4.1) In the processing pathway for intracellular antigens, the proteasome will ____ viral protein molecules until peptides of ____ residues are formed; these can bind to class I MHC molecules.

a) Build; 8-11
b) Build; 9-30
c) Break down; 8-11
d) Break down; 9-30

4.2) The transporter associated with antigen presentation (TAP) ____ the peptides to traverse the membrane bilayer of the endoplasmic reticulum and bind in the empty peptide-binding groove of nascent MHC ____ molecules being synthesized in the endoplasmic reticulum.

a) Permits; Class I
b) Permits; Class II
c) Does not allow; Class I
d) Does not allow; Class II

5) Mutations in TAP-1 or TAP-2 may alter the function of the heterodimer TAP. Which of the following is common for patients with TAP mutations?

a) Human immuno-deficiency virus (HIV) infection
b) Acquired immune deficiency syndrome (AIDS)
c) Upper respiratory tract infections
d) Coagulation disorders (hemophilia)
e) Systemic inflammatory response syndrome (SIRS, sepsis)

6.1) Certain strains of adenovirus express a protein that inhibits the transcription of class I MHC molecules. What is a consequence of this?

a) Reduced likelihood that peptides will be expressed at the cell surface
b) Fewer peptides are available to bind to class I MHC

c) Reduced number of class I MHC molecules available to display peptides to CD8+ lymphocytes

6.2) A protein of herpes simplex virus (HSV) binds to TAP and inhibits peptide transport into the endoplasmic reticulum. What is a consequence of this?

a) Reduced likelihood that peptides will be expressed at the cell surface
b) Fewer peptides are available to bind to class I MHC
c) Reduced number of class I MHC molecules available to display peptides to CD8+ lymphocytes

6.3) Bacteria such as *Mycobacterium tuberculosis* have acquired the capacity to inhibit phagosome-lysosome fusion. What is a consequence of this?

a) Reduced likelihood that peptides will be expressed at the cell surface
b) Fewer peptides are available to bind to class I MHC
c) Reduced number of class I MHC molecules available to display peptides to CD8+ lymphocytes

11 – Lymphocyte Activation

1.1) The structure of the B-cell receptor contains the invariant proteins Igα and Igβ, which are linked via ____ and are essential for signal generation across the B-cell surface membrane and for surface expression of immunoglobulin receptors (mIgs).

a) Covalent bonding
b) Hydrophobic interactions
c) Sulfide bonding
d) Hydrogen bonding
e) Peptide bonding

1.2) Immunoreceptor tyrosine-based activation motifs (ITAMs) are essential for signal transduction in ____ cells.

a) B cells
b) T cells
c) B cells or T cells
d) B cells and T cells
e) Neither B or T cells

1.3) Regarding the structure of the T-cell receptor, which of the following is NOT an invariant CD3 protein chain?

a) Zeta (ζ) chain
b) Epsilon (ε) chain
c) Gamma (γ) chain
d) Delta (δ) chain

2) Which of the following is the correct order for a lymphocyte to be activated?

a) Recognition of antigen, activation of tyrosine kinases, clustering of receptors, phosphorylation
b) Recognition of antigen, clustering of receptors, activation of tyrosine kinases, phosphorylation
c) Recognition of antigen, activation of tyrosine kinases, phosphorylation, clustering of receptors
d) Recognition of antigen, activation of tyrosine kinases, clustering of receptors, phosphorylation

e) Recognition of antigen, clustering of receptors, phosphorylation, activation of tyrosine kinases

3.1) The B cell co-receptor can co-cluster with the BCR and increase the efficiency of signaling. Which of the following proteins does NOT make up the co-receptor?

a) CD19
b) CD20
c) CD21
d) CD81

3.2) Protein antigens bound to complement component C3d can bind simultaneously to both ____ and the BCR. This enables the co-receptor complex to cluster and crosslink with the BCR, inducing phosphorylation.

a) CD19
b) CD20
c) CD21
d) CD81

3.3) B cell co-receptor phosphorylation sites include Igα/Igβ and which of the following?

a) CD19
b) CD20
c) CD21
d) CD81

4.1) Presence of the TCR co-receptor molecules (CD4 or CD8) has been estimated to reduce the number of MHC-peptide complexes required to trigger a T-cell response by about:

a) 5-fold
b) 10-fold
c) 50-fold
d) 100-fold
e) 1000-fold

4.2) Leukocyte-specific protein tyrosine kinase (Lck) is integral in the signaling cascade in ____ cells. Zeta-chain-associated protein kinase 70 (ZAP-70), which binds CD3-zeta, is ____ cell specific. Spleen tyrosine kinase (Syk), a signal transmitter, is found predominantly in ____ cells.

a) B; B; B
b) T; T; T
c) B; B; T
d) T; T; B
e) B; T; T
f) T; B; B

5.1) Protein tyrosine kinases (PTKs) play an important role in lymphocyte function and activation. A mutation in the genes encoding the enzyme ZAP-70 would lead to which of the following?

a) Human immuno-deficiency virus (HIV) infection
b) Acquired immune deficiency syndrome (AIDS)
c) Severe combined immunodeficiency (SCID) syndrome
d) Systemic inflammatory response syndrome (SIRS, sepsis)
e) X-linked agammaglobulinemia

5.2) A mutation in the genes encoding the enzyme Bruton's tyrosine kinase (Btk) would lead to which of the following?
a) Human immuno-deficiency virus (HIV) infection
b) Acquired immune deficiency syndrome (AIDS)
c) Severe combined immunodeficiency (SCID) syndrome
d) Systemic inflammatory response syndrome (SIRS, sepsis)
e) X-linked agammaglobulinemia

12 – Hematopoiesis

1.1) What is the major site for hematopoiesis, where all blood cells are formed?
a) Spleen
b) Bone marrow
c) Liver
d) Thymus
e) Kidneys

1.2) Which of the following are cells with some lineage commitment and little or no self-renewal capacity?
a) Hematopoietic stem cells (HSCs)
b) Progenitor (precursor) cells
c) Mature cells

1.3) Which of the following are lineage restricted, morphologically identifiable, and express differentiation markers?
a) Hematopoietic stem cells (HSCs)
b) Progenitor (precursor) cells
c) Mature cells

1.4) Which of the following are pluripotential, self-renewing CD34+ cells?
a) Hematopoietic stem cells (HSCs)
b) Progenitor (precursor) cells
c) Mature cells

2) Which of the following is NOT a cell that progenitors ultimately differentiation into?
a) B cells
b) T cells
c) Erythrocytes
d) Platelets
e) Granulocytes
f) NK cells
g) Macrophages (monocytes)
h) HSCs

3) Cytokine interleukin-7 (IL-7) is a hematopoietic growth factor secreted by the stromal cells (macrophages and adipocytes) of the red marrow and thymus capable of stimulating the proliferation of lymphoid ____. It ____ affected by X-linked SCID.
a) Hematopoietic stem cells (HSCs); Is
b) Progenitor (precursor) cells; Is
c) Mature cells; Is
d) Hematopoietic stem cells (HSCs); Is not
e) Progenitor (precursor) cells; Is not

f) Mature cells; Is not

Match the lymphoid or myeloid cell type with its role:
ADCC = antibody-dependent cell-mediated cytotoxicity

4.1) Lyse certain virally infected cells and some tumor cells
4.2) Phagocytose, bacteriocidal activity, ADCC
4.3) Important role in allergic response; heparin & histamine
4.4) Major source of antigen-specific protection against viral infection
4.5) Combat certain parasitic infections (e.g. worms); hydrolytic enzymes
4.6) Critical in antigen-capture and uptake in peripheral tissues
4.7) Produce antibody and express immunoglobulin
4.8) Phagocytic and cytotoxic activities; chemotactic factors

a) B cells
b) T cells
c) NK cells
d) Neutrophils
e) Mast cells
f) Eosinophils
g) Monocytes/Macrophages
h) Dendritic cells

5) The mutation on the X chromosome responsible for X-SCID is in the gene for a subunit of several cytokine receptors. Which of the following is true for boys affected with X-SCID at birth?

a) Non-functional B cells, T cells, & NK cells
b) Non-functional B cells & T cells, and no NK cells
c) Non-functional B cells, and no T cells or NK cells
d) Non-functional T cells & NK cells, and no B cells
e) No B cells, T cells, or NK cells

6.1) Granulocyte colony-stimulating factor (G-CSF) causes an increase in the production of which of the following in the bone marrow?

a) Neutrophils
b) Mast cells
c) Eosinophils
d) Monocytes/Macrophages
e) Dendritic cells

6.2) Macrophage colony-stimulating factor (M-CSF) causes an increase in the production of which of the following?

a) Neutrophils
b) Mast cells
c) Eosinophils
d) Monocytes/Macrophages
e) Dendritic cells

6.3) Granulocyte-macrophage colony-stimulating factor (GM-CSF) causes an increase in the production of which of the following?

a) Neutrophils
b) Mast cells
c) Eosinophils
d) Monocytes/Macrophages
e) Dendritic cells

13 – The Organs and Tissues of the Immune System

1.1) In the embryonic human, the primary lymphoid organs are initially in the yolk sac, then in the fetal ____, and finally in the ____.

a) Spleen and kidneys; Bone marrow and thymus
b) Spleen and thymus; Bone marrow and kidneys

c) Kidneys and thymus; Bone marrow and spleen
d) Kidneys and bone marrow; Spleen and thymus
e) Spleen and liver; Bone marrow and thymus

1.2) In the adult, the primary lymphoid organs, whose cells expand clonally, are the ____ and secondary lymphoid organs, which create effector cells, are the ____, as well as mucosa associated lymphoid tissue (MALT) lining the respiratory, GI, and reproductive tracts.

a) Spleen and lymph nodes; Bone marrow and thymus
b) Bone marrow and thymus; Spleen and lymph nodes
c) Spleen and bone marrow; Lymph nodes and thymus
d) Bone marrow and lymph nodes; Thymus and spleen

2) The thymus is the primary site of T-cell development. Which of the following is the correct order arranged from the area with the earliest progenitor cells to the area with the most mature T lymphocytes?

a) Medulla then cortex then subcapsular zone
b) Medulla then subcapsular zone then cortex
c) Subcapsular zone then medulla then cortex
d) Subcapsular zone then cortex then medulla
e) Cortex then medulla then subcapsular zone
f) Cortex then subcapsular zone then cortex

3.1) The spleen, the major filter for blood, is about the size of a clenched fist and is found on the ____ side associated posteriorly with ribs ____.

a) Left; 7-9
b) Left; 9-11
c) Right; 5-7
d) Right; 7-9
e) Right; 9-11

3.2) The spleen has a red pulp (macrophages and red blood cells) and a white pulp (dense lymphoid tissue). T cells are found chiefly in the ____ and B cells are found in the ____, both within the ____ pulp.

a) Periarteriolar lymphoid sheaths (PALS); Follicles; White
b) Periarteriolar lymphoid sheaths (PALS); Follicles; Red
c) Follicles; Periarteriolar lymphoid sheaths (PALS); White
d) Follicles; Periarteriolar lymphoid sheaths (PALS); Red

3.3) The spleen responds to ____ antigens and the lymph nodes respond to ____ antigens for presentation to ____.

a) Lymph-borne; Blood-borne; B cells
b) Lymph-borne; Blood-borne; T cells
c) Blood-borne; Lymph-borne; B cells
d) Blood- borne; Lymph-borne; T cells

4.1) Which of the following is NOT a major area where lymph nodes can be found?

a) Cervical
b) Axillary
c) Mesenteric
d) Inguinal
e) Cardiac

Match the lymph node location with the cells it contains:

4.2) Medulla a) B cells
4.3) Paracortex b) CD4+ T cells
4.4) Cortex c) B cells, T cells, macrophages

5.1) Epithelial ____ cells take up antigens that are inhaled or ingested, through the process of ____.

a) M; Phagocytosis
b) N; Phagocytosis
c) G; Phagocytosis
d) M; Pinocytosis
e) N; Pinocytosis

5.2) Which of the following locations has cell that transport the antigens by transcytosis into sub-epithelial tissues (e.g. lamina propria) where they encounter lymphocytes?

a) Tonsils (nasopharyngeal-associated lymphoid tissue, NALT)
b) Adenoids (nasopharyngeal-associated lymphoid tissue, NALT)
c) Peyer's patches (gut-associated lymphoid tissue, GALT)
d) Axilla (lymph node center)
e) Thymus (T cell development)

5.3) Regarding mucosa-associated lymphoid tissue (MALT), which of the following is secreted by B cells across the epithelium?

a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

6) Intraepithelial lymphocytes (IEL) act to protect the host against viral and bacterial pathogens encountered in the gut and secrete cytokines. Their predominant phenotype is:

a) αβ T cells
b) γδ T cells
c) B cells
d) Macrophages
e) Dendritic cells

7) Regarding the cutaneous immune system (skin), T lymphocytes and Langerhans cells (chiefly ____) are found in the ____ and macrophages and T cells are found in the ____.

a) CD4+; Dermis; Epidermis
b) CD8+; Dermis; Epidermis
c) CD4+; Epidermis; Dermis
d) CD8+; Epidermis; Dermis

8.1) ____ lymphocytes migrate to and lodge in selected tissue sites (lymphocyte homing). ____ constantly circulate among the ____ lymphoid organs until they encounter antigen or die.

a) Effector (memory) T lymphocytes; Naïve T lymphocytes; Primary
b) Effector (memory) T lymphocytes; Naïve T lymphocytes; Secondary
c) Naïve T lymphocytes; Effector (memory) T lymphocytes; Primary
d) Naïve T lymphocytes; Effector (memory) T lymphocytes; Secondary

8.2) ____ are trafficked via cell adhesion molecules (CAMs), which are a part of the immunoglobulin superfamily.
a) Naïve T lymphocytes
b) Effector (memory) T lymphocytes
c) Both naïve T lymphocytes and effector (memory) T lymphocytes
d) Either naïve T lymphocytes or effector (memory) T lymphocytes
e) Neither naïve T lymphocytes nor effector (memory) T lymphocytes

9.1) Which of the following is the correct order of lymphocyte extravasation?
a) Lymphocyte activation then adhesion to endothelium then arrested adhesion then transmigration/chemostaxis
b) Arrested adhesion then lymphocyte activation then adhesion to endothelium then transmigration/chemostaxis
c) Arrested adhesion then adhesion to endothelium then lymphocyte activation then arrested adhesion then transmigration/chemostaxis
d) Adhesion to endothelium then arrested adhesion then lymphocyte activation then transmigration/chemostaxis
e) Adhesion to endothelium then lymphocyte activation then arrested adhesion then transmigration/chemostaxis

9.2) Lymphocyte passage (diapedesis or transmigration) occurs at the ____ between adjacent endothelial cells then into the tissues.
a) Gap junction
b) Tight junction (zonula occludens)
c) Adherens junction (zonula adherens)
d) Desmosome (macular adherens)

14 – B Cell Development

1.1) During B cell development, negative selection occurs in an attempt to ensure the antigen receptor:
a) Can bind with a specific antigen
b) Cannot bind with certain foreign antigens
c) Can bind to self-antigens
d) Cannot bind to self-antigens

1.2) During B cell development, precursor cells are found in the ____ and immature cells are found in the ____.
a) Bone marrow; Bone marrow
b) Bone marrow; Periphery
c) Periphery; Periphery
d) Periphery; Bone marrow
e) Spleen; Bone marrow

2) Which of the following has the surface marker CD34 instead of the surface marker CD19, during B cell development?
a) Stem cell
b) Pro-B cell
c) Early pre-B cell
d) Late pre-B cell
e) Immature cell

3.1) During B cell development, when is there rearrangement in the heavy (H) chain of the immunoblobulin gene started?

a) Pro-B cell stage
b) Early pre-B cell stage
c) Late pre-B cell stage
d) Immature cell stage
e) Stem cell

3.2) During B cell development, when is there rearrangement in the light (L) chain of the immunoblobulin gene started?

a) Pro-B cell stage
b) Early pre-B cell stage
c) Late pre-B cell stage
d) Immature cell stage
e) Stem cell

3.3) During B cell development, at what stage can cytoplasmic μ chains being to be found?

a) Pro-B cell stage
b) Early pre-B cell stage
c) Late pre-B cell stage
d) Immature cell stage
e) Stem cell

3.4) During B cell development, at what stage is membrane bound IgM found?

a) Pro-B cell stage
b) Early pre-B cell stage
c) Late pre-B cell stage
d) Immature cell stage
e) Stem cell

4) Which of the following best describes the role of the pre-B cell receptor (pre BCR)?

a) Signal transduction leading to cell proliferation
b) Signal transduction leading to cell apoptosis
c) Prevention of self-recognition and thus cell proliferation
d) Acquisition of self-recognition and thus cell apoptosis
e) Binding with cell adhesion molecules (CAMs)

5) At what stage of B cell development are auto-reactive cells removed?

a) Stem cell
b) Pro-B cell stage
c) Early pre-B cell stage
d) Late pre-B cell stage
e) Immature cell stage

6) Allelic exclusion creates monospecific B-cell receptors (BCRs). The result is these cells each secrete:

a) Different antibodies with distinct antigenic specificities
b) Similar antibodies with distinct antigenic specificities
c) Different antibodies with the same antigenic specificity
d) Similar antibodies with the same antigenic specificity

7.1) What surface immunoglobulins are present once an immature B cell becomes a mature (peripheral) B cell?
a) IgD
b) IgM
c) IgA
d) IgA & IgM
e) IgM & IgD

7.2) What are peripheral cells called if they have never come in contact with antigen?
a) Mature cell
b) Immature cell
c) Naïve cell
d) Plasma cell
e) Stem cell

8) Tolerance refers to the ability of B cells to:
a) Tolerate T cells
b) Tolerate other B cells
c) Tolerate self antigens
d) Tolerate foreign antigens
e) Tolerate changes in pH, body temperature, and other homeostatic changes

9) The activation of a naïve B cell, which generally requires a second accessory signal, occurs when the B cell exits the bloodstream and into a ____ lymphoid organ, meets antigen, internalizes the BCR-antigen complex, and eventually becomes ____ cells.
a) Primary; Plasma
b) Primary; Memory
c) Primary; Plasma & memory
d) Secondary; Plasma
e) Secondary; Memory
f) Secondary; Plasma & memory

10) A young child undergoes implantation of a cardiac pacemaker. During surgery, the physician must remove the thymus. If this child encounters an antigen requiring B-cell-T-cell collaboration, they will ____ to mount an immune response. These antigens are thus called ____.
a) Still be able; Thymus dependent (TD)
b) Still be able; Thymus independent (TI)
c) Not be able; Thymus dependent (TD)
d) Not be able; Thymus independent (TI)

11.1) B cells whose BCRs bind antigen with high-affinity receive survival signals (called ____ selection) from follicular dendritic cells (FDCs) and germinal center T cells, whereas those that fail to bind antigen ____.
a) Positive; Proliferate
b) Positive; Die (apoptosis)
c) Negative; Proliferate
d) Negative; Die (apoptosis)
e) Negative; Re-enter circulation

11.2) Where does affinity maturation occur?
a) Paracortex of lymphoid tissue

b) Cortex of lymphoid tissue
c) Germinal center of lymphoid tissue
d) Follicular dendritic cells
e) Plasma cells

12) Most peripheral B cells belong to a pool of long lived follicular B lymphocytes called ____ cells. The majority of B cells found in the fetus and neonate are ____ cells, which express the surface marker CD5. ____ cells are the most likely to be involved in autoimmunity.

a) B-1; B-1; B-1
b) B-2; B-1; B-1
c) B-1; B-1; B-2
d) B-2; B-1; B-2
e) B-1; B-2; B-1
f) B-2; B-2; B-1
g) B-1; B-2; B-2
h) B-2; B-2; B-2

15 – T Cell Development

1.1) Which of the following is the correct order of developmental stages for T cells?

a) Double-positive (DP) then double-negative (DN) then single-positive (SP)
b) Double-positive (DP) then single-positive (SP) then double-negative (DN)
c) Double-negative (DN) then double-positive (DP) then single-positive (SP)
d) Double-negative (DN) then single-positive (SP) then double-positive (DP)

1.2) In which of the following developmental stages of T cells are surface molecules CD4 and CD8 NOT expressed?

a) DN cell
b) DP cell
c) SP cell
d) Mature T cell

2.1) Where are single-positive (SP) cells found?

a) Bone marrow
b) Thymus subcapsular zone
c) Thymus cortex
d) Thymus medulla
e) Periphery

2.2) Where are double-negative (DN) cells found?

a) Bone marrow
b) Thymus subcapsular zone
c) Thymus cortex
d) Thymus medulla
e) Periphery

2.3) Where are double-positive (DP) cells found?

a) Bone marrow
b) Thymus subcapsular zone
c) Thymus cortex
d) Thymus medulla

e) Periphery

3.1) At what stage does selection occur and where in the thymus does it occur?

a) DN; Cortex
b) DP; Cortex
c) SP; Cortex
d) DN; Subcapsular zone
e) DP; Subcapsular zone
f) SP; Subcapsular zone

3.2) Approximately how many cells survive the selection process?

a) 95%
b) 75%
c) 50%
d) 25%
e) 5%

4.1) Which of the following begins at the DP stage and not the DN stage?

a) α chain rearrangement
b) β chain rearrangement
c) γ chain rearrangement
d) δ chain rearrangement

4.2) At what stage are rearranged TCRs expressed on the cell surface?

a) DN
b) DP
c) SP
d) Mature naïve T cell

5) Establishment of self-restriction occurs in the thymus ____ and is called ____ selection. Establishment of central self-tolerance occurs in the thymus ____ and is called ____ selection.

a) Cortex; Positive; Medulla; Negative
b) Cortex; Negative; Medulla; Positive
c) Medulla; Positive; Cortex; Negative
d) Medulla; Negative; Cortex; Positive

6) Where does a mature T cell encounter antigen for the first time?

a) Freely in the blood stream
b) Freely in a primary lymphoid organ
c) Freely in a secondary lymphoid organ
d) On an antigen presenting cell (APC) in a primary lymphoid organ
e) On an antigen presenting cell (APC) in a secondary lymphoid organ

7) Activation of a T cell requires ____. Following activation, the T cell proliferates and differentiates into ____, then moves into peripheral tissues and other organs.

a) Recognition of antigen displayed on MHC molecules; Naïve cells
b) A costimulatory signal; Naïve cells
c) Recognition of antigen displayed on MHC molecules and a costimulatory signal; Naïve cells
d) Recognition of antigen displayed on MHC molecules; Effector cells
e) A costimulatory signal; Effector cells

f) Recognition of antigen displayed on MHC molecules and a costimulatory signal; Effector cells

8.1) CD4+ cells recognize antigen displayed on MHC ____ molecules and CD8+ cells recognize antigen displayed on MHC ____ molecules. ____ has TH1 and TH2 cell populations.

a) Class I; Class II; CD4+
b) Class I; Class II; CD8+
c) Class II; Class I; CD4+
d) Class II; Class I; CD8+

8.2) Which of the following enhances IgE antibody response and mast cell and eosinophil function?

a) TH1 cell population
b) TH2 cell population

8.3) Which of the following enhances inflammatory responses (e.g. activate macrophages to kill intracellular bacteria) and stimulates IgG production?

a) TH1 cell population
b) TH2 cell population

9) Patients with MHC class II (or class I) antigen deficiency would exhibit which of the following?

a) Human immuno-deficiency virus (HIV) infection
b) Acquired immune deficiency syndrome (AIDS)
c) Persistent bacterial and viral infections
d) Coagulation disorders (hemophilia)
e) Systemic inflammatory response syndrome (SIRS, sepsis)

10.1) The γδ T cell acts as a part of the first line of defense, recognizing microbial invaders. They appear to recognize commonly occurring microbial pathogens. Where can γδ T cells be found?

a) Liver and kidney
b) Bone marrow and spleen
c) Skin and gut mucosa
d) Respiratory tract and bone marrow
e) Brain and spinal cord

10.2) In contrast to αβ T cells, γδ T cells recognize certain peptide and nonpeptide antigens ____ processing and in the ____ of MHC class I and/or II molecules.

a) Only with; Absence
b) Only with; Presence
c) Without; Absence
d) Without; Presence

16 – Cell-Cell Interaction in Generating Effector Lymphocytes

1) Antigens and lymphoid cells are delivered to the secondary lymphoid tissues (spleen, lymph nodes) via:

a) αβ T cells
b) γδ T cells
c) B cells
d) Macrophages

e) Dendritic cells

2.1) Cytokines produced by TH1 are ____ (microbial infection response) and cytokines produced by TH2 are ____ (parasitic infection response and allergy response).

a) IFN-γ and tumor necrosis factor β; IL-4 and IL-5
b) IL-4 and IL-5; IFN-γ and tumor necrosis factor β
c) IFN-γ and IL-4; Tumor necrosis factor β and IL-5
d) Tumor necrosis factor β and IL-5; IFN-γ and IL-4
e) IFN-γ and IL-5; Tumor necrosis factor β and IL-4

2.2) IFN-γ stimulates ____ immunity by enhancing ____ T cells as well as activating macrophages and natural killer cells. IL-4/IL-5 stimulate ____ immunity (antibodies) by activating B cells and eosinophils and induce ____-type responses.

a) Cell-mediated; CD8+; Humoral; IgE
b) Cell-mediated; CD4+; Humoral; IgE
c) Cell-mediated; CD8+; Humoral; IgM
d) Cell-mediated; CD4+; Humoral; IgM
e) Humoral; CD8+; Cell-mediated; IgE
f) Humoral; CD4+; Cell-mediated; IgE
g) Humoral; CD8+; Cell-mediated; IgM
h) Humoral; CD8+; Cell-mediated; IgM

3.1) Cellular interactions between B and T cells involve costimulatory activation. There is a physical interaction between ____ on the B cell and ____ on the T cell. This leads to a B cell producing high affinity antibody.

a) CD154; CD40
b) CD28; CD4
c) CD40; CD154
d) CD28; CD3
e) CD3; CD80
f) CD80; CD3

3.2) Activation of the gene for IL-2, and eventually TH proliferation, is causes by a critical signal (along with TCR signal transduction) from ____ on the B cell and ____ on the T cell.

a) CD154; CD40
b) CD28; CD80
c) CD40; CD154
d) CD80; CD28
e) CD3; CD4
f) CD4; CD3

4) What is the immunologic consequence of mutation in CD40L (CD154)?

a) Leprosy and immunity to protozoal infections
b) Acquired immune deficiency syndrome (AIDS)
c) X-linked hyper-IgM syndrome
d) Systemic inflammatory response syndrome (SIRS, sepsis)
e) X-linked agammaglobulinemia

5) Which of the following is required for a CD8+ cell to differentiate into an effector cytotoxic T cell (CTL)? Is this a physical interaction?

a) Recognition of antigen; No

b) Costimulatory signals from CD4+ TH cells; No
c) Recognition of antigen; Yes
d) Costimulatory signals from CD4+ TH cells; Yes
e) A and B
f) C and D

6.1) Extracellular pathogen response involves ____ T cells and MHC ____ molecules. Intracellular pathogen response involves ____ T cells and MHC ____ molecules.
a) CD4+; Class I; CD8+; Class II
b) CD4+; Class II; CD4+; Class I
c) CD8+; Class I; CD4+; Class II
d) CD8+; Class II; CD4+; Class I

6.2) ____ T cell activation of TH1 leads to ____ antibody production and opsonization (or macrophage activation). Activation of TH2 leads to ____ antibody production and activation of mast cells and eosinophils.
a) CD4+; IgE; IgG
b) CD4+; IgG; IgE
c) CD8+; IgE; IgG
d) CD8+; IgG; IgE

17 – Immunologic Memory

1) Which of the following is NOT true when comparing primary immune response to subsequent (secondary) immune response?
a) Primary response takes 5-10 days
b) Secondary response takes 1-3 days
c) Primary response has IgM as the major antibody class
d) Secondary response has IgH (IgA or IgE) as the major antibody class
e) Primary response has a high affinity for antigen

2.1) Which of the following is a low affinity antibody?
a) IgA
b) IgE
c) IgH
d) IgM

2.2) Which of the following best describes the affinity of antibody secreted for effector B cells?
a) High
b) Low
c) Increases during response
d) Decreases during response

2.3) The response time to antigenic stimulation for memory B and T cells is described as ____, for naïve B and T cells is described as ____, and for effector B and T cells is described as ____.
a) Slow; Fast; Responding
b) Fast; Slow; Responding
c) Responding; Slow Fast
d) Responding; Fast; Slow
e) Slow; Slow; Slow

f) Fast; Fast; Fast

2.4) Expression of L-selectin (CD62L), the receptor that facilitates homing of peripheral lymph nodes, is ____ for memory T cells, ____ for naïve T cells, and ____ for effector T cells.

a) High; Low; Variable
b) Low; High; Variable
c) Variable; High; Low
d) Variable; Low; High
e) High; Variable; Low
f) Low; Variable; High

3) Which of the following is NOT true regarding apoptosis of target cells?

a) Apoptosis is triggered by Fas-Fas interactions and the activation of Caspase
b) The critical cascade step is the activation of Caspase-activatable DNase (CAD)
c) bcl genes are apoptotic genes meant to shorten memory cell survival
d) Apoptosis of memory cells would lead to decreased secondary response
e) Lack of apoptosis would lead to long term survival of memory cells

18 – Review of Immune Physiology

1.1) The route of antigen processing (cytosolic versus vesicle bound) determines whether an antigen is presented by MHC class II molecules to a TCR on a CD4+ helper (TH) cell, or by major histocompatibility complex (MHC) class I molecules to a TCR on a CD8+ cytotoxic T cell.

a) True
b) False

1.2) The processes of affinity maturation and class switching are used to generate a lower-affinity, less effective antibody molecule during the immune response.

a) True
b) False

1.3) Cell adhesion molecules (CAMs) are important in the trafficking of lymphocytes.

a) True
b) False

1.4) Antiapoptotic molecules are encoded by the death-inhibiting family of bcl genes.

a) True
b) False

19 – Constitutive Defenses Including Complement

1.1) Which of the following is a function of the adaptive immune system and NOT the innate immune system?

a) Distinguishes self from non-self
b) Has preformed or rapidly formed components
c) Responds within minutes to infection
d) Has no specificity and responds to a range of pathogens
e) Uses pattern-recognition molecules

1.2) Which of the following is a function of the innate immune system and NOT the adaptive immune system?

a) Has possibility of up to 10^18 different receptors

b) Recognizes conformational structures or short peptides bound to MHC
c) Has immunological memory
d) Frequently malfunctions and may cause autoimmunity
e) Uses germline genes to produce collectins

Match the innate immune component with the name and location:

2.1) Low pH	a) Langerhans cells in skin
2.2) Surfactants, pathogen binding collectins	b) Upper respiratory tract
2.3) Initially prevent organism penetration	c) GI tract
2.4) Mucociliary escalator	d) Dead skin keratinocytes
2.5) Migrate and present antigen to T cells	e) Living skin keratinocytes
2.6) Secrete cytokines if damaged	f) Lower respiratory tract

3.1) What type of cells produce type I interferons (IFN-α and IFN-β)?
a) Monocytes
b) Myeloid dendritic cells (mDC)
c) Plasmacytoid dendritic cells (pDC)
d) Plasma cells
e) Goblet cells

3.2) Type I interferon is released in response to ____, which is recognized using a pattern-recognition molecule called Toll-like receptor 3.
a) Single-stranded DNA
b) Double-stranded DNA
c) Single-stranded RNA
d) Double-stranded RNA

3.3) Which of the following is NOT true regarding interferon?
a) Interferon prevents infection spreading from cell to cell
b) NK cells are activated by interferon and lyse infected cells
c) Antigen-presenting cells are inactivated
d) Interferon is viral specific, attacking viral protens
e) Stimulation of activity of TAP (transporter-associated with antigen presentation) occurs

4.1) In the lectin complement pathway, mannan-binding lecting (MBL) indirectly activated which of the following components?
a) C1
b) C2
c) C3
d) C4
e) C2 & C4

4.2) In the classical complement pathway, which of the following components is the initiating protein(s)?
a) C1
b) C2
c) C3
d) C4
e) C2 & C4

4.3) Which of the following component molecules is activated in the classical pathway after binding to an Fc?

a) C1
b) C2
c) C3
d) C4
e) C2 & C4

4.4) In the alternative complement pathway, this component molecule undergoes spontaneous activation, which creates a challenge for organ xenotransplantation.

a) C1
b) C2
c) C3
d) C4
e) C2 & C4

4.5) Which complement pathway is activated by (and requires) antibodies, with IgM being particularly good at C1 binding?

a) Lectin
b) Classical
c) Alternative

5.1) Anaphylatoxins are chemotaxins that stimulate phagocytosis and degranulation. Which complement components is/are mainly involved?

a) C2 & C4
b) C3
c) C5
d) C3 & C5
e) C5-C9

5.2) Opsonization is the process by which bacteria and other cells are made available for phagocytosis and involves opsonin or IgG. Which complement components is/are mainly involved?

a) C2 & C4
b) C3
c) C5
d) C3 & C5
e) C5-C9

5.3) The membrane attack complex (MAC) uses C3 to activate the final part of the complement pathway. It is important in defense against Neisseria. Which of the following components is/are inserted into the plasma membrane of the target cell, allowing for free passage of water/solute and thus killing the cell?

a) C5 & C6
b) C7
c) C8
d) C9
e) C7-C9

6) Which of the following is NOT a major function of complement activation?

a) Opsonization
b) B-cell stimulation
c) T-cell stimulation
d) Immune complex clearance

7.1) To prevent inadvertent complement activation, eight inhibitors exist. Which of the following is an inhibitor preventing activation of C2 and C4, and prevents C3 activation by the alternative pathway?

a) C1 inhibitor
b) C2 inhibitor
c) C3 inhibitor
d) C4 inhibitor
e) C2 & C4 inhibitor

7.2) A deficiency in complement inhibitors could lead to which of the following?

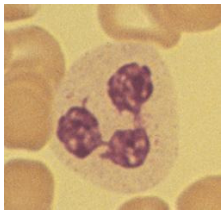
a) Meningitis
b) Leprosy
c) X-linked hyper-IgM syndrome
d) Hereditary angiodema
e) X-linked agammaglobulinemia

20 – Phagocytes

1.1) Pus formed at the site of infection is largely composed of dead:

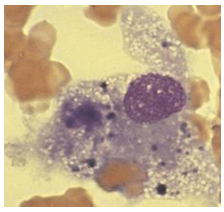
a) Macrophages
b) Neutrophils
c) Eosinophils
d) Basophils
e) Lymphocytes

1.2) Which of the following describes this image?



a) Macrophage
b) Neutrophil
c) Eosinophil
d) Basophil
e) Lymphocyte

1.3) Which of the following describes this image?



a) Macrophage
b) Neutrophil
c) Eosinophil
d) Basophil
e) Lymphocyte

1.4) Which of the following is NOT true of neutrophils compared with macrophages?

a) Rapid increase in production during acute response
b) Is short-lived (dies after phagocytosis)
c) Has a single mature form
d) Found in healthy tissues
e) Rapidly forms pus

Match the description with the term involved in recruitment of phagocytes:

2.1) Follows concentration gradient of chemokines to the site of infection
2.2) Uses integrin molecules to squeeze between endothelial cells
2.3) Makes integrins more "sticky"
2.4) Increases marrow production of neutrophils

a) Diapedesis
b) Chemotaxis
c) G-CSF
d) Chemokines

Match the description with the receptor involved in recruitment of phagocytes:

2.5) Binds sugars on bacteria — a) Fc
2.6) Mediate adherence and prime for phagocytosis — b) CD14 & toll-like
2.7) Bind lipopolysaccharide on pathogens and dying cells — c) Complement
2.8) Bind opsonized pathogens on immune complexes — d) Chemokine & cytokine
2.9) Bind Ig-coated pathogens — e) C-lectin

Match the respiratory burst enzyme with the resulting molecule:

3.1) NADPH oxidase — a) HOCl
3.2) Myeloperoxidase — b) Nitric oxide
3.3) Nitric oxide synthetase — c) H2O2

3.4) A 4-year-old boy presents with chronic granulomatous disease (CGD), confirmed with a nitro blue tetrazolium (NBT) test. Which of the following pathogens could this child still mount a defense against?

a) Staphylococcus
b) Enterobacteria
c) Aspergillus
d) Streptococcus
e) Pseudomonas

4.1) What is the primary response seen in acute-phase responses to infection?

a) Decreased blood pH
b) Decreased metabolic pH
c) Increased body temperature
d) Increased heart rate
e) Decreased blood pressure

4.2) Which of the following is a chemoattractant that attracts neutrophils to the site of infection?

a) IL-1
b) IL-6
c) IL-7
d) IL-12
e) TNF
f) A, B, & C

4.3) Which of the following alerts the adaptive immune system to the presence of infection?

a) IL-1
b) IL-6
c) IL-8
d) IL-12
e) TNF
f) A, B, & E

4.4) Which of the following are secreted by macrophages after they have recognized pathogens using pattern recognition molecules (induction phase)?

a) IL-1
b) IL-6
c) IL-7
d) IL-12
e) TNF

f) A, B, & E

5.1) Which of the following are early clinical signs of (septic) shock?
a) Hypertension and bradycardia
b) Hypotension and bradycardia
c) Hypertension and tachycardia
d) Hypotension and tachycardia

5.2) Most cases of septic shock are caused by gram ____ organisms with the ____ acting as the endotoxin in the disease.
a) Positive; Lipopolysaccharide (LPS)
b) Negative; Lipopolysaccharide (LPS)
c) Positive; Capsule
d) Negative; Capsule

5.3) ____ shock syndrome is mediated by cytokines secreted from ____ cells.
a) Septic; B
b) Septic; T
c) Toxic; B
d) Toxic; T

21 – Killing in the Immune System

1) Parasitic worm eggs are resistant to low pH and proteolytic digestion in the stomach. Adult worms living inside the lower gut are protected from many of the components of the immune response. Mast cells respond to worms. What immunoglobulin activates these mast cells, leading to degranulation?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

Match the description with the pre-stored granular chemical mediator:

2.1) Increases vascular permeability — a) Trypase & Chemotrypsin
2.2) Increase mucus secretion and smooth muscle contraction — b) Histamine
2.3) Enhance diapedesis and stimulate TH2 responses — c) Cytokines/IL-4
2.4) Activates TH2 and stimulates eosinophil production — d) Cytokines/TNF

2.5) Mast cell arachidonic acid metabolites include cyclo-oxygenase, which produces prostaglandins that stimulate ____ and increase ____ of smooth muscle in the gut and bronchi. Metabolites also include leukotrienes, which have a ____ effect than prostaglandins.
a) Vasoconstriction; Constriction; Slower
b) Vasoconstriction; Constriction; Faster
c) Vasodilation; Dilation; Slower
d) Vasodilation; Dilation; Faster
e) Vasodilation; Constriction; Slower
f) Vasodilation; Constriction; Faster

2.6) Which of the following would NOT act initially during mast cell (or basophil) activation?
a) Trypase

b) Chemotrypsin
c) Histamine
d) Prostaglandins
e) Leukotrienes

3) Which of the following is NOT true regarding eosinophils?
a) They are specifically recruited to tissues during some types of inflammation
b) Their granules contain particularly toxic substances
c) Their production is stimulated by IL-3 and IL-5
d) They are recruited to parasite infected sites by chemokine eotaxin
e) They are a major acidic and anionic protein

4.1) Natural killer (NK) cells are excellent killers of cells infected by some ____. They also have an additional role of stimulating the ____ immune response.
a) Bacteria; Adaptive
b) Viruses; Adaptive
c) Bacteria; Innate
d) Viruses; Innate

4.2) Antibody-dependent cellular cytotoxicity (ADCC) is the process by which natural killer cells destroy infected cells, identified by what immunoglobulin on the surface?
a) IgA
b) IgD
c) IgE
d) IgG
e) IgM

4.3) Natural killer cells are thought to fill the gap between initial innate response and adaptive immune response. They evolved to detect low levels of MHC caused by the diseases of ____ and ____.
a) Staph bacteria; Strep bacteria
b) Catalase positive bacteria; Helminths (worms)
c) Herpes virus; Tumor cells
d) Influenza virus; Rabies virus
e) Leprosy; Gonorrhea bacteria

4.4) Natural killer cell receptors NKG2/CD94 and killer inhibitory receptors allow for the killing of antibodies in the presence of:
a) MHC class I
b) MHC class II
c) Both MHC class I and II
d) Either MHC class I or II
e) Neither MHC class I nor II

Match the description with the cytotoxic T cell (CTL) killing mechanism:

5.1) Potent inducer of apoptosis	a) Perforin
5.2) Degrade host cell proteins, activate caspase enzyme system	b) Granzyme
5.3) Forms a pore in the target cell membrane (like MAC)	c) Fas ligand

24 – Infections and Vaccines

1) Vaccines (natural exposure) is considered active immunotherapy and leads to the development of immunologic memory.

a) True
b) False

2.1) Which of the following is NOT true about live vaccines?
a) They were the first vaccines to be discovered
b) They are currently the least effective vaccines
c) They replicate and thus deliver sustained doses of antigen
d) They deliver antigenic peptides to MHC class I
e) They replicate at the infection site, focusing immune response

2.2) Which of the following live vaccines is recommended for children but not adults?
a) Poliovirus
b) Measles, mumps, rubella (MMR)
c) Varicella
d) Meningococcal
e) Influenza

2.3) Which of the following live vaccines is recommended for adults but not children?
a) Poliovirus
b) Measles, mumps, rubella (MMR)
c) Varicella
d) Meningococcal
e) Influenza

3) Killed vaccines are theoretically much safer than live vaccines, but cannot replicate in hosts and cannot enter intracellular antigen presenting pathways. Which of the following killed vaccines is recommended for children but not adults?
a) Hepatitis A
b) Influenza
c) Inactivated poliovirus

4.1) Subunit vaccines contains components from pathogens, which are inactivated and referred to as ____. These vaccines are generally of low immunogenicity and may need ____ to work effectively.
a) Cytokines; IgE
b) LPS; Live vaccination
c) Capsules; Homeostasis
d) Toxoids; Adjuvants
e) Antigens; B & T cells

4.2) Which of the following subunit vaccines is recommended for children but not adults?
a) Pneumonococcal (PCV)
b) Haemophilus influenzae type B
c) Hepatitis B
d) Diptheria, tetanus, pertussis

5.1) DNA vaccines (tested in mice) use the gene for the immunogenic protein and coat it with what element, which is injected into cells and results in antibody production?
a) Tin
b) Zinc
c) Copper
d) Gold
e) Silver

f) Lead

5.2) Immunostimulatory complexes (ISCOMS) can be used for mucosal vaccines and induce widespread mucosal immunity in the gut and respiratory tract. They are the one way that ____ response can be promoted.

a) B cell
b) Helper T cell
c) Cytotoxic T cell
d) Eosinophil
e) Macrophate

5.3) Which of the following is NOT true regarding live viral vectored vaccines?

a) They require strong adjuvants
b) They are economical to produce
c) They can be delivered through needle-free methods
d) They induce a broad and long-lasting immune response
e) They induce both cellular and humoral immunity
f) Adenovirus vectors are a good choice to use for vaccines

6) Pathogens can evade the immune system through antigenic drift, which is a ____ mutation that leaves existing antibodies ____, and antigenic shift, which is a ____ mutation that leaves existing antibodies ____.

a) Minor; Partially effective; Major; Ineffective
b) Minor; Ineffective; Major; Partially effective
c) Major; Partially effective; Minor; Ineffective
d) Major; Ineffective; Minor; Partially effective

31 – Primary Immunodeficiency Diseases

1.1) Which of the following diseases occurs with the absence of a thymus?

a) DiGeorge's syndrome
b) Severe combined immunodeficiency disease (SCID)
c) Chronic granulomatous disease (CGD)
d) Bare lymphocyte syndrome (BLS)
e) Wiskott Aldrich syndrome (WAS)

1.2) Which of the following diseases affect neutrophils?

a) DiGeorge's syndrome
b) Severe combined immunodeficiency disease (SCID)
c) Chronic granulomatous disease (CGD)
d) Bare lymphocyte syndrome (BLS)
e) Wiskott Aldrich syndrome (WAS)

1.3) Which of the following diseases affects mature T cells?

a) DiGeorge's syndrome
b) Severe combined immunodeficiency disease (SCID)
c) Chronic granulomatous disease (CGD)
d) Bare lymphocyte syndrome (BLS)
e) Wiskott-Aldrich syndrome (WAS)

1.4) A child presents with a maculopapular rash on the extremities and trunk. Petechiae is found on the trunk and mucous membranes. Lab tests show a Neisseria infection and the

physician is concerned about meningococcemia. Which of the following is the most likely?

a) C3 deficiency
b) C5-C9 deficiency
c) Leukocyte adhesion deficiency (LAD)
d) Hyper IgM syndrome (HIM)
e) Selective IgA deficiency

1.5) A patient in their early 20s presents with recurrent bacterial infections. Lab work shows B cells in the periphery as well as low immunoglobulin levels. History shows immunoglobulin levels have decreased with age. Which of the following is the most likely?

a) Myeloperoxidase deficiency
b) DiGeorge's syndrome
c) X-linked agammaglobulinemia
d) Wiskott-Aldrich syndrome (WAS)
e) Common variable immunodeficiency

1.6) A child presents with recurrent infections with bacteria, fungi, and viruses. The resident asks the attending physician about IL-2R γ chain mutations, as the patient is a male. The attending physician makes a diagnosis and begins writing orders for bone marrow transplantation and possible gene therapy. Which of the following does the patient have?

a) Ataxia telangiectasia
b) Wiscott-Aldrich syndrome (WAS)
c) Hereditary angioedema
d) Severe combined immunodeficiency disease (SCID)
e) C3 deficiency

1.7) A young child presents with cervical adenitis and gingivostomatitis. History reveals recurrent pyogenic infections. Tests are done to determine leukocytosis and the presence of cell adhesion molecules. Which of the following is the most likely?

a) C3 deficiency
b) Wiscott-Aldrich syndrome (WAS)
c) Leukocyte adhesion deficiency (LAD)
d) Hyper IgM syndrome (HIM)
e) Selective IgA deficiency

1.8) A patient presents in the winter months with swollen lips. The patient says they forgot their lip balm. Uncontrolled activation of the classical complement pathway is responsible for the swelling. Records show the patient has a C1inh deficiency. Which of the following does this patient have?

a) C5-C9 deficiency
b) Glucose-6-phosphate dehydrogenase deficiency
c) Hereditary angioedema
d) Severe combined immunodeficiency disease (SCID)
e) C3 deficiency

1.9) An infant presents with recurrent bacterial infections and partial albinism. Lab work reveals giant granules and neutropenia. Which of the following is the most likely?

a) DiGeorge's syndrome

b) Chediak-Higashi disorder
c) Chronic granulomatous disease (CGD)
d) Bare lymphocyte syndrome (BLS)
e) Myeloperoxidase deficiency

1.10) A male patient presents with severe and recurrent bacterial infections. Lab work confirms the patient is only infected with certain bacteria due to a mutation in a gene for NADPH oxidase. Which of the following is the most likely?
a) DiGeorge's syndrome
b) Chediak-Higashi disorder
c) Bare lymphocyte syndrome (BLS)
d) Wiskott-Aldrich syndrome (WAS)
e) Chronic granulomatous disease (CGD)

1.11) A 6-year-old presents with the appearance of being intoxicated while walking. Opthlamoscopic findings reveal broken capillaries in the sclera of the eye. Lab work reveals IgA deficiency. Which of the following is the most likely?
a) Ataxia telangiectasia
b) Wiscott-Aldrich syndrome (WAS)
c) Hereditary angioedema
d) Myeloperoxidase deficiency
e) C3 deficiency

1.12) A male infant presents with a triad of symptoms including thrombocytopenia, eczema, and immunodeficiency. Which of the following is the most likely?
a) Transient hypogammaglobulinemia of infancy
b) Wiscott-Aldrich syndrome (WAS)
c) Hereditary angioedema
d) Selective IgA deficiency
e) Hyper IgM deficiency

1.13) A young patient presents with severe infections from encapsulated bacteria and collagen vascular disease. Lab work confirms a diagnosis via CH50 and AP50. Which of the following is the most likely?
a) Transient hypogammaglobulinemia of infancy
b) Wiscott-Aldrich syndrome (WAS)
c) Paroxysmal nocturnal hemoglobinuria (PNH)
d) Selective IgA deficiency
e) C3 deficiency

1.14) An infant presents with recurrent infections with Candida and viruses. Cardiac abnormalities result in the patient requiring heart surgery. During surgery, no thymus is found. Which of the following is the most likely?
a) DiGeorge's syndrome
b) Chediak-Higashi disorder
c) Bare lymphocyte syndrome (BLS)
d) Wiskott-Aldrich syndrome (WAS)
e) Chronic granulomatous disease (CGD)

1.15) A patient presents for a follow-up visit after a diagnosis of systemic lupus erythematosus (SLE). The physician suspects a misdiagnosis after finding immune

complexes accumulated in the blood, lymph, and tissues. Which of the following is the most likely?

a) C3 deficiency
b) C5-C9 deficiency
c) Early complement deficiency
d) Hyper IgM syndrome (HIM)
e) Selective IgA deficiency

1.16) A patient presents with complaints of dark urine in the morning that clears up partially during the day. Lab work reveals hemolytic anemia, thrombosis in large vessels, and a deficiency in Hematopoiesis. Which of the following is the most likely?

a) Transient hypogammaglobulinemia of infancy
b) Wiscott-Aldrich syndrome (WAS)
c) Selective IgA deficiency
d) Paroxysmal nocturnal hemoglobinuria (PNH)
e) Chediak-Higashi disorder

1.17) A patient presents with symptoms similar to chronic granulomatous disease (CGD). It is found that there is a problem with generation of NADPH. Which of the following is the most likely?

a) C5-C9 deficiency
b) Glucose-6-phosphate dehydrogenase deficiency
c) Myeloperoxidase deficiency
d) Severe combined immunodeficiency disease (SCID)
e) C3 deficiency

1.18) A patient is being seen for recurrent infections. However, the patient does not seem to think anything special of these infections and there has been no previous diagnosis other than the infections. Lab work reveals abnormalities with hypochlorous acid and H2O2 conversion. Which of the following is the most likely?

a) Ataxia telangiectasia
b) Wiscott-Aldrich syndrome (WAS)
c) Hereditary angioedema
d) Myeloperoxidase deficiency
e) C3 deficiency

1.19) A patient presents at age 6-months with pneumonia and difficulty fighting off infections of encapsulated bacteria and enteroviruses. A mutation in Bruton's tyrosine kinase (btk) is suspected. Which of the following is the most likely?

a) Myeloperoxidase deficiency
b) DiGeorge's syndrome
c) X-linked agammaglobulinemia
d) Wiskott-Aldrich syndrome (WAS)
e) Common variable immunodeficiency

1.20) A male infant presents with decreased levels of IgA, IgG, and IgE. History reveals recurrent bacterial infections and severe diarrhea. A mutation on CD40L (CD154) on T cells is suspected. Which of the following is the most likely?

a) Bare lymphocyte syndrome (BLS)
b) C5-C9 deficiency
c) Early complement deficiency

d) Hyper IgM syndrome (HIM)
e) Selective IgA deficiency

1.21) A patient presents at 3-years-old for a follow-up visit. At age 6-months, the patient had a delayed onset of synthesis of an immunoglobulin. At this visit, the mother reports that the recurrent respiratory infections have stopped due to antibiotics and globulin replacement. Which of the following was the most likely for this patient?

a) Transient hypogammaglobulinemia of infancy
b) Wiscott-Aldrich syndrome (WAS)
c) Paroxysmal nocturnal hemoglobinuria (PNH)
d) Selective IgA deficiency
e) C3 deficiency

1.22) Which of the following is often asymptomatic to presenting with an increased incidence of respiratory tract infections and is the most common immunodeficiency disease?

a) C3 deficiency
b) C5-C9 deficiency
c) Early complement deficiency
d) Hyper IgM syndrome (HIM)
e) Selective IgA deficiency

1.23) A patient presents with symptoms similar to DiGeorge's syndrome. It is determined that the patient's TH cells are unable to develop. Which of the following is the most likey?

a) Leukocyte adhesion deficiency (LAD)
b) Chediak-Higashi disorder
c) Bare lymphocyte syndrome (BLS)
d) Wiskott-Aldrich syndrome (WAS)
e) Chronic granulomatous disease (CGD)

AnswerKey

Imm #1
1.1) C
1.2) C
1.3) E
1.4) D
1.5) A
1.6) B
1.7) A
1.8) C
1.9) D
1.10) D
1.11) E

Imm #2
1) C
2) E
3.1) B
3.2) E
3.3) D
4.1) A
4.2) E
4.3) C
4.4) E
5) B
6) C
7.1) C
7.2) A
7.3) D
7.4) B
7.5) E
7.6) B
7.7) D
7.8) B
7.9) C
7.10) A
8) B
9.1) B
9.2) C
9.3) A
9.4) C
10.1) B
10.2) C
10.3) A

Imm #3
1.1) C
1.2) B
2.1) B
2.2) A
2.3) C
2.4) D
2.5) A
2.6) C
3.1) D
3.2) E
3.3) B
4.1) A
4.2) B
5.1) D
5.2) D

Imm #4
1) C
2) D
3) D
4) A
5) D
6) E
7.1) B
7.2) A
7.3) D
8) B
9) C
10.1) E
10.2) C
10.3) D
10.4) A
10.5) B
10.6) D
11.1) D
11.2) B
11.3) C
11.4) E
11.5) A
11.6) A
11.7) C
11.8) E
11.9) A
11.10) C
11.11) B

Imm #5
1) E
2.1) B
2.2) C
3.1) C
3.2) A
3.3) D
3.4) B
3.5) A
3.6) E
3.7) E
3.8) B
3.9) D

Imm #6
1.1) D
1.2) C
2.1) C
2.2) A
2.3) E
2.4) A
3) D
4) C
5.1) B
5.2) E
5.3) C
6) B
7) E

Imm #7
1.1) C
1.2) C
2.1) D
2.2) B
3.1) E
3.2) E
3.3) B
3.4) C
3.5) D
4) C
5.1) C
5.2) B
6.1) B
6.2) A
7.1) B
7.2) E
7.3) D
8.1) D
8.2) B
9.1) B
9.2) D
9.3) A
9.4) C
9.5) E
9.6) C
9.7) C
9.8) E

Imm #8
1.1) E
1.2) C
1.3) E
1.4) F
1.5) E
2.1) D
2.2) D
3.1) C
3.2) A
3.3) C
4) D
5.1) A
5.2) E
5.3) D
5.4) C
5.5) B
5.6) B
5.7) D

Imm #9
1.1) A
1.2) B
1.3) C
1.4) A
1.5) A
1.6) E

Imm #10
1) B
2.1) E
2.2) C
3.1) C
3.2) D
4.1) C
4.2) A
5) C
6.1) C
6.2) B
6.3) A

Imm #11
1.1) C
1.2) D
1.3) A
2) B
3.1) B
3.2) C
3.3) A
4.1) D
4.2) D
5.1) C
5.2) E

Imm #12
1.1) B
1.2) B
1.3) C
1.4) A
2) H
3) B
4.1) C
4.2) G
4.3) E
4.4) B
4.5) F
4.6) H
4.7) A
4.8) D
5) C
6.1) A
6.2) D
6.3) E

Imm #13
1.1) E
1.2) B
2) D
3.1) B
3.2) A

3.3) D
4.1) E
4.2) C
4.3) B
4.4) A
5.1) D
5.2) C
5.3) A
6) B
7) D
8.1) B
8.2) C
9.1) E
9.2) B

Imm #14
1.1) D
1.2) B
2) A
3.1) A
3.2) C
3.3) B
3.4) D
4) A
5) E
6) D
7.1) E
7.2) C
8) C
9) F
10) C
11.1) B
11.2) C
12) B

Imm #15
1.1) C
1.2) A
2.1) D
2.2) B
2.3) C
3.1) B
3.2) E
4.1) A
4.2) B
5) A
6) E
7) F
8.1) C
8.2) B
8.3) A
9) C
10.1) C
10.2) C

Imm #16
1) E
2.1) A
2.2) B
3.1) C
3.2) D
4) C
5) E
6.1) C
6.2) B

Imm #17
1) E
2.1) D
2.2) C
2.3) B
2.4) C
3) C

Imm #18
1.1) A
1.2) B
1.3) A
1.4) A

Imm #19
1.1) A
1.2) E
2.1) C
2.2) F
2.3) D
2.4) B
2.4) A
2.6) E
3.1) C
3.2) D
3.3) C
4.1) E
4.2) A
4.3) C
4.4) C
4.5) B
5.1) D
5.2) B
5.3) E
6) C
7.1) A
7.2) D

Imm #20
1.1) B
1.2) B
1.3) A
1.4) D
2.1) B
2.2) A
2.3) D
2.4) C
2.5) E
2.6) D
2.7) B
2.8) C
2.9) A
3.1) C
3.2) A
3.3) B
3.4) D
4.1) C
4.2) B
4.3) D
4.4) F
5.1) D
5.2) B
5.3) D

Imm #21
1) C
2.1) B
2.2) A
2.3) D
2.4) C
2.5) E
2.6) E
3) E
4.1) B
4.2) D
4.3) C
4.4) D
5.1) C
5.2) B
5.3) A

Imm #24
1) A
2.1) B
2.2) A
2.3) D
3) C
4.1) D
4.2) B
5.1) D
5.2) C
5.3) A
6) A

Imm #31
1.1) A
1.2) C
1.3) D
1.4) B
1.5) E
1.6) D
1.7) C
1.8) C
1.9) B
1.10) E
1.11) A
1.12) B
1.13) E
1.14) A
1.15) C
1.16) D
1.17) B
1.18) D
1.19) C
1.20) D
1.21) A
1.22) E
1.23) C

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Please let me know if there are any errors and I will fix them. Email James Lamberg:
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If you think these quizzes are a good resource, please help me make them better.