Chapter 1 Overview if the Immune System

1. Which is the best definition of “immunity”?

A. The state of having been exposed to a pathogen repeatedly

B. The state of being resistant to reinfection with a pathogen

C. When an individual has never been exposed to a pathogen

D. When the immune system is activated

E. When physical barriers are not enough to prevent infection

Answer: B

Section: A Historical Perspective

Difficulty: 1

Hint: Vaccines can induce immunity.

2. What happens to a pathogen as it becomes attenuated?

A. It becomes more dangerous to the host.

B. It gets smaller.3

C. It has weakened virulence.

D. At becomes older.

E. All of the above

Answer: C

Section: A Historical Perspective

Difficulty: 2

Hint: Attenuated viruses are used as vaccines.

3. Which of the following is the BEST example of herd immunity?

A. A child infected with measles travels from Germany to the United States. Several babies contract the disease, but the outbreak is largely contained due to vaccinations.

B. Certain populations of cattle are less susceptible to infection with encephalitis because of their genetic makeup.

C. Once a certain threshold of individuals has been infected with a novel human pathogen, it is unlikely that any more will be.

D. Geese and chickens are infected with different strains of influenza because they express different receptors on their cell surface.

E. When infection spreads through a population, certain individuals generate stronger immune responses than others.

Answer: A

Section: A Historical Perspective

Difficulty: 2

Hint: The herd protects the individual.

4. Which of the following diseases does NOT currently have an effective vaccine?

A. Chicken pox

B. Polio

C. HIV

D. Small pox

E. Diptheria

Answer: C

Section: A Historical Perspective

Difficulty: 1

Hint: Most vaccines protect almost everyone from infection.

5. Effectors of the humoral immune system are known as:

A. antibodies.

B. immunoglobulin.

C. complement.

D. B cells.

E. All of the above

Answer: E

Section: A Historical Perspective

Difficulty: 1

Hint: There is a cellular and a humoral component to the adaptive immune response.

6. Which of the following cell types are lymphocytes?

A. Macrophages

B. Mast cells

C. Neutrophils

D. Erythrocytes

E. T cells

Answer: E

Section: A Historical Perspective

Difficulty: 1

Hint: lymphocytes are involved in adaptive immunity.

7. Which of the following is TRUE about antigens?

A. They are always derived from pathogens.

B. They are always proteins.

C. They are recognized by T cells or B cells.

D. They must be microbial in origin.

E. They usually cause cellular damage.

Answer: C

Section: A Historical Perspective

Difficulty: 1

Hint: There are many kinds of antigens.

8. Two main early theories were proposed to explain how antigen-specific antibodies develop: the instructional theory and the selective theory. How did the two differ? Which was ultimately shown to be CORRECT?

Answer: The selective theory says that, when an antigen receptor binds with an antigen, the cell becomes activated (or the cell is selected to proliferate and secrete more copies of the receptor). The

instructional theory says that the antigen receptor molds itself to the antigen. The selective theory was shown to be correct.

Section: A Historical Perspective

Difficulty: 3

Hint: There is a cellular and a humoral component to the adaptive immune response.

9. Which of the following is a fungal pathogen?

A. Vibrio cholerae

B. Leishmania major

C. Poliovirus

D. Candida albicans

E. Bordetella pertussis

Answer: D

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 1

Hint: Yeasts are fungi.

10. Which of the following cell types is MOST commonly associated with recognizing antigens found inside of cells?

A. Macrophages

B. B cells

C. Th cells

D. CTL

E. Antibodies

Answer: D

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 1

Hint: Viruses are found inside of cells.

11. Which of the following classes of cell surface receptors are directly encoded in the germline?

A. TCR

B. BCR

C. PRR

D. Antibodies

E. All of the above

Answer: C

Difficulty: 1

Section: Important Concepts for Understanding the Mammalian Immune Response

Hint: Some receptors are randomly generated rather than encoded in the germline.

12. What is the central mechanism for establishing self-tolerance?

A. Self-reactive T cells and B cells are killed during development.

B. Individuals that have immune systems that respond to self-antigens do not survive to reproduce.

C. Immune cells that react to self-antigens are turned off when they recognize self-tissues.

D. Certain immune suppressive cytokines are maintained in tissues to dampen auto reactive immune responses.

E. Peripheral tissues have mechanisms to kill T or B cells that respond to them.

Answer: A

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 1

Hint: Central tolerance develops as cells are maturing.

13. Complete the following table comparing and contrasting innate and adaptive immune responses.

	Innate Immunity	Adaptive Immunity
Is mediated by what cells?		
What do they recognize?		
How are the receptors encoded?		
Why can't they control all infections alone?		
What do they do in response to antigen?		

Answer:

	Innate Immunity	Adaptive Immunity
Is mediated by what cells?	Macrophages, NK cells, neutrophils, mast cells eosinophils	T cells and B cells
What do they recognize?	Pathogen patterns	Specific epitopes
How are the receptors encoded?	Germline	Rearranged gene segments

Why can't they control all infections alone? Pathogens evolve escape mechanisms Takes too long to develop

What do they do in response to antigen? Engulf and destroy, induce inflammation
Produce antibodies, kill infected cells

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 3

Hint: Review Table 1-4.

14. What are the hallmarks of inflammation? Describe the physical characteristics of someone experiencing an inflammatory response.

Answer: Redness, swelling, heat, pain. Someone experiencing inflammation might have localized swelling and redness or itching, or may be experiencing faintness due to a lowering of blood pressure if more severe.

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 2

Hint: Many people experience inflammation in response to an insect bite.

15. Which of the following BEST describes chemokines?

A. Membrane receptors that detect the presence of soluble messengers in the environment

B. Soluble proteins that recruit specific cells to an area

C. Chemical messengers that induce cell differentiation

D. Transcription factors that induce the expression of genes involved in cell adhesion

E. Adhesion molecules that bind to the inside of blood vessels

Answer: B

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 2

Hint: Chemokines are a specific kind of cytokine.

16. Which of the following statements BEST differentiates innate and adaptive immune responses?

A. Innate responses are stronger during the primary and less important during the secondary response, while adaptive responses are less robust during primary responses and stronger during secondary responses.

B. Innate responses are weaker during the primary and more robust during the secondary response, while adaptive responses are stronger during the primary and weaker during secondary responses.

C. Innate responses are slower and weaker than adaptive responses.

D. Adaptive responses are slower and weaker than innate responses.

E. Adaptive responses are required for effective immune responses, while innate responses are not required.

Answer: A

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 2

Hint: Innate and adaptive responses are intertwined.

17. True or False? The innate and adaptive immune responses largely work independently of one another.

Answer: False

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 2

Hint: How are adaptive responses initiated?

18. How do memory cells develop?

A. Upon reinfection, memory centers in the brain send signals to the bone marrow to induce T-cell and B-cell differentiation.

B. T cells and B cells from the primary response persist and become reactivated.

C. Innate cells are trained to activate new T cells and B cells more quickly with secondary infection.

D. T cells and B cells from the primary infection slowly mutate their receptors over time, priming themselves for the secondary response.

E. Innate cells modify their cell surface receptors to prepare for reinfection.

Answer: B

Section: Important Concepts for Understanding the Mammalian Immune Response

Difficulty: 2

Hint: Memory cells are derived from effector cells.

19. Which of the following is the BEST example of a hypersensitivity reaction?

A. T cells responding vigorously to the flu virus

B. B cells failing to respond to HIV allowing it to replicate out of control

C. Inflammation of the airways in response to pollen

D. Anemia as a result of iron deficiency

E. T cells attacking the myelin sheath of nerves resulting in paralysis.

Answer: C

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 2

Hint: Hypersensitivity reactions occur in response to common, benign antigens.

20. The hygiene hypothesis posits that there is a connection between environmental conditions and certain inappropriate immune responses. If you were a supporter of the hygiene hypothesis, what recommendations would you make to keep people healthier?

Answer: Expose children to more common antigens found in dirt and in the outdoors. Reduce use of antimicrobials.

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 3

Hint: This hypothesis suggests that hygienic conditions have caused immune responses to become skewed toward allergy.

21. HIV disease is a/an:

A. autoimmune disease.

B. hypersensitivity disease.

C. immunodeficiency.

D. genetic disorder.

E. allergic reaction.

Answer: C

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 1

Hint: People with HIV disease get sick more often than usual.

22. Predict the outcome of being immunosuppressed as it relates to the development of cancer.

A. Immunosuppressed individuals are at lower risk of cancer because cytokines produced by the immune system induce cancer.

B. Immunosuppressed individuals are at lower risk of cancer because they are more likely to contract infectious diseases.

C. Immunosuppressed individuals are at higher risk of cancer because the immune system recognizes and destroys cancerous cells.

D. Immunosuppressed individuals are at higher risk of cancer because they bear a higher load of microbes that damage host tissues.

E. None of the above.

Answer: C

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 3

Hint: T cells can recognize modified host proteins.

23. What occurs when someone receives a tissue transplant from an unrelated individual?

A. The host's lymphocytes enter the tissues and become suppressed.

B. The host's lymphocytes enter the tissues and become activated.

C. The host's lymphocytes that react to the tissue graft are deleted in the thymus.

D. The donor's lymphocytes suppress the host's lymphocytes, allowing for graft survival.

E. The donor's lymphocytes destroy the host's immune system.

Answer: B

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 3

Hint: People receiving transplants are often put on immunosuppressive drugs.

24. Which of the following is TRUE?

A. Vaccines cause autism.

B. Vaccines cause obesity.

C. Vaccines cause cancer.

D. Vaccines cause diabetes.

E. None of the above

Answer: E

Section: A Historical Perspective

Difficulty: 1

Hint: The Lancet article was retracted.

25. Conditions in which the immune system attacks self-antigens are known as:

A. autoimmunity.

B. immune deficiency.

C. hypersensitivities.

D. neuroplasias.

E. None of the above

Answer: A

Section: The Good, Bad, and Ugly of the Immune System

Difficulty: 2

Hint: People with HIV disease get sick more often than usual.

Chapter 2 Cells, Organs, and Microenvironments

of the Immune System

1. All blood cells in an adult human can trace their ancestry to which compartment within the body?

A. Thymus

B. Bone marrow

C. Lymph node

D. Peyer's patch

E. None of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 1

Hint: Which of the above is a reservoir of stem cells?

2. A pluripotent stem cell can do which of the following?

A. Differentiate into a finite number of different cell types

B. Differentiate into any type of cell found in the adult

C. Divide an infinite number of times

D. All of the above

E. None of the above

Answer: A

Section: Cells of the Immune System

Difficulty: 2

Hint: A pluripotent stem cell is not always a totipotent cell.

KNOW:

HSC (haematopoetic SC's) - all blood cells

CLP (common lymphoid progenitor) - NK cells, T cells, B cells

CMP (common lymphoid progenitor) - eosinophils, monocytes

CEP (circulating endothelial progenitor?) - platelets, RBC's

CLP & CMP - DC's (dendritic cells)

3. Which of the following is the pluripotent stem cell that gives rise to all blood cells?

A. CLP

B. CMP

C. CEP

D. HSC

E. None of the above

Answer: D

Section: Cells of the Immune System Difficulty: 3

Hint: One of the cell types listed gives rise to the other three, which, in turn, give rise to the cellular heterogeneity in the blood.

4. From which of the following stem cells are NK cells derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: A

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

5. From which of the following stem cells are DCs derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: D

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

6. From which of the following stem cells are platelets derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: C - from megakaryocytes, technically

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

7. From which of the following stem cells are eosinophils derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

8. From which of the following stem cells are helper T cells (TH) derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: A

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

9. From which of the following stem cells are monocytes derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

10. From which of the following stem cells are RBCs derived?

A. CLP

B. CMP

C. CEP

D. Both A and B

E. None of the above

Answer: C

Section: Cells of the Immune System

Difficulty: 2

Hint: Know which stem cells give rise to which effectors; DCs are tricky.

11. What level of gene expression is regulated by such factors as Notch1, GATA-2 and Bmi-1?

A. Replication

B. Transcription

C. RNA processing

D. Translation

E. None of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 2

Hint: Many cellular differentiation programs in the immune system are regulated by master regulators that function early in gene expression.

12. Which lineage of immune cells constitutes the first line of defense against an infection?

A. Lymphoid

B. Erythroid

C. Myeloid

D. All of the above

E. None of the above

Answer: C

Section: Cells of the Immune System

Difficulty: 1

Hint: Granulocytes are important first responders; from what kind of progenitor do they develop?

13. Which of the following is NOT descended from the common lymphoid progenitor?

A. T cells

B. NK cells

C. B cells

D. Eosinophils

E. All of the above are descended from the common lymphoid progenitor.

Answer: D

Section: Cells of the Immune System

Difficulty: 1

Hint: One of the choices develops from the CMP.

14. Which of the following granulocytes contains histamine within its granules?

A. Neutrophils

B. Eosinophils

C. Basophils

D. Both B and C

E. All of the above

Answer: C - recall that basophils give mast cells, which have histamine

Section: Cells of the Immune System

Difficulty: 2

Hint: Only one of the types listed above features histamine within its granules.

15. Which of the following is NOT true about monocytes?

A. They comprise between 5–10% of circulating leukocytes.

B. They have the ability to differentiate into macrophages or dendritic cells.

C. They can be subdivided into inflammatory monocytes and patrolling monocytes.

D. They can give rise to platelets.

E. All of the above are true.

Answer: D

Section: Cells of the Immune System

Difficulty: 2

Hint: One of the statements is not true; what cell types descend from monocytes?

16. Which of the following cell types is responsible for the secretion of immunoglobulins?

A. TH1

B. TH2

C. TH17

D. TFH

E. Plasma cell

Answer: E

Section: Cells of the Immune System

Difficulty: 2

Hint: Which types of lymphocytes are responsible for the regulation of immune responses; which specialize in production of antigen-specific antibodies?

17. Which of the following cell types is responsible for regulating responses against intracellular pathogens?

A. TH1

B. TH2

C. TH17

D. TFH

E. Plasma cell

Answer: A

Section: Cells of the Immune System

Difficulty: 2

Hint: Which types of lymphocytes are responsible for the regulation of immune responses; which specialize in production of antigen-specific antibodies?

18. Which of the following cell types is responsible for activating B cells in germinal centers?

A. TH1

B. TH2

C. TH17

D. TFH

E. Plasma cell

Answer: D

Section: Cells of the Immune System

Difficulty: 2

Hint: Which types of lymphocytes are responsible for the regulation of immune responses; which specialize in production of antigen-specific antibodies?

19. Which of the following cell types is responsible for regulating responses against predominantly extracellular pathogens?

A. TH1

B. TH2

C. TH17

D. TFH

E. Plasma cell

Answer: B

Section: Cells of the Immune System

Difficulty: 2

Hint: Which types of lymphocytes are responsible for the regulation of immune responses; which specialize in production of antigen-specific antibodies?

20. Which of the following cell types secretes IL-17 and may play a role in anti-fungal responses?

A. TH1

B. TH2

C. TH17

D. TFH

E. Plasma cell

Answer: C

Section: Cells of the Immune System

Difficulty: 2

Hint: Which types of lymphocytes are responsible for the regulation of immune responses; which specialize in production of antigen-specific antibodies?

21. Which of the following effector T lymphocyte populations is produced via the activation of a naïve T cell through antigen presented in MHC Class I?

A. CTL

B. TH1

C. TH2

D. TH17

E. None of the above

Answer: A

Section: Cells of the Immune System

Difficulty: 2

Hint: Which of the choices comes from a CD8+ naïve T cell?

22. Which of the following types of effector T lymphocytes is capable of inhibiting an immune response to an

antigen recognized with its T-cell receptor (TCR)?

A. TH1

B. Treg

C. TH2

D. TH17

E. None of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 2

Hint: Which cells listed stimulate specific elements of the immune response?

23. Which of the following descendants of the CLP act in the innate immune response?

A. T cells

B. NK cells

C. B cells

D. Plasma cells

E. All of the above

Answer: B

Section: Cells of the Immune System

Difficulty: 1

Hint: Which cell type does not regulate immune responses or secrete antibodies?

24. Which of the following is NOT considered primary lymphoid tissue?

A. Draining lymph node

B. Thymus

C. Peyer's patch

D. Choices A and C are not primary lymphoid tissue.

E. None of the above is primary lymphoid tissue.

Answer: D

Section: Primary Lymphoid Organs—Where Immune Cells Develop

Difficulty: 2

Hint: How do primary and secondary lymphoid tissue differ functionally; what happens in each of the tissues listed?

25. In mammals, T-cell development occurs in the _____, while B-cell development occurs predominantly in the _____.

A. thymus; bursa of Fabricius

B. bone marrow; mesenteric lymph nodes

C. bone marrow; thymus

D. thymus; bone marrow

E. None of the above

Answer: D

Section: Primary Lymphoid Organs—Where Immune Cells Develop

Difficulty: 2

Hint: B cells (and their antigen-specific receptors) develop in different sites in mammals than in birds.

26. As thymocytes develop, they are classified on the basis of the state of their T-cell receptors and which of the following?

A. Which class of MHC they express on their surface

B. The state of the immunoglobulin heavy and light chains on their surface

C. The presence of coreceptor proteins CD4 and CD8 on their surface

D. The expression of the transcription factor, FoxP3

E. None of the above

Answer: C - MHC is on ANTIGENS, not on IMMUNE CELLS

Section: Primary Lymphoid Organs—Where Immune Cells Develop

Difficulty: 2

Hint: Which of the above factors on the surface of T cells is essential for T-cell function?

27. Upon entering the thymus, thymocytes are classified as double _____ with regard to coreceptor;

before exiting as single-positive, naïve T cells, they pass through a period in which they are double _____.

A. positive; negative

B. negative; positive

C. Both of these are true.

D. Neither of these are true.

E. Coreceptor expression state does not change in the thymus.

Answer: B

Section: Primary Lymphoid Organs—Where Immune Cells Develop

Difficulty: 2

Hint: Expression of the coreceptor genes change during thymocyte development.

28. Contraction of which of the following types of muscles is responsible for propulsion of lymph through the lymphatic system?

A. Cardiac

B. Skeletal

C. Smooth

D. Both B and C

E. None of the above

Answer: D

Section: Secondary Lymphoid Organs—Where the Immune Response Is Initiated

Difficulty: 2

Hint: Lymph is not propelled through the body the same way blood is.

29. Naïve lymphocytes enter secondary lymphoid tissues via which of the following structures?

A. Afferent lymphatics

B. Efferent lymphatics

C. HEVs (high endothelial venules)

D. Marginal sinus

E. None of the above

Answer: C

Section: Secondary Lymphoid Organs—Where the Immune Response Is Initiated

Difficulty: 2

Hint: Lymphocytes enter via a different route than antigens.

30. Which of the following does NOT appear to utilize the FRCC system as its primary means for trafficking through the lymph node?

A. B cells

B. T cells

C. Free antigen that entered via an afferent lymphatic

D. Cytokines and chemokines

E. None of the above utilizes the FRCC system.

Answer: A

Section: Secondary Lymphoid Organs—Where the Immune Response Is Initiated

Difficulty: 3

Hint: How does the FRCC system help molecules and cells move through the lymph node?

Chapter 3 Receptors and Signaling: B and T-Cell Receptors

1. Which of the following types of bonds would be LEAST likely in a receptor-ligand interaction?

A. Ionic bond

B. Covalent bond

C. Hydrogen bond

D. Hydrophobic interaction

E. Ionic bond

Answer: B

Section: Receptor-Ligand Interactions

Difficulty: 2

Hint: Most receptor ligand interactions can be disrupted with high salt concentrations.

2. Ka, the association constant, is a measure of which of the following?

A. The concentration of unbound ligand

B. The concentration of unbound receptor

C. The affinity of receptor for ligand

D. The size of the receptor relative to the ligand

E. The number of ligands for each receptor

Answer: C

Section: Receptor-Ligand Interactions

Difficulty: 2

Hint: It is the ratio of association rate constant over the dissociation rate constant.

3. Receptors that are multivalent tend to bind to their ligands more strongly than receptors with a single binding site.

What is the term used to describe this phenomenon?

A. Avidity

B. Valency

C. Affinity

D. Magnetism

E. None of the above

Answer: A

Section: Receptor-Ligand Interactions

Difficulty: 2

Hint: Affinity is factored into the calculation for avidity.

4. Which of the following BEST describes how cytokines are released from activated T cells?

A. Cytokines are released near where T-cell receptors are clustered.

B. T cells release cytokines on the side of the cell opposite the MTOC in order to more efficiently distribute the response around the cell.

C. T cells release cytokines evenly around the cell.

D. Cytokines are released in short bursts from pre-formed vesicles full of cytokines.

E. Cytokines are released in whatever direction the MTOC happens to be facing upon TCR ligation.

Answer: A

Section: Receptor-Ligand Interactions

Difficulty: 1

Hint: The MTOC orients the secretory apparatus toward the T-cell receptors.

5. Receptors that dimerize upon ligand binding often contain_____in their cytoplasmic domains.

A. tyrosine kinases

B. hydrophobic regions

C. proteases

D. metal-binding regions

E. large immunoglobulin folds

Answer: A

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 1

Hint: Signaling often initiates with the addition of a phosphate.

6. Portions of the cytoplasmic domains of many immune receptors are targets for phosphorylation. These domains are known as:

A. Grb domains.

B. ITAMs.

C. leucine zipper motifs.

D. SOS domains.

E. None of the above

Answer: B

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 1

Hint: Activation induces phosphorylation.

7. Lipid rafts are highly ordered regions of the cell membrane that are enriched in:

A. unsaturated fats.

B. cholesterol.

C. metabolic proteins.

D. clathrin.

E. tubulin.

Answer: B

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 1

Hint: Lipid rafts are more rigid than other regions of the membrane.

8. Which of the following are well established ways that tyrosine phosphorylation directly affects signaling pathways?

A. Inducing kinase activity

B. Recruiting enzymes through SH2 domains

C. Opening calcium channels

D. Both a and b

E. Both b and c

Answer: D

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 1

Hint: A soluble second messenger binds to calcium channels on the endoplasmic reticulum.

9. Which of the following is the CORRECT relationship?

A. PIP2 = PIP3 – DAG

B. PIP2 = IP3 + DAG

C. PLC = PIP2 + PIP3

D. DAG = PIP2 + PIP3

E. PIP3 = IP3 + PIP2

Answer: B

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 2

Hint: PLC-?? cleaves PIP2 leading to downstream signals.

10. Which transcription factor becomes translocated to the nucleus downstream of calmodulin activation?

A. NF-?B

B. NFAT

C. STAT1

D. STAT2

E. STAT3

Answer: B

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 2

Hint: Calcineurin acts on this transcription factor.

11. G proteins:

A. bind GTP.

B. dephosphrylate ITAMs.

C. are transcription factors.

D. downmodulate immune responses.

E. are adhesion molecules.

Answer: A

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 2

Hint: G proteins are often associated with the membrane.

12. Which of the following is responsible for IL-2 expression in T cells?

A. NF-?B

B. NFAT

C. AP1

D. Both A and B

E. All of the above

Answer: E

Section: Common Strategies Used in Many Signaling Pathways

Difficulty: 2

Hint: The IL-2 promoter has many transcription factor binding sites.

13. Immunoglobulin domains consist of:

A. series of ? helices bound together by hydrophobic interactions in their side chains.

B. ? helices alternating with parallel ?-pleated sheets.

C. anti-parallel ?-pleated sheets folded and stabilized by hydrophobic interactions.

D. compact, parallel ? sheets forming a barrel structure.

E. ? helices held together by leucine repeats.

Answer: C

Section: The Structure of Antibodies

Difficulty: 2

Hint: The IL-2 promoter has many transcription factor binding sites.

14. On the gel below, which bands would you expect to bind antigen?

A. A

B. B

C. C

D. D

E. A, B, and C

Answer: E

Section: The Structure of Antibodies

Difficulty: 3

Hint: The Fab domain binds antigen.

15. Antibodies consist of:

A. two identical heavy chains and two identical light chains.

B. an ? chain, a ??chain, a ? chain, and a ? chain.

C. two ? chains, an ? chain, and a ? chain.

D. two ? chains, an ? chain, and a ??chain.

E. either an ? chain or a ??chain, a ? chain and a ? chain.

Answer: A

Section: The Structure of Antibodies

Difficulty: 2

Hint: Antibodies are shaped like a Y.

16. Which of the following isotypes of antibodies is the largest?

A. IgM

B. IgG

C. IgA

D. IgE

E. IgD

Answer: A

Section: The Structure of Antibodies

Difficulty: 2

Hint: Some isotypes are multimers.

17. An antibody's idiotype refers to:

A. the kind of Fc region it contains.

B. the sequence of its CDR.

C. Ii's allelic form.

D. whether it is membrane bound or secreted.

E. which accessory molecules associate with it.

Answer: B

Section: The Structure of Antibodies

Difficulty: 2

Hint: The idiotype of an antibody determines what antigen it binds.

18. Carbohydrate chains attached to the CH2 domains of IgA, IgD, and IgG are believed to:

A. allow for closer contact between partner chains.

B. confer stability to the molecule resulting in a higher desaturation temperature.

C. prevent protease degradation.

D. provide space for complement protein binding.

E. increase binding affinity for antigen.

Answer: D

Section: The Structure of Antibodies

Difficulty: 2

Hint: Other immune molecules interact with the CH2 domain.

19. Whether an immunoglobulin is secreted or membrane bound is directly determined by:

A. the sequence of the DNA in the Ig locus.

B. mRNA splicing.

C. the kind of B cell is producing it.

D. DNA rearrangement.

E. GPI anchors.

Answer: B

Section: The Structure of Antibodies

Difficulty: 3

Hint: This mechanism is different than what determines antigen binding.

20. Receptors that bind the constant regions of antibodies are known as:

A. B-cell receptors.

B. T-cell receptors.

C. idiotype receptors.

D. toll-like receptors.

E. Fc receptors.

Answer: E

Section: The Structure of Antibodies

Difficulty: 2

Hint: Which portion of an antibody contains the constant region?

21. Large amounts of monoclonal antibodies in the serum of an individual might be an indicator of:

A. infection.

B. T-cell deficiency.

C. autoimmune disease.

D. myeloma.

E. stress.

Answer: D

Section: Signal Transduction in B Cells

Difficulty: 3

Hint: How do you get monoclonal antibodies?

22. Which of the following would be BEST for depleting an entire class of antibodies?

A. Anti-idiotype antibody

B. Anti-isotype antibodies

C. Anti-CD19

D. Anti-CD4

E. Anti-CD8

Answer: B

Section: Signal Transduction in B Cells

Difficulty: 2

Hint: How do you get monoclonal antibodies?

23. Which of the following BEST describes why it is challenging for surface immunoglobulin to transduce a signal

into the cell upon antigen binding?

A. It takes twice as much antigen to stimulate the cells because each antibody has two antigen binding sites.

B. The cytoplasmic domain of surface Ig only has three amino acids.

C. Ig? is rapidly dephosphorylated.

D. Ig is an inflexible molecule.

E. All of the above.

Answer: B

Section: Signal Transduction in B Cells

Difficulty: 3

Hint: What transmits the signal into the cell?

24. Regions of TCRs and BCRs that are particularly variable in their amino acid sequences are known for:

A. binding to antigen.

B. sticking to denatured proteins.

C. spanning the plasma membrane.

D. binding to adaptor proteins.

E. becoming phosphorylated.

Answer: A

Section: Signal Transduction in B Cells

Difficulty: 3

Hint: What happens when amino acid sequences change in a protein?

25. Which of the following contains the MOST ITAMs?

A. CD3?

B. CD3?

C. CD3?

D. TCR?

E. TCR?

Answer: C

Section: T-Cell Receptors and Signaling

Difficulty: 3

Hint: It is the chain with the longest cytoplasmic domain.

26. CD4 binds to:

A. TCR?

B. TCR?

C. MHC class I

D. MHC class II

E. CD8

Answer: D

Section: T-Cell Receptors and Signaling

Difficulty: 3

Hint: It is only expressed on professional APCs.

27. The antigen specific component of the B-cell receptor is:

A. ITAM.

B. CD19.

C. Ig?/??

D. CD21.

E. Lyn.

Answer: C

Section: Signal Transduction in B Cells

Difficulty: 3

Hint: It is not involved in signaling.

Chapter 4 Receptors and Signaling: Cytokines and Chemokines

1. A(n) ____ is a molecule that is used by immune cells for communication.

A. chemoattractant

B. chemokine

C. cytokine

D. interleukin

E. All of the above

Answer: E

Section: Introduction

Difficulty: 1

Hint: Immune cells use several cell types to communicate, activate, and regulate each other.

2. Which of the following is NOT a property of cytokines?

A. Induce apoptosis (programmed cell death)

B. Induce cell motility

C. Membrane-bound signaling molecule

D. Soluble signaling molecule

E. Upregulate transcription

Answer: B

Section: Introduction

Difficulty: 2

Hint: Cytokines regulate cell activation and regulation.

3. _____ are responsible for recruiting immune cells to a specific location within the body, organ, or tissue.

A. Chemokines

B. Immunoglobulins

C. G proteins

D. Receptors

E. None of the above

Answer: A

Section: Introduction

Difficulty: 2

Hint: Chemokines are a type of chemoattractant specific to the immune system.

4. The activity of most cytokines is BEST described as:

A. autocrine.

B. paracrine.

C. endocrine.

D. Both A and B

E. Both B and C

Answer: D

Section: Introduction

Difficulty: 1

Hint: As a general rule, cytokines stimulate themselves or neighboring cells.

5. Differentiate between endocrine, paracrine, and autocrine.

Provide an example of a cytokine that demonstrates such activity.

(Different cytokines may be listed for each term.)

Answer: See below table.

	Autocrine	Paracrine	Endocrine

Definition Signal stimulates cell that released the signal (self-stimulation) Signal stimulates neighboring cellSignal stimulates cell in another organ; pass through bloodstream before binding receptor

Example IL-2 (T-cell differentiation to memory Ts and cytotoxic Ts [CTL])

IL-2 (stimulates B-cell proliferation, e.g., secondary immune organs—lymph node, spleen)
IL-2 (causes activation of NK cells that may be present in close proximity or far away)

Section: Introduction

Difficulty: 3

Hint: Cytokines function to stimulate self, neighboring cells, and cells that are far away.

6. What determines if a particular cell will be acted up on by a cytokine?

A. A high local concentration of the cytokine molecule

B. Location of the cell releasing the cytokine

C. Presence or absence of a cytokine receptor

D. Two different cytokines binding the receiving cell

E. Both A and C

Answer: C

Section: General Properties of Cytokines and Chemokines

Difficulty: 1

Hint: All chemical signals must be detected by a receptor molecule.

7. IL-2 acts on several cell types thus regulating multiple immune processes. IL-2 is said to be:

A. antagonistic.

B. cascade inducible.

C. pleiotropic.

D. redundant.

E. synergistic.

Answer: C

Section: General Properties of Cytokines and Chemokines

Difficulty: 1

Hint: Cytokines that have one target are monotropic, while cytokines with multiple targets are pleiotropic.

8. You are a new member of a graduate research lab. Your research is to study the effects of a novel cytokine TNF-mu (TNF-μ).

During the course of your research, you discover that TNF-μ induces monocyte maturation, inhibits eosinophil development,

and begins a signaling cascade that promotes histamine release.

What term best describes the action of TNF-μ on eosinophils?

A. Antagonistic

B. Cascade inducible

C. Pleiotropic

D. Redundant

E. Synergistic

Answer: A

Section: General Properties of Cytokines and Chemokines

Difficulty: 3

Hint: Inhibition is a form of antagonism.

9. B-cell proliferation is triggered by IL-2, IL-4, and IL-5. Each of these cytokines is secreted by activated

TH cells thus their action is:

A. antagonistic.

B. cascade inducible.

C. pleiotropic.

D. redundant.

E. synergistic.

Answer: D

Section: General Properties of Cytokines and Chemokines

Difficulty: 1

Hint: Multiple signals for the same event is defined as immunologic redundancy.

10. Which of the following is an example of antagonism?

A. IL-2 stimulates B-cell proliferation so that antibodies are produced.

B. IL-4 causes B cells to differentiate into plasma and memory cells.

C. IL-4 and IL-5 cause class switching of immunoglobulins secreted by plasma cells.

D. IFN-? prevents class switching in plasma cells by binding IL-4.

E. IL-12 stimulates activation of TH cells.

Answer: D

Section: General Properties of Cytokines and Chemokines

Difficulty: 2

Hint: Antagonism blocks a receptor or inhibits a signaling pathway.

11. Chemokines often show redundancy in their signaling. Why might redundancy be beneficially in multicellular

organisms to starting certain immune responses?

A. Immune response can be up-regulated or down-regulated based on how many chemokines are released.

B. Receiving multiple signals allows a double check before an immune response is started.

C. Some signals target multiple cells and are nonspecific.

D. Inactivated cells do not bind chemokine signals.

E. A, B, and C

Answer: E

Section: General Properties of Cytokines and Chemokines

Difficulty: 3

Hint: Redundancy repeats a specific chemical signal using more than one signaling pathway.

12. Cytokines are grouped into functional families. How many families of cytokines are identified to date?

A. 2

B. 6

C. 14

D. 50

E. Over 100

Answer: B

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 1

Hint: There are six cytokine receptor families.

13. Which cytokine family is responsible for promoting inflammation?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 1 family

E. Tumor Necrosis Factor family

Answer: D

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 1

Hint: Interleukins are involved with inflammation.

14. IRAK is a cytokine receptor activated kinase that binds MyD88 and TRAF6.

The IRAK-TRAF6 complex activates TAK1 protein that will activate either the MAP kinase cascade or the NF-?B pathway.

Which family of cytokine receptors can activate IRAK?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 1 family

E. Interleukin 17 family

Answer: D

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 3

Hint: Interleukins are frequently used in signaling pathways.

15. IL-2, GM-CSF, erythropoietin, prolactin, and IL-12 are representatives of which cytokine family?

A. Chemokines family

B. Hematopoietin family

C. Interferon family

D. Interleukin 1 family

E. Interleukin 17 family

Answer: B

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 2

Hint: GM-CSF and erythropoietin stimulate blood cell development.

16. Which family of cytokines was the first to be discovered?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 1 family

E. Tumor Necrosis Factor family

Answer: C

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 1

Hint: Interferon history.

17. Members of type I and type III interferon are responsible for controlling:

A. viral replication within host cells.

B. TC destruction of viral infected host cells.

C. proliferation of viral infected host cells.

D. apoptosis of viral infected host cells.

E. Both A and C

Answer: E

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 2

Hint: Interferons are used to regulate viral infections.

18. Which family of cytokine receptors uses the Janus activated kinase (JAK) family of tyrosine kinases?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 17 family

E. Tumor Necrosis Factor family

Answer: C

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 2

Hint: JAK kinases are often sites of viral entry into cells.

19. Which family of cytokines regulates target-cell development, proliferation, or death?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 1 family

E. Tumor Necrosis Factor family

Answer: E

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 1

Hint: TNF can trigger apoptosis.

20. This family of cytokines is the most recently discovered and contains cytokines that contribute to both innate

and adaptive immunity.

A. Chemokines family

B. Interferons family

C. Interleukin 1 family

D. Interleukin 17 family

E. Tumor Necrosis Factor family

Answer: D

Section: Six Families of Cytokines and Associated Receptor Molecules

Difficulty: 1

Hint: Interleukins represent a relatively new division within cytokines.

21. _____ are proteins that inhibit the activity of various cytokines.

A. ß-blockers

B. Cytokine antagonists

C. Cytokine receptors

D. G proteins

E. JAK kinases

Answer: B

Section: Cytokine Antagonists

Difficulty: 1

Hint: Antagonists block signaling pathways or receptor molecules.

22. Epstein-Barr virus produces an IL-10 homologue. What is the purpose of the IL-10 homologue?

A. The IL-10 homologue binds to cell receptors to prevent other viruses from infecting the host cell.

B. The IL-10 homologue binds to the cell receptor to prevent cytokines from triggering an inflammatory response.

C. The IL-10 homologue binds all plasma-soluble cytokines to prevent an immune response.

D. The IL-10 homologue binds to cell receptors to trigger an early inflammatory response.

E. The IL-10 homologue serves no purpose.

Answer: B

Section: Cytokine Antagonists

Hint: Cytokine receptors and signaling pathways represent a common site of viral entry into a host cell.

Difficulty: 2

23. Variola virus, the causative agent of small pox, produces soluble TNF receptors. What advantage does the production of a

TNF receptor have for avoiding immune response?

A. TNF represents a family of soluble cytokines. By producing soluble receptors that bind cytokines, then the cytokine effector

response is eliminated and only a limited immune response will occur.

B. TNF receptors bind to cells of the immune system and prevent the release of cytokines.

C. TNF receptors block transcription within infected cells so that new virus particles cannot be made.

D. TNF receptors bind to TC cells, preventing lysis of infected cells.

E. TNF receptors allow an infected cell to become infected by more than one variola virion (virus particle).

Answer: A

Section: Cytokine Antagonists

Difficulty: 2

Hint: Cytokines will bind their receptors or molecules that mimic their receptors.

24. Septic shock is caused by:

A. clotting factor.

B. cytokines produced by dying cells.

C. fungal infections.

D. gram-positive bacteria.

E. lipid A (an endotoxin).

Answer: E

Section: Cytokine-Related Diseases

Difficulty: 2

Hint: Lipid A is an endotoxin that can elicit a massive immune response that usually overwhelms the immune system.

25. A cytokine storm, or hypercytokinemia, is a condition where cytokines are released that trigger the release of other

cytokines to develop a positive feedback loop.

It is thought that the 1917–1918 Influenza pandemic induced a cytokine storm in its victims.

Which of the following mechanisms would be BEST to stop the positive feedback loop created by a cytokine storm?

A. The use of soluble antagonists to bind soluble cytokines

B. The use of soluble antagonists to bind membrane-bound cytokine receptors

C. Infecting the patient with other viruses that are known to target and kill immune cells

D. Treating the patient with drugs that kill all immune cells

E. Nothing can be done for the patient.

Answer: B

Section: Cytokine-Related Diseases

Difficulty: 3

Hint: To stop a positive feedback loop, signals must be blocked on removed. Because blocking is easier in most cases than

removing a signaling molecule, antagonists are a popular option when treating positive feedback loops.

26. Several drugs have been developed over the past decade that target and bind to specific cytokines (e.g., TNF-a).

What detrimental health effects result from blocking cytokines?

A. The immune response will not be as robust because certain pathways have been blocked.

B. Hyperstimulation of the immune system may result in a cytokine storm (hypercytokinemia).

C. Excessive amounts of energy will be required to maintain the immune response when so many cytokines are present so the

patient will require more than eight hours of sleep.

D. Both A and B are potential concerns.

E. Both B and C are potential concerns.

Answer: D

Section: Cytokine-Based Therapies

Difficulty: 2

Hint: Cytokines direct every movement of the immune response from cell activation to proliferation and regulation.

27. All of the following may occur when using a low dosage of a cytokine to treat a virus infection EXCEPT:

A. anemia.

B. faster recovery time.

C. hyperstimulation of the immune system.

D. increased chance of fever.

E. No result will occur.

Answer: E

Section: Cytokine-Related Diseases

Difficulty: 1

Hint: Cytokines always produce an effect if their receptor is present.

28. All of the following reasons contribute to the current low usages of cytokine therapy in medicine EXCEPT:

A. Cytokines have a short half-life, usually less than 10 min.

B. Cytokines may be bound by soluble receptors and never reach their target cell.

C. Cytokine injections often cause an allergic reaction because rabbits make the perfect cytokine factory.

D. Cytokines may result in an unexpected or overly powerful immune response.

E. Cytokines must be given multiple times on a specific schedule.

Answer: C

Section: Cytokine-Based Therapies

Difficulty: 2

Hint: Cytokines are highly regulated signaling molecules that typically work on self or neighboring cells.

29. Immunotherapy for RA (rheumatoid arthritis), Crohn's disease, and multiple sclerosis rely upon which family of cytokines?

A. Chemokines family

B. Hematopoietin family

C. Interferons family

D. Interleukin 1 family

E. Tumor Necrosis Factor family

Answer: C

Section: Cytokine-Based Therapies

Difficulty: 2

Hint: Interferon therapy is a current and developing technology to treat several autoimmune diseases.

Chapter 5 Innate Immunity

1. Which of the following is NOT entirely a response of the innate immune system?

A. Phagocytosis by macrophages

B. Protection from infection by the skin

C. Low pH in the stomach

D. Antibody mediated complement activation

E. Microbial cell lysis by defensin

Answer: D

Section: Introduction

Difficulty: 2

Hint: What makes antibodies?

2. Which of these characteristics are adaptive?

A. Response takes several days to develop

B. Responds more quickly upon secondary exposure to pathogens

C. Pathogen receptors are extremely varied

D. Recognize broad classes of pathogens

E. A, B, and C

Answer: E

Section: Introduction

Difficulty: 1

Hint: Review Table 5-1.

3. Which of these characteristics are innate?

A. Found in all multicellular plants and animals

B. Receptors are encoded in the germline

C. Recognize broad classes of pathogens

D. Responds more quickly upon secondary exposure to pathogens

E. A, B, and C

Answer: E

Section: Introduction

Difficulty: 1

Hint: Review Table 5-1.

4. A mixture of S. aureus and the enteric bacteria E. coli was placed onto the skin of the fingertips of a volunteer.

The volunteer immediately touched one of their inoculated fingertips to nutrient agar plate #1 and then waited 30 minutes and touched a different

inoculated finger to nutrient agar plate #2.

After incubating the plates overnight, what pattern of growth would you expect to see on the plates?

A. Both E. coli and S. aureus grew on both plates.

B. Plate #1 grew both, while plate #2 grew only S. aureus.

C. Plate #1 grew both, while plate #2 grew only E. coli.

D. Plate #1 grew only S. aureus, while plate #2 grew both.

E. Plate #1 grew only E. coli, while plate #2 grew both.

Answer: B

Section: Anatomical Barriers to Infection

Difficulty: 3

Hint: The skin contains psoriasin, an antibacterial protein.

5. Where would you be LEAST likely to find significant levels of defensins?

A. The lung

B. The intestine

C. The liver

D. The skin

E. The bladder

Answer: C

Section: Anatomical Barriers to Infection

Difficulty: 2

Hint: Defensins are found in locations where pathogens first contact the host.

6. Which of the following is the CORRECT relationship? _____ on _____ recognize _____ on _____.

A. PRRs; macrophages; PAMPs; pathogens

B. PRRs; pathogens; PAMPs; macrophages

C. PAMPs; macrophages; PRRs; pathogens

D. PAMPs; neutrophils; PRR; pathogens

E. PRRs; macrophages; PAMPs; neutrophils

Answer: A

Section: Phagocytosis

Difficulty: 2

Hint: PRRs are found on antigen-presenting cells.

7. Why are many opsonins multimeric?

A. Because they are all derived from the same proto-opsonin

B. Because they bind repeating structures on pathogen surfaces

C. So that they can be regulated allosterically

D. Because they have to crosslink receptors on phagocytes in order for phagocytosis to occur

E. Because one subunit binds pathogen and the other has enzymatic activity

Answer: B

Section: Phagocytosis

Difficulty: 2

Hint: Multimeric receptors have several identical binding sites.

8. Which of the following are associated with damaged or dead cells?

A. Lysophosphatidic acid

B. Altered carbohydrates

C. Low CD47

D. Cell-surface annexin I

E. All of the above

Answer: E

Section: Phagocytosis

Difficulty: 2

Hint: Cell membranes change radically during apoptosis.

9. Which of the following would you predict to result from a mutation in TLR-4 that prevents binding to LPS?

A. Increased susceptibility to infection with gram-positive bacteria

B. Decreased susceptibility to septic shock

C. Failure to develop from an embryo

D. Tighter binding between bacteria and macrophages

E. Increased phagocytosis

Answer: B

Section: Induced Cellular Innate Responses

Difficulty: 3

Hint: Many symptoms of inflammation are initiated by LPS.

10. Match the following toll-like receptors with their ligands.

TLR	Ligands
TLR3	Flagellin
TLR4	Zymosan
TLR5	dsRNA
TLR6	CpG unmethylated dinucleotides
TLR9	LPS

A. TLR3/LPS; TLR4/CpG unmethylated dinucleotides; TLR5/dsRNA; TLR6/Zymosan; TLR9/Flagellin

B. TLR3/dsRNA; TLR4/LPS; TLR5/Flagellin; TLR6/Zymosan; TLR9/CpG unmethylated dinucleotides

C. TLR3/dsRNA; TLR4/LPS; TLR5/CpG unmethylated dinucleotides; TLR6/Flagellin; TLR9/Zymosan

D. TLR3/CpG unmethylated dinucleotides; TLR4/Zymosan; TLR5/Flagellin; TLR6/LPS; TLR9/dsRNA

E. TLR3/Zymosan; TLR4/LPS; TLR5/Flagellin; TLR6/dsRNA; TLR9/CpG unmethylated dinucleotides

Answer: B

Section: Induced Cellular Innate Responses

Difficulty: 1

Hint: Review Table 5-4.

11. Which of the following is NOT usually induced in response to TLR signaling?

A. TNF-?

B. IL-1

C. iNOS

D. IL-6

E. IL-4

Answer: E

Section: Induced Cellular Innate Responses

Difficult: 2

Hint: TLR signaling often leads to inflammation.

12. Where would you MOST likely find a TLR that recognizes RNA?

A. On the cell surface

B. In the endosome/lysosome

C. In the nucleus

D. In the mitochondria

E. In the endoplasmic reticulum

Answer: B

Section: Induced Cellular Innate Responses

Difficulty: 2

Hint: RNA receptors are often found where viruses uncoat and disassemble.

13. Which of the following adaptor proteins activate the NF-?B pathway?

A. MyD88

B. IKK?

C. Calmodulin

D. IL-2 receptor

E. SOS

Answer: A

Section: Induced Cellular Innate Responses

Difficulty: 1

Hint: The key to this question is the word "adaptor."

14. Which cytokine is known for its anti-viral properties?

A. IL-2

B. IL-4

C. IFN-?

D. TNF-?

E. IL-1

Answer: C

Section: Induced Cellular Innate Responses

Difficulty: 1

Hint: This cytokine's name reflects its function.

15. What is the Latin word for pain?

a. Rubor

b. Calor

c. Dolor

d. Tumor

e. Accio

Answer: C

Section: Inflammatory Responses

Difficulty: 1

Hint: Many Latin words have similar derivatives in English, except the word for pain.

16. C-reactive protein is a/an:

A. chemokine.

B. cytokine.

C. acute phase response protein.

D. surfactant.

E. cell-adhesion molecule.

Answer: C

Section: Inflammatory Responses

Difficulty: 1

Hint: C-reactive protein is produced by the liver.

17. How do natural killer cells kill their targets?

A. By lysing them

B. By inducing inflammation

C. By inducing apoptosis

D. By causing them to leave the bloodstream and be trapped by the liver

E. By coating them with opsonins

Answer: C

Section: Natural Killer Cells

Difficulty: 2

Hint: NK cells kill by a similar mechanism to CTL

18. What types of cells are good targets for natural killer cells and why?

A. Bacterial cells because they contain LPS

B. Gram positive cells because they contain LTA

C. Antigen presenting cells because they have high levels of costimulatory molecules

D. Endothelial cells in inflamed tissues because they have high levels of adhesion molecules

E. Virally infected cells because they have low levels of class I MHC

Answer: E

Section: Natural Killer Cells

Difficulty: 3

Hint: Many viruses try to evade immune responses by blocking antigen presentation.

19. Predict the clinical outcome of a genetic defect in IRAK4, a protein required for the MyD88 pathway.

A. Increased rates of cancer

B. Increased rates of autoimmune disease

C. Decreased muscle tone

D. Increased rates of bacterial infection

E. Increased TLR signaling

Answer: D

Section: Clinical Focus

Difficulty: 3

Hint: MyD88 is an adaptor for almost all TLRs.

20. Activation of dendritic cells with TLR4 or TLR5 results in the production of _____ that induces differentiation of CD4 T cells into _____.

A. IL-12; TH1

B. IL-12; TH2

C. IL-10; TH1

D. IL-10; TH2

E. IL-4; TH1

Answer: A

Section: Interactions Between the Innate and Adaptive Immune Systems

Difficulty: 1

Hint: TH1 responses are more protective against gram-negative bacteria.

21. Dendritic cells present _____ antigens on class I MHC through a process known as cross presentation.

A. endogenous

B. exogenous

C. bacterial

D. viral

E. complex

Answer: B

Section: Interactions Between the Innate and Adaptive Immune Systems

Difficulty: 2

Hint: Cross presentation is different than the usual pathway.

22. Activation of B cells with TLR rather than with T-cell help would result in the overall antibody response being:

A. more specific.

B. more long lasting.

C. more polyclonal.

D. reduced.

E. more protective.

Answer: C

Section: Interactions Between the Innate and Adaptive Immune Systems

Difficulty: Understanding/Application

Hint: In order for a T cell to help a B cell, it usually recognizes the same antigen.

23. Which type of vaccine would MOST likely require an adjuvant?

A. Killed bacteria

B. Attenuated virus

C. Inactivated virus

D. Purified protein

E. All of the above

Answer: D

Section: Interactions Between the Innate and Adaptive Immune Systems

Difficulty: 3

Hint: Adjuvants are required when the vaccine itself does not contain sufficient PAMPs.

24. At what point in evolution did adaptive immunity develop?

Answer: Around the same point that fish developed jaws.

Section: Ubiquity of Innate Immunity

Difficulty: 3

Hint: Organisms with adaptive immune systems have antibodies.

25. Which of the following defenses is MOST likely to protect a plant from a microbial pathogen?

A. Antibodies

B. CTL

C. Phagocytes

D. Reactive-oxygen species

E. CD4

Answer: D

Section: Ubiquity of Innate Immunity

Difficulty: 2

Hint: Plants do not have adaptive immunity.

26. Imagine you are walking barefoot across a pasture when your foot becomes punctured with a dirty splinter.

Describe the physiological and molecular changes that occur in your foot over the next few hours.

Answer: Many potential correct answers. Phagocytes in the area would respond to PAMPs and damaged cells by secreting cytokines such as IL-1, IL-6, and TNF-a.

This would result in swelling and redness in the area as chemokines get released and other leukocytes leave the bloodstream and enter the tissue.

Section: Whole chapter

Difficulty: 3

Hint: How would phagocytes respond to PAMPs?

Chapter 6 The Complement System

1. Which of the following complement fixation pathways can be initiated by a soluble C3 convertase?

A. Alternative

B. Classical

C. Lectin

D. All of the above

E. None of the above

Answer: A

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: Two of the three pathways require a protein to recognize a specific antigen or other molecular complex on the surface of the

pathogen to form the C3 convertase.

2. Which of the following provides serine protease activity in the classical complement activation pathway?

A. MASP-2

B. C1r

C. C1s

D. Both B and C

E. None of the above acts in the classical pathway.

Answer: D

Section: The Major Pathways of Complement Activation

Difficulty: 3

Hint: The serine protease that acts on the classical pathway components that will ultimately be deposited into the surface of the

pathogen need to be activated, which consists of proteolytic cleavage.

3. Which of the following is the MOST potent anaphylatoxin produced during the complement cascade?

A. C3a

B. C3b

C. C5a

D. C5b

E. Ba

Answer: C

Section: The Major Pathways of Complement Activation

Difficulty: 2

Hint: Anaphylatoxins produced during complement activation are not inserted into the surface of the pathogen.

4. To which of the following is MBL most structurally similar?

A. C3b

B. C1q

C. Bb

D. C5b

E. None of the above

Answer: B

Section: The Major Pathways of Complement Activation

Difficulty: 3

Hint: Two of the complement activation pathways are initiated by the binding of proteins to the pathogens that, in spite of the differences

in primary structure, have remarkable similarities in their higher order structure.

5. Which of the following refers to the complex that provides the enzymatic activity in the alternative pathway C3 convertase?

A. $C3^{-}b^{-}B^{-}b^{-}$

B. C3bBb

C. C4b2a

D. C4?b2?a

E. None of the above

Answer: A

Section: The Major Pathways of Complement Activation

Difficulty: 2

Hint: How do you differentiate between enzymatically active versus inactive complexes?

6. Which of the following is TRUE about the C5 convertase?

A. C5 convertase can consist of the membrane-bound components C3b2Bb.

B. C5 convertase cleaves C5 into C5a and C5b, with the b chain attached to the pathogen surface and the a chain dissociating

away to serve as a potent proinflammatory chemotactic factor.

C. C5 convertase is an important player in the production of the MAC.

D. All of the above

E. None of the above

Answer: D

Section: The Major Pathways of Complement Activation

Difficulty: 3

Hint: Of what does the C5 consist, and what does it do?

7. Which of the following BEST explains the timing of the classical pathway of complement fixation, relative to the other pathways of complement fixation, against a pathogen in an individual who has never been exposed to said pathogen?

A. No target for C1qrs exists on the surface of the pathogen in the earliest stages of the response to it.

B. The chemical environment of the pathogen's surface favors the spontaneous activation of soluble C3 immediately upon exposure to the pathogen.

C. C1qrs immediately recognizes carbohydrate antigens on the surface of the pathogen, allowing for rapid formation of the C4b2a C3 convertase.

D. The pathogen expresses one or more factors on its surface that act as negative regulators of C3 convertase formation.

E. None of the above

Answer: A

Section: The Major Pathways of Complement Activation

Difficulty: 3

Hint: What complement protein(s) recognize(s) which antigens to initiate C3 convertase formation?

8. Which of the following binds to surface-bound C3b during formation of the alternative C3 convertase?

A. Factor Bb

B. Factor B

C. C2a

D. C4b

E. Factor D

Answer: B

Section: The Major Pathways of Complement Activation

Difficulty: 2

Hint: When does cleavage of the factor that binds to C3 occur in relation to that factor's binding to C3b?

9. Which of the following can be directly activated as a soluble protein in the microenvironment surrounding a pathogenic cell?

A. C2

B. C3

C. Factor B

D. Factor D

E. C4

Answer: B

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: What complement factors are involved in which activation pathways, and how does each participate?

10. Which of the following acts as a protease that is required to generate the alternative pathway C3 convertase?

A. C2

B. C3

C. Factor B

D. Factor D

E. C4

Answer: D, Factor B binds to C3b during formation of alternative C3 convertase

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: What complement factors are involved in which activation pathways, and how does each participate?

11. Which of the following is the first complement factor to be activated, resulting in insertion of one of its subunits into the

pathogen surface in two of the three complement fixation pathways?

A. C2

B. C3

C. Factor B

D. Factor D

E. C4

Answer: E

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: What complement factors are involved in which activation pathways, and how does each participate?

12. Which of the following, when activated itself, acts as a protease that converts soluble C3 into C3a and C3b in the alternative pathway?

A. C2

B. C3

C. Factor B

D. Factor D

E. C4

Answer: C

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: What complement factors are involved in which activation pathways, and how does each participate?

13. Which of the following, when activated, utilizes its “a” component instead of the “b” component in the formation of the C3 convertase?

A. C2

B. C3

C. Factor B

D. Factor D

E. C4

Answer: A

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: What complement factors are involved in which activation pathways, and how does each participate?

14. Which of the following immunoglobulin isotypes is the MOST efficient at initiating a complement fixation cascade?

A. IgG

B. IgE

C. IgM

D. IgD

E. None of the above

Answer: C

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: Which of the isotypes named in the answer choices presents the most binding sites for C1q to recognize?

15. Addition of which of the following components to any C3 convertase leads to the formation of the C5 convertase?

A. C3b

B. C2a

C. C4b

D. C5b

E. C3a

Answer: A

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: An additional copy of one of the membrane-bound components of C3 convertase is required to generate the C5 convertase.

16. Which form of IgM is MOST readily recognized by C1q?

A. Monomeric IgM

B. Planar pentameric IgM

C. “Staple-form” pentameric IgM

D. All of the above are recognized equally well.

E. None of the above

Answer: C

Section: The Major Pathways of Complement Activation

Difficulty: 1

Hint: Which form allows for C1q greatest accessibility to its binding sites on the IgHμ?

17. Which of the following acts as a positive regulator of complement fixation via stabilization of C3bBb?

A. DAF (CD55)

B. Properdin

C. Factor H

D. Factor I

E. MCP (CD46)

Answer: B

Section: The Diverse Functions of Complement

Difficulty: 2

Hint: Differentiate between positive and negative regulation of complement fixation, and understand the mechanisms by which each occurs.

18. Which of the following acts as a serine protease that, with cofactors, cleaves C3b and C4b?

A. DAF (CD55)

B. Properdin

C. Factor H

D. Factor I

E. MCP (CD46)

Answer: D

Section: The Diverse Functions of Complement

Difficulty: 2

Hint: Differentiate between positive and negative regulation of complement fixation, and understand the mechanisms by which each occurs.

19. Which of the following facilitates dissociation of both the C4b2a and C3bBb C3 convertases?

A. DAF (CD55)

B. Properdin

C. Factor H

D. Factor I

E. MCP (CD46)

Answer: A

Section: The Diverse Functions of Complement

Difficulty: 2

Hint: Differentiate between positive and negative regulation of complement fixation, and understand the mechanisms by which each occurs.

20. Which of the following is capable of initiating the alternative pathway of complement fixation by directly binding to the surfaces of certain cell types?

A. DAF (CD55)

B. Properdin

C. Factor H

D. Factor I

E. MCP (CD46)

Answer: B

Section: The Diverse Functions of Complement

Difficulty: 2

Hint: Differentiate between positive and negative regulation of complement fixation, and understand the mechanisms by which each occurs.

21. The MAC consists of a multimeric complex of which of the following proteins that, by their association, forms a pore in the surface of the attacked cell?

A. C3b

B. C5b

C. C6

D. C9

E. C4b

Answer: D

Section: The Major Pathways of Complement Activation

Difficulty: 2

Hint: Which spans the cell surface instead of merely being inserted in the extracellular face of it?

22. How does binding of complement-opsonized microbes to CR1 facilitate clearing of the microbe from the host?

A. Promotion of phagocytosis of opsonized microbes by leukocytes

B. Secretion of proinflammatory cytokines

C. Mediating phagocytosis of C3b-opsonized pathogen by B cells

D. All of the above occur as a result of CR1 binding of complement-opsonized microbes.

E. None of the above

Answer: D

Section: The Diverse Functions of Complement

Difficulty: 3

Hint: CR1 facilitates clearance in multiple ways.

23. Which of the following is TRUE about the binding of C5b to the pathogen surface?

A. C5b binds to the pathogen surface the same way C4b and C3b do.

B. C5b requires C6 binding to stabilize it before it dissociates away.

C. C5b, when complexed to C6 and C7, is capable of forming the MAC on any cell membrane, pathogen or host.

D. Both B and C

E. All of the above

Answer: D

Section: The Major Pathways of Complement Activation

Difficulty: 3

Hint: How C5b binds is important to, not only its normal function, but also to potential abnormal function associated with it.

24. Which of the following is NOT an effect of C3a and C5a binding their receptors on leukocytes?

A. Increased vascular permeability via induction of TNF-a and IL-6 secretion

B. Induction of degranulation by granulocytes

C. Increased smooth muscle contraction to aid in delivering immune cells and molecules to the site of infection

D. All of the above are effects of C3a and C5a binding their receptors.

E. None of the above is an effect of C3a and C5a binding their receptors.

Answer: D

Section: The Diverse Functions of Complement

Difficulty: 3

Hint: Anaphylatoxins display more than one single activity upon their binding.

25. Which of the following regulates complement function by directly inhibiting formation of the MAC?

A. Protectin (CD59)

B. Factor I

C. DAF (CD55)

D. C1INH

E. Factor H

Answer: A

Section: The Diverse Functions of Complement

Difficulty: 2

Hint: Not all complement regulatory factors act at the same stages in complement fixation; some act early in the process, others act later.

Chapter 7 The Organization and Expression of

Lymphocyte Receptor Genes

1. Which of the following BEST encapsulates the findings of the Hozumi and Tonegawa experiments?

A. Every possible light chain that could be formed, in terms of receptor specificity, is encoded by a separate gene within the human genome.

B. Light chains are produced by means of somatic rearrangement of germ-line DNA in B cells.

C. The different light-chain variable regions are produced by means of alternative splicing of pre-mRNA that has been transcribed from a fixed, unchanging DNA sequence.

D. Different light chains, each with unique specificity, are produced via the activity of alternative transcription factors that regulate antibody production at the level of transcription initiation.

E. None of the above

Answer: B

Section: The Puzzle of Immunoglobulin Gene Structure

Difficulty: 1

Hint: The mechanism of variable region formation required asking a question that went against the current of thought at the time.

2. Which of the following gene segments is NOT found in the mouse IgL loci?

A. V

B. J

C. D

D. C

E. All of the above are found in the mouse IgL loci.

Answer: C

Section: Multigene Organization of Ig Genes

Difficulty: 1

Hint: One of the variable gene segments is missing in the IgL loci.

3. At which point in the variable segments does the RAG-1/2 complex introduce a single-strand break into the DNA during somatic rearrangement?

A. Between the coding region and the conserved heptamer

B. Between the conserved heptamer and the 12-bp spacer

C. Between the 23-bp spacer and the conserved nonamer

D. Between the nonamer and 12-bp spacer

E. None of the above

Answer: A

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Only one cleavage point will allow for both types of joints produced during the rearrangement process.

4. What introduces a transient hairpin that links the two strands in the V(D)J coding regions?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: C

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

5. What binds cut DNA and retains it in protein-DNA complex?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: E

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

6. What cleaves interstrand hairpin in V(D)J coding regions?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: B

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

7. What introduces single-strand break between V(D)J coding sequence and heptamer RSS?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: C

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

8. What introduces nucleotides in a template-independent manner to free 3? OH created upon cleavage of the interstrand hairpin?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: A

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

9. What closes the final nicks in the sugar-phosphate backbone to generate coding and signal joints?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: D

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

10. What recognizes nonamer RSS to begin lymphocyte receptor rearrangement?

A. TdT

B. Artemis

C. RAG-1/2

D. XRCC4 with DNA ligase IV

E. Ku 70 and Ku 80

Answer: C

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Understand what players function at which times during the course of rearrangement.

11. Which of the following is NOT a means of generating diversity in the variable regions of the T cell receptor genes?

A. Cleavage at the coding-heptamer RSS junction by RAG-1/2

B. Somatic hypermutation following activation

C. Hairpin cleavage by Artemis to generate P nucleotides

D. Addition of N nucleotides by TdT

E. All of the above generate diversity in the variable regions of the T-cell receptor genes.

Answer: B

Section: T-Cell Receptor Genes and Expression

Difficulty: 2

Hint: Maturation of the T-cell receptor does not occur following activation as does the B-cell receptor.

12. How many Dß-Jß rearrangements are possible in a normal human thymocyte?

A. 2

B. 6

C. 4

D. 40

E. None of the above

Answer: C

Section: T-Cell Receptor Genes and Expression

Difficulty: 1

Hint: Which of the segments is the limiting one? How many copies are present within the locus? What is the ploidy state of a normal thymocyte?

Consider the following figure, depicting regions in dsDNA, for Questions 13–17:

13. The indicated items are found in an IgL gene. Which of the labeled elements serves as a spacer?

A. VL

B. 7 bp

C. 12 bp

D. 9 bp

E. None of the above

Answer: C

Section: The Mechanism of V(D)J Recombination

Difficulty: 1

Hint: Which component is not a target for binding or cutting by RAG-1/2?

14. Where does RAG-1/2 cut the dsDNA depicted in the figure?

A. Between VL and the 7 bp regions

B. Between the 7 bp and 12 bp regions

C. Between the 12 bp and 9 bp regions

D. Within the 12 bp region

E. RAG-1/2 does not cut dsDNA

Answer: A

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: What is the likeliest manner in which the DNA can be cut so as to generate a contiguous open reading frame that will specify an IgL variable region?

15. In which cells are the IgL loci rearranged by RAG-1/2?

A. Developing T cells

B. Developing B cells

C. Developing neutrophils

D. Developing monocytes

E. None of the above

Answer: B

Section: The Mechanism of V(D)J Recombination

Difficulty: 1

Hint: Even though RAG-1/2 functions in more than one cell type, rearrangement of the IgL loci only occurs in one type of immune cell.

16. What length must the RSS spacer be to link the above V element to its appropriate D element?

A. 7 bp

B. 23 bp

C. 9 bp

D. 12 bp

E. None of the above

Answer: E

Section: The Mechanism of V(D)J Recombination

Difficulty: 3

Hint: Which lymphocyte receptor genes possess D elements?

17. To which fundamental process is rearrangement of the above locus tightly linked?

A. Replication

B. Transcription

C. Translation

D. Pre-mRNA processing

E. None of the above; rearrangement is independent of other genetic processes.

Answer: B

Section: The Mechanism of V(D)J Recombination

Difficulty: 1

Hint: The gene must be expressed in order to allow for rearrangement.

18. Which of the following is capable of undergoing successive rearrangements to prevent the formation of autoreactive lymphocyte receptors?

A. IgL?

B. TCRa

C. IgHμ

D. Both A and B

E. All of the above

Answer: D

Section: The Puzzle of Immunoglobulin Gene Structure

Difficulty: 2

Hint: One type of chain for each lymphocyte receptor does not undergo successive rearrangements once formed.

19. Which of the following IgH chains is NOT produced as a result of CSR?

A. d

B. a1

C. ?

D. ?2

E. None of the above is produced as a result of CSR.

Answer: A

Section: B-Cell Receptor Expression

Difficulty: 2

Hint: One type of heavy chain is not produced by CSR.

20. Which of the following TCR gene variable regions possesses a “D” segment?

A. ß

B. ?

C. d

D. Both A and C

E. All of the above

Answer: D

Section: The Mechanism of V(D)J Recombination

Difficulty: 3

Hint: Different subsets of T cells have TCRs composed of different subunits; however, formation of the TCR in the different subsets follows similar tendencies.

21. Which of the following accounts for allelic exclusion in rearrangement within the IgH locus?

A. Rearrangement only occurs on one homolog at a time, and once one homolog has successfully rearranged, the other is methylated to produce heterochromatin.

B. Rearrangement is regulated by VpreB and ?5, which are themselves only expressed at specific times during IgH rearrangement.

C. Both homologs rearrange simultaneously, undergoing multiple V-J rearrangements until a productive one occurs.

D. All of the above promote allelic exclusion in IgH.

E. Allelic exclusion does not occur in IgH.

Answer: A

Section: B-Cell Receptor Expression

Difficulty: 3

Hint: While the mechanism of regulation remains unclear, it is clear that allelic exclusion occurs within the IgH locus, and that a well-defined, stepwise approach is used by developing B cells.

22. Which of the following is used to generate diversity in the antibody repertoire?

A. Presence of multiple variable gene segments that can be assembled in multiple different combinations

B. Addition of N nucleotides that are not encoded in the germ line

C. Exonuclease trimming of excess nucleotides at variable segment junctions

D. Ability to pair a single heavy chain with different light chains, so as to avoid generation of autoreactive antibodies

E. All of the above

Answer: E

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: Multiple ways exist to that all contribute to diversification of the antibody repertoire.

23. Which of the following components that are essential for rearrangement of the IgH and IgL loci are not utilized in rearrangement of the TCR loci?

A. RAG-1/2

B. Artemis

C. TdT

D. RSS sequences with spacers of 12 bp and 23 bp

E. All of the above are essential for rearrangement of the TCR loci

Answer: E

Section: T-Cell Receptor Genes and Expression

Difficulty: 1

Hint: The rearrangement process between V(D)J segments in the TCR genes is nearly identical to that in the Ig genes.

24. Which of the following accounts for the transition from membrane-bound IgM to secreted IgM upon activation of a B cell?

A. CSR

B. Affinity maturation

C. Alternative splicing of pre-mRNA

D. Additional modification of nuclear DNA via RAG-1/2

E. None of the above

Answer: C

Section: B-Cell Receptor Expression

Difficulty: 2

Hint: The transition is, technically, a reversible one; which of the above choices is reversible?

25. Deficiency in RAG-1 and/or RAG-2 can affect the proper development of which of the following cell types, resulting in decreased numbers of circulating cells of those types?

A. B cells

B. T cells

C. NK cells

D. Both A and B

E. All of the above

Answer: D

Section: The Mechanism of V(D)J Recombination

Difficulty: 2

Hint: One of the cell types listed shows normal levels in RAG-1/2 deficient patients.

Chapter 8 The Major Histocompatibility Complex and

Antigen Presentation

1. MHC molecules:

A. are secreted by T cells and bind and neutralize antigen in the serum.

B. are membrane-bound molecules found exclusively on T cells.

C. bind repeating patterns found on pathogens.

D. are recognized by T cells.

E. are conserved between individuals.

Answer: D

Section: The Structure and Function of MHC Molecules

Difficulty: 1

Hint: MHC molecules present foreign peptides.

2. Match the following structural characteristics with either MHC class I (I), class II (II), or both (I & II).

a. Contains ?2-microglobulin _____

Answer: I

b. Contains two transmembrane domains _____

Answer: II

c. Binds 8-10 amino acid peptides _____

Answer: I

d. Contains two heavy chains _____

Answer: II

e. Has closed ends on the peptide binding groove _____

Answer: I

Section: The Structure and Function of MHC Molecules

Difficulty: 1

Hint: Review Fig. 8-1.

3. A mutation in which part of a viral protein might allow the virus to evade the adaptive immune response because it MHC binding?

A. A TCR contact residue

B. A residue in the transmembrane domain of an envelope protein

C. A residue in the DNA-binding domain

D. An anchor residue

E. An amino acid on the surface of the virus

Answer: D

Section: The Structure and Function of MHC Molecules

Difficulty: 1

Hint: Peptides bind to MHC by inserting side chains into pockets in the peptide-binding groove.

4. MHC polymorphisms tend to cluster:

A. in the peptide-binding groove.

B. in the transmembrane domain.

C. in the coreceptor contact residues.

D. in the framework region.

E. All of the above

Answer: A

Section: The Structure and Function of MHC Molecules

Difficulty: 1

Hint: MHC molecules present foreign peptides.

5. How many different MHC classical class I proteins does each nucleated cell in a human heterozygous at the MHC locus express?

A. None. Only APC express class I.

B. One

C. Two

D. Three

E. Six

Answer: E

Section: General Organization and Inheritance of the MHC

Difficulty: 1

Hint: MHC class I is codominantly expressed.

6. Which of the following would be the MOST likely source of a peptide bound to an MHC class I molecule?

a. The Golgi apparatus

b. Outside the cell

c. The endosome/lysosome

d. The cytoplasm

e. The chloroplast

Answer: D

Section: The Endogenous Pathway

Difficulty: 1

Hint: Class I peptides are transported into the ER, where they bind class I.

7. One way a developing fetus is protected from attack by the maternal immune system is:

A. expression of paternal MHC class I molecules.

B. expression of paternal MHC class II molecules.

C. expression on nonclassical class I molecules.

D. expression of nonclassical class II molecules.

E. expression of class III MHC molecules.

Answer: C

Section: General Organization and Inheritance of the MHC

Difficulty: 1

Hint: HLA-G is expressed on fetal cells.

8. Which of the following is NOT a mouse MHC gene?

A. IA

B. IE

C. DP

D. D

E. K

Answer: C

Section: General Organization and Inheritance of the MHC

Difficulty: 1

Hint: The mouse MHC region is called H-2.

9. Peptide binding diversity is increased by:

A. multiple MHC alleles in the population.

B. multiple homologous MHC genes in the genome.

C. Both A and B

D. None of the above

Answer: C

Section: General Organization and Inheritance of the MHC

Difficulty: 2

Hint: How many different MHC molecules are expressed in a population?

10. Your chances of having the same MHC haplotype as your sibling are:

A. 1:1.

B. 1:2.

C. 1:4.

D. 1:8.

E. 1:16.

Answer: C

Section: General Organization and Inheritance of the MHC

Difficulty: 2

Hint: MHC Class I is codominantly expressed.

11. The human MHC locus is one of the most polymorphic regions of the genome. What does this mean?

A. It has the most different genes.

B. There are many different alleles of these genes.

C. Sequence variability is low in this region.

D. There are many introns in this region.

E. This region is regulated by many different mechanisms.

Answer: B

Section: General Organization and Inheritance of the MHC

Difficulty: 2

Hint: Polymorphisms are genetic variants that result in phenotypic differences.

12. MHC diversity ultimately affects the:

A. variety of peptides that bind to MHC.

B. variety of BCRs that are expressed on mature B cells.

C. rate of somatic hypermutation.

D. number of antigen presenting cells.

E. transmembrane domain.

Answer: A

Section: General Organization and Inheritance of the MHC

Difficulty: 1

Hint: MHC diversity is located primarily in the peptide-binding groove.

13. Which of the following BEST represents the relationship of polypeptide units in MHC class II?

A. ? and ? chains from any gene can pair with each other.

B. Only ? and ? chains from the same gene can pair with each other.

C. Only ? and ? chains of the same allele can pair with each other.

D. ? chains can pair with other ? chains, but ? chains can only pair with ? chains.

E. ? and ? chains pair until the complex is exported to the cell surface and can bind ?-2 microglobulin.

Answer: B

Section: General Organization and Inheritance of the MHC

Difficulty: 2

Hint: There are four different class II molecules for each gene that can be produced in a heterozygote.

14. Tasmanian devils are a largely inbred population with little diversity in the MHC. Which of the following would be a likely outcome of this?

A. They would compensate for low diversity in the MHC with high diversity in the TCR.

B. They would compensate for low diversity in the MHC with high diversity in the BCR.

C. They would rely only on innate immune responses.

D. They would be at higher risk of infection.

E. All of the above

Answer: D

Section: General Organization and Inheritance of the MHC

Difficulty: 2

Hint: Low diversity in the MHC would result in an immunodeficient population.

15. Which of the following cell types would be LEAST likely to express MHC class II?

A. B cells

B. T cells

C. Dendritic cells

D. Thymic epithelial cells

E. Vascular endothelial cells

Answer: B

Section: Role of the MHC and Expression Patterns

Difficulty: 1

Hint: Class II is expressed on antigen-presenting cells.

16. Which of the following cell types would be MOST likely to express MHC class I?

A. B cells

B. T cells

C. Dendritic cells

D. Lung epithelial cells

E. All of the above

Answer: E

Section: Role of the MHC and Expression Patterns

Difficulty: 1

Hint: Class I is expressed on all nucleated cells.

17. Compare and contrast the holes-in-the–repertoire model and the determinant-selection model of immune responsiveness.

Answer: In the determinant-selection model, differences in responsiveness are explained by the ability or inability of MHC to bind peptide. In the holes-in-the repertoire model, differences in responsiveness are explained by the presence or absence of specific T cells. T cells that respond to certain peptides may be deleted during selection on certain MHC backgrounds.

Section: Role of the MHC and Expression Patterns

Difficulty: 3

Hint: Different haplotypes have different responsiveness to simple antigens.

18. Which of the following is the BEST example of self-MHC restriction of T cells?

A. A T-cell clone is deleted when it binds too tightly to self MHC.

B. A T-cell clone responds more vigorously to a self-peptide than a foreign peptide.

C. A T-cell clone recognizes foreign MHC.

D. A T-cell clone only recognizes foreign peptides when presented by self MHC.

E. All of the above

Answer: D

Section: Role of the MHC and Expression Patterns

Difficulty: 3

Hint: Passive immunization with T cells is not effective.

19. Under which of the following conditions would T-cell activation be LEAST likely to occur?

A. Macrophages are incubated with antigen, then fixed with paraformaldehyde, then incubated with antigen-specific T cells.

B. Macrophages are fixed with paraformaldehyde, then incubated with antigen, then incubated with antigen-specific T cells.

C. Macrophages are fixed with paraformaldehyde, then incubated with digested antigen, then incubated with antigen-specific T cells.

D. Macrophages are incubated with digested antigen, then fixed with paraformaldehyde, then incubated with antigen-specific T cells.

E. Macrophages are incubated with antigen and then incubated with antigen-specific T cells.

Answer: B

Section: Role of the MHC and Expression Patterns

Difficulty: 3

Hint: T cells recognize antigens that have been processed prior to presentation.

20. Place the class I processing pathway in the correct order:

a. Peptides exported from the ER by TAP > peptides are digested by the proteasome > peptides are loaded onto class I > class I is exported to the cell surface

b. Proteins are digested by the proteasome > peptides are imported into the ER by TAP > peptides are loaded onto MHC class I > class I is exported to the cell surface

c. MHC class I moves from the cell surface to the lysosome by endocytosis > class I bound peptides are replaced with antigenic peptides in the lysosome > class I returns to the cell surface

d. Proteins are degraded by TAP > peptides are imported into the lysosome by the proteasome > peptide-MHC class I complexes are exported to the cell surface

e. MHC class I is transported to the ER by TAP > proteins in the ER are degraded into peptides by the proteasome > peptides bind MHC class I in the ER and the complex is exported to the cell surface

Answer: B

Section: The Endogenous Pathway

Difficulty: 2

Hint: Class I peptides originate in the cytoplasm.

21. In people infected with human cytomegalovirus, class I MHC and b2-microglobulin are produced, but very little mature class I MHC is found at the cell surface.

Inhibition of which of the following molecules by human cytomegalovirus may account for this phenomenon?

A. TCR

B. RAG

C. CLIP

D. TAP

E. Ii

Answer: D

Section: The Endogenous Pathway

Difficulty: 2

Hint: Class I remains in the ER if there are no peptides available to bind to it.

22. T-cell activation can be inhibited by treating antigen-presenting cells with chloroquine. What is chloroquine's mechanism of action?

A. It blocks protein synthesis.

B. It disrupts the Golgi apparatus.

C. It increases the pH of the lysosome.

D. It blocks TLR signaling.

E. All of the above

Answer: C

Section: The Exogenous Pathway

Difficulty: 1

Hint: Cloroquine prevents the removal of CLIP and the replacement with antigenic peptide.

23. What is the role of the invariant chain (Ii)?

A. To prevent peptide binding to class II in the ER

B. To assist in folding class II ? and ? chains

C. To direct class II to the endocytic compartment

D. To serve as a substrate for proteases in the lysosome

E. All of the above

Answer: E

Section: The Exogenous Pathway

Difficulty: 1

Hint: Different regions of the invariant chain have different functions.

24. A mutation that renders the MHC class II molecule DM nonfunctional would likely lead to:

A. cells with no class II MHC.

B. cells with no DO.

C. cells with class II MHC only bound with CLIP.

D. cells with class II MHC bound with a variety of self-antigens.

E. a deficiency in CD8+ T cells.

Answer: C

Section: The Exogenous Pathway

Difficulty: 2

Hint: DM is an enzyme that catalyzes the exchange of CLIP for antigenic peptide.

25. Which of the following is an example of cross-presentation?

A. An endogenous peptide being presented on MHC class I

B. An exogenous peptide being presented on MHC class I

C. An endogenous peptide being presented on MHC class II

D. An exogenous peptide being presented on MHC class II

E. A B-cell antigen being presented to a T cell

Answer: B

Section: Cross-Presentation of Exogenous Antigens

Difficulty: 2

Hint: There must be a mechanism to activate CD4+ T cells that recognize intracellular antigens.

Chapter 9 T-Cell Development

1. Committed lymphocyte progenitors originate in the:

A. thymus.

B. bone marrow.

C. spleen.

D. lymph node.

E. brain.

Answer: B

Section: Early Thymocyte Development

Difficulty: 1

Hint: All blood cells originate in the same anatomical location.

2. Hematopoietic stem cells cultured in the presence of which receptor differentiate into T cells rather than B cells?

A. CD4

B. CD8

C. Notch-ligand

D. B7-1

E. CD3

Answer: C

Section: Early Thymocyte Development

Difficulty: 1

Hint: Markers of T-cell subset differentiation are up-regulated in the thymus.

3. Which of the following molecules would double-negative T cells fail to express?

A. CD3

B. CD4

C. MHC class I

D. TAP

E. All of the above

Answer: B

Section: Early Thymocyte Development

Difficulty: 1

Hint: Developing T cells have intact antigen processing machinery.

4. Explain why T cells are more likely to develop into ?? T cells than ?? T cells.

Answer: Because, once a cell successfully produces a ? chain, the preTCR is expressed. In order for a cell to become ??, it must successfully rearrange ? and ? before ?, and the chances of that are much smaller.

Section: Early Thymocyte Development

Difficulty: 3

Hint: It has to do with somatic recombination.

5. Signaling through the pre-TCR occurs as a result of:

A. binding to MHC class I

B. binding to MHC class II

C. binding to either MHC class I or MHC class II

D. successful assembly of the pre-TCR

E. expression of CD4

Answer: D

Section: Early Thymocyte Development

Difficulty: 1

Hint: This signaling does not require ligand binding.

6. At what stage of T cell development is the pre-TCR expressed?

A. DN

B. DP

C. SP

D. Pro-T cell

E. None of the above

Answer: A

Section: Early Thymocyte Development

Difficulty: 1

Hint: ?-locus rearrangement does not begin until a signal is received from the pre-TCR.

7. Signaling through the pre-TCR results in:

A. maturation to the DN4 stage.

B. suppression of TCR ?-chain rearrangement.

C. cessation of proliferation.

D. TCR ?-chain rearrangement.

E. All of the above

Answer: E

Section: Early Thymocyte Development

Difficulty: 2

Hint: Development does not progress until there is a signal through the pre-TCR.

8. Which of the following represents the earliest stage in T-cell development?

A. DP

B. DN

C. SP-CD4

D. SP-CD8

E. Mature T cell

Answer: B

Section: Early Thymocyte Development

Difficulty: 1

Hint: Co-receptors are necessary for positive and negative selection.

9. T cells selected on a b haplotype thymus would be able to respond to antigen presenting on which of the following haplotype antigen presenting cells?

A. a

B. b

C. a ? b

D. B and C

E. A, B, and C

Answer: D

Section: Positive and Negative Selection

Difficulty: 2

Hint: During positive selection, only cells that receive a weak signal through their TCR survive.

10. Injecting a TCR transgenic mouse with the peptide that it recognizes would result in an increase in which process?

A. Positive selection

B. Negative selection

C. Complement fixation

D. Phagocytosis

E. All of the above

Answer: B

Section: Positive and Negative Selection

Difficulty: 2

Hint: T cells that receive strong signals during development die.

11. MHCa mice that are irradiated and reconstituted with MHCa ? b bone marrow would accept grafts from which of the following donors?

A. MHCa

B. MHCb

C. MHCa ? b

D. Both B and C

E. A, B, and C

Answer: E

Section: Positive and Negative Selection

Difficulty: 2

Hint: Macrophages mediate negative selection.

12. In negative selection, cells that receive _____ signal through their antigen receptors die.

A. a weak

B. a strong

C. an Intermediate

D. no

E. intermittent

Answer: B

Section: Positive and Negative Selection

Difficulty: 1

Hint: Negative selection deletes autoreactive cells.

13. What happens to autoreactive cells that escape the thymus?

A. They attack self tissues.

B. They can be rendered anergic.

C. They negatively regulate other autoreactive cells.

D. They require TCR-ligation and costimulation to be activated.

E. All of the above

Answer: E

Section: Exit from the Thymus and Final Maturation

Difficulty: 2

Hint: Not all self antigens are expressed in the thymus.

14. What are the two major goals of lymphocyte development?

Answer: The two goals are (1) to ensure that all T cells have functional TCR and that (2) autoreactive cells are deleted (self-tolerance in ensured).

Section: Positive and Negative Selection

Difficulty: 2

Hint: What do all T-Cells need for lymphocyte development, and what needs to be deleted?

15. How do self-antigens that are specific to tissues away from the thymus (like insulin or keratin for example) get in the thymus so that developing T cells that react to them can be deleted?

A. Dendritic cells pick them up in the periphery and carry them to the thymus.

B. Specialized macrophages in the thymus filter the bloodstream and present antigens found there to developing T cells.

C. A transcription factor, AIRE is expressed in thymic medullary epithelial cells, which allows these cells to express proteins normally found in other tissues.

D. They do not get to the thymus, all tissue-specific T cells are deleted in the periphery.

E. There are special chaperone proteins that bind to peripheral proteins and carry them to the thymus.

Answer: C

Section: Positive and Negative Selection

Difficulty: 2

Hint: Expression of antigens is not limited to peripheral tissues.

16. Superantigens differ from regular peptide antigens because they:

A. bind outside the peptide-binding groove.

B. activate a larger proportion of T cells.

C. interact with the V? domain of the TCR.

D. can result in toxic shock.

E. All of the above

Answer: E

Section: Positive and Negative Selection

Difficulty: 2

Hint: Superantigens produced by some bacteria cause polyclonal activation of T cells.

17. Compare and contrast the affinity hypothesis and altered peptide hypothesis to explain the thymic selection paradox (why we don't negatively select all cells that we positively select).

Answer: The affinity hypothesis states that the strength of the TCR/MHC/peptide interaction determines whether a T cell is positively or negatively selected. The altered peptide hypothesis states that thymic

epithelial cells express a special set of peptides that mediate positive selection. There is support for both hypotheses and both may contribute to the paradox of thymic selection.

Section: Positive and Negative Selection

Difficulty: 3

Hint: T cells can distinguish survival signals and negative selection signals.

18. What is currently the best explanation for what determines whether a T cell develops into a CD8+ T cell or a CD4+ T cell?

A. CD4/TCR coengagement suppresses CD8 expression, and CD8/TCR coengagement suppresses CD4 expression.

B. T cells randomly down-regulate CD4 or CD8, and only cells that still bind the appropriate MHC will get a strong enough signal to survive.

C. CD4 or CD8 expression is determined by the strength and duration of the TCR/MHC interaction.

D. CD4 or CD8 expression is predestined in the bone marrow.

E. Only ?? T cells express CD8.

Answer: C

Section: Lineage Commitment

Difficulty: 3

Hint: The kinetic model has the greatest experimental support.

19. Which of the following BEST describes the relationship between natural TREGs and induced TREGs?

A. Natural TREGs differentiate into induced TREGs in response to stimulation through the TCR.

B. Natural TREGs are derived from memory T cells, and induced TREGs differentiate directly from developing thymocytes.

C. Natural TREGs develop in the thymus, and induced TREGs develop in the periphery.

D. Natural TREGs have less diverse TCRs than induced TREGs.

E. None of the above

Answer: C

Section: Exit from the Thymus and Final Maturation

Difficulty: 2

Hint: Some autoreactive cells in the thymus gain the ability to suppress other autoreactive cells.

20. Which transcription factor is characteristic of TREG cells?

A. AP-1

B. NFAT

C. NF?B

D. OCT-1

E. FOXP3

Answer: E

Section: Exit from the Thymus and Final Maturation

Difficulty: 1

Hint: This transcription factor is not characteristic of T-cell activation.

21. TREGs have been shown to be protective against which of the following conditions?

A. Inflammatory bowel disease

B. HIV disease

C. Influenza infection

D. MRSA

E. Malaria

Answer: A

Section: Exit from the Thymus and Final Maturation

Difficulty: 1

Hint: TREGs can develop from autoreactive cells.

22. Describe the cellular changes that occur during apoptosis.

Answer: Cells decrease in cell volume, the membrane blebs, chromatin is condensed, and DNA is degraded into fragments.

Section: Apoptosis

Difficulty: 3

Hint: Apoptosis is programmed cell death.

23. Which of the following are characteristics of apoptosis?

A. Membrane blebbing

B. Swelling of the cytoplasm

C. Increased metabolism

D. Release of cellular contents into the extracellular space

E. All of the above

Answer: A

Section: Apoptosis

Difficulty: 2

Hint: Apoptosis occurs naturally and does not necessarily lead to inflammation.

24. Ligation of which of the following cell-surface receptors leads to cell death?

A. TCR

B. TLR

C. Fas

D. Caspase-8

E. Bcl-2

Answer: C

Section: Apoptosis

Difficulty: 1

Hint: Note that the question asks about cell-surface receptors.

25. In some cases of B-cell lymphoma, translocation of bcl-2 into the Ig locus results in overexpression of this gene.

Knowing what you do about lymphoma and cancer, what do you predict is the function of bcl-2?

A. It lowers the threshold for negative selection.

B. It inhibits apoptosis.

C. It regulates expression of IL-2.

D. It is responsible for TH2 differentiation.

E. None of the above

Answer: B

Section: Apoptosis

Difficulty: 3

Hint: Lymphoma cells replicate in an uncontrolled manner.

Chapter 10 B-Cell Development

1. B lymphocytes are made in the:

A. blood stream.

B. bone marrow.

C. liver.

D. thymus.

E. totipotent cell.

Answer: B

Section: Introduction

Difficulty: 1

Hint: Location of B cell production from a HSC.

2. How long does B cell maturation from an HSC to a mature B cell take?

A. 1 to 2 hours

B. 1 to 2 days

C. 1 to 2 weeks

D. 1 to 2 months

E. 1 to 2 years

Answer: C

Section: Introduction

Difficulty: 1

Hint: B cell will begin to secrete antibodies within a few days of infection.

3. Which cell type is found in both B- and T-cell lineages?

A. Common lymphoid progenitors

B. Common pro-B-T cells

C. Immature B cell

D. Naïve lymphoid progenitor

E. Pro-B-T cell

Answer: A

Section: Introduction

Difficulty: 1

Hint: B cells belong to the lymphoid lineage.

4. This type of cell will leave the bone marrow and complete maturation in the spleen.

A. Common lymphoid progenitor cell

B. hematopoietic stem cell

C. immature B cell

D. pro-B cell

E. pro-T cell

Answer: C

Section: Introduction

Difficulty: 1

Hint: B cells will see potential antigens in the germinal centers of secondary lymphoid organs such as the spleen.

5. All of the following are true regarding B-cell development EXCEPT:

A. B cells complete maturation in the spleen.

B. B cells are mostly developed when they leave the bone marrow.

C. B cells, like T cells, are MHC class restricted.

D. Self-reactive B cells may be eliminated though apoptosis.

E. Self- reactive B cells may be rendered unreactive (anergic).

Answer: C

Section: Introduction

Difficulty: 2

Hint: B cells display IgD as their BCR.

6. Hematopoiesis produces:

A. B cells only.

B. Red blood cells only.

C. myeloid lineage cells only.

D. lymphoid and myeloid lineage cells.

E. erythorid, lymphoid, and myeloid lineage cells.

Answer: E

Section: The Site of Hematopoiesis

Difficulty: 2

Hint: Hematopoietic stem cells produce all blood cells.

7. Hematopoiesis begins at around day 7 after fertilization in mice. What is the site of precursor cells at this stage of fetal development?

A. Bone marrow

B. Fetal liver

C. Placenta

D. Primitive organ

E. Yolk sac

Answer: E

Section: The Site of Hematopoiesis

Difficulty: 2

Hint: Developing embryos do not make bone marrow until the later stages of fetal development.

8. At what site can fetal HSCs be found by day 8 in the mouse model?

A. AGM (aorta-gonad-mesonephros)

B. Bone marrow

C. Fetal liver

D. Placenta

E. Yolk

Answer: A

Section: The Site of Hematopoiesis

Difficulty: 2

Hint: The AGM will develop into bone marrow during the later stages of fetal development.

9. At what site(s) can mature HSCs be found by day 11 in the mouse model?

A. AGM

B. Fetal liver

C. Placenta

D. Yolk

E. All of the above

Answer: E

Section: The Site of Hematopoiesis

Difficulty: 2

Hint: Mice have a short gestation period so day 11 represents the half-way point of fetal development. At this point, mature HSCs can be found throughout the developing embryo.

10. What type of cell will predominately be produced by hematopoiesis in the fetal liver of mice?

A. Erythroid lineage cells

B. Lymphoid lineage cells

C. Myeloid lineage cells only

D. Lymphoid and myeloid lineage cells

E. Erythorid, lymphoid, and myeloid lineage cells

Answer: A

Section: The Site of Hematopoiesis

Difficulty: 2

Hint: Red blood cell development occurs in the liver.

11. VDJ recombination occurs during which phase of a B cell's development?

A. Activated B cell

B. Mature B cell

C. Naïve B cell

D. Pro-B cell

E. Immature B cell

Answer: D

Section: B-Cell Development in the Bone Marrow

Difficulty: 1

Hint: VDJ rearrangement takes place while B cells develop in the bone marrow. Unsuccessful recombinations in young B cells result in apoptosis.

12. What are two functions of bone marrow stromal cells with respect to B-cell development?

A. Cytokine expression and traps developing B cells in a specific location

B. Recruits macrophages to phagocytize self-recognizing B cells and decreases HSC when no active infection is present

C. Secretes release factors that direct the B cell to the spleen and expresses necessary cytokines

D. Traps developing B cells in a specific location and recruits red bloods to bring oxygen to developing B cells

E. Triggers HSCs to produce more pro-B cells and secretes cytokines to stimulate osteoblast development

Answer: A

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: Bone marrow stromal cells provide the proper environment for B cell development.

13. Individuals of retirement age or older show lower antibody mediate immune responses due to all of the following reasons EXCEPT:

A. increased likelihood of autoimmune disorders.

B. limited HSC production of pro-B cells.

C. poor antibody response to vaccination.

D. reduced-memory B-cell generation.

E. smaller thymus.

Answer: E

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: B-cell production and the checkpoints that ensure only non-self-recognizing B cells are allowed to live decreases as an individual ages.

14. What type of immunoglobulin gene rearrangement occurs during B-cell progenitor development?

A. DH-JH rearrangement

B. DL-JL rearrangement

C. Both heavy- and light-chain rearrangement

D. VH-DJH rearrangement

E. VL-DJL rearrangement

Answer: C

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: B cells must have a functional BCR (IgD) before leaving the bone marrow.

15. The common lymphoid progenitor cell gives rise to all of the following cell lines EXCEPT:

A. dendritic cells.

B. megakaryocytes.

C. natural killer cells.

D. pre-pro B cells.

E. T-cell progenitor.

Answer: B

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: Megakaryocytes produce platelets (thrombocytes).

16. Which of the following statements regarding HSCs is/are TRUE?

I. HSCs are not self-renewing.

II. HSCs can make copies of themselves.

III. HSCs give rise to one cell lineage.

IV. HSCs are multipotent.

V. HSCs express both Rag 1 and Rag 2 surface markers.

A. Statement I only

B. Statements I and III only

C. Statements II and III only

D. Statements II and IV only

E. Statements III and V only

Answer: D

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: Multipotent cells are self-renewing and give rise to multiple cell lines.

17. Where can early lymphoid progenitor cells (ELPs) be found in humans?

A. Blood stream

B. Bone marrow

C. Lymphatic tissue

D. Thymus

E. Both B and C

Answer: B

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: ELPs are young common lymphoid progenitor cells that will give rise to NK cells, B cells, and T cells.

18. At what stage of development does a B cell begin to express a pre-B-cell receptor?

A. Pre-pro B cell

B. Early pro-B cell

C. Late pro-B cell

D. Late pre-B cell

E. Immature B cell

Answer: D

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: Pre-BCRs are expressed immediately after VH-DJH rearrangement.

19. At what stage of development does a B cell undergo D-JH rearrangement?

A. Pre-pro B cell

B. Early pro-B cell

C. Late pro-B cell

D. Late pre-B cell

E. Immature B cell

Answer: B

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: The first checkpoint for self-reactivity with a B cell is VH-DJH rearrangement.

20. At what stage of development does a B cell begin to display an IgM receptor?

A. Pre-pro B cell

B. Early pro-B cell

C. Late pro-B cell

D. Late pre-B cell

E. Immature B cell

Answer: E

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: IgM is the first Ig displayed on a developing B cell, and it is functional just before the second checkpoint for self-reactivity during B-cell development.

21. B-cell development has one checkpoint to determine if V-DJ rearrangement has produced a successful VH-DJH combination that does not recognize self. If no successful combination is produced, then the B cell will undergo apoptosis. At what point of B-cell development does this checkpoint occur?

A. Pre-pro B cell

B. Early pro B cell

C. Late pro B cell

D. Late pre B cell

E. Immature B cell

Answer: C

Section: B-Cell Development in the Bone Marrow

Difficulty: 2

Hint: VH-DJH rearrangement occurs during the late pro-B cell phase.

22. How does allelic exclusion prevent multiple heavy-chain rearrangements from occurring in pre-B cells?

A. RAG1 and RAG2 are down-regulated, and TdT activity is lost so that no additional heavy-chain rearrangements may take place.

B. RAG1 is up-regulated while RAG2 and TdT are down-regulated to prevent heavy-chain recombination on the second set of chromosomes.

C. RAG1 and RAG2 induce silencing of the second alleles for VH-DJH rearrangement.

D. TdT initiates light-chain rearrangement.

E. TdT releases a cytokine to trigger apoptosis in the pre-B cell.

Answer: A

Section: B-Cell Development in the Bone Marrow

Difficulty: 3

Hint: RAG1, RAG2, and TdT are signals that allow heavy-chain rearrangement.

23. Mature naïve B cells express high levels of ____ on their cell surfaces.

A. IgA

B. IgD

C. IgE

D. IgG

E. IgM

Answer: B

Section: B-Cell Development in the Bone Marrow

Difficulty: 1

Hint: Membrane-bound IgD serves as the BCR.

24. Mature B-2 or follicular B cells are most commonly found in the:

A. bone marrow.

B. lymph node.

C. marginal zones of the spleen.

D. peritoneal.

E. secondary lymphoid organs.

Answer: E

Section: The Development of B-1 and Marginal-Zone B Cells

Difficulty: 2

Hint: B-2 cells are the conventional B cells found in germinal centers of the spleen, Peyer's patch, MALT, skin, tonsils, and adenoids.

25. Mature B-1 cells show _____ diversity in their V-region.

A. high

B. moderate (somewhat restricted)

C. low (restricted)

D. high or low depending on active infection

E. high or low depending on CD21 expression

Answer: C

Section: The Development of B-1 and Marginal-Zone B Cells

Difficulty: 1

Hint: B-1 cells reside in the peritoneal and pleural cavities and typically target carbohydrate antigens.

26. Marginal-zone B cells express:

A. IgD.

B. IgG.

C. IgM.

D. IgE.

E. Both B and C

Answer: E

Section: The Development of B-1 and Marginal-Zone B Cells

Difficulty: 1

Hint: Marginal-zone B cells are designed to recognize and respond to blood-borne antigens.

27. Which type of mature B cell is MOST likely to respond to a protein antigen?

A. B-1 B cells

B. B-2 B cells

C. MZ B cells

D. B-2 B cells and MZ B cells

E. B-1 B cells, B-2 B cells, and MZ B cells

Answer: D

Section: The Development of B-1 and Marginal-Zone B Cells

Difficulty: 2

Hint: B cells that target protein or peptide antigens show higher variable region diversity than B cells that target carbohydrate antigens.

28. What is the initial location of B-cell and T-cell development?

A. Blood for B cell and thymus for T cell

B. Bone marrow for both B cell and T cell

C. Bone marrow for B cell and thymus for T cell

D. Secondary lymphoid organs for B cell and thymus for T cell

E. Thymus for both B cell and T cell

Answer: B

Section: Comparison of B- and T-Cell Development

Difficulty: 1

Hint: B cells and T cells come from a common lymphoid progenitor cells.

29. Which cell type undergoes negative selection of ectopic expressing self-antigen cells in primary lymphoid organs?

A. B cells

B. MZ B cells

C. T cells

D. Both B cells and T cells

E. Neither B cells nor T cells

Answer: C

Section: Comparison of B- and T-Cell Development

Difficulty: 1

Hint: B cells that bind self-antigens are selected against during B-cell development while T-cell selection occurs in the thymus.

30. V-J rearrangement occurs in:

A. all B cells.

B. all T cells.

C. only B-1 B cells.

D. only B-2 B cells.

E. both B cells and T cells.

Answer: E

Section: Comparison of B- and T-Cell Development

Difficulty: 1

Hint: The BCR and TCR undergo V-J rearrangement during development.

Chapter 11 T-Cell Activation, Differentiation, and Memory

1. What event initiates an adaptive immune response?

A. The interaction of a B cell with a TH cell

B. The expression of cytokines CD4 or CD8

C. The production of MHC class I or II molecules

D. The interaction of a naïve T cell with an antigen-presenting cell

E. The phagocytosis of a pathogen by a macrophage

Answer: D

Section: Introduction

Difficulty: 1

Hint: T-cell activation

2. For pathogen peptides to be seen as foreign, they must be displayed on a T cell in the context of a/an:

A. B-cell marker.

B. CD molecule.

C. IgM molecule.

D. MHC peptide.

E. pattern-recognition receptor molecule.

Answer: D

Section: Introduction

Difficulty: 1

Hint: T-cell activation

3. CD4+ T cells recognize:

A. CD8+ markers.

B. IgM.

C. MHC class I peptides.

D. MHC class II peptides.

E. both MHC class I and class II peptides.

Answer: D

Section: Introduction

Difficulty: 1

Hint: TH cells

4. CD8+ T cells exposed to MHC class I peptides are:

A. cytotoxic T cells.

B. helper T cells.

C. both cytotoxic T cells and helper T cells.

D. natural killer cells.

E. dendritic T cells.

Answer: A

Section: Introduction

Difficulty: 1

Hint: TC cells

5. CD4+ T cells become helper T cells in response to:

A. exposure to antigen.

B. exposure to MHC class II peptide.

C. exposure to any MHC peptide.

D. exposure to MZ B cells.

E. exposure to TNF-a.

Answer: B

Section: Introduction

Difficulty: 1

Hint: TH cell activation

6. Naïve CD4+ and CD8+ T cells leave the _____ and enter circulation.

A. bone marrow

B. liver

C. lymph node

D. spleen

E. thymus

Answer: E

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 1

Hint: Site of T-cell development

7. A naïve T cell refers to a T cell that:

A. does not express CD4+ or CD8+.

B. has not left the bone marrow.

C. has not yet encountered an antigen.

D. is not mature.

E. resides in the thymus.

Answer: C

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 1

Hint: T-cell activation

8. Bonds formed between the T cell and a dendritic cell are relatively weak. Which of the following help to strengthen this association so that a T cell can see which antigen is being presented by a dendritic cell?

A. CD28/LFA-5

B. CD 28

C. ICAM-1/LFA-1

D. IL-2R

E. Pattern-recognition molecules

Answer: C

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 2

Hint: T-cell co-receptors

9. Which of the following is required for T-cell activation?

A. Antigen-specific TCR binding to MHC peptide

B. Expression of CD4+ or CD8+

C. Interaction with CD80, CD86, or ICOS-L

D. Both A and B

E. Both A and C

Answer: E

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 3

Hint: T-cell activation and T-cell co-receptors

10. Co-receptor molecules are required by TC and TH cells so that the TCR can stably bind to the MHC peptide presenting the antigen. Which co-receptor molecules are common to both TC and TH cells and their respective antigen presenting cells?

A. CD2/LFA-3

B. CD28/B7

C. CD45R/CD22

D. LFA-1/ICAM-1

E. All but B

Answer: E

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 2

Hint: T-cell co-receptors

11. CTLA-4 is a co-stimulatory receptor on T cells that belongs to the same family as the CD28 co-stimulatory receptor. However, CTLA-4 is antagonistic to CD28. Which of the following could be a functional advantage of CTLA-4 expression within the immune response?

A. CTLA-4 competes with CD28 for ligand binding so that, if CD28 binds to its ligand, the response will be magnified.

B. CTLA-4 is often given to immunosuppressed individuals to trigger an immune response.

C. CTLA-4 limits the immune response of TC and TH cells after an infection has been cleared.

D. CTLA-4 limits TC activity in healthy individuals during a viral infection.

E. CTLA-4 reduces the lag time between antigen presentation to a TH cell and B cell activation.

Answer: C

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 3

Hint: Receptor antagonism

12. PD-1 is a negative co-stimulatory signal expressed by tumor cells. What advantage would the expression of PD-1 have in a tumor cell avoiding the immune response?

A. None. Tumor cells are recognized as self and therefore do not pose a health threat.

B. Tumor cells can avoid being killed by activated TC cells.

C. Tumor cells can avoid apoptosis triggered by TH cells.

D. Tumor cells avoid phagocytosis by dendritic cells.

E. Tumor cells are stimulated to reproduce much faster than tumor cells that do not express PD-1.

Answer: B

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 3

Hint: Receptor antagonists and tumor evasion of cytotoxic T cells

13. T cells are frequently at fault for causing damage in autoimmune disorders and in transplant rejection. As an immunologist, your dream is to discover a method for decreasing T-cell response to self-antigens. Which of the following would be the BEST target for your research?

A. Activated B cells because they make T cell receptor molecules

B. Antibody-mediated apoptosis of dendritic cells

C. CTLA-4 antagonists that block the action of CTLA-4

D. Ligands that block the binding of one co-stimulatory molecule

E. Radiation therapy directed at all T cells

Answer: D

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 3

Hint: Receptor antagonists

14. T-cell activation requires antigen being displayed in the context of an APC and interaction between co-stimulatory molecules on the APC and the T cell. In addition to these two signals, T-cell activity is often influenced by cytokines. Which of the following is an example of how cytokines can influence T-cell activity in the presence of MHC presentation and co-stimulatory ligand interaction?

A. CD28 causes memory NK cells to be produced.

B. CD8 triggers apoptosis in T cells that recognize self-antigens.

C. IL-2 triggers T-cell proliferation.

D. Opsonins recruit eosinophils to present carbohydrate antibodies to naïve TC cells.

E. TNF-a increases the production of IgM by activated T cells.

Answer: C

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 2

Hint: Cytokines direct T cell activities.

15. Which type of professional antigen-presenting cells is a naïve T cell most likely to encounter?

A. B cell

B. Dendritic cell

C. Macrophage

D. Both A and B

E. Both B and C

Answer: D

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 1

Hint: T-cell activation

16. TSST-1 is a protein produced by some species of bacteria that acts as a superantigen. What ligand does TSST-1 bind?

A. T-cell receptor

B. MHC class I

C. MHC class II

D. Both T-cell receptor and MHC class I

E. Both T-cell receptor and MHC class II

Answer: E

Section: T-Cell Activation and the Two-Signal Hypothesis

Difficulty: 2

Hint: Superantigens elicit strong immune responses so that the body is overwhelmed.

17. With respect to T-cell activation, effector molecules trigger all of the following functions EXCEPT:

A. cell-cycle entry.

B. cell division to produce additional T cells.

C. cell differentiation into various types of T cells.

D. cell stimulation of B cells.

E. cell survival.

Answer: D

Section: T-Cell Differentiation

Difficulty: 2

Hint: T-cell functions

18. Which type of T cell directs and regulates B-cell activity and differentiation?

A. Memory T

B. NK

C. TC

D. TH1

E. TH2

Answer: E

Section: T-Cell Differentiation

Difficulty: 1

Hint: Functions of activated T cells

19. Which type of T helper cell regulates allergic reactions and protects against extracellular pathogens?

A. TH1

B. TH2

C. TH17

D. TREG

E. TFH

Answer: B

Section: T-Cell Differentiation

Difficulty: 1

Hint: Helper T-cell functions

20. Which type of T helper cell inhibits inflammation?

A. TH1

B. TH2

C. TH17

D. TREG

E. TFH

Answer: D

Section: T-Cell Differentiation

Difficulty: 1

Hint: Helper T-cell functions

21. Cross-regulation of various members of a subset of T cells is frequently observed with:

A. all TC cells.

B. all TH cells.

C. only TC 1 subset.

D. only T1 subset.

E. only TREG subset.

Answer: B

Section: T-Cell Differentiation

Difficulty: 1

Hint: Cross reactivity in T cells

22. All of the following are functions of TH1 cells EXCEPT:

A. contributes to autoimmunity.

B. enhances APC activity.

C. enhances TC activity.

D. involved with delayed type hypersensitivity reactions.

E. protects against intracellular pathogens.

Answer: A

Section: T-Cell Differentiation

Difficulty: 1

Hint: Functions of TH cells

23. TH17 cells are involved with all of the following EXCEPT:

A. autoimmunity.

B. delayed-type hypersensitivity.

C. inflammatory response.

D. protection against fungal infections.

E. protection against bacterial infections.

Answer: B

Section: T-Cell Differentiation

Difficulty: 1

Hint: Functions of TH cells

24. Follicular helper T cells are a recent discovery in the Helper T-cell lineage. What is the primary role of TFH cells?

A. To help B cell development in germinal centers

B. To regulate TREG cell activity

C. To stimulate dendritic cell production

D. To suppress B-cell activation after pathogen has been cleared

E. To suppress TC cells after an infection has been cleared

Answer: A

Section: T-Cell Differentiation

Difficulty: 2

Hint: Functions of TH cells

25. Current research suggests that members in one subpopulation of helper T cells may be able to change the cytokines they produce to mimic or become members of another subpopulation of helper T cells. What advantage(s) would the ability to change helper T cell subpopulations have in an immune response?

A. A more rapid and specific response to an immune threat

B. Ability of the immune system to recover function during an autoimmune disease

C. The continued expression of a particular subset of TH cells after that subset has been cross-regulated

D. Both A and B

E. Both B and C

Answer: D

Section: T-Cell Differentiation

Difficulty: 3

Hint: Functions of TH cells

26. Mycobacterium leprae, the causative agent of leprosy in humans, is an intracellular pathogen that resides in the phagosome of macrophages. Leprosy presents in two main clinical manifestations. Tuberculoid leprosy results in the formation of granulomas and a cell-mediated immune response while lepromatous leprosy results in the production of high levels of IgG (hypergammaglobulinemia). If TH2 is produced in high levels during an M. leprae infection, which type of leprosy would result?

A. Lepromatous leprosy

B. Tuberculoid leprosy

C. Either lepromatous leprosy or tuberculoid leprosy

D. Neither one; leprosy depends on the expression of TREG cells

E. Cannot determine; insufficient clinical evidence to support either outcome

Answer: A

Section: T-Cell Differentiation

Difficulty: 2

Hint: TH cell cytokine production predicts the type of leprosy that develops in humans.

27. Which of the following is MOST likely to simulate a memory T cell?

A. B cell

B. Dendritic cell

C. Memory cell

D. Either A or B

E. Either A, B, or C

Answer: E

Section: T-Cell Memory

Difficulty: 1

Hint: Memory T-cell development

28. What is the function of a memory T cell?

A. To activate TC and TH cells during an active primary infection

B. To avoid autoimmune disorders by producing memory for self-antigens during T-cell development

C. To maintain an active T-cell response (TC or TH) after an infection is cleared

D. To provide an almost immediate response upon subsequent exposure to a specific pathogen

E. To suppress TC activity after a pathogen is cleared

Answer: D

Section: T-Cell Memory

Difficulty: 2

Hint: Memory T-cell function

29. Which cell type can activate a memory T cell?

A. B cell

B. Dendritic cell

C. Macrophage

D. Both A and B

E. All of the above

Answer: E

Section: T-Cell Memory

Difficulty: 1

Hint: Activation of memory T cells

30. Memory T cells, effector T cells, and naïve T cells share several characteristics. Which of the following descriptions could only be said of memory T cells?

A. Memory T cells are activated by any APC.

B. Memory T cells are only found in one location and do not circulate.

C. Memory T cells express CD44, CD62L, and CCR7.

D. Memory T cells recognize MHC class I or class II peptides displaying antigen molecules.

E. Memory T cells depend upon co-stimulatory signals from CD2/ LFA-3, CD45R/ CD22, and LFA-1/ ICAM-2.

Answer: A

Section: T-Cell Memory

Difficulty: 2

Hint: Memory T-cell activation

Chapter 12 B-Cell Activation, Differentiation and

Memory Generation

1. With regard to the type of B-cell response generated, protein antigens typically provoke which of the following responses?

A. TI-1

B. TI-2

C. TD

D. Both A and B

E. None of the above

Answer: C

Section: Introduction

Difficulty: 3

Hint: Proteins must be converted to peptides and presented to T cells; which of the following accounts for this?

2. Activated TH cells signal to B cells to initiate their activation program via which of the following?

A. CD40L on the T cell to CD40 on the B cell

B. CD40 on the T cell to CD40L on the B cell

C. FasL on the T cell to Fas on the B cell

D. Fas on the T cell to FasL on the B cell

E. Notch ligand on the B cell to notch-1 on the T cell

Answer: A

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the signaling types induces apoptosis instead of activating a differentiation program.

3. B cells follow which of the following chemotactic signals to migrate to the cortical regions of secondary lymphoid tissue?

A. CCL19

B. CXCL13

C. CCL21

D. Both A and C

E. None of the above

Answer: B

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: The chemotactic signals that induce extravasation from the circulation differ from signals that direct trafficking within the secondary lymphoid tissue.

4. Which of the following constitutes the critical survival cytokine for B cells in the secondary lymphoid tissue cortex?

A. BAFF

B. IL-7

C. IL-2

D. IL-6

E. None of the above

Answer: A

Section: T-Independent B-Cell Responses

Difficulty: 1

Hint: Two of the cytokines are essential for T-cell survival and activation, while another is important in directing class-switch recombination.

5. The first immunoglobulin isotype produced during the course of a primary immune response contains which of the following heavy chains?

A. ?

B. ?

C. d

D. μ

E. None of the above

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 1

Hint: One of the choices is not a type of heavy chain, one is predominantly membrane-bound versus secreted, and one only occurs in secondary responses and beyond.

6. Which of the following do you expect would be actively functioning in a B cell that had migrated to a germinal center?

A. RAG-1

B. Artemis

C. AID

D. Ku70

E. None of the above

Answer: C

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: The GC reaction does not involve further rearrangement of IgH or IgL loci.

7. AID converts cytosine into which of the following bases?

A. Adenine

B. Thymine

C. Uracil

D. Guanine

E. None of the above

Answer: C

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: Which of the following is not normally found in DNA?

8. Which of the following mechanisms of mutagenesis via AID activity is possible?

A. The lesion is not repaired prior to replication, resulting in a CG?TA transition.

B. Base excision repair, followed by error-prone DNA polymerase fill-in of the gap created.

C. Mismatch repair, followed by error-prone DNA polymerase fill-in of the gap created.

D. Choices A and B are both possible.

E. All of the above are possible.

Answer: E

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: There are multiple possible ways in which AID-induced mutagenesis can occur.

9. SHM and CSR are both dependent on the activity of which of the following enzymes?

A. AID

B. RAG-1/2

C. Artemis

D. DNA uridine glycosylase

E. Both A and D are required for SHM and CSR.

Answer: E

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: Two of the choices function prior to CSR and SHM.

10. A knockout of which of the following genes results in the inability to form germinal centers?

A. Blimp-1

B. IRF-4

C. Pax-5

D. Bcl-6

E. NF-?B

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the factors is particularly important for maintaining B cells in a state that can proliferate upon activation, as well as preventing it from becoming a plasma cell.

11. Which of the following is considered to be the “master regulator” of terminal plasma cell differentiation?

A. Blimp-1

B. IRF-4

C. Pax-5

D. Bcl-6

E. NF-?B

Answer: A

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the factors is particularly important for maintaining B cells in a state that can proliferate upon activation, as well as preventing it from becoming a plasma cell.

12. Which of the following represses expression of the transcription factor identified in Question 11?

A. Blimp-1

B. IRF-4

C. Pax-5

D. Bcl-6

E. NF-?B

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the factors is particularly important for maintaining B cells in a state that can proliferate upon activation, as well as preventing it from becoming a plasma cell.

13. Blimp-1 represses the expression of which of the following transcription factors?

A. Blimp-1

B. IRF-4

C. Pax-5

D. Bcl-6

E. NF-?B

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the factors is particularly important for maintaining B cells in a state that can proliferate upon activation, as well as preventing it from becoming a plasma cell.

14. Which of the following factors is thought to induce expression of Blimp-1?

A. Blimp-1

B. IRF-4

C. Pax-5

D. Bcl-6

E. NF-?B

Answer: B

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the factors is particularly important for maintaining B cells in a state that can proliferate upon activation, as well as preventing it from becoming a plasma cell.

15. Which of the following is a way in which follicular B cells can acquire antigen entering a lymph node via an afferent lymphatic?

A. Direct capture of whole antigen that directly enters the follicle by passing between sub-capsular sinus macrophages

B. Transfer of complement-bound antigen from surface receptors on sub-capsular sinus macrophages to B cells

C. Passage of antigen from sub-capsular sinus macrophages to follicular dendritic cells to B cells

D. Passage of antigen from DCs that reside near HEVs to B cells

E. All of the above are possible.

Answer: E

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: Is a B cell limited to one means by which it can acquire antigen?

16. Which of the following does NOT occur shortly following oligomerization of the BCR upon antigen binding?

A. Movement of the BCR complex into areas of the membrane called “lipid rafts”

B. Positioning of Iga and Igß to allow for phosphorylation of their ITAM motifs

C. Positioning of CD3 to allow for phosphorylation if its ITAM motifs

D. Formation of clathrin-coated pits around BCR complex

E. All of the above occur.

Answer: C

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: One of the choices involves a component of the T-cell receptor, as opposed to the BCR.

17. Which of the following is or appears to be controlled by Blimp-1 during plasma cell differentiation?

A. Exit from the cell cycle

B. Transitioning from membrane-bound to secreted IgM

C. Loss of MHC class II from the cell surface

D. All of the above

E. None of the above

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: As a master regulator, Blimp-1 controls multiple aspects of differentiation.

18. Which factors on the surfaces of B cells and T cells, through their interaction, are required to allow germinal center formation to occur?

A. CD40 and CD40L

B. Fas and FasL

C. CD28 and CD80/86

D. TCR and MHC class II

E. None of the above

Answer: A

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: Understand what part of the immune response each of the following interactions regulates.

19. The follicular mantle zone primarily consists of which of the following?

A. Follicular dendritic cells

B. Naïve IgD+ B cells that are not participating in the response against the antigen

C. TFH cells

D. Plasmacytoid dendritic cells

E. None of the above

Answer: B

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: Two of the cell types listed above are found within a GC, instead of around its outer margins.

20. Which cells that are found within GC light zones are generally NOT found in the GC dark zones?

A. Differentiating B cells

B. TFH cells

C. FDCs

D. Naïve IgD+ B cells that are not participating in the response to the antigen

E. None of the above

Answer: C

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: What cell type predominates within the dark zones?

21. The function of SHM is BEST described by which of the following statements?

A. Increasing junctional diversity in IgH and IgL V regions

B. Increasing the affinity of immunoglobulins for their antigen

C. Irreversibly changing the isotype of immunoglobulin

D. Promoting alternative splicing of an immunoglobulin heavy chain transcript to produce different isotypes on the B cell surface

E. None of the above

Answer: B

Section: T-Dependent B-Cell Responses

Difficulty: 3

Hint: Where does SHM fit into the list of choices temporally?

22. To which compartment in the body can long-lived plasma cells potentially be retained for the lifetime of the individual?

A. Medullary cords of the lymph node

B. Germinal center

C. Bone marrow

D. Red pulp of spleen

E. None of the above

Answer: C

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: The site of long-lived plasma-cell localization has only recently been reported.

23. Post-germinal-center plasma cells that take up residence in the bone marrow can be found in close proximity to which other type of immune cells that provide survival factors to the plasma cells?

A. Macrophages

B. DCs

C. Monocytes

D. Eosinophils

E. All of the above

Answer: D

Section: T-Dependent B-Cell Responses

Difficulty: 2

Hint: A member of the granulocyte lineage is capable of producing survival cytokines that are required to maintain plasma cells.

24. Which immunoglobulin isotype CANNOT be produced by memory B cells?

A. IgM

B. IgG1

C. IgA2

D. IgE

E. All of the above can be produced by memory B cells.

Answer: A

Section: T-Dependent B-Cell Responses

Difficulty: 1

Hint: CSR irreversibly removes germ-line DNA from the IgH locus that specifies IgH C domains; which is the first C domain produced and, thus, removed during CSR?

25. Which of the following antigen types could be characterized as TI antigens?

A. Soluble proteins

B. Bacterial cell wall components

C. Capsular polysaccharides

D. Both B and C

E. All of the above

Answer: D

Section: T-Independent B-Cell Responses

Difficulty: 1

Hint: Which antigens allow for either costimulation of BCR with innate receptors, or are polyvalent to the extent that they are capable of crosslinking the BCR by themselves?

26. Which of the following statements are TRUE about ?dT cells and B-1 B cells?

A. Both can self-renew in the periphery and do not need to be replenished from primary lymphoid tissues.

B. Both have identical lymphocyte receptors to one another.

C. Both respond to their antigens via high-affinity receptor responses.

D. Both A and D

E. All of the above

Answer: A

Section: T-Independent B-Cell Responses

Difficulty: 3

Hint: High-affinity responses are generally not seen in the following-named cell types.

27. Which of the following statements is TRUE about B-1 B cells and MZB cells?

A. Both are self-renewing in the periphery, not requiring replacement from bone marrow.

B. Both can respond to TI antigen.

C. Both do not undergo SHM.

D. Both A and B

E. All of the above

Answer: D

Section: T-Independent B-Cell Responses

Difficulty: 3

Hint: One of the cell types is capable of undergoing SHM, although via apparently different cell-cell interactions than those seen in conventional B-cell populations.

28. What do SHP-1 and IL-10 have in common with regard to B-cell function?

A. Both exert negative regulation of B-cell activity.

B. Both exert positive regulation of B-cell activity.

C. Both are B-cell survival factors.

D. Both induce B-cell proliferation.

E. None of the above

Answer: A

Section: Negative Regulation of B Cells

Difficulty: 2

Hint: Not all factors lead to increased B-cell activity.

Chapter 13 Effector Responses:

Cell and Antibody-Mediated Immunity

1. What is the effector molecule of humoral immunity?

A. Antibodies

B. Cytotoxic T cells

C. Dendritic cells

D. Helper T cells

E. Plasma cells

Answer: A

Section: Introduction

Difficulty: 1

Hint: Humoral immunity is based on activated B cells.

2. The role of cell-mediated immunity is:

A. to find cells infected with intracellular pathogens.

B. to find and eliminate cells infected with intracellular pathogens.

C. to present antigens to TH cells.

D. to produce memory B cells.

E. to secrete antibodies.

Answer: B

Section: Introduction

Difficulty: 1

Hint: Cell-mediated immunity uses T cells.

3. Cell mediated immunity includes:

A. antibodies.

B. plasma cells.

C. TC cells.

D. TH cells.

E. Both C and D

Answer: E

Section: Introduction

Difficulty: 1

Hint: Cell-mediated immunity uses T-lineage cells.

4. Examples of cytotoxic effector cells include all of the following EXCEPT:

A. basophils.

B. eosinophils.

C. macrophages.

D. NK cells.

E. TC cells.

Answer: A

Section: Introduction

Difficulty: 2

Hint: Cytotoxic effector cells are responsible for inducing cell death of the target cell.

5. NK T cells (NKTs) express:

A. CD4.

B. CD8.

C. CD12.

D. CD33.

E. Both A and B

Answer: A

Section: Introduction

Difficulty: 1

Hint: TH CD expression

6. _____ describes the action of antibodies whereby antibodies bind to a pathogen and prevent the pathogen from interacting with cell receptors.

A. Antibody-dependent cell-mediated cytotoxicity

B. Antigen presentation

C. Complement fixation

D. Neutralization

E. Opsonization

Answer: D

Section: Antibody-Mediated Effector Functions

Difficulty: 1

Hint: Blocking of receptors prevents a pathogen from invading a host cell.

7. _____ describes the recruitment of phagocytic cells by the Fab portion of an antibody.

A. Antibody-dependent cell-mediated cytotoxicity

B. Antigen presentation

C. Complement fixation

D. Neutralization

E. Opsonization

Answer: E

Section: Antibody-Mediated Effector Functions

Difficulty: 1

Hint: Recruitment of phagocytes

8. Lysis of a pathogen by MAC formation is an example of:

A. antibody-dependent cell-mediated cytotoxicity.

B. antigen presentation.

C. complement fixation.

D. neutralization.

E. opsonization.

Answer: C

Section: Antibody-Mediated Effector Functions

Difficulty: 2

Hint: MAC formation is a result of complement.

9. Virally infected host cells are tagged with antigen-antibody complexes. These complexes recruit NK cells that trigger apoptosis in the infected host cell. This is an example of:

A. antibody-dependent cell-mediated cytotoxicity.

B. antigen presentation.

C. complement fixation.

D. neutralization.

E. opsonization.

Answer: A

Section: Antibody-Mediated Effector Functions

Difficulty: 2

Hint: Antibodies are used to mediate cell death.

10. Which class of antibodies is the FIRST to be produced during the primary immune response?

A. IgA

B. IgD

C. IgE

D. IgG

E. IgM

Answer: E

Section: Antibody-Mediated Effector Functions

Difficulty: 1

Hint: The early BCR on an immature B cell

11. Which class of antibodies is good at fixing complement?

A. IgA

B. IgD

C. IgE

D. IgG

E. IgM

Answer: D

Section: Antibody-Mediated Effector Functions

Difficulty: 1

Hint: The Fc receptor enhances phagocytosis.

12. IgA is typically found as a dimer in high levels of secretions such as milk, tears, and saliva. What is the primary function of IgA in secretions?

A. To alert plasma cells of an invading pathogen

B. To neutralize toxins and pathogens

C. To secrete nonspecific enzymes such as lysozyme

D. To stimulate the growth of normal microbiota (normal flora) species

E. To trigger apoptosis in infected mucosal cells

Answer: B

Section: Antibody-Mediated Effector Functions

Difficulty: 2

Hint: IgA represents an early barrier to pathogens.

13. Monoclonal antibodies may be used to treat cancer in all of the following ways EXCEPT:

A. directly binding of monoclonal antibodies may trigger apoptosis or antibody-dependent cell-mediated cytotoxicity.

B. monoclonal antibodies compete with growth factors to bind receptors on tumor cells.

C. monoclonal antibodies may prevent the formation of new blood vessels to tumors.

D. monoclonal antibodies may recruit TH cells to a developing tumor.

E. monoclonal antibodies may serve as a vector to target tumor cells for toxin mediated therapy.

Answer: D

Section: Antibody-Mediated Effector Functions

Difficulty: 3

Hint: Monoclonal antibodies are made against one specific antigen.

14. Fc-receptor molecules tend to have short cytoplasmic tails. How does this influence signaling events within the Fc-receptor cell?

A. The Fc receptor is adjacent to secondary messengers (e.g., MAP kinase) that translocate into the nucleus to affect transcription.

B. The Fc receptor is dependent upon a co-receptor (e.g., ITAM or ITIM) that will trigger signaling events within the cell.

C. The Fc receptor is not directly involved in a signaling event.

D. The Fc receptor serves only to enhance or dampen a signaling event.

E. The Fc receptor translocates into the cytoplasm where it will binding to secondary messengers.

Answer: B

Section: Antibody-Mediated Effector Functions

Difficulty: 3

Hint: Immune receptor signaling

15. Which Fc receptor is responsible for triggering the release of histamine, proteases, and other inflammatory signals from IgE?

A. Fca receptor

B. Fce receptor

C. Fc? receptor

D. Neonatal Fc receptor

E. Polymeric immunoglobulin receptor (pIgR)

Answer: B

Section: Antibody-Mediated Effector Functions

Difficulty: 2

Hint: Ig receptors carry their isotype class in their receptor name.

16. Cell-mediated effector cells include:

A. CTLs and NK-T cells.

B. Plasma cells and dendritic cells.

C. TC cells and NK cells.

D. TC cells, NK-T cells, and NK cells.

E. TC cells and memory TH cells.

Answer: D

Section: Cell-Mediated Effector Responses

Difficulty: 1

Hint: Cell-mediated immune reaction involves T-cell lineage cells.

17. The Fas ligand (FASL) represents a key-signaling pathway among cell-mediated effector cells. What is the function of the Fas-FasL signaling pathway?

A. Activation of the Fas-FasL signaling pathway triggers apoptosis.

B. Binding of Fas to FasL induces phagocytosis by dendritic cells.

C. Expression of Fas occurs only on naïve B cells.

D. FAS-FASL binding recruits TH cells.

E. TNF-a is released by NK-T cells triggering histamine release in infected target cells.

Answer: A

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: Fas-signaling pathway is found in TC cells.

18. At what location are naïve TC cells activated to become CTLs?

A. Blood stream

B. Bone marrow

C. Germinal centers of lymph node

D. Spleen

E. Thymus

Answer: D

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: TC activation occurs in secondary lymphoid tissues.

19. CTLs mediate a powerful and lethal immune response to infected host cells. Which of the following steps is NOT involved with CTL activation and function?

A. Antigen presented with MHC class I is recognized by CTLs.

B. APC presentation occurs to both TC and TH cells.

C. Fas-FasL signaling pathway is activated triggering apoptosis.

D. Histamine is released from cytoplasmic granules recruiting macrophages to the site of infection.

E. Perforin and granzymes are released triggering apoptosis of infected cell.

Answer: D

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: CTL signaling pathway for apoptosis

20. Precursor CTLs are characterized by each of the following EXCEPT:

A. they do not divide.

B. they do not express high affinity for CD25.

C. they express CD4.

D. they lack cytotoxic activity.

E. they produce low amounts of IL-2.

Answer: C

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: TH expresses CD4.

21. Which of the following statements about NK T cells is TRUE?

A. Activated NK-T cells can act as both a TH and a TC cell.

B. CD4 is expressed by all NK-T cells

C. NK-T cells rely on p53 expression to cause apoptosis in an infected host cell.

D. NK-T cells express most of the T cell lineage characteristics.

E. The TCR on NK-T cells recognizes antigens presented with MHC class I and class II molecules.

Answer: A

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: NK T cells develop from the T-cell lineage but are distinct from TC and TH cells.

22. Natural cytotoxicity receptors (NCRs) belong to the _____ family of receptor molecules.

A. chemokine

B. class I cytokine

C. class II cytokine

D. Ig superfamily

E. TNF

Answer: D

Section: Cell-Mediated Effector Responses

Difficulty: 3

Hint: NCRs include NKp30, NKp44, and NKp46 receptors.

23. Licensing on an NK cells refers to:

A. activation of an NK cell by MHC class II displayed peptide antigen.

B. expression of IFN-? and TNF-a by NK cells.

C. production of memory cells.

D. suppressing the activity of a self-recognizing NK cell.

E. testing an NK cell to ensure that it will not target healthy host cells.

Answer: E

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: NK cells target infected self-cells and induce apoptosis.

24. In a recent experiment, NK cells were collect from an MCMV infected mouse and place into a healthy mouse. Upon exposure to the MCMV virus, the healthy mouse quickly mounted an immune response. How could these results BEST be interpreted?

A. MCMV virus failed to infect the healthy mouse.

B. NK cells show memory and are quickly able to recognize MCMV infected cells in the healthy mouse.

C. Plasma cells were transferred along with NK cells and produce antibodies that target MCMV virus particles.

D. TC cells were transferred along with the NK cells and have been targeting MCMV virus particles.

E. TH cells were transferred to the healthy mouse instead of NK cells and have stimulated B cells to activate.

Answer: B

Section: Cell-Mediated Effector Responses

Difficulty: 3

Hint: NK cell functions

25. How many sub-populations of TC cells are there?

A. One: TC

B. Two: TC1 and TC2

C. Three: TC1, TC2, and TC3

D. Five: TCA, TCD, TCE, TCG, and TCM

E. It varies depending on the type of infection that is found.

Answer: B

Section: Cell-Mediated Effector Responses

Difficulty: 1

Hint: TC subpopulations are similar to TH populations.

26. MHC tetramers:

A. are a novel way to detect and follow specific T-cell populations within an organisms.

B. are found only in mice though a parallel system in humans is under current investigation.

C. describe high-functioning TC cells found in autoimmune response.

D. represent novel immunotherapy for patients with Chron's disease.

E. use fluorescent staining to bind to MHC class I molecules on dendritic cells.

Answer: A

Section: Cell-Mediated Effector Responses

Difficulty: 2

Hint: A method used to follow specific TC cells

27. During the mixed lymphocyte reaction (MLR), T lymphocytes are mixed with allogeneic spleen cells. The T lymphocytes undergo extensive cell proliferation and are tracked using radiolabeled thymine. What purpose does the radiolabeled thymine serve in tracking T lymphocytes?

A. Radiolabeled thymine will be incorporated in all immunoglobulins produced by the T lymphocytes.

B. Radiolabeled thymine will be incorporated into the DNA of new T lymphocytes.

C. Radiolabeled thymine will be incorporated into the CTL receptors of TC1 cells.

D. Radiolabeled thymine will fluoresce when exposed to UV light and can be used to identify cytokine producing cells.

E. Radiolabeled thymine will be broken down into indole during ATP production by T lymphocytes.

Answer: B

Section: Experimental Assessment of Cell-Mediated Cytotoxicity

Difficulty: 3

Hint: Thymine is found in this class of organic molecule.

28. What is measured by the cell-mediated lympholysis (CML) assay?

A. Cell lysis of plasma cells

B. Cell lysis of target bacterial cells

C. Cell lysis of target tumor or viral infected host cells

D. Cell uptake of 51Cr by new TC cells

E. Cell uptake of 51Cr by new NK-T cells

Answer: C

Section: Experimental Assessment of Cell-Mediated Cytotoxicity

Difficulty: 2

Hint: The function of TC cells

29. When receiving a transplant, some lymphocytes may be transferred with the transplant organ or tissue. Unless transplant lymphocytes are from a genetically identical source to the new host (a very rare event), then a reaction will occur. What is this reaction?

A. An allergic reaction to the transplant tissue or organ will occur by type IV hypersensitivity.

B. Lymphocytes found in the transplant tissue or organ will begin to attack the new host.

C. The tissue or organ will be rejected by the new host's lymphocytes.

D. There is no reaction if immunosuppressive drugs are used appropriately.

E. All of the above reactions are possible.

Answer: B

Section: Experimental Assessment of Cell-Mediated Cytotoxicity

Difficulty: 2

Hint: The transplant tissue or organ contains immune cells.

Chapter 14 The Immune Response in Space and Time

1. After production, naïve lymphocytes travel briefly through the blood to the:

A. spleen.

B. peripheral lymph nodes.

C. mucosal associated lymphoid tissue.

D. Both A and B.

E. All of the above.

Answer: E

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 1

Hint: Where will naïve cells encounter antigen?

2. Continual lymphocyte circulation is needed because:

A. antigen is usually present in large amounts.

B. lymphocytes have a small chance or recognizing a particular antigen.

C. the chance of a naïve cell encountering its target antigen is moderately high.

D. there are relatively few antigen presenting cells in the lymph nodes compared to lymphocytes.

E. All of the above.

Answer: B

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 2

Hint: Circulation increases contact between the population of lymphocytes and antigens.

3. Lymphocytes exit the blood and enter the lymph node by extravasating at the high-endothelial venules (HEVs) present in the lymph node cortex. Extravasation does NOT require which of the following?

A. Homing

B. Addressins

C. Chemokines

D. Dentritic cells

E. All of these are required.

Answer: D

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 2

Hint: Chemokines are signaling molecules that direct homing.

4. After extravasation, naïve lymphocytes enter the _____ to scan for antigen.

A. thymic cortex

B. lymph-node medulla

C. lymph-node cortex

D. high-endothelial venule

E. None of the above.

Answer: C

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 2

Hint: The T-cell zone is also called the paracortex.

5. Reticular networks in the lymph nodes:

A. are made of fibroblasts.

B. guide T-cell movements.

C. guide B-cell movements.

D. regulate lymphocyte direction.

E. All of the above

Answer: E

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 1

Hint: Fibroblasts make up most of the lymph node but do not directly participate in lymphocyte interactions with antigen presenting cells.

6. Naïve B cells do NOT depend on which of the following as they move through a lymph node?

A. Follicular dendritic cells

B. Fibroblastic reticular fibers

C. Chemokines CCL21 and CCL19

D. The chemokine CXCL13

E. Actually, they do depend on all of these.

Answer: C

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 3

Hint: CCL21 is found in the T-cell zone of lymph nodes.

7. S1P1 receptor is upregulated by naïve T cells and B cells after 12–18 hours if they fail to encounter antigen in the lymph node. This means all of the following EXCEPT:

A. the naïve cells have not been activated.

B. the naïve cells have not encountered antigen.

C. the naïve cells will exit the lymph node.

D. space will be made for other cells to enter the lymph node.

E. the naïve cells will die by apoptosis.

Answer: E

Section: Immune Cell Behavior Before Antigen Is Introduced

Difficulty: 3

Hint: Lymph-node circulation is designed to maximize interaction between antigen and cells that have to potential to recognize it.

8. Pattern-recognition receptors on innate immune cells:

A. Coordinate killing of pathogens.

B. Alert the adaptive immune system of an infection.

C. Recognize specific pathogen

D. Both A and B.

E. All of the above.

Answer: D

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 1

Hint: Molecular patterns are found on a variety of pathogens.

9. Early in an infection, antigen-presenting cells:

A. become less effective at phagocytosis.

B. become more effective at antigen processing.

C. become less effective at cross presentation.

D. recruit more adaptive immune cells than innate immune cells.

E. remain at the site of infection.

Answer: B

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 2

Hint: Innate immune response both targets pathogens and activates the adaptive immune response.

10. Which of the following is the CORRECT sequence of events?

A. Antigen uptake > antigen processing > APC migration to lymph nodes > antigen presentation

B. APC migration to lymph nodes > antigen uptake > antigen processing > antigen presentation

C. APC migration to lymph nodes > antigen presentation > antigen uptake > antigen processing

D. Antigen uptake > antigen processing > antigen presentation > APC migration to lymph nodes

E. APC migration to lymph nodes > antigen uptake > antigen processing > antigen presentation

Answer: A

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 1

Hint: The functional sequence has to start with antigen uptake and end with presentation.

11. As antigen is picked up in peripheral tissues by antigen-presenting cells, it is:

A. processed for presentation to B cells.

B. processed for presentation to T cells.

C. moved without processing over several hours to the lymph nodes.

D. taken in unprocessed form for presentation to T cells.

E. All of the above.

Answer: B

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 1

Hint: How is antigen recognized by adaptive immune cells?

12. Which of the following mechanisms of travel to lymph nodes by unprocessed antigen is CORRECT?

A. Small and soluble antigens travel through afferent lymphatics as opsonized particles.

B. Small and soluble antigens travel directly through the bloodstream.

C. Large particles and pathogens travel directly through the bloodstream.

D. Opsonized pathogens travel directly through the bloodstream.

E. Small particles are carried by macrophages.

Answer: B

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 2

Hint: Soluble particles do not need to be carried.

13. Which of the following is the proper order of transfer for opsonized antigens?

A. CD169+ macrophages > follicular dendritic cells > antigen non-specific B cells

B. Antigen non-specific B cells > Cd169+ macrophages > follicular dendritic cells

C. CD169+ macrophages > antigen non-specific B cells > follicular dendritic cells

D. Antigen non-specific B cells > follicular dendritic cells > CD169+ macrophages

E. None of the above.

Answer: C

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 1

Hint: Follicular dendritic cells are the ones that actually present antigen to B cells.

14. The use of complement receptor deficient cells has shown that:

A. normal B cells sample antigen on macrophages and leave it intact.

B. normal B cells sample antigen on macrophages and take part of it.

C. complement receptor-deficient B cells do not sample antigen on macrophages.

D. complement receptor-deficient B cells sample antigen on macrophages and take part of it.

E. Both A and C.

Answer: B

Section: Immune Cell Behavior During the Innate Immune Response

Difficulty: 3

Hint: Normally, opsonized antigen is transferred.

15. During activation, naïve CD4+ T cells:

A. interact with antigen presenting cells.

B. reduce movement.

C. begin to divide .

D. move to interact with B cells.

E. All of the above.

Answer: E

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 1

Hint: What happens to activation if one of these steps is not carried out?

16. While our understanding of the kinetics of T-cell activation has changed over time, we now believe that:

A. antigen availability does not affect T-cell APC interactions.

B. antigen quantity does not affect T-cell APC interactions.

C. optimal proliferation of helper T cells requires only relatively brief APC exposure.

D. optimal proliferation of helper T cells requires several hours of APC exposure.

E. dendritic cell activation does not affect T cell activation.

Answer: D

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 2

Hint: Consider the necessary interactions between the T cell and the antigen-presenting cell.

17. B cells have been shown to need two signals for activation. Absent T-cell help, they will not activate because:

A. T cells provide signal 1 through the B-cell receptor.

B. T cells provide signal 2 through the B-cell receptor.

C. T cells activate B cells indirectly by activating follicular dendritic cells.

D. T cells activate B cells through CD40 signaling.

E. Actually, they will still activate because of dendritic cells.

Answer: D

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 1

Hint: Signal 1 is always the antigen-specific, receptor-recognizing antigen.

18. Several types of T cells have been shown to be able to provide help for B cells during activation. Which of the following statements is TRUE?

A. All produce the same chemokine to activate but provide different CD40 signals.

B. All produce the same chemokine, and the same CD40 signal as well.

C. All provide CD40 signaling but produce different chemokines.

D. All provide CD40 signaling but trigger distinct class switching.

E. Both C and D.

Answer: E

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 2

Hint: All T-helper cells provide CD-40 ligand.

19. Activation of naïve B cells is a two-step process, during which:

A. antigen triggers B-cell production of CCR7, which leads it to interact with T cells.

B. antigen triggers T-cell production of CCR7, which recruits B cells.

C. T-cell help stimulates B cells to produce CCR7, then divide.

D. macrophages trigger B-cell production of CCR7, which leads it to interact with T cells.

E. None of the above.

Answer: A

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 1

Hint: CCR7 is a chemokine receptor.

20. T-cell help of B cells will be impaired if the T cells lack CD28 because:

A. CD28 is needed to activate class switching by turning on AICD.

B. CD28 is needed to interact with CD40 on the B cell.

C. CD28 is needed to signal through the B-cell receptor.

D. CD28 is needed to signal through the T-cell receptor.

E. Both B and C.

Answer: D

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 3

Hint: CD28 (and CTLA-4) interacts with B-7 on the B cell.

21. Visualization of B-cell traffic between the light and dark zones of the germinal center has shown that they migrate far less than had been predicted. This demonstrates that:

A. The traditional model of trafficking is inaccurate.

B. The rate of hypermutation and selection does not require extensive movement.

C. Only brief contacts by the B cells with helper T cells are needed.

D. Both B and C.

E. All of the above.

Answer: D

Section: Immune Cell Behavior During the Adaptive Immune Response

Difficulty: 3

Hint: In the germinal center, both hypermutation and positive selection take place.

22. A major difference between naïve and effector lymphocytes is that effector lymphocytes:

A. do not home to the lymph nodes.

B. follow chemokine trails.

C. do not require co-stimulation.

D. Both B and C.

E. All of the above.

Answer: E

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 1

Hint: Effector cells are, by definition, already stimulated.

23. Effector cells, in order to avoid returning to the lymph nodes:

A. up-regulate chemokine receptors to allow them to home to site of infection.

B. down-regulate L-selectin, so they do not enter the high-endothelial venules (HEVs).

C. down-regulate chemokine receptors, so they do not enter the high-endothelial venules (HEVs).

D. Both A and B.

E. Both B and C.

Answer: D

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 2

Hint: L-selectin interacts with HEVs leading to lymph nodes.

24. Tracking of responses to a transgenic pathogen (toxoplasma) has shown that:

A. T-cell behavior followed patterns predicted by previous studies.

B. dendritic cell behavior followed patterns predicted by previous studies.

C. lymph-node architecture changed due to inflammation.

D. T cells divided at the site of infection.

E. All of the above.

Answer: C

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 2

Hint: Predictions and reality did not fully match.

25. Studies of graft rejection using cells labeled with fluorescent markers demonstrate that:

A. any infiltration of a skin graft depends on MHC mismatch.

B. deep infiltration of a skin graft depends on MHC mismatch.

C. antigen-presenting cells from a skin graft migrate to lymph nodes and present antigen there.

D. host antigen-presenting cells enter the skin graft, then migrate to lymph nodes.

E. Both B and D.

Answer: E

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 2

Hint: The grafted APCs do migrate to the lymph node but seem to die off quickly.

26. Listeria is able to persist in an infection because it:

A. avoids being broken down and presented as antigen.

B. localizes quickly to lymph nodes and persists there.

C. reproduces inside macrophages.

D. is passed by dendritic cells to monocytes.

E. None of the above.

Answer: D

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 2

Hint: Blood-borne pathogens such as Listeria drain to the spleen.

27. The failure of cytotoxic T cells to eliminate tumors can be attributed to:

A. failure of tumor antigen presentation.

B. failure of activation of tumor-specific T cells.

C. failure of recruitment of T cells to the tumor.

D. failure of the T cells to produce cytotoxic effector molecules.

E. All of the above.

Answer: A

Section: Immune Cell Behavior in Peripheral Tissues

Difficulty: 1

Hint: Activated T cells can be monitored at the tumor sites.

Chapter 15 Allergy, Hypersensitivities, and

Chronic Inflammation

1. Hypersensitivity reactions to penicillin have been identified that correspond to which of the above types of reactions?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: E

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

2. Hypersensitivity reactions to cell surface antigens via IgG or IgM are classified as which type?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: B

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

3. Which of the following types of hypersensitivity reactions is associated with IgE?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: A

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

4. Which of the following types of hypersensitivity reactions includes the transfusion reaction?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: B

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

5. Which of the following reactions features mast cell degranulation as one of its key features?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: A

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

6. The Arthus reaction is considered to be which of the following hypersensitivity types?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: D

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

7. Formation of immune complexes between antibodies and soluble antigens is considered to be which type of hypersensitivity reaction?

A. Type I hypersensitivity

B. Type II hypersensitivity

C. Type III hypersensitivity

D. Type IV hypersensitivity

E. All of the above

Answer: C

Section: All Sections

Difficulty: 2

Hint: Know how each type of hypersensitivity reaction occurs.

8. A normal individual should only produce IgE in response to which of the following types of antigens?

A. Antigens from extracellular bacterial antigens

B. Antigens from intracellular bacterial antigens

C. Viral antigens

D. Parasite antigens

E. All of the above

Answer: D

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 1

Hint: IgE is normally only produced against one of the types of antigens listed above.

9. Which of the following cell-surface receptors is MOST closely linked to activating type I hypersensitivity reactions?

A. FceRII

B. Fc?RIIB

C. FceRI

D. LFA-1

E. None of the above

Answer: C

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 1

Hint: Which of the above receptors are prevalent on the cells that drive type I hypersensitivity reactions?

10. Which of the following cell types are implicated in type I hypersensitivity reactions?

A. Neutrophils

B. Mast cells/basophils

C. T cells

D. Monocytes

E. None of the above

Answer: B

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 1

Hint: Type I reactions have been linked to related cells that can be circulating or tissue-resident.

11. Which of the following is NOT packaged within basophil and mast cell granules?

A. Prostaglandins

B. Histamine

C. Heparin

D. Tryptase

E. All of the above are found in granules.

Answer: A

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 2

Hint: One of these choices is not pre-formed; it is only produced following mast cell/basophil activation.

12. Which of the following cell types are targets of the products of mast-cell degranulation, as well as the mediators produced by mast cells following degranulation?

A. Smooth muscle

B. Nervous tissue

C. Hematopoietic cells

D. Epithelial cells

E. All of the above

Answer: E

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 2

Hint: Do the mediators released by mast cells only influence one type of cell?

13. The effects of histamine in allergic reactions are primarily attributable to its binding which of the following histamine receptors?

A. H1

B. H2

C. H3

D. H4

E. None of the above

Answer: A

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 2

Hint: Which receptors activate the allergic response, as opposed to which inhibit degranulation of mast cells?

14. Which of the following effects is NOT a result of histamine binding to histamine receptor H1?

A. Intestinal smooth muscle contraction

B. Suppression of mast-cell degranulation

C. Increased vascular permeability

D. Increased mucous secretion

E. All of the above result from histamine binding H1.

Answer: B

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 2

Hint: Which of these blocks stimulation of the allergic response?

15. Which of the following cytokines is NOT generally associated with allergic reactions?

A. TNF-a

B. GM-CSF

C. IL-4

D. TGF-ß

E. All of the above are associated with allergic reactions.

Answer: D

Section: Allergy: A Type I Hypersensitivity Reaction

Difficulty: 2

Hint: Which of the listed cytokines have an immunosuppressive effect?

16. Which of the following is NOT a means by which type II hypersensitivity reactions occur?

A. IgE binding to FceRI on mast cells

B. IgM binding to cell-surface antigens, leading to complement fixation on the cell surface

C. Cytotoxic cells with Fc receptors for antibodies bound to the surface of a cell, leading to cytotoxic killing

D. Antibody-antigen complexes that form opsonins, leading to phagocyte-driven cell killing

E. All of the above are associated with type II hypersensitivity reactions.

Answer: A

Section: Antibody-Mediated (Type II) Hypersensitivity Reactions

Difficulty: 2

Hint: One of the choices is not associated with type II reactions.

17. The transfusion reaction involves which of the following antigens that are antigenically identical to antigens on the surface of commensal bacteria?

A. Fc receptors on the surface of mast cells

B. Complement receptors on the surface of APCs

C. Carbohydrates on the surface of erythrocytes

D. Fc receptors on the surface of cytotoxic cells

E. None of the above

Answer: C

Section: Antibody-Mediated (Type II) Hypersensitivity Reactions

Difficulty: 1

Hint: Not all cell-surface antigens that can be recognized by the immune system are proteins.

18. Which of the following BEST describes the difference(s) between types II and III hypersensitivity reactions?

A. Direct recognition of cell-surface antigens by antibodies in type II reactions versus deposition of improperly cleared antibody-antigen complexes in type III reactions

B. Direct recognition of cell-surface antigens by antibodies in type III reactions versus deposition of improperly cleared antibody-antigen complexes in type II reactions

C. Cross-linking of FceRI by IgE-opsonized pathogens

D. Cross-linking of Fc?RIIB by IgG-opsonized pathogens

E. None of the above

Answer: A

Section: Antibody-Mediated (Type II) Hypersensitivity Reactions & Immune Complex-Mediated (Type III) Hypersensitivity

Difficulty: 3

Hint: One of the choices involves a different hypersensitivity reaction.

19. Which of the following is NOT an explanation for inefficient clearing of antibody-antigen complexes that could lead to type III hypersensitivity reactions?

A. High affinity for tissues of particular antigens

B. Antigens that are prone to formation of lattices when bound by antibodies

C. Highly charged antigens

D. Compromised phagocytic system

E. All of the above could explain inefficient clearing of antibody-antigen complexes.

Answer: E

Section: Immune Complex-Mediated (Type III) Hypersensitivity

Difficulty: 2

Hint: There is no single explanation for the development of type III hypersensitivity reactions.

20. The tuberculin reaction is an example of which type of hypersensitivity?

A. Type I

B. Type II

C. Type III

D. Type IV

E. None of the above

Answer: D

Section: All Sections

Difficulty: 1

Hint: What is the tuberculin reaction detecting, and how are its effects detected?

21. Which of the following cell types is NOT typically associated with type IV hypersensitivity reactions?

A. B cells

B. TH1

C. TH17

D. Langerhans cells

E. None of the above are typically associated with type IV hypersensitivity reactions.

Answer: A

Section: Delayed-Type (Type IV) Hypersensitivity (DTH)

Difficulty: 2

Hint: Which of the above types of cells, by means of what they secrete in all of the other types of hypersensitivity reactions, play a lesser role in type IV reactions?

22. Which of the following is a potential cause of chronic inflammation?

A. Obesity

B. Infectious agents

C. Tissue damage

D. Intestinal commensal microbiota components

E. All of the above

Answer: E

Section: Chronic Inflammation

Difficulty: 2

Hint: Is there only one single cause of chronic inflammation?

23. Which of the following cytokines is NOT generally found in increased concentrations in individuals with chronic inflammation?

A. IL-10

B. TNF-a

C. IL-1

D. IL-6

E. All of the above are generally elevated in chronic inflammation.

Answer: A

Section: Chronic Inflammation

Difficulty: 1

Hint: Which of the choices is not pro-inflammatory?

24. Which of the following is NOT involved in the development of Type II diabetes?

A. Antibodies against pancreatic islet cells

B. Signaling from IL-6R

C. Inactivation of components involved in signaling from the insulin receptor by JNK

D. Both B and C are not involved in the development of Type II diabetes.

E. None of the above are involved in the development of Type II diabetes.

Answer: A

Section: Chronic Inflammation

Difficulty: 3

Hint: How does Type II diabetes differ from Type I diabetes?

25. Chronic stimulation of the tissue regeneration function of the inflammatory response primarily involves which of the following cells?

A. T cells

B. Fibroblasts

C. B cells

D. Basophils

E. None of the above

Answer: B

Section: Chronic Inflammation

Difficulty: 2

Hint: Which of the cells is responsible for producing components that will contribute to tissue repair?

Chapter 16 Tolerance, Autoimmunity, and Transplantation

28. Central tolerance:

a) is the first step of tolerance mechanisms.

b) affects both T cells and B cells.

c) deletes cells that are autoreactive.

d) occurs in the bone marrow and thymus.

e) All of the above.

Answer: E

Section: Establishment and Maintenance of Tolerance

Difficulty: 1

Hint: Autoreactivity can involve both T cells and B cells.

29. Which of the following statements does NOT describe tolerogens accurately?

a) They can be the same molecules as immunogens.

b) They lead cells to become unresponsive.

c) They are part of peripheral tolerance.

d) They only affect B cells.

e) All of the above.

Answer: D

Section: Establishment and Maintenance of Tolerance

Difficulty: 2

Hint: Tolerogens are equivalent to immunogens, but in different context.

30. The tolerogenic response:

a) is not antigen specific.

b) leads to apoptosis but not anergy.

c) results in cells becoming non-responsive.

d) depends of the presentation context.

e) affects T cells only.

Answer: C

Section: Establishment and Maintenance of Tolerance

Difficulty: 2

Hint: Anergy and apoptosis are both mechanisms of tolerance.

31. Tolerance is promoted by all of the following circumstances EXCEPT:

a) high doses of antigen.

b) persistent antigen.

c) oral introduction of antigen.

d) presence of adjuvant.

e) low levels of costimulation.

Answer: D

Section: Establishment and Maintenance of Tolerance

Difficulty: 2

Hint: Oral polio vaccine is unusual in its effectiveness.

32. Tolerance is promoted by:

a) induction of anergy.

b) induction of apoptosis.

c) regulation of activity of cells.

d) Both A and B.

e) All of the above.

Answer: E

Section: Establishment and Maintenance of Tolerance

Difficulty: 1

Hint: Autoreactivity is such a large potential problem that multiple systems to control it are used.

33. Apoptosis is:

a) similar to necrosis.

b) important in peripheral tolerance, but not central tolerance.

c) important in central tolerance, but not peripheral tolerance.

d) impaired in Fas-deficient systems.

e) None of the above.

Answer: D

Section: Establishment and Maintenance of Tolerance

Difficulty: 2

Hint: Apoptosis is widely used.

34. Maintaining immunologically protected sites, such as the eye:

a) allows sequestration of antigens.

b) reduces central tolerance.

c) can lead to autoreactivity secondary to injury.

d) can reduce background reactivity.

e) All of the above.

Answer: E

Section: Establishment and Maintenance of Tolerance

Difficulty: 2

Hint: Keeping self antigens away from immune cells reduces interactions, both during development and afterwards.

35. Central tolerance employs all but which of the following mechanisms?

a) Apoptosis

b) Receptor editing

c) Positive selection

d) Negative selection

e) Clonal deletion

Answer: C

Section: Establishment and Maintenance of Tolerance

Difficulty: 1

Hint: Removal of autoreactive cells is a major mechanism.

36. Peripheral tolerance:

a) Is caused by costimulation without TcR-MHC+ peptide interaction.

b) Is caused by TcR-MHC+ peptide interaction without costimulation.

c) Leads to anergy.

d) Both A and C.

e) Both B and C.

Answer: E

Section: Establishment and Maintenance of Tolerance

Difficulty: 1

Hint: It is antigen specific.

37. Autoimmune diseases:

a) involve a failure of central tolerance.

b) involve a failure of peripheral tolerance.

c) lead to tissue destruction.

d) Both A and B.

e) All of the above.

Answer: E

Section: Autoimmunity

Difficulty: 1

Hint: Multiple failures must take place for autoimmunity to develop.

38. Hashimoto's thyroiditis targets the thyroid and:

a) is more common in men than in women.

b) shows juvenile onset.

c) is primarily T-cell mediated.

d) leads to hypothyroidism.

e) All of the above.

Answer: D

Section: Autoimmunity

Difficulty: 2

Hint: It reduces thyroid function.

39. Insulin-dependent diabetes:

a) usually shows juvenile onset.

b) is more common in men that in women.

c) interferes with fat metabolism.

d) seems to be triggered by antibodies.

e) None of the above.

Answer: A

Section: Autoimmunity

Difficulty: 1

Hint: It is also known as juvenile-onset diabetes.

40. Myasthenia gravis is an autoimmune disease that:

a) is triggered by antibodies.

b) targets the neuromuscular junction.

c) leads to destruction of muscle cells.

d) Both A and B.

e) All of the above.

Answer: E

Section: Autoimmunity

Difficulty: 1

Hint: Acetylcholine receptors are on muscle cells.

41. Systemic lupus erythematosus:

a) is more common in women than in men.

b) is antibody mediated.

c) targets multiple organs.

d) Both B and C.

e) All of the above.

Answer: E

Section: Autoimmunity

Difficulty: 1

Hint: Systemic means spread throughout.

42. Multiple sclerosis:

a) does not seem to have an environmental component.

b) seems to have some genetic component.

c) is more common in Europe than North America.

d) seems to be primarily mediated by antibodies.

e) All of the above.

Answer: B

Section: Autoimmunity

Difficulty: 1

Hint: If one sibling has it, others are more likely to have it as well.

43. Rheumatoid arthritis:

a) seems to be T-cell mediated, with cytotoxic T cells being primarily responsible.

b) is more common in men than in women.

c) targets the joint capsules.

d) is characterized by juvenile onset.

e) All of the above.

Answer: C

Section: Autoimmunity

Difficulty: 1

Hint: The etiology includes activation of the complement cascade at the joints.

44. Individuals who express HLA-B27 are 90 times more likely to develop the autoimmune disorder ankylosing spondylitis than individuals with a different HLA allele at this locus. This leads to the conclusion that:

a) HLA-B27 causes ankylosing spondylitis.

b) individuals with HLA-B27 will develop ankylosing spondylitis.

c) autoimmune disorders must have genetic components.

d) patients with ankylosing spondylitis express HLA-B27.

e) None of the above is true.

Answer: E

Section: Autoimmunity

Difficulty: 2

Hint: Likelihood does not equal causation.

45. Many autoimmune disorders are treated with immunosuppressive drugs, which produce other problems. Antigen specific immunotherapy would be much better because:

a) they would target only the autoreactive cells.

b) they would not induce general suppression of the immune system.

c) they would produce a general reduction in inflammation.

d) Both A and B.

e) All of the above.

Answer: D

Section: Autoimmunity

Difficulty: 3

Hint: The key to effective immune function is the ability to mount specific responses.

46. Autografts will be rejected only rarely because of all but which of the following?

a) They are from the same individual.

b) They are MHC matched.

c) They do not trigger an immune response.

d) They have Th17 cells.

e) All of the above.

Answer: D

Section: Transplantation Immunology

Difficulty: 1

Hint: “Auto” means self.

47. Isografts are NOT usually rejected because:

a) they are between genetically identical individuals.

b) they are MHC matched.

c) they do not trigger an immune response.

d) they are syngeneic.

e) All of the above.

Answer: E

Section: Transplantation Immunology

Difficulty: 1

Hint: “Syngeneic” means shared genes.

48. Rejection of allografts:

a) does not depend on MHC mismatching.

b) demonstrates immunological specificity.

c) demonstrates immunological memory.

d) Both A and B.

e) Both B and C.

Answer: E

Section: Transplantation Immunology

Difficulty: 1

Hint: Rejection does depend on mismatches of MHC.

49. Because T cells are essential in graft rejection, nude mice, which lack a thymus:

a) will reject grafts the same as wild-type mice.

b) will reject grafts more vigorously than wild-type mice.

c) will not reject grafts since they lack T cells.

d) will not reject grafts since they lack B cells.

e) will not reject grafts because of peripheral tolerance.

Answer: C

Section: Transplantation Immunology

Difficulty: 2

Hint: Without a thymus, T-cell development does not occur.

50. Kidney transplant infiltrates show both CD4+ and CD8+ T cells. This suggests that to reduce graft rejection:

a) CD4+ T cells should be depleted.

b) CD8+ T cells should be depleted.

c) Both CD4+ and CD8+ cells should be depleted.

d) Inflammatory cells should be depleted.

e) None of the above are viable treatments.

Answer: E

Section: Transplantation Immunology

Difficulty: 3

Hint: What effect will T-cell depletion have on immune function?

51. While MHC matching is important for transplantation, ABO blood group matching is also critical because:

a) ABO antigens are expressed on nervous tissue.

b) ABO antigens are expressed on muscle cells.

c) complement will cause rapid lysis of ABO mismatched cells.

d) Both A and C.

e) None of the above.

Answer: C

Section: Transplantation Immunology

Difficulty: 2

Hint: ABO is expressed on connective tissues.

52. Minor histocompatibility locus genes can cause tissue rejection:

a) only if major histocompatibility genes also cause rejection.

b) even if major histocompatibility genes match properly.

c) more quickly than MHC-mediated rejection.

d) at the same rate as MHC rejection.

e) None of the above

Answer: B

Section: Transplantation Immunology

Difficulty: 2

Hint: Major is major and minor is minor.

53. Allografts can be accepted without use of immunosuppressive drugs if:

a) they lack alloantigens, such as cartilage.

b) cells are grafted to a site that is immunologically privileged.

c) tolerance has been induced previously, such as non-identical twins.

d) Both A and B.

e) All of the above.

Answer: E

Section: Transplantation Immunology

Difficulty: 1

Hint: Lack of antigens leads to a lack of immune response.

54. Graft rejection consists of:

a) sensitization, when T cells are stimulated, and effector, when they attack the graft.

b) sensitization, when B cells are stimulated, and effector, when they attack the graft.

c) recognition, when T cells are stimulated, and effector, when they attack the graft.

d) recognition, when B cells are stimulated, and effector, when they attack the graft.

e) None of the above.

Answer: A

Section: Transplantation Immunology

Difficulty: 1

Hint: Sensitization of T cells is essential.

Chapter 17 Infectious Diseases and Vaccines

1. Viruses, like many good pathogens, have adapted to survive in their hosts. Which of the following scenarios would be MOST favorable to viral transmission and long term survival of the viral species?

A. Virus X enters a host cell, produces many progeny viruses (virions), and lyses the host cell.

B. Virus X enters the host cell and merges viral DNA with the host DNA so that the virus is copied into all progeny host cells.

C. Virus X enters the host cells, merges viral DNA with the host DNA until the host cell is stressed, and then begins to produce many virions eventually lysing the host cell.

D. Virus X enters the host cell and consistently makes virions at a low level so that all host cell functions are not disrupted.

E. Virus X enters the host cell, makes many progeny virions, and releases virions through exocytosis so that each virion is wrapped in the host cell plasma membrane. The host cell will eventually die or be targeted by the immune system for apoptosis.

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 3

Hint: Good pathogens produce progeny without killing their host cells.

2. Which of the following is recognized by the innate immune system and triggers an immune response that will produce antiviral cytokines and trigger effector molecules?

A. Complement

B. IgA

C. IL-2

D. PAMPs

E. TNF-a

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: The innate immune system looks for common, non-specific identifiers on viruses.

3. One mechanism that viruses use to avoid the immune response is to bind up immune effector molecules. All of the following methods are used by antibodies to block viral infection EXCEPT:

A. antibodies bind to and coat virus particles, preventing viral ligands from binding to cell receptors.

B. antibodies trigger complement, which can lyse viral particles or recruit opsonins.

C. antibodies stimulate activation of cytotoxic T cells.

D. antibodies aid in phagocytosis.

E. antibodies compete for binding with viral ligands.

Answer: C

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Viruses must bind to a ligand before they can enter a host cell and begin their life cycle.

4. Influenza virus is an annual concern in the United States and worldwide. Each year, millions of people receive the flu vaccine to protect against the influenza virus. What two viral ligands does the flu vaccine produce immunity to?

A. Hemagglutinin and TNF-a

B. Hemagglutinin and N-acetyl glucosamine

C. N-acetyl glucosamine and Neuraminidase

D. N-acetyl glucosamine and reverse transcriptase

E. Neuraminidase and Hemagglutinin

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Influenza viruses are named after their H and N antigens.

5. Viruses such as Epstein-Barr virus, cytomegalovirus, and HIV are capable of suppressing the immune system by:

A. binding antibodies but avoiding an immune response.

B. infecting lymphocytes or phagocytic cells.

C. production of cytokine antagonists.

D. wrapping progeny viral particles in the host-cell plasma membrane.

E. Both B and C.

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Viruses can evade or decrease an immune response by targeting host immune cells or cytokines.

6. By which mechanisms can bacterial pathogens evade a host immune response?

A. Avoiding phagocytosis by the production of a capsule

B. Escape of the phagolysosome within phagocytic cells

C. Neutralization of digestive enzymes found within phagocytic cells

D. Both A and B.

E. All of the above.

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Phagocytes capture pathogens and degrade them using hydrolytic enzymes.

7. Each of the following is a step in bacterial infection EXCEPT:

A. attachment to host cells.

B. the host feels tired or uncomfortable.

C. invasion of host tissue.

D. proliferation of bacterial cells.

E. toxin-induced damage to host cells.

Answer: B

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Pathogens infect, reproduce, and move to the next host.

8. _____ is known as an endotoxin.

A. C3a

B. Capsular proteins

C. Flagellar proteins (H antigen)

D. Lipid A of the LPS in gram-negative cells

E. Peptidoglycan in gram-positive cells

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Endotoxins are not secreted.

9. Anaphylatoxins stimulate a localized inflammatory response, which includes mast-cell degranulation, vasodilation, and recruitment of lymphocytes and phagocytic cells. What is the purpose of this localized immune response?

A. Mast cells contain histamine, which triggers vasodilation, which will increase blood flow to an infected area so that higher numbers of white blood cells will be recruited.

B. Serum proteins contain specific and nonspecific immune effector molecules to bind up and neutralize the invading pathogen and any toxins.

C. Vasodilation locally increases the temperate of an infected area so that bacterial proteins become denatured.

D. Vasodilation increases tenderness at the site of infection and causes edema (swelling) to that the host is careful not to overuse or tax the infected area.

E. All of the above.

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Anaphylatoxins trigger an immune cascade to recruit other immune-effector molecules.

10. Which of the following are anaphylatoxins?

A. C1 and MASP 1

B. C3a and C5a

C. C3b and C5b

D. C4b and factor D

E. C5b and the MAC

Answer: A <- TYPO, its B!

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Anaphylatoxins are a cleaved product from important effector molecules found common to each of the three complement pathways.

11. Parasitic infections include:

A. protozoans.

B. protozoans and helminthes.

C. prions and viruses.

D. prions, viruses, and bacteria.

E. protozoans, helminthes, prions, viruses, and bacteria.

Answer: B

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Parasitic infections involve larger microbes.

12. Sleeping sickness and Chagas's disease are caused by members of the genus Trypanosoma, protozoans that reside in the bloodstream. What is the principle way trypanosomes evade the immune response?

A. Antagonistic cytokines are produce by the trypanosome.

B. Periodic changes in the surface antigen (VSG) of trypanosomes ensures that at least some cells will survive antibody mediate attacks.

C. Trypanosomes are human pathogens and thus immune to human immune responses.

D. Trypanosomes invade the brain and red blood cells so that immune effector cells such as macrophages and dendritic cells cannot phagocytize trypanosomes.

E. Vaccines are readily available to people in trypanosome infested areas.

Answer: B

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Trypanosomes are masters at hiding from the immune system.

13. How do Plasmodium cells avoid immune clearance?

A. Antagonistic cytokines are produced by the Plasmodium cells.

B. Periodic changes in the surface antigen (VSG) of Plasmodium ensures that at least some cells will survive antibody mediate attacks.

C. Plasmodium cells show multi-drug resistance.

D. Plasmodium invades red blood cells so that immune-effector cells such as macrophages and dendritic cells cannot phagocytize Plasmodium cells.

E. TNF-a is produced in large amounts by Plasmodium, thus overwhelming the immune response and creating a cytokine storm.

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Plasmodium is the causative agent of malaria. People with sickling red blood cells are less likely to have malaria.

14. Schistomiasis is a debilitating and potentially fatal disease caused by the helminthic parasite Schistosoma. Which antibody is specific for helminth response?

A. IgA

B. IgD

C. IgE

D. IgG

E. IgM

Answer: C

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Typical immune response to helmiths releases histamine, which recruits eosinophils.

15. Leishmaniasis is a disease that can either be fatal to its host or will be cleared by the immune response of the host. Which pathway is responsible for clearing leishmaniasis?

A. Memory B cells

B. Complement

C. Plasma cells

D. TC cells

E. TH cells

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Production of TNF and interferon is the main immune response to Leishmania major.

16. Some species of fungi are part of the normal microbiota or normal microbial flora of a host organism. How does the immune system differentiate between “good” fungi and “bad” fungi?

A. Good fungi only reside in certain places and thereby will not trigger an immune response.

B. Good fungi are weakly virulent, while bad fungi are highly virulent.

C. Fungi are differentiated based on their cytokine production.

D. Low levels of any fungi are ignored by the immune system.

E. PAMPs such as motifs in peptidoglycan are used to mark fungal cells.

Answer: B

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Normal microbiota are weakly immunogenic and serve to stimulate the immune system so that an immune response can develop quickly (within days).

17. Cryptococcus may spread throughout an infected host. By what mechanism is Cryptococcus controlled by the acquired immune system?

A. Activation of TH cells

B. Degranulation of eosinophils and IgE

C. Expression of TNF-a

D. Granuloma formation

E. Plasma cell activation

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Granulomas represent an attempt by the immune system to wall off a pathogen.

18. Primary virulence in fungi indicates:

A. an aggressive fungal infection.

B. infection by a rare fungal species with high pathogenicity.

C. infection by an opportunistic fungal species with low pathogenicity.

D. infection by a multi-drug-resistant fungal species.

E. infection by multiple fungal species as at once.

Answer: B

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Virulence is divided into primary and opportunistic.

19. People encounter fungi on a daily basis, yet few healthy individuals develop fungal infections. Each of the following are mechanisms of the innate immune system that help prevent or limit fungal infections in healthy individuals EXCEPT:

A. neutrophils are especially good a phagocytizing fungal cells.

B. normal microbial flora (commensals) limit fungal growth by toxin (antimicrobial) production.

C. normal microbial flora use available nutrients and colonization space on the host, which makes the host an inhospitable environment for fungal cells.

D. PAMPs such as b-glucans, mannans, and chitin are recognized by innate immune cells.

E. several species of fungi are able to block PRR binding.

Answer: E

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 2

Hint: Normal flora species are the primary defense against fungal infections. Other non-specific immune cells can also recognize non-host motifs in fungal cell walls.

20. Acquired fungal immunity is supported by:

A. multiple antifungals and vaccines that are available.

B. normal flora species that produce new antimicrobial compounds.

C. plasma-cell and memory B-cell activation.

D. TH1 and INF-? production.

E. TNF-a and TC production.

Answer: D

Section: Importance of Barriers to Infection and the Innate Response

Difficulty: 1

Hint: Cytokine production is required for long-term immunity to fungal pathogens.

21. Which of the following is not considered to be a newly emerging infectious disease?

A. Ebola

B. Legionnaires disease (Legionella)

C. Multi-drug-resistant tuberculosis

D. SARS

E. West Nile

Answer: C

Section: Emerging and Re-emerging Infectious Diseases

Difficulty: 1

Hint: Most emerging infectious diseases are animal viruses that have managed to jump the species barrier and infect humans.

22. Re-emerging infectious diseases prevent a major problem worldwide. What actions can be taken to prevent the spread of re-emerging infectious diseases such as whooping cough (Bordetella pertussis)?

A. Create new antibiotics, antifungals, and antivirals to treat existing stains of pathogen and limit development of multi-drug resistances.

B. Ensure proper precautions during travel, especially for airborne pathogens.

C. Maintain rigorous vaccination programs for all healthy individuals.

D. Provide herd immunity during outbreaks.

E. All of the above are good preventative actions.

Answer: E

Section: Emerging and Re-emerging Infectious Diseases

Difficulty: 2

Hint: Preventing the spread of infectious disease involves proper treatment for infected individuals and vaccinations where possible for healthy individuals.

23. Vaccines are MOST readily made against:

A. bacteria because their cell walls remain relatively unchanged from generation to generation.

B. fungi because several species of fungi are commensals therefore priming the immune response to readily produce antibodies to the new vaccine.

C. helminths because they are large organisms and make for easy targets.

D. prions because they are new microbe so there is much research effort to stop prion related diseases.

E. viruses, particularly RNA viruses, because their cell receptors are unchanging and bind human cell receptors.

Answer: A

Section: Vaccines

Difficulty: 2

Hint: For a vaccine to be efficient, the vaccine's target must be something that does not readily change.

24. Modern-day vaccines try to elicit an immune response from:

A. memory B cells.

B. cytotoxic T cells.

C. hematopoietic stem cells.

D. innate immune cells.

E. naïve B cells and TH cells.

Answer: E

Section: Vaccines

Difficulty: 1

Hint: Good vaccines should activate both B and T cells.

25. Which of the following is an example of a passive immunization?

A. Antibodies against rabies given to someone who was bitten by a potentially rabid dog

B. Heat-killed flu antigen grown in chicken eggs

C. Live viral antigen given on a sugar cube to protect against polio

D. Both A and B.

E. Both B and C.

Answer: A

Section: Vaccines

Difficulty: 1

Hint: Passive immunity uses antibodies while active immunity uses antigen.

26. Which maternal antigens are protective against diseases such as diphtheria, tetanus, streptococcal infections, and measles?

A. IgA and IgE

B. IgA and IgG

C. IgD and IgE

D. IgG and IgM

E. All classes of immunoglobulins

Answer: B

Section: Vaccines

Difficulty: 2

Hint: Certain classes of immunoglobulins are capable of crossing the placenta and may be secreted in breast milk.

27. Why does active immunity produce long-term immunity better than passive immunity?

A. Active immunity always leads to having the illness though in a milder form than an unvaccinated individual.

B. Antibodies do not produce long term immunity because they breakdown after two weeks.

C. During active immunity, antigens for the disease are presented to the immune system through classical antigen presentation mechanisms, so an active B-cell response and immunologic memory develop.

D. Long-term storage of antibodies maintains vaccine integrity however antigens cannot be stored long term.

E. Both A and B.

Answer: C

Section: Vaccines

Difficulty: 2

Hint: Developing immunologic memory is the single most important factor in vaccine design. Vaccines that do not develop memory cells are not good vaccines and will require frequent boosters.

28. Several vaccines are combination vaccines and are used to vaccinate people against two or more pathogens. One example of a combination vaccine is the TDaP vaccine (tetanus, diphtheria, pertussis). How does a combination vaccine develop immunologic memory to more than one pathogen?

A. Allergic reactions are less common with combination vaccines than with single-antigen vaccines.

B. Combination vaccines develop immunity against very similar or the same (broad spectrum) antigens.

C. Combination vaccines are more economical to produce than single vaccines.

D. Each antigen target included in the combination vaccine must be different enough so that the immune system can recognize the target antigen on the pathogen cell.

E. Similar antigens can be chemically modified so that immune system will recognize each antigen as unique.

Answer: C

Section: Vaccines

Difficulty: 1

Hint: For a vaccine to develop long-term safe immunity, the vaccine's target antigen must be specific.

29. What would happen if a person who is undergoing chemotherapy were given a live virus vaccine against polio?

A. The cancer patient would likely develop a strong immune response to the vaccine because a live viral antigen was used.

B. The cancer patient would likely develop polio because the immune system is compromised and would not be able to fight off the live virus.

C. The chemotherapy the cancer patient is receiving would inactivate the vaccine by killing the live polio virus.

D. There would be no effect, as the cancer patient does not produce a high number of immune cells for the polio virus to interact with.

E. Using a live viral antigen in a vaccine is lethal to immunocompromised people because their immune system would be overwhelmed and toxic shock would occur.

Answer: B

Section: Vaccines

Difficulty: 2

Hint: Cancer patients are immunocompromised because of their cancer treatments, long-term illness, and self-immune response.

30. What is herd immunity?

A. A global vaccination day established by the World Health Organization to ensure every person on the planet is vaccinated against a particular pathogen. The last herd immunity day was in the early 1980s with smallpox.

B. A vaccination program started by progressive nations to prevent the spread of prion diseases such as Mad Cow (BSE).

C. Herd immunity refers to a special vaccination method whereby immunocompromised individuals are given vaccines made only of antibodies.

D. Receiving all government recommended vaccines in one day. This produces the strongest immune response possible but frequently leaves the person being vaccine experience malaise (generally feeling bad) and feverish.

E. Vaccinating the majority of a population to protect immunocompromised individuals from a particular pathogen.

Answer: E

Section: Vaccines

Difficulty: 2

Hint: Herd immunity is utilized when there is insufficient vaccine available to vaccinate everyone and to protect the immunocompromised.

Chapter 18 Immunodeficiency Disorders

1. Primary immunodeficiencies:

A. are inherited.

B. are severe.

C. alter the complement pathway.

D. affect a range of cell types.

E. are contagious.

Answer: A

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: Primary means heritable in this context.

2. Primary immunodeficiencies are NOT:

A. extremely rare.

B. mostly monogenic.

C. almost always very severe.

D. useful in understanding immune function.

E. Actually, they are all of these things.

Answer: C

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: Severity depends on the gene affected.

3. Impairments of a single immunoglobulin isotype:

A. are the most common primary immunodeficiencies.

B. are generally not especially severe.

C. do not impair complement fixation.

D. Both A and B.

E. All of the above.

Answer: D

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: Antibodies are a primary means of complement fixation.

4. Primary immunodeficiencies affecting T cells tend to be more severe than those affecting B cells because:

A. T cells control the innate immune response.

B. T cells regulate antigen presentation.

C. T cells regulate the adaptive immune response.

D. T cells can trigger apoptosis.

E. None of the above.

Answer: C

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: Helper T cells activate other cell types.

5. Primary immunodeficiencies that affect B cells are often characterized by:

A. recurring bacterial infections.

B. persistent viral infections.

C. unresolved inflammatory responses.

D. All of the above.

E. None of the above.

Answer: A

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: Antibodies opsonize bacteria.

6. Impairment of T-cell function can lead to increased susceptibility to bacterial infection because:

A. T cells help fully activate B cells.

B. T cells help trigger class switching.

C. T cells help regulate antigen presentation by dendritic cells.

D. Both A and B.

E. All of the above.

Answer: D

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: T cells have minimal effects on antigen presentation.

7. Severe combined immunodeficiency (SCID):

A. is a result of the absence of macrophages or B cells.

B. affects only part of the adaptive immune response.

C. can be caused by failure of TAP transporters.

D. can be caused by failure of VDJ recombination.

E. All of the above.

Answer: D

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: Severe means no T cells or B cells in this context.

8. Severe combined immunodeficiency (SCID) can be caused by:

A. failure of VDJ recombination.

B. failure of cytokine receptors.

C. failure of T-cell receptor signaling.

D. failure of lymphoid progenitor survival.

E. All of the above.

Answer: E

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: Adenosine deaminase deficiency leads to accumulation of toxins in precursors.

9. Children born with SCID often first become infected with fungi or viruses because:

A. their T cells function well enough to handle bacterial infection.

B. maternal antibodies provide protection against bacteria for several months.

C. their macrophage function is not impaired, and it can contain bacterial pathogens.

D. complement lysis of bacteria, especially by the alternative pathway, is sufficient protection.

E. None of the above.

Answer: B

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: Antibodies cross the placenta; cells do not.

10. Deficiency in the common gamma chain of cytokine receptors is a particular severe problem because:

A. it is encoded on the X chromosome, so males are hemizygous.

B. it is used by several cytokine receptors.

C. it leads to defects in T cells, B cells, and NK cells

D. Both a and b

E. All of the above

Hint: It is more common in men than in women.

Difficulty: 1

Answer: E

Section: Primary Immunodeficiencies

Taxonomy: Understand

11. Adenosine deaminase deficiency leads to SCID, even though:

A. cells have alternate pathways to use.

B. it primarily affects dendritic cells.

C. it is only used in adults.

D. the gene is not part of the immune system.

E. None of the above.

Answer: D

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: The mutation leads to the accumulation of toxic compounds.

12. Bare lymphocyte syndrome does NOT:

A. produce a phenotype like SCID.

B. result from a defect in the TAP transporter.

C. lead to a lack of MHC class II.

D. result in a deficiency of cytotoxic T cells.

E. increase susceptibility to viral infections.

Answer: C

Section: Primary Immunodeficiencies

Difficulty: 1

Hint: TAP loads onto MHC class I.

13. Hyper Ig-M syndrome:

A. is autosomal.

B. is a result of a helper T-cell defect.

C. includes normal affinity maturation.

D. has impaired cytotoxic T-cell responses.

E. None of the above.

Answer: B

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: Ig-M accumulates because of a failure of induction of class switching.

14. X-linked agammaglobulinemia (X-LA):

A. is more common in women than men.

B. has increased Ig-G levels.

C. has increased susceptibility to fungal infections.

D. can be treated with anti-viral medication.

E. results from a B-cell signaling defect.

Answer: E

Section: Primary Immunodeficiencies

Difficulty: 2

Hint: It is also known as Bruton's hypogammaglobulinemia, with reference to Brunton's tyrosine kinase.

15. Secondary immunodeficiencies:

A. can be brought on by multiple factors.

B. can be contagious.

C. can be inherited.

D. Both A and B.

E. All of the above.

Answer: D

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: Primary immunodeficiencies are heritable.

16. Hypogammaglobulinemia differs from common variable immunodeficiency in that it:

A. is not heritable.

B. is characterized by low levels of Ig-G.

C. can be treated by IV-gamma globulin.

D. is relatively mild.

E. All of the above.

Answer: A

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: This is a secondary immunodeficiency.

17. Agent-induced immunodeficiency does NOT:

A. lead to an immunosuppressed state.

B. accompany transplant treatments.

C. come about after radiation treatment.

D. get passed on in gametes.

E. Actually, it does all of these things.

Answer: D

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: This is a broad category for secondary immunodeficiencies.

18. World wide, the most common acquired immunodeficiency:

A. is HIV/AIDS.

B. is malnutrition.

C. affects mostly T cells.

D. affects T cells and, indirectly, B cells.

E. Both A and D.

Answer: B

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: HIV is epidemic, but starvation is far more common.

19. HIV-1:

A. is a retrovirus.

B. belongs to the lentivirus family.

C. integrates as a pro-virus.

D. Both A and C.

E. All of the above.

Answer: E

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: Lentiviruses are a type of retrovirus.

20. HIV-1 and HIV-2 are very similar EXCEPT that:

A. HIV-2 progresses far more quickly.

B. HIV-2 is resident in high percentages in some populations.

C. HIV-1 is thought to have arisen from FIV, Feline Immunodeficiency Virus.

D. HIV-2 is more widespread.

E. All of the above are true, describing multiple differences between the two.

Answer: B

Section: Secondary Immunodeficiencies

Difficulty: 2

Hint: HIV-2 is persistent, found in up to 8% of some populations, without parthenogenesis.

21. HIV-1 is NOT:

A. most often transmitted by sexual contact.

B. most often transmitted by blood products.

C. able to be transmitted from mother to children during birth.

D. treatable by antiviral drugs.

E. able to progress over the course of many years.

Answer: B

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: It is classified as an STD; other transmission forms are less common.

22. Which of the following routes is thought NOT to be a major factor in HIV-1 early infection?

A. Transmission by Langerhans cells

B. Activation of local CD4+ cells

C. Transmission by macrophages

D. Transmission by dendritic cells

E. All of these are major factors.

Answer: C

Section: Secondary Immunodeficiencies

Difficulty: 2

Hint: CD4+ cells and Langerhans cells tend to be resident near the mucosa.

23. The HIV-1 pol protein encodes:

A. a protease.

B. an integrase.

C. a reverse transcriptase.

D. Both A and B.

E. All of the above.

Answer: E

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: Pol encodes three polypeptides.

24. Since reverse transcriptase is an error-prone enzyme, it follows that:

A. HIV-1 will have a high mutation rate.

B. drugs targeting HIV will affect only part of any population.

C. treatment of HIV will produce temporary results only.

D. Both A and B.

E. All of the above.

Answer: E

Section: Secondary Immunodeficiencies

Difficulty: 1

Hint: High mutation leads to a diverse population.

25. Since the gp120 protein on HIV-1 interacts with both CD4 and CCR5, it is NOT reasonable to conclude that:

A. CD4 cells will not be infected.

B. CCR5 cells will not be infected.

C. CCR5 deficiency should confer HIV-1 resistance.

D. blocking CCR5 should provide some protection.

E. blocking CD4 is a useful therapeutic approach.

Answer: E

Section: Secondary Immunodeficiencies

Difficulty: 2

Hint: Blocking cell-surface receptors could have multiple effects.

26. Multi-drug treatment of HIV-1 is preferred over single-drug treatment because:

A. the high mutation rate of HIV-1 means that many drugs are not likely to work against it.

B. multi-drug treatment places a more challenging selective pressure on the virus; to survive requires multiple mutations.

C. protecting itself against one drug makes the virus less able to protect itself against the others.

D. the drugs work synergistically with each other.

E. one drug makes the virus more susceptible to the others.

Answer: B

Section: Secondary Immunodeficiencies

Difficulty: 3

Hint: Multiple drugs target multiple genes.

Chapter 19 Cancer and the Immune System

55. The major difference between benign and malignant tumors is that:

a) benign tumors are capable of metastasis.

b) malignant tumors do not invade surrounding tissue.

c) benign tumors are not neoplasms.

d) malignant tumors are capable of uncontrolled growth.

e) All of the above.

Answer: D

Section: Terminology and Common Types of Cancer

Difficulty: 1

Hint: Benign means harmless; malignant means harmful.

56. The MOST common kind of cancers are carcinomas, which:

a) are derived from epithelial tissue.

b) include breast and colon cancer.

c) include leukemia.

d) Both a and b

e) All of the above

Answer: C

Section: Terminology and Common Types of Cancer

Difficulty: 1

Hint: Leukemia is not a carcinoma.

57. Metastasis is NOT which of the following?

a) A property of benign tumors

b) Invasion of new sites by tumor cells

c) The production of secondary tumors

d) A property of malignant tumors

e) Extremely dangerous

Answer: A

Section: Terminology and Common Types of Cancer

Difficulty: 1

Hint: Dislodging and invasion are very dangerous.

58. Hematopoietic tumors include all but which of the following?

a) Lung cancer

b) Leukemia

c) Lymphoma

d) Myeloma

e) These are all hematopoietic tumors.

Answer: A

Section: Terminology and Common Types of Cancer

Difficulty: 2

Hint: Lung cancer is a carcinoma.

59. While leukemias used to be defined according to speed of onset, now they are defined as:

a) acute and chronic, where chronic is longer lasting.

b) acute and chronic, where chronic involves less mature cells.

c) acute and chronic, where chronic involves more mature cells.

d) lymphocytic or myelogenous, where lymphocytic involves lymphocytes.

e) lymphocytic or myelogenous, where lymphocytic involves any white blood cell.

Answer: C

Section: Terminology and Common Types of Cancer

Difficulty: 2

Hint: Acute leukemias are derived from immature cells.

60. Malignant transformation of cells usually means that they:

a) grow in a density independent fashion.

b) have reduced dependence on growth factors.

c) are not anchorage dependent.

d) Both A and B.

e) All of the above.

Answer: E

Section: Malignant Transformation of Cells

Difficulty: 1

Hint: Consider the normal requirements for growth of cells; malignant cells obviate almost all of those.

61. Carcinogens are NOT:

a) agents that induce DNA mutations.

b) agents that induce transformation.

c) energy such as ionizing radiation.

d) viruses such as Epstein-Barr virus.

e) chemicals such as formaldehyde.

Answer: D

Section: Malignant Transformation of Cells

Difficulty: 1

Hint: Carcinogens are abiotic factors.

62. Oncogenes:

a) were originally discovered in viruses.

b) have been found to be normal parts of cellular function.

c) often regulate cell growth.

d) are mutated or disregulated in cancer.

e) All of the above.

Answer: E

Section: Malignant Transformation of Cells

Difficulty: 1

Hint: Rous sarcoma virus was the first agent found to cause cancer.

63. Tumor-suppressor genes are NOT:

a) normally regulating cell growth.

b) called anti-oncogenes.

c) causes of cancer when they become inactive.

d) causes of cancer when they become activated.

e) Both A and C.

Answer: D

Section: Malignant Transformation of Cells

Difficulty: 2

Hint: The normal function of tumor suppressors is to restrict cell division.

64. Hallmarks of tumor transformation include all of the following EXCEPT:

a) growth-factor independence.

b) dependence of tumor suppressors.

c) angiogenesis.

d) evasion of apoptotic signals.

e) All of these are hallmarks of tumor transformation.

Answer: C

Section: Malignant Transformation of Cells

Difficulty: 2

Hint: Angiogenesis and evasion of apoptosis are both necessary.

65. Most tumor antigens:

a) are products of viruses.

b) target the tumor for immune recognition.

c) are not recognized as self antigens.

d) are oncogene products.

e) Both B and C.

Answer: D

Section: Tumor Antigens

Difficulty: 2

Hint: Tumors are self tissues.

66. T cells can recognize tumor antigens from each of the following classes, EXCEPT for:

a) antigens encoded by genes exclusively expressed by tumors (e.g., viral genes).

b) antigens encoded by variant forms of normal genes that are altered by mutation.

c) antigens that are expressed at lower than normal levels.

d) antigens normally expressed only at certain stages of development.

e) antigens that are overexpressed in particular tumors.

Answer: C

Section: Tumor Antigens

Difficulty: 1

Hint: T-cell recognition depends on protein production, not its absence or reduction.

67. Tumor-specific antigens:

a) trigger T-cell killing of the tumor.

b) can be difficult to identify.

c) are strongly selected against by the immune system.

d) Both A and B.

e) All of the above.

Answer: E

Section: Tumor Antigens

Difficulty: 1

Hint: If the tumor cells are killed, what survives are those that are not targeted.

68. Tumor-associated antigens:

a) are not normal cellular proteins.

b) are viral proteins.

c) have abnormal expression patterns.

d) Both A and B.

e) All of the above

Answer: C

Section: Tumor Antigens

Difficulty: 2

Hint: These are up-regulated genes.

69. Alpha-feto protein (AFP) is:

a) normally expressed by embryos.

b) normal for pregnant women.

c) expressed aberrantly by some cancers.

d) Both A and C.

e) All of the above.

Answer: E

Section: Tumor Antigens

Difficulty: 1

Hint: Liver cancer can express AFP.

70. The immune system does NOT control cancer with which of the following mechanisms?

a) Elimination of transforming viruses

b) Elimination of tumor inflammation

c) Induction of apoptosis in cancer cells

d) Induction of anergy in cancer cells

e) It uses all of these mechanisms.

Answer: D

Section: The Immune Response to Cancer

Difficulty: 1

Hint: Anergy is a mechanism of tolerance induction.

71. The theory that the immune system actively monitors and eliminates cancer cells is supported by the observation that:

a) AIDS patients have higher rates of some types of cancer than other populations.

b) transplant patients on immunosuppressive therapy have higher rates of some types of cancer than other populations.

c) patients who are deficient in adenosine deaminase and on immunosuppressive therapy have higher rates of some types of cancer than other populations.

d) Both A and B.

e) All of the above.

Answer: D

Section: The Immune Response to Cancer

Difficulty: 2

Hint: ADA deficiency has not yet been linked to cancer.

72. Immunoediting does NOT:

a) lead to more aggressive tumors by natural selection.

b) lead to elimination of tumor cells.

c) consist of elimination, equilibrium, and escape.

d) extend over a period of several to many years.

e) Actually, it does all of these.

Answer: E

Section: The Immune Response to Cancer

Difficulty: 2

Hint: Elimination of some tumor cells leads to natural selection of others.

73. Variability in the immune response to cancer leads to observations that:

a) NK cells and dendritic cells can control cancer cells directly.

b) NK cells and dendritic cells can activate a helper T-cell response to control cancer.

c) NK cells and dendritic cells can activate a cytotoxic T-cell response to control cancer.

d) Th17 cells can activate a response to control cancer.

e) All of the above.

Answer: C

Section: The Immune Response to Cancer

Difficulty: 2

Hint: Cancer cells have to evade induction of apoptosis.

74. A key role for natural killer cells in controlling cancer is NOT supported by the:

a) observation that NK-deficient mice have higher than normal rates of sarcoma development.

b) observation that NK cells can kill cancer cells in vitro.

c) observation that many tumors down-regulate MHC genes, including NK receptors.

d) observation that cellular stress up-regulates many NK receptors.

e) All of these support the role.

Answer: D

Section: The Immune Response to Cancer

Difficulty: 2

Hint: NK cells kill targets that lack the appropriate signal molecules.

75. Responses of the immune system that can promote cancer include all of the following EXCEPT:

a) chronic inflammation.

b) inhibition of Th1 responses.

c) myeloid-derived suppressor cells (MDSCs).

d) CTL activation.

e) All of these promote cancer.

Answer: D

Section: The Immune Response to Cancer

Difficulty: 2

Hint: CTLs can control tumor growth.

76. Immunotherapy designed to target B-cell lymphoma with a monoclonal antibody is easier to administer than other immunotherapies because:

a) the lymphoma is more prone to apoptosis.

b) an anti-idiotypic monoclonal antibody won't target bystander cells.

c) the lymphoma is able to conduct class switching.

d) the lymphoma is localized to specific organs.

e) All of the above.

Answer: B

Section: Cancer Immunotherapy

Difficulty: 2

Hint: Lymphomas will have unique antigen receptors.

77. Immunotoxins work by:

a) inducing apoptosis in the target cells.

b) recruiting complement to kill the target cells.

c) delivering chemicals specifically to the target cells.

d) recruiting NK cells.

e) None of the above.

Answer: C

Section: Cancer Immunotherapy

Difficulty: 1

Hint: Toxins are chemical in nature.

78. Cytokine treatment of cancer has proven problematic because:

a) cytokines can show in vivo toxicity.

b) dosages are very hard to control properly.

c) cytokines can regulate the production of other cytokines.

d) cytokines exert effects on a large number of target cells.

e) All of the above.

Answer: E

Section: Cancer Immunotherapy

Difficulty: 1

Hint: Cytokines are great when applied to specific target cells; therapeutic use isn't like that.

79. The use of tumor-specific T cells re-introduced to patients requires all of the following EXCEPT:

a) tumor-specific cells being isolated.

b) tumor-specific cells being activated in order to overcome tumor-induced anergy.

c) the patient being lymphodepleted to facilitate re-introduction.

d) tumor-specific cells being depleted of autoreactive clones.

e) All of these steps are required.

Answer: D

Section: Cancer Immunotherapy

Difficulty: 2

Hint: Tumors can survive by inducing anergy in responsive cells.

80. Manipulation of costimulatory signals has potential to treat tumors because:

a) tumors that do not provide costimulation induce anergy instead.

b) it is relatively easy to isolate and introduce genes to tumor cells.

c) modified tumors with increased costimulatory activity can be reintroduced to patients.

d) blockage of CTLA-4 on tumors will increase T-cell activation.

e) All of the above.

Answer: E

Section: Cancer Immunotherapy

Difficulty: 2

Hint: In order to survive, tumors have to down-modulate positive costimulation, or up-regulate negative costimulation.

Chapter 20 Experimental Systems and Methods

81. Polyclonal antibodies differ from monoclonal antibodies in all ways EXCEPT which of the following:

a) They generally have fewer cross-reactivities.

b) They are generally better for immunoprecipitation.

c) They generally have lower affinity.

d) They can vary from preparation to preparation.

e) They differ in all of these ways.

Answer: A

Section: Antibody Generation

Difficulty: 2

Hint: Polyclonal antibodies are produced by a variety of individual B-cells.

82. Monoclonal antibodies make excellent research tools because:

a) as products of a single B cell, they all have the same specificity.

b) their specificity is stable over time.

c) their cross-reactivity can be well characterized.

d) they are produced by transformed cells and therefore can be produced in large quantities.

e) All of the above.

Answer: E

Section: Antibody Generation

Difficulty: 1

Hint: Monoclonals are produced by fusing B cells with immortalized cell lines, then selecting for individual clones.

83. Immunoprecipitation does NOT:

a) allow characterization of molecules bound to cells.

b) take place in gel matrices.

c) work well in solution.

d) require the use of a monoclonal antibody.

e) Actually, it does all of the above.

Answer: D

Section: Immunoprecipitation- and Agglutination-Based Techniques

Difficulty: 2

Hint: Immunoprecipitation is the use of an antibody or antibodies to bind to their target for further manipulation.

84. Immunoprecipitation can be used:

a) with Western blotting to assess its efficiency.

b) with Western blotting to determine protein abundance.

c) with secondary antibodies to ascertain protein-protein interactions.

d) to purify proteins.

e) All of the above.

Answer: E

Section: Immunoprecipitation- and Agglutination-Based Techniques

Difficulty: 1

Hint: Immunoprecipitation has an enormous range of applications.

85. All of the following concerning agglutination reactions are true EXCEPT:

a) they are used only with red blood cells.

b) they only detect molecules on the surface of cells.

c) they require a high degree of expertise to interpret.

d) they should be done with titrations of antibodies.

e) All of the above are true.

Answer: C

Section: Agglutination Reactions

Difficulty: 2

Hint: This is probably the most common immunoassay preformed worldwide.

86. Hemagglutination inhibition reactions are used to detect:

a) responses to bacteria.

b) responses to viruses.

c) proteins on the surface of red blood cells.

d) Both A and B.

e) All of the above.

Answer: B

Section: Agglutination Reactions

Difficulty: 2

Hint: Influenza viruses can induce pathogenesis by triggering hemagglutination.

87. ELISPOT assays:

a) are modifications of Western blotting.

b) are used to detect individual cells.

c) involve the use of “capture” antibodies.

d) Both B and C.

e) All of the above.

Answer: D

Section: Antibody Assays Based on Antigen Binding to Solid Phase Supports

Difficulty: 1

Hint: ELISPOTs work by coating surfaces with primary antibodies, then letting cells settle onto the surface.

88. Design of an effective ELISA can be challenging because:

a) different detection systems have sensitivity that ranges over five orders of magnitude.

b) the number of replicates required for any ELISA is quite high.

c) the anticipated concentration of targets must be estimated in order to determine the sensitivity required of the assay.

d) signal amplification by the assay conditions can impair interpretations.

e) All of the above.

Answer: C

Section: Antibody Assays Based on Antigen Binding to Solid Phase Supports

Difficulty: 3

Hint: One of the most highly variable factors is the amount of target to be measured.

89. Which of the following does NOT describe equilibrium dialysis?

a) It is used to quantitate binding between antibody and antigen.

b) It depends on the ligand being able to cross a semi-permeable membrane.

c) It measures the amount of antibody bound ligand compared to unbound ligand.

d) It requires an enzyme-amplification step.

e) All of the above describe equilibrium dialysis.

Answer: D

Section: Methods to Determine the Affinity of Antigen:Antibody Interactions

Difficulty: 2

Hint: Equilibrium dialysis is not a form of ELISA.

90. Surface plasmon resonance:

a) is a relatively recently developed technique.

b) depends on the molecules close to a reflective surface.

c) requires that both binding and dissociation be evaluated.

d) Both A and C.

e) All of the above.

Answer: E

Section: Methods to Determine the Affinity of Antigen:Antibody Interactions

Difficulty: 1

Hint: Dissociation can only be assessed after saturation in binding occurs.

91. Immunohistochemistry and immunocytochemistry do NOT share which of the following characteristics?

a) Use of antibodies to recognize specific targets

b) Use of enzymes to amplify the signal

c) Use of irrelevant proteins, such as milk, to reduce non-specific binding

d) Use of detergent to permeabilize the membrane

e) They do share all of these characteristics.

Answer: D

Section: Microscopic Visualization of Cells and Subcellular Structures

Difficulty: 2

Hint: Sectioning of tissues sometimes breaks the cell membranes.

92. Immunohistochemistry and immunocytochemistry differ from each other in that:

a) immunocytochemistry analyzes tissue sections.

b) immunohistochemistry analyzes individual cells.

c) immunohistochemistry uses electron-gold microscopy.

d) Immunocytochemistry analyzes individual cells.

e) None of the above.

Answer: D

Section: Microscopic Visualization of Cells and Subcellular Structures

Difficulty: 2

Hint: Histology is the study of tissues.

93. Immunofluorescence-based imaging:

a) allows fine-scale visualization of subcellular localization.

b) has been enhanced by the availability of multiple dyes.

c) has been simplified by genetic engineering to tag GFP onto target proteins.

d) can take advantage of molecules that do not need antibodies to bind targets.

e) All of the above.

Answer: E

Section: Immunofluorescence-Based Imaging Techniques

Difficulty: 1

Hint: Recent technology has improved this technique in many ways.

94. Confocal microscopy improves on immunofluorescence in that it:

a) increases the resolution of the image.

b) allows construction of three-dimensional images.

c) allows detection of multiple molecules.

d) is the only technique that allows use of living cells.

e) None of the above.

Answer: B

Section: Immunofluorescence-Based Imaging Techniques

Difficulty: 1

Hint: Confocal removes the artifact of molecules being above or below the plane of imaging that is found with most microscopic techniques.

95. In flow cytometry, in addition to fluorescent markers, forward (FSC) and side (SSC) scatter are measured, and:

a) side scatter is a reflection of the size of the cell.

b) forward scatter is a measure of the amount of DNA in the cell.

c) side scatter is a measure of the amount of DNA in the cell.

d) forward scatter is a reflection of the internal complexity of the cell.

e) None of the above.

Answer: E

Section: Flow Cytometry

Difficulty: 1

Hint: DNA is measured by DNA specific dyes.

96. Intracellular staining is a major advance in cell sorting that:

a) requires permeabilization of the cell membrane.

b) allows detection of molecules inside the cell instead of simply at the cell surface.

c) allows sub-cellular localization of molecules.

d) Both A and B.

e) All of the above.

Answer: D

Section: Flow Cytometry

Difficulty: 1

Hint: Immunocytochemistry allows visualization inside cells.

97. The major distinction between FACS and MACS is that:

a) MACS is not as precise as FACS.

b) MACS does not use a fluorescent marker.

c) MACS can be used with living cells.

d) MACS can be used for intracellular staining.

e) All of the above.

Answer: B

Section: Magnetic Activated Cell Sorting

Difficulty: 1

Hint: FACS stands for fluorescence-activated cell sorting.

98. You might want to use MACS instead of FACS if you:

a) have a very small number of cells to sort.

b) are working with cells that are especially fragile.

c) are working with a very large number of cells.

d) need a very high degree of accuracy.

e) are using multiple antibodies.

Answer: C

Section: Magnetic Activated Cell Sorting

Difficulty: 1

Hint: FACS sorts cells one at a time.

99. Which of the following is TRUE regarding propidium iodide and cell cycle analysis?

a) Apoptotic cells will have more DNA than normal G1 content.

b) S-phase cells will have the same DNA content as G1 cells.

c) G2 cells will have more DNA than normal G1 cells.

d) M cells will have the same DNA content as normal G1 cells.

e) All of the above.

Answer: C

Section: Cell Cycle Analysis

Difficulty: 1

Hint: S is the phase during which DNA replication takes place.

100. Carboxyfluorescein succinimidyl ester (CFSE) can be used to track cell division because:

a) after pulsing the cells with it, dividing cells will incorporate more into their DNA.

b) after pulsing cells with it, dividing cells will incorporate more into their proteins.

c) its intensity is cut in half, approximately, when DNA replicates.

d) its intensity is cut in half, approximately, when the cell divides.

e) None of the above.

Answer: D

Section: Cell Cycle Analysis

Difficulty: 2

Hint: CFSE labels proteins.

101. In chromium release assays, or more recently in CFSE release assays, cells that die release the marker if they:

a) die by apoptosis only.

b) die by necrosis only.

c) die by either apoptosis or necrosis.

d) divide before dying.

e) replicate DNA before dying.

Answer: C

Section: Assays of Cell Death

Difficulty: 2

Hint: Cell death eliminates membrane integrity.

102. Annexin-V staining of cells identifies:

a) a failure of membrane integrity.

b) broken ends of chromosomes produced during DNA fragmentation.

c) necrotic but not apoptotic cells.

d) both apoptotic and necrotic cells.

e) a breakdown of membrane asymmetry.

Answer: E

Section: Assays of Cell Death

Difficulty: 2

Hint: Annexin-V binds the membrane lipid phosphatidyl-serine.

103. The use of inhibitors to analyze signaling pathways carries the caveat that:

a) application of the signaling molecule must precede application of the inhibitor.

b) application of the inhibitor must precede application of the signaling molecule.

c) inhibition of signal transduction applies in both simple and complex pathways.

d) inhibitor specificity needs to be known precisely.

e) None of the above.

Answer: D

Section: Biochemical Approaches Used to Elucidate Signal Transduction Pathways

Difficulty: 2

Hint: Inhibitors initially developed for the Erk1 transcription factor are now known to also inhibit Erk5.

104. Identification of proteins that interact with a target molecule can be done by all but which of the following mechanisms?

a) Electorphoretic mobility shift assay (EMSA)

b) Co-immunoprecipitation

c) Western blot analysis

d) Micro-sequencing

e) Yeast two hybrid system

Answer: A

Section: Biochemical Approaches Used to Elucidate Signal Transduction Pathways

Difficulty: 2

Hint: EMSA is used to identify DNA binding by proteins.

105. The use of inbred lines of mice:

a) reduces genetic heterogeneity.

b) reduces experimental variables.

c) increases similarity between individuals.

d) leads to syngeneic animals.

e) All of the above.

Answer: E

Section: Whole Animal Experimental Systems

Difficulty: 1

Hint: Syngeneic means sharing genes.

106. Congenic strains are NOT:

a) identical genetically at almost all loci.

b) distinct at only one locus.

c) useful for adoptive transfer experiments.

d) equivalent to identical twins.

e) congenics are all of these things.

Answer: D

Section: Whole Animal Experimental Systems

Difficulty: 2

Hint: Congenics avoid the problem of tissue rejection.