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Name: _____ Class: _____ Date: _____

Chapter 02

1. Imagine that you are a thymocyte that has just entered the thymus. Assuming you will survive positive and negative selection, what changes will you experience before developing in a naïve $CD4^+$ T cell?

ANSWER: The thymocyte would change from a DN cell, to a DP cell, to an SP cell. In this case the SP cell would contain CD4 on the surface but not CD8.

2. Name three parts of the human body where you would expect to find secondary lymphoid tissues.

ANSWER: More than three answers are possible. Correct answers would include areas of the body most directly exposed to potential, outside pathogens, including the skin, the lungs, the upper respiratory tract, the small intestine, and the large intestine.

3. In your own words, explain how an NKT cell displays properties of both innate and adaptive immunity.

ANSWER: NKT cells have TCRs, yet also express surface markers associated with innate immunity. NKT cells do not require antigen presentation for activity. NKT TCRs are not diverse.

4. Plasma cells can secrete thousands of antibodies per second. Based on this observation, name two organelles that you might expect to find in abundance within an active plasma cell.

ANSWER: An abundance of Golgi and endoplasmic reticulum would be anticipated, allowing for efficient production of secreted antibodies.

5. What important role do antibodies play in the isolation of HSCs from the bone marrow?

ANSWER: Antibodies can be used to eliminate bone marrow cells that express surface molecules not expressed by HSCs. Antibodies can also be used to select for bone marrow cells that express HSCs-associated molecular markers.

6. A graduate student observes a strain of mice that are impaired in their ability to combat parasitic worms. Given this observation, which arm of hematopoiesis is MOST likely deficient in this strain?

ANSWER: The myeloid arm of hematopoiesis. The myeloid branch gives rise to innate cells specialized in the defense against parasitic worms including eosinophils and basophils.

7. In addition to the bone marrow, HSCs have been observed to occur within the blood. How has this observation improved the procedures used to transplant HSCs from donors to recipients that are bone marrow deficient?

ANSWER: In some cases, it is now possible to obtain HSCs directly from blood draws from donors; as opposed to bone marrow aspirations, which are painful and require anesthesia.

8. Can you think of two cellular activities occurring within a swelling lymph node that has been exposed to antigen from a pathogen?

ANSWER: Immune cells are actively migrating into the lymph node, and T and B cells within the node are proliferating via clonal selection and expansion. Collectively, these activities are contributing to swelling.

9. Beyond structural differences, name functional differences between a lymph node and the spleen.

ANSWER: Two major functional differences exist when comparing the spleen to a lymph node. First, the spleen primarily reacts to antigens present in the blood, whereas lymph nodes react to lymph-borne antigens. Second, the spleen has well-defined functions not directly related to mounting an immune

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response including being a site where old and defective red blood cells are eliminated.

10. You have discovered a potentially new leukocyte that appears to share a common progenitor with $CD8^+$ T cells, lack antigen-specific receptors, do not participate in antigen presentation, and have a capacity for ADCC. Using knowledge of hematopoiesis, which cell type MOST closely resembles the potentially new leukocyte?

ANSWER: Innate lymphoid cells, which arise from lymphoid progenitors. ILCs lack antigen-specific receptors, but can participate in ADCC via the expression of Fc receptors.

11. 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 answers are correct.

ANSWER: b

12. If a human were unable to produce lymphoid progenitor cells, predict which part of the immune system would be MOST greatly impacted?

a. Innate immunity
b. Adaptive immunity
c. Both innate and adaptive would be equally impacted
d. Neither innate nor adaptive immunity would be impacted
e. None of the answers would be impacted.

ANSWER: b

13. 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 answers are correct.
e. None of the answers are correct.

ANSWER: a

14. 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 answers are correct.

ANSWER: d

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15. From which of the following stem cells are NK cells derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP are correct.
    e. None of the answers are correct.

ANSWER: a

16. Which cell can differentiate into the GREATEST variety of cells during hematopoiesis?
    a. B-cell progenitor
    b. Basophil progenitor
    c. T-cell progenitor
    d. Eosinophil progenitor
    e. Myeloid progenitor

ANSWER: e

17. Using a light microscope, you observe a human blood smear. Among the abundance of erythrocytes, you note a leukocyte that appears to contain a multilobed nucleus. What is the MOST likely identity of the observed leukocyte?
    a. T lymphocyte
    b. B lymphocyte
    c. Neutrophil
    d. Eosinophil
    e. Both Neutrophil and eosinophil are equally likely.

ANSWER: e

18. From which of the following stem cells are DCs derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

ANSWER: d

19. From which of the following stem cells are platelets derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

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ANSWER: c

20. From which of the following stem cells are eosinophils derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

ANSWER: b

21. From which of the following stem cells are helper T cells (T_H) derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

ANSWER: a

22. From which of the following stem cells are monocytes derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

ANSWER: b

23. From which of the following stem cells are RBCs derived?
    a. CLP
    b. CMP
    c. CEP
    d. Both CLP and CMP.
    e. None of the answers are correct.

ANSWER: c

24. 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 answers are correct.

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ANSWER: b

25. Which lineage of immune cells constitutes the first line of defense against an infection?
    a. Lymphoid
    b. Erythroid
    c. Myeloid
    d. All of the answers are correct.
    e. None of the answers are correct.

ANSWER: c

26. You have consumed a salad contaminated with *Salmonella enterica*, which typically causes a self-limiting, gastrointestinal disease in humans. Based on this information, which immune organ is MOST likely to first recognize and mount a response against the pathogen?
    a. Spleen
    b. SALT
    c. Thymus
    d. GALT
    e. Lymph node

ANSWER: d

27. Which properties listed below are shared by both naïve B cells and mature T cells?
    a. Are derived from lymphoid progenitor cells
    b. Are considered lymphocytes
    c. Contain membrane-bound antigen receptors
    d. All of the answers are correct.
    e. None of the answers are correct.

ANSWER: e

28. 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 answers are descended from the common lymphoid progenitor.

ANSWER: d

29. Which of the following granulocytes contains histamine within its granules?
    a. Neutrophils
    b. Eosinophils
    c. Basophils

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d. Both Eosinophils and Basophils
e. All of the answers are correct.

ANSWER: c

30. 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 answers are true.

ANSWER: d

31. Which of the following cell types is responsible for the secretion of immunoglobulins?
a. T_H1
b. T_H2
c. T_H17
d. T_{FH}
e. Plasma cell

ANSWER: e

32. Which of the following cell types is responsible for regulating responses against intracellular pathogens?
a. T_H1
b. T_H2
c. T_H17
d. T_{FH}
e. Plasma cell

ANSWER: a

33. Which of the following cell types is responsible for activating B cells in germinal centers?
a. T_H1
b. T_H2
c. T_H17
d. T_{FH}
e. Plasma cell

ANSWER: d

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

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a. T_H1
b. T_H2
c. T_H17
d. T_{FH}
e. Plasma cell

ANSWER: b

35. Which of the following cell types secretes IL-17 and may play a role in antifungal responses?

a. T_H1
b. T_H2
c. T_H17
d. T_{FH}
e. Plasma cell

ANSWER: c

36. 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. T_H1
c. T_H2
d. T_H17
e. None of the answers are correct.

ANSWER: a

37. 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. T_H1
b. T_{REG}
c. T_H2
d. T_H17
e. None of the answers are correct.

ANSWER: b

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

a. T cells
b. NK cells
c. B cells

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d. Plasma cells
e. All of the answers are correct.

ANSWER: b

39. Which of the following is NOT considered primary lymphoid tissue?
a. Draining lymph node
b. Thymus
c. Peyer's patch
d. Neither draining lymph node nor Peyer's patch are primary lymphoid tissue.
e. None of the answers are primary lymphoid tissue.

ANSWER: d

40. In mammals, T-cell development occurs in the _____, whereas 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 answers are correct.

ANSWER: d

41. 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 answers are correct.

ANSWER: c

42. Upon entering the thymus, thymocytes are classified as double _____ with regard to coreceptors; 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 "positive; negative" and "negative; positive" are correct.
d. Neither "positive; negative" nor "negative; positive" are correct.
e. Coreceptor expression state does not change in the thymus.

ANSWER: b

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

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a. Cardiac
b. Skeletal
c. Smooth
d. Both skeletal and smooth are correct.
e. None of the answers are correct.

ANSWER: d

44. Naïve lymphocytes enter secondary lymphoid tissues via which of the following structures?
a. Afferent lymphatics
b. Efferent lymphatics
c. HEVs
d. Marginal sinus
e. None of the answers are correct.

ANSWER: c

45. 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 answers utilizes the FRCC system.

ANSWER: a

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