Chapter 10 The Cardiovascular System—Blood

OVERVIEW

The purpose of this chapter is to teach the anatomy and physiology of the cardiovascular system concerning blood. At the latter part of the chapter, there are select disorders of the blood discussed.

The cardiovascular system has been divided into two chapters: Chapter 10 on blood, and Chapter 11 on the heart and vessels. The functions for this system are explained in this chapter as they relate to blood. The Putting the Pieces Together feature is placed in Chapter 11.

Blood typing is usually a difficult topic for students to understand. It is important that they differentiate between antibody and antigen, and understand that a donor's antigens must survive a recipient's antibodies. A group activity to give them practice determining compatibilities is listed under Individual Outcome 10.15.

This chapter offers an opportunity to discuss sex-linked disorders outlined in an Applied Genetics feature on hemophilia. A discussion of the treatment for this disorder is listed under Individual Outcome 10.19, which leads to a group activity on the blood banking system.

No introductory A&P student is capable of diagnosing patients; however, case study questions do help students apply critical thinking skills to see the connections between anatomy and physiology. A group activity under Individual Outcome 10.19 gives each group of students four sets of patient blood lab results to evaluate.

Chapter figures can be found in the Online Learning Center (OLC). Discussion points, group activities, and quizzes listed in the summary table below are explained under their individual outcomes following the table. Answer keys to the text chapter review questions, workbook concept maps, and workbook review questions are located at the end of the chapter.

A review guide is also available on the OLC. This guide lists all of the learning outcomes for the chapter and gives space for students to take notes and make sketches. This can be an important tool to encourage students to pay attention to what they are learning and to use to either take initial notes or to organize their existing notes before exams.

COMPETENCY CORRELATION GRID

Learning Outcome	CAAHEP Competencies	ABHES Competencies
10.1 Use medical terminology related to the cardiovascular system.	I.C.1. Describe structural organization of the human body	3.a. Define and use entire basic structure of medical words and be able to accurately identify in the correct context, i.e., root, prefix, suffix, combinations, spelling and definitions
10.2 Identify the components of blood.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.3 List the constituents of plasma and their functions.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.4 Identify the formed elements and list their functions.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.5 Compare the various forms of hemopoiesis in terms of starting cell, factors influencing production, location, and final product.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.6 Describe the structure and function of hemoglobin.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.7 Summarize the nutritional requirements of red blood cell production.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.8 Describe the life cycle of a red blood cell from its formation to removal.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.9 Describe the body's mechanisms for controlling bleeding.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.10 Describe two pathways for blood clotting in terms of what starts each, their relative speed, and the clotting factors involved.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

10.11 Describe what happens to blood clots when they are no longer needed.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.12 Explain what keeps blood from clotting in the absence of injury.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.13 Explain what determines ABO and Rh blood types.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.14 Explain how a blood type relates to transfusion compatibility.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.15 Determine, from a blood type, the antigens and antibodies present and the transfusion compatibility.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.16 Predict the compatibility between mother and fetus given Rh blood types for both and describe the possible effects.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.17 Summarize the functions of blood by giving an example or explanation of each.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.18 Describe common diagnostic blood tests and explain what can be learned from them.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
10.19 Describe disorders of the cardiovascular system concerning blood and relate abnormal function to pathology.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

SUMMARY TABLE 10

LEARNING OUTCOME	LECTURE OUTLINE	ACTIVITIES – TALKING POINTS	ASSIGNMENTS/ ASSESSMENTS

10.1 Use medical terminology related to the cardiovascular system.		***WkBk Word Roots and Combining Forms***	***WkBk Review Questions:*** • Word Deconstruction: 1-5
10.2 Identify the components of blood.	I. Overview II. Anatomy of blood **Chapter Figure:** 10.2 (Composition of blood)	***WkBk Concept Maps:*** Figure 10.6 (Blood composition concept map)	***Spot Check:*** 1, 3 ***WkBk Review Questions:*** • MS: 7
10.3 List the constituents of plasma and their functions.	A. Plasma 1. Albumins 2. Globulins 3. Fibrinogen and clotting factors 4. Ions 5. Nutrients 6. Waste products 7. Gases 8. Regulatory substances **Chapter Figure:** 10.2 (Composition of blood)		***Spot Check:*** 2 ***WkBk Review Questions:*** • Matching: 1-5
10.4 Identify the formed elements and list their functions.	B. Formed elements 1. Erythrocytes 2. Leukocytes a. Neutrophils	***WkBk Coloring Book:*** Figure 10.1 (Formed elements) **Talking point:** When you put whole blood into a	***Spot Check:*** 3-5 **Quiz:** 1 (Covers LOs 10.2- 10.4 See Individual Outcome 10.4)

	b. Basophils c. Eosinophils d. Monocytes e. Lymphocytes 3. Thrombocytes **Chapter Figures:** 10.2 (Composition of blood) 10.3 (Hemopoiesis) **Chapter Table:** 10.1 (Formed elements)	test tube and let it sit for a while, the more dense components will settle toward the bottom, thus creating 3 distinct layers: plasma, leukocytes, and erythrocytes. ***WkBk Lab Exercises and Activities:*** • Blood cell identification Figures: 10.2-10.5	Figure IMQ 10.1 ***WkBk Review Questions:*** • MS: 8
10.5 Compare the various forms of hemopoiesis in terms of starting cell, factors influencing production, location, and final product.	III. Physiology of blood A. Hemopoiesis 1. Thrombopoiesis 2. Leukopoiesis 3. Erythropoiesis a. high altitude b. exercise c. exposure to carbon monoxide d. blood loss **Chapter Figures:** 10.3 (Hemopoiesis) 10.4 (Negative-feedback correction to hypoxemia)	**Discussion Point:** Chemotherapy. (See Individual Outcome 10.5) ***WkBk Lab Exercises and Activities:*** • Blood doping ***WkBk Concept Maps:*** Figure 10.7 (Hemopoiesis concept map) **Talking Point:** "Poiesis" is a suffix that means "the formation of."	***Spot Check:*** 6, 7 **Quiz: 2** (Covers LO 10.5 See Individual Outcome 10.5)\Figure IMQ 10.2 ***WkBk Review Questions:*** • MS: 9

10.6 Describe the structure and function of hemoglobin.	i. Hemoglobin **Chapter Figures:** 10.5 (Hemoglobin molecule composed of four amino acid chains) 10.6 (Sickle cell disease)	**Talking Point:** The standard abbreviation for hemoglobin is Hb or Hgb. Be sure students do not write Hg (mercury).	***WkBk Review Questions:*** • MS: 10
10.7 Summarize the nutritional requirements of red blood cell production.	ii. Nutritional requirements for erythropoiesis (a) Folic acid (b) Vitamin B-12 (c) Copper (d) Vitamin C	**Talking Point:** Have students research the role of vitamin B-12 and folic acid in RBC formation.	***WkBk Review Questions:*** • Matching: 6-9
10.8 Describe the life cycle of a red blood cell from its formation to removal.	B. Life cycle of a red blood cell **Chapter Figure:** 10.7 (The breakdown of hemoglobin by the liver and spleen)	**Talking Point:** Be sure to discuss why excess bilirubin could be found in the blood of alcoholics and premature babies.	***Spot Check:*** 8 ***WkBk Review Questions:*** • MS: 3
10.9 Describe the body's mechanisms for controlling bleeding.	C. Hemostasis 1. Vascular spasm 2. Platelet plug formation 3. Blood clotting (coagulation) **Chapter Figure:** 10.8 (Hemostasis)	***WkBk Concept Maps:*** Figure 10.8 (Hemostasis concept map)	***Spot Check:*** 9 ***WkBk Review Questions:*** • MS: 1

10.10 Describe two pathways for blood clotting in terms of what starts each, their relative speed, and the clotting factors involved.	a. Pathways of blood clotting **Chapter Figures:** 10.9 (Pathways of coagulation) 10.10 (Blood clot)		***WkBk Review Questions:*** • Matching: 10 • Critical Thinking: 1
10.11 Describe what happens to blood clots when they are no longer needed.	b. Elimination of blood clots		***WkBk Review Questions:*** • Completion: 2
10.12 Explain what keeps blood from clotting in the absence of injury.	c. Preventing inappropriate clotting i. platelet repulsion ii. dilution iii. anticoagulants		**Quiz: 3** (Covers LOs 10.2, 10.4, 10.5, 10.8-10.12 See Individual Outcome 10.12) ***WkBk Review Questions:*** • MS: 4
10.13 Explain what determines ABO and Rh blood types.	D. Blood typing 1. Determining a blood type and transfusion compatibility **Chapter Figures:** 10.11 (Antigens and antibodies for each ABO blood type) 10.12 (Agglutination)	**Talking Point:** It is very important for the student to be able to differentiate between "antigen" and "antibody". **Talking Point:** Other terms for antigen and antibody regarding strictly blood are: agglutinogen (antigen) and agglutinin (antibody).	***Spot Check:*** 10, 11 ***WkBk Review Questions:*** • MS: 2

10.14 Explain how a blood type relates to transfusion compatibility.	**Chapter Figure:** 10.13 (ABO blood typing)	**Talking Point:** It is crucial that the student understand that a donor's antigens must survive a recipient's antibodies. In other words, make sure there are not any antibodies in the recipient's bloodstream that will be activated by the donated antigens.	***WkBk Review Questions:*** • Completion: 4, 5
10.15 Determine, from a blood type, the antigens and antibodies present and the transfusion compatibility.		**Group Activity:** Blood Typing. See Individual Outcome 10.15. ***WkBk Lab Exercises and Activities:*** • Blood typing ***WkBk* Table 10.1 (**Blood typing and transfusion compatibility) ***WkBk Concept Maps:*** Figure 10.9 (Blood typing concept map)	***Spot Check:*** 12 ***WkBk Review Questions:*** • MS: 6
10.16 Predict the compatibility between mother and fetus given Rh blood types for both and describe the possible effects.	2.Mother/fetus blood type compatibility **Chapter Figure:** 10.14 (Hemolytic disease of the newborn)		***WkBk Review Questions:*** • Completion: 1
10.17 Summarize the functions of blood by giving an example or	E. Functions of blood 1. Transportation 2. Protection		***WkBk Review Questions:*** • MS: 5

explanation of each.	3. Regulation **Chapter Figure:** 10.15 (Andre)		
10.18 Describe common diagnostic blood tests and explain what can be learned from them.	F. Diagnostic tests for blood disorders **Chapter Table:** 10.3 (Blood tests) **Chapter Figure:** 10.16 (Hematocrit)	***WkBk Lab Exercises and Activities:*** • Blood tests	***Spot Check:*** 13 ***WkBk Review Questions:*** • Critical Thinking: 2, 3
10.19 Describe disorders of the cardiovascular system concerning blood and relate abnormal function to pathology.	IV. Blood disorders A. Blood cancers 1. Acute myeloid leukemia 2. Chronic myeloid leukemia 3. Acute lymphoblastic leukemia 4. Chronic lymphoblastic leukemia 5. Primary polycythemia B. Secondary polycythemia C. Anemias 1. Inadequate erythropoiesis 2. Hemorrhagic anemia 3. Hemolytic anemia	**Talking Point:** Most students have heard of hemophilia. This is a good opportunity to discuss sex-linked diseases. (See Applied Genetics box). **Discussion Point:** Hemophilia**. (**See Individual Outcome 10.19). **Group Activity:** Blood banking. (See Individual Outcome 10.19). **Group Activity:** Blood tests. (Covers LOs 10.4, 10.18, 10.19 See Individual Outcome 10.19) ***WkBk Lab Exercises and Activities:***	**Quiz:** 3 (Covers LOs 10.9-10.14, 10.18, 10.19 See Individual Outcome 10.19) ***WkBk Review Questions:*** • Completion: 3 ***Spot Check:*** 14

	D. Clotting disorders 1. Hemophilia 2. Thrombocytopenia 3. Disseminated intravascular coagulation **Chapter Figure:** 10.17 (Leukemia) **Chapter table:** 10.4 (Summary of diseases and disorders of the blood)	• Blood doping ***WkBk Concept Maps:*** Figure 10.10 (Anemia concept map)	

INDIVIDUAL OUTCOMES

OUTCOME 10.2

Spot Check 1: Why is blood classified as a connective tissue?

Answer: It is cells in a matrix. The cells are the formed elements. The matrix is plasma.

Spot Check 3: What percentage of a single drop of blood are leukocytes?

Answer: Less than 1%.

OUTCOME 10.3

Spot Check 2: Give an example of one regulatory substance that may be found in plasma. Include where it is produced and its destination.

Answers will vary: The answer should give a hormone, the endocrine gland that produced it, and its target tissue.

OUTCOME 10.4

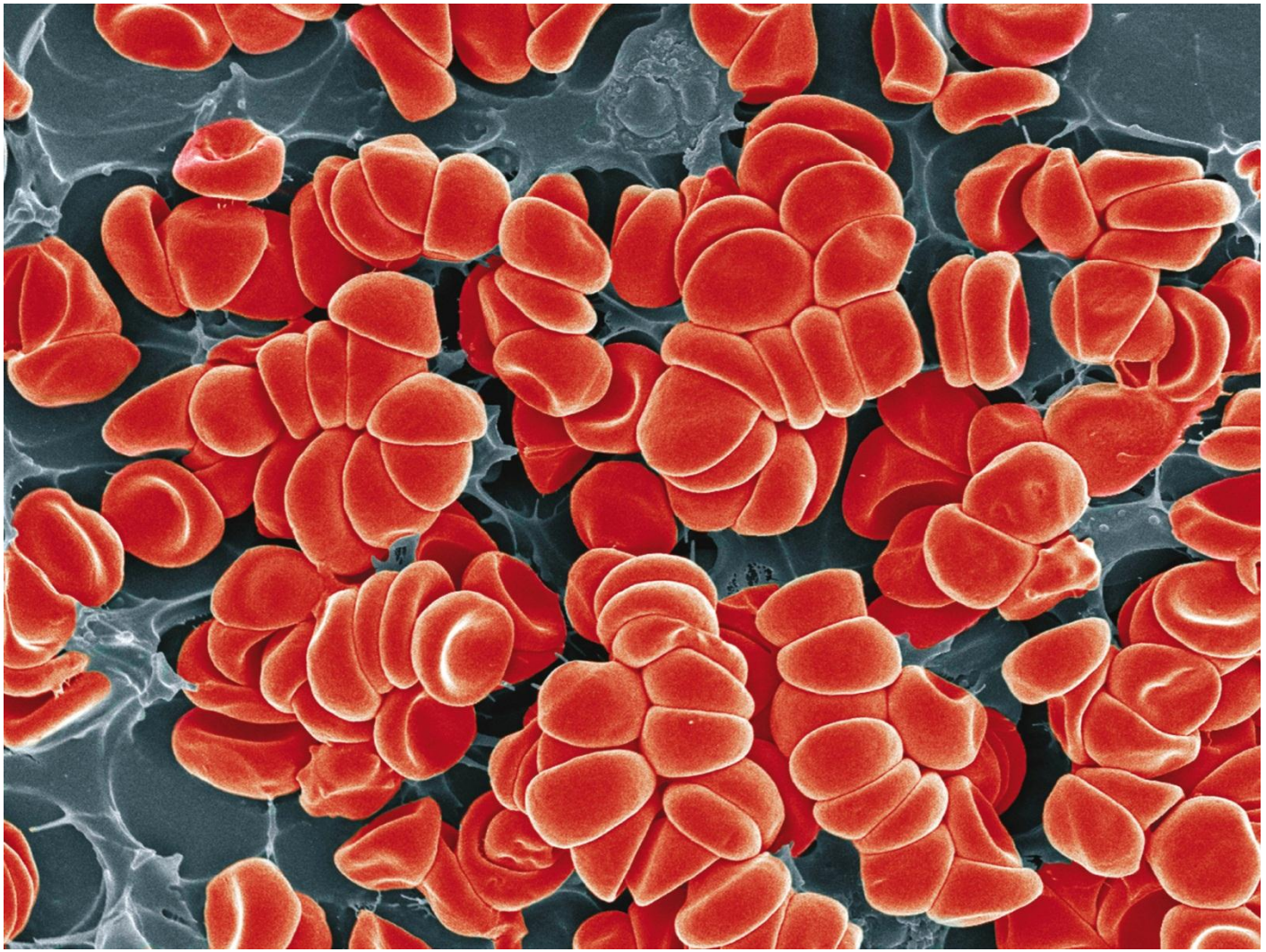
Spot Check 4: Why are WBCs not white?

Answer: They are stained so they can be seen and differentiated from one another.

Spot Check 5: Which leukocyte(s) would you expect to increase in number if you had hay fever?

Answer: Basophils and eosinophils

Quiz : 1



Use this figure to answer the following questions.

1. What is the collective name for the solids found in blood? *Formed elements*
2. Identify the two names for the red cells in this figure. *Red blood cells, erythrocytes*
3. What percentage of whole blood is composed of these red cells? *45%*
4. What is the main function of these cells? *Carry oxygen and carbon dioxide*
5. What is the fluid portion of blood called? *Plasma*
6. What percentage of whole blood is this fluid? *55%*
7. What percentage of this fluid is water? *91%*
8. List the leukocytes found in blood. *Neutrophils, basophils, eosinophils, lymphocytes, monocytes*
9. On average, how much blood is in a human body? *4 to 6 Liters*
10. What is serum? *Plasma with the clotting proteins removed*

OUTCOME 10.5

Spot Check 6: Professional basketball players train to be able to use aerobic respiration continually during a game. How would the red blood count of a Miami Heat player compare to that of a Denver Nuggets player? (*Hint:* Miami is at sea level; Denver is the "mile-high city.") Explain.

Answer: The Denver player would have a higher RBC count because of the increased altitude.

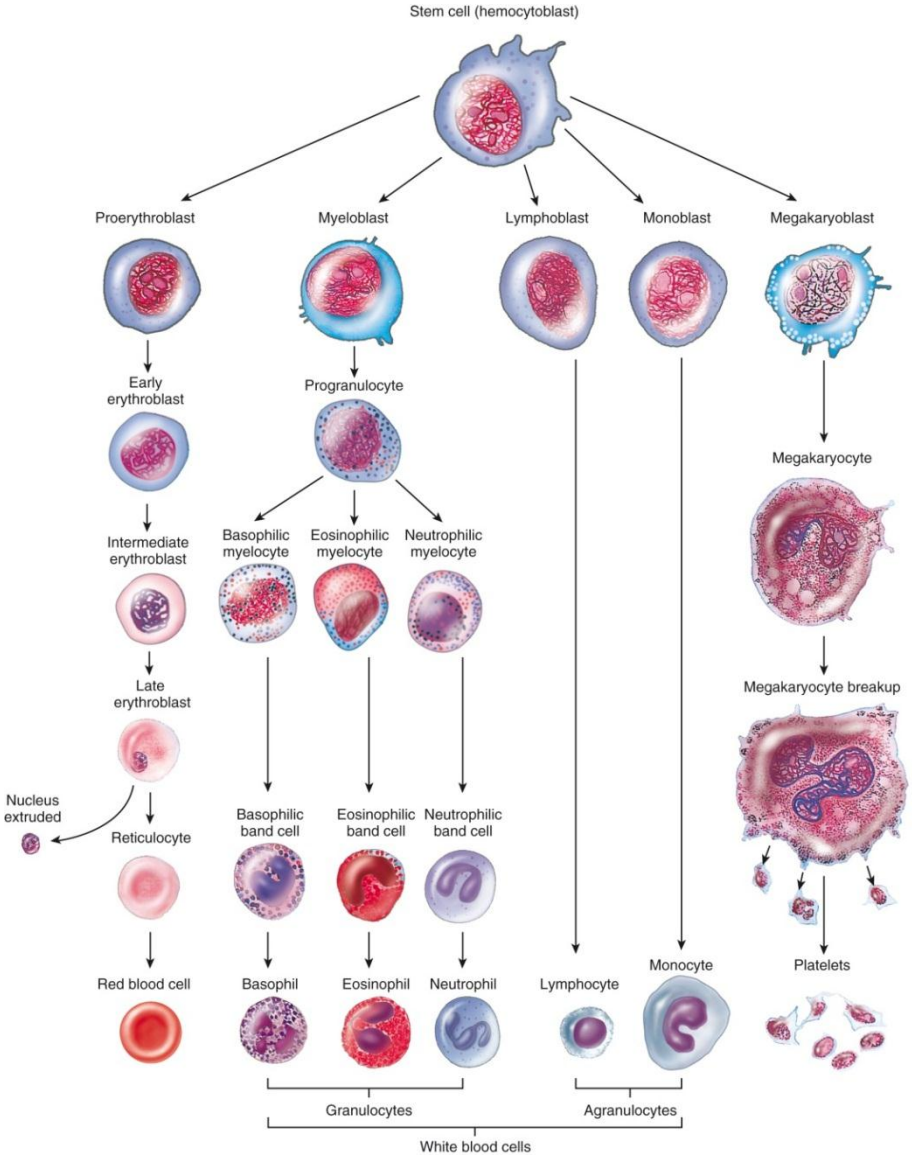
Spot Check 7: How would the red blood count of a Miami Heat player likely compare to that of a University of Miami anatomy and physiology professor? Explain.

Answer: The Miami Heat player probably has a higher RBC count because of the increased demand for oxygen due to the level of exercise of a professional athlete.

Discussion Point: Chemotherapy. Chemotherapy involves administering toxic chemicals to slow fast growing cells in order to slow or stop the growth of cancerous tumors. What effect would chemotherapy have on blood production? What would be the signs of its effects? What can be done about it?

Hemopoiesis involves the bone marrow, a very fast growing tissue. Hemopoiesis would be slowed causing reduced numbers of RBCs, WBCs, and platelets. There would be less oxygen carrying capacity (fatigue), reduced ability to fight pathogens(infections), reduced ability to clot(bruising). EPO could be given to boost erythropoiesis. (Students may have seen Procrit commercials on TV)

Quiz: 2



Use this figure to answer the following questions.

1. Where does a hemocytoblast reside? *Red bone marrow*
2. What term means the production of red blood cells? *Erythropoiesis*
3. What organ(s) stimulate(s) red blood cell production? *Kidneys*
4. What chemical is released by the organ(s) to stimulate red blood cell production? *Erythropoietin (EPO)*
5. When is this chemical released? *When the blood oxygen level is low*
6. What cells stimulate leukocyte production? *Lymphocytes and macrophages*
7. What do these cells release to stimulate leukocyte production? *Colony stimulating factors (CSFs)*
8. What is the term for platelet production? *Thrombopoiesis*
9. Where are platelets produced? *Red bone marrow*
10. What chemical is released to stimulate platelet production? *Thrombopoietin*

OUTCOME 10.8

Spot Check 8: Why can leukocytes last for decades if erythrocytes last only 110 to 120 days?

Answer: Lymphocytes spend much of their lives in tissues, not in circulation.

OUTCOME 10.9

Spot Check 9: How are platelets involved in each of the three mechanisms of hemostasis?

Answer: Platelets secrete vasoconstrictors in vascular spasm, form platelet plugs, and start the intrinsic pathway of coagulation.

OUTCOME 10.13

Spot Check 10: What antigens and antibodies would be present in a person with type-A blood? Where would the antigens and antibodies be located?

Answer: A type A person would have A antigens on the surface of the blood cells and Anti-B antibodies dissolved in plasma.

Spot Check 11: Would an Rh+ person produce anti-Rh antibodies?

Answer: No, because the Rh antigen is present on the Rh+ person's cells. It is not foreign. Antibodies are only produced to respond to foreign antigens.

OUTCOME 10.15

Spot Check 12: To which blood types could a person with type B– donate blood? From which blood types could a person with type B– receive blood?

Answer: Type B- could donate to blood types: B-, B+, AB-, and AB+. Type B- could receive blood from types: B- and O-. You would not want to expose an Rh negative person to Rh antigens to promote an immune response.

Group Activity: Blood typing.

Divide the class into groups. The following blood typing chart shows a typical class of 28 students with their blood types. The task for each group of students is to determine if the donors listed across the top row can donate to the recipients listed in the left column. If they are compatible, the students should put an X in the box where the row and column intersect. The chart approximates the average number of students with each blood type in a class of 28. The activity can be extended by asking the groups to determine the percentage of students with each type (how does this compare to national averages—a research question) and what are the odds for each blood type that a suitable donor could be found in the class?

Blood types	**Donor**	Jason	Mark	John	Tanya	Jacob	Beth	Jessica	Wayne	Judy	Carol	Bill	Robert	Joan	Laura	Nick	Barb	Aidan	Reed	Penny	Gabe	Gavin	Hailey	Nadine	Ben	Emily	Kate	Jim	Maria
Recipient		O+	A+	A-	O+	O+	O+	A+	B+	A+	O-	A-	O+	O+	A+	O+	A+	AB+	A+	B-	A+	O+	O+	A+	B+	A+	O+	A+	O+
Jason	O+																												
Mark	A+																												
John	A-																												
Tanya	O+																												
Jacob	O+																												
Beth	O+																												
Jessica	A+																												
Wayne	B+																												
Judy	A+																												
Carol	O-																												
Bill	A-																												
Robert	O+																												
Joan	O+																												
Laura	A+																												
Nick	O+																												
Barb	A+																												
Aidan	AB+																												
Reed	A+																												
Penny	B-																												
Gabe	A+																												
Gavin	O+																												
Hailey	O+																												
Nadine	A+																												
Ben	B+																												

Emily	A+																											
Kate	O+																											
Jim	A+																											
Maria	O+																											

OUTCOME 10.18

Spot Check 13: What should the total of all the values of a white blood cell differential equal?

Answer: 100. They are percentages.

OUTCOME 10.19

Spot Check: 14: Does leukocytosis always indicate a disorder or disease? Explain your answer.

Answer: Leukocytosis is a condition where the WBCs have increased in number. WBCs increase in number in order to respond to invading pathogens or in an allergic response. Either way, there is a disorder or disease of some sort. Think of the WBCs as creating an army of cells to fight infectious agents when necessary.

Quiz: 3

1. What are the three methods of hemostasis?	*Vascular spasm, platelet plug formation, coagulation*
2. What starts the intrinsic pathway of coagulation?	*Platelets*
3. What process gets rid of blood clots when they are no longer useful?	*Fibrinolysis*
4. How do basophils help in preventing inappropriate clotting?	*They release heparin*
5. Where are the antigens for blood typing?	*On blood cells*
6. Where are the antibodies in blood typing?	*Dissolved in plasma*
7. What is the clumping of cells called in an incompatibility reaction?	*Agglutination*
8. What does a WBC Differential tell you?	*The percentage of each type of WBC of the total amount of WBCs*
9. How do leukemia and leukocytosis differ?	*Although they are both indicated by a high WBC count, in leukocytosis the cells are mature, in leukemia they are not mature.*
10. What causes pernicious anemia?	*A lack of vitamin B_{12} usually due to a lack of intrinsic factor*

Discussion Point: Although it had nothing to do with having unprotected sex, hemophiliacs were one of the first groups to become infected with HIV in the U. S. With what you now know about blood, why do you think that is the case? *Hemophiliacs were given injections of clotting factors to treat their disease. The clotting factors were derived from multiple donors before there was a way of testing the blood supply for HIV. (Consider the composition of blood and how much clotting factor would be available in a single donation.) "And the Band Played On" is a very good HBO movie that depicts the discovery of HIV and the tracking of groups that led to developing measures to protect the blood banking system.*

Group Activity: Blood banking. Divide the class in groups. Derive a class list of questions concerning the blood banking system or use questions from the following list:

- Who can donate blood? Who can donate plasma?
- What is the procedure for donating blood or plasma?
- What screening is done for blood donations? What screening is done for plasma donations?
- What tests are performed on donated blood and plasma?
- Why might blood or plasma be rejected?
- How often can one donate either blood or plasma?
- Is there compensation for donating blood or plasma?
- Where locally can you donate blood or plasma?
- How much blood is available at any one time?
- What shortages are there for blood and plasma?
- For what is donated blood and plasma used?

Divide the questions amongst the groups to research and report their findings to the class. After hearing all of the presentations, each group discusses within their group whether the blood banking system is safe. The discussion is then opened to the class as a whole.

Group Activity: Blood tests

Blood Tests
Your group is to evaluate the blood test results for the each of the following four patients that have come into the clinic. First, compare the patient values to normal values listed in Table 10.3 in your text. Secondly, from your analysis of the results, predict what you might expect to see when you meet the patient. Lastly, if you suspect something is wrong, what questions might you want to ask the patient to confirm your suspicions?

Patient 1 (female)
- Hematocrit: 32%
- Hemoglobin: 9.5g/dL of blood
- Red blood cell count: 3.5 million/mm^3 of blood
- White blood cell count: 3,500/mm^3 of blood
- White blood cell differential:
  Neutrophils: 70%
  Basophils: 2%
  Eosinophils: 5%
  Monocytes: 4%
  Lymphocyte: 19%
- Platelet count: 170,500/mm^3 of blood

Patient 2 (male)
- Hematocrit: 56%
- Hemoglobin: 14g/dL of blood
- Red blood cell count: 8.1 million/mm^3 of blood
- White blood cell count: 8,000/mm^3 of blood
- White blood cell differential:
  Neutrophils: 65%
  Basophils: 2%
  Eosinophils: 1%
  Monocytes: 5%
  Lymphocyte: 27%
- Platelet count: 200,500/mm^3 of blood

Patient 3 (male)
- Hematocrit: 46%
- Hemoglobin: 14g/dL of blood
- Red blood cell count: 4.8 million/mm^3 of blood
- White blood cell count: 12,000/mm^3 of blood
- White blood cell differential:

Neutrophils: 60%
Basophils: 10%
Eosinophils: 8%
Monocytes: 2%
Lymphocyte: 20%

- Platelet count: 180,500/mm^3 of blood

Patient 4 (female)

- Hematocrit: 44%
- Hemoglobin: 14g/dL of blood
- Red blood cell count: 4.8 million/mm^3 of blood
- White blood cell count: 7,000/mm^3 of blood
- White blood cell differential:
  Neutrophils: 60%
  Basophils: 2%
  Eosinophils: 6%
  Monocytes: 8%
  Lymphocyte: 24%
- Platelet count: 350,500/mm^3 of blood

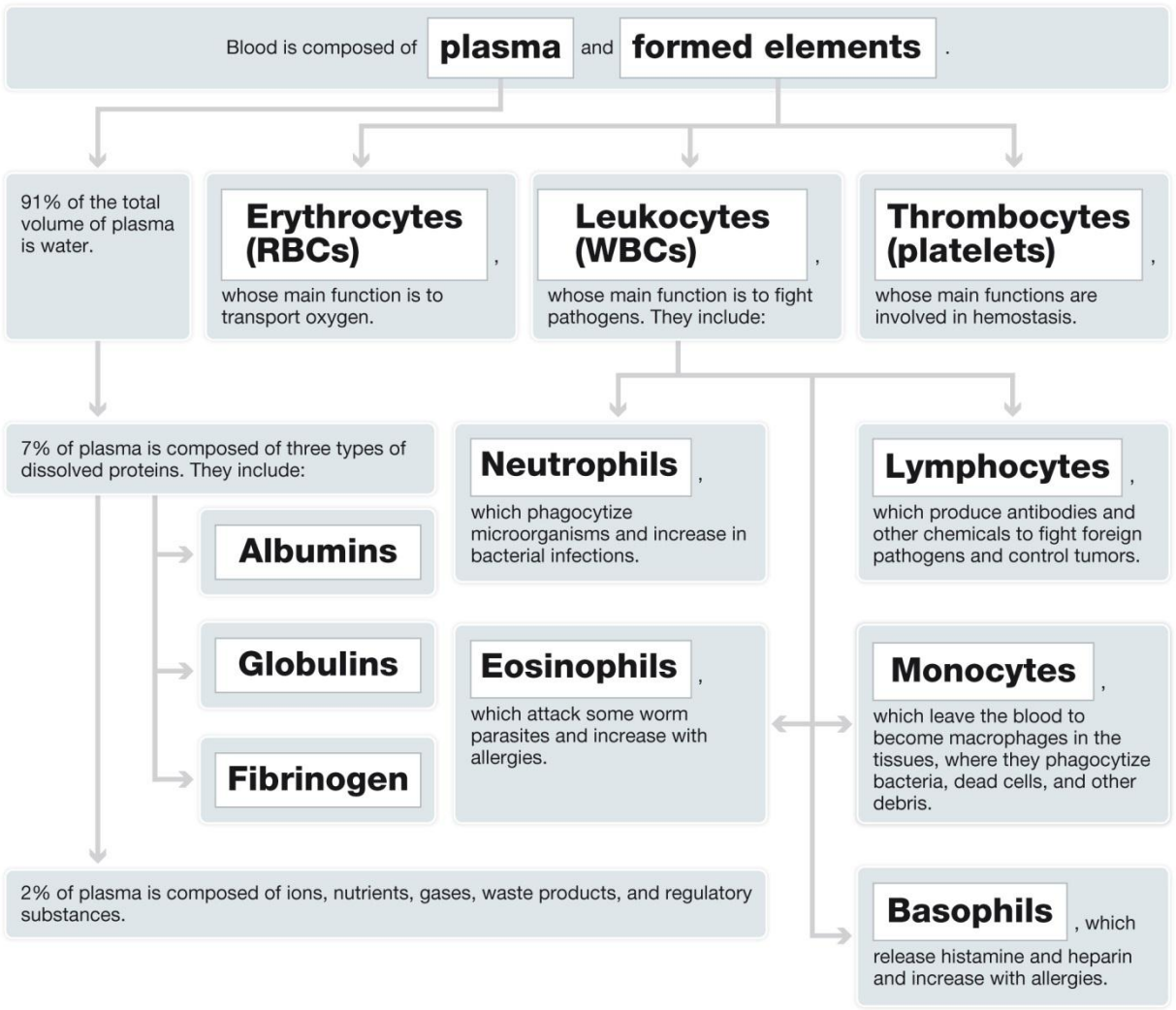
ANSWER KEYS

Chapter Review Questions

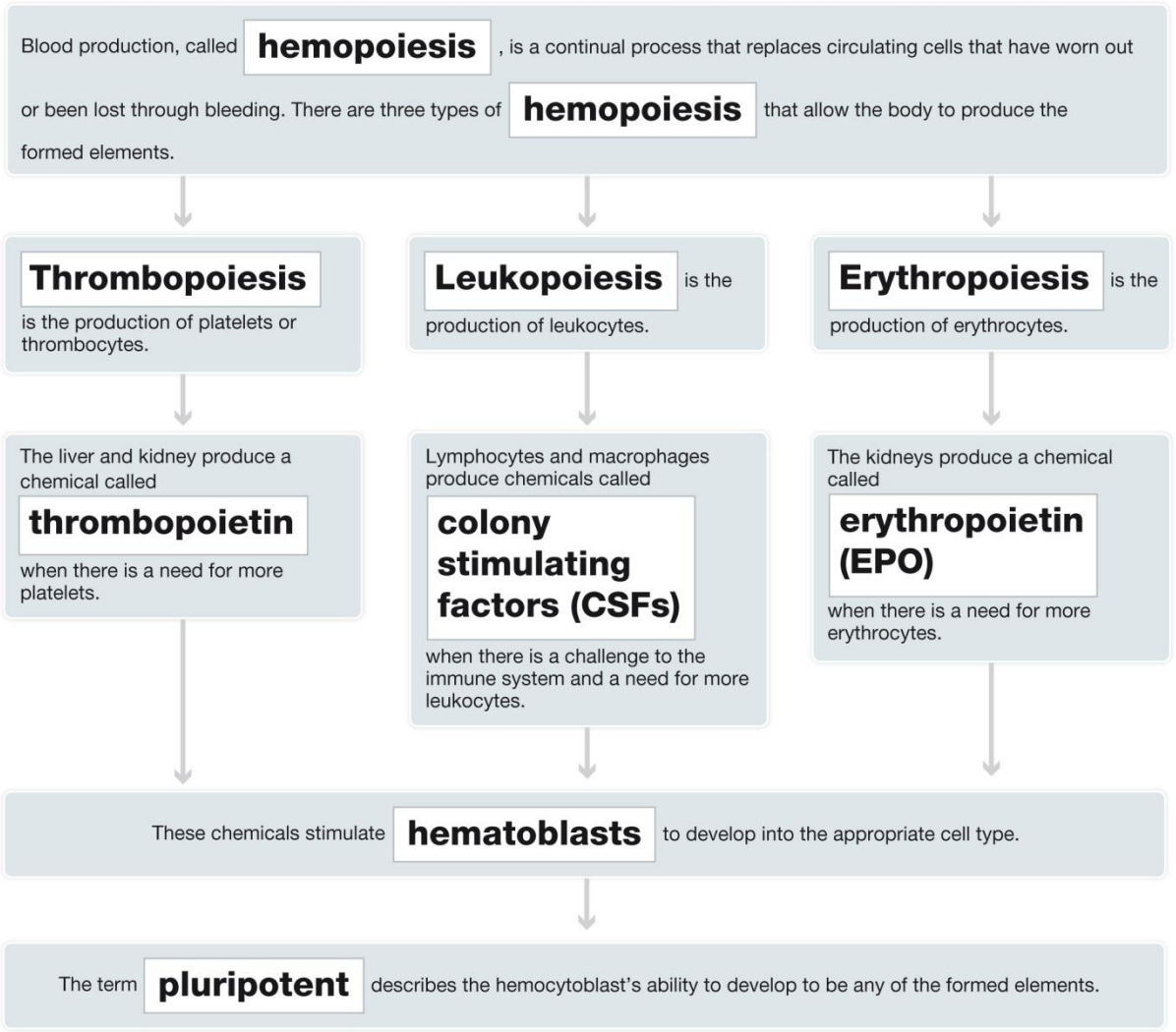
1. A
2. A
3. B
4. B
5. B
6. D
7. D
8. D
9. C
10. C
11. B
12. A
13. B
14. C
15. D
16. C
17. B
18. B
19. C

Workbook Concept Maps

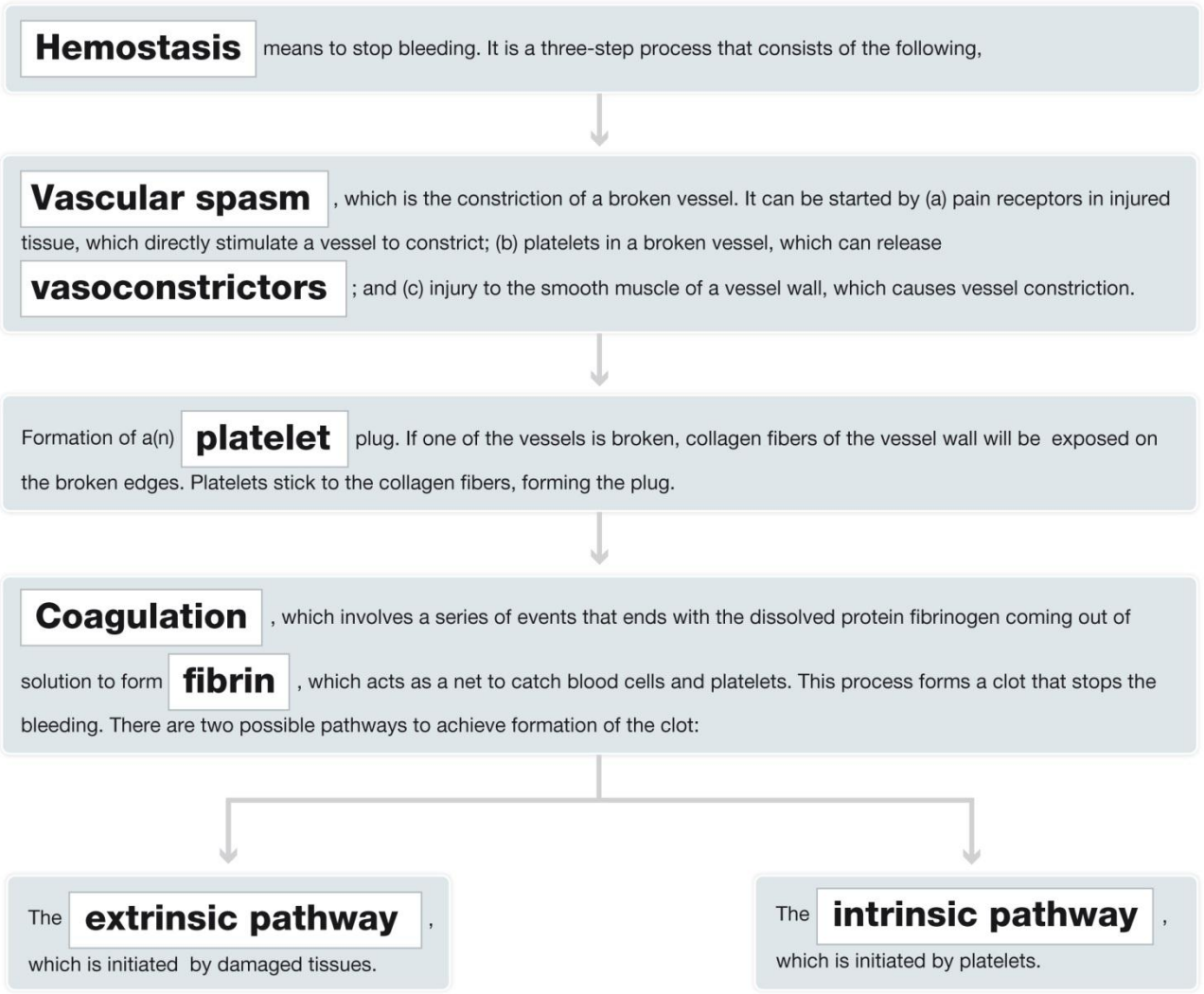
Blood Composition



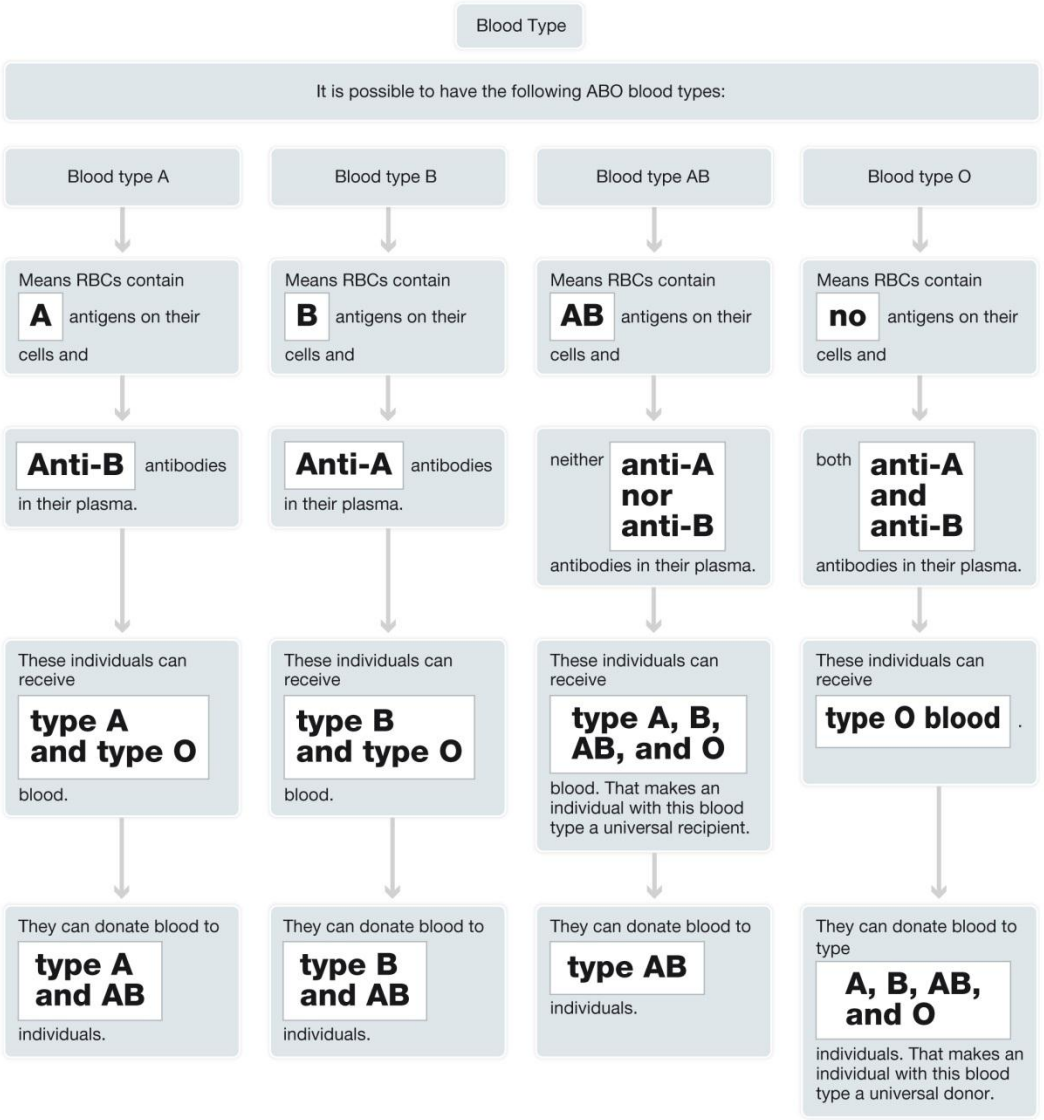
Hemopoiesis



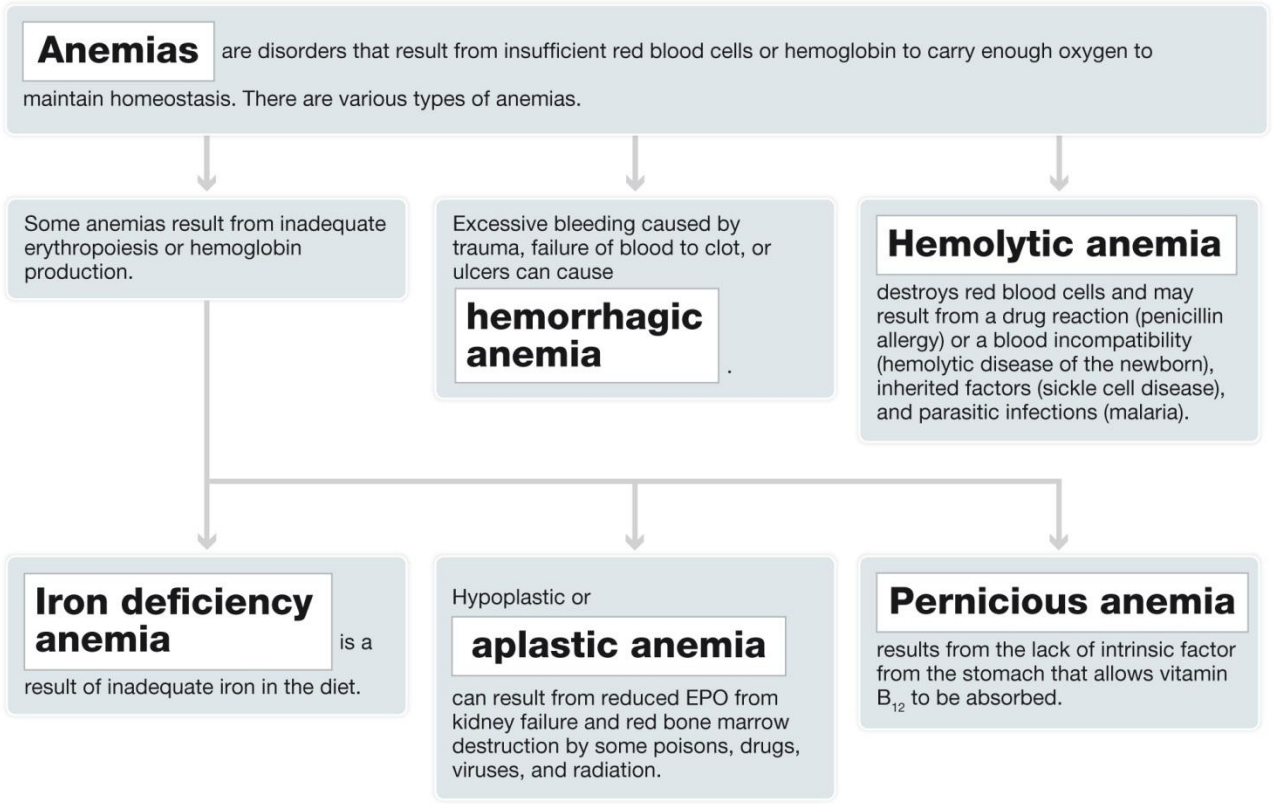
Hemostasis



Blood Typing



Anemia



Workbook Chapter Review Questions

Word Deconstruction:

In the textbook, you built words to fit a definition using combining forms, prefixes, and suffixes. Here you are to break down the term into its parts (prefixes, roots, and suffixes) and give a definition. Prefixes and suffixes can be found inside the back cover of the textbook.

FOR EXAMPLE Dermatitis: dermat/itis—inflammation of the skin

1. Thrombocytopenia: ___*Thrombo/cyto/penia, deficiency of platelets*_____

2. Anticoagulant: _____*Anti/coagul/ant, against clotting*_____

3. Agranulocyte: _____*A/granulo/cyte, a cell without granules*_____

4. Hemarthrosis:_____*Hem/arthro/sis, condition of blood in the joints*_____

5. Hematology: _____*Hemato/logy, study of blood*_____

Multiple Select:

Select the correct choices for each statement. The choices may be all correct, all incorrect, or any combination of correct and incorrect.

1. What happens in hemostasis?

a. Platelets release vasodilators, so vessel walls become more permeable.

b. Fibrin becomes fibrinogen.

c. Platelet plug formation usually occurs last.

d. Coagulation is caused by antibodies attaching to antigens.

e. Clotting factors activate other clotting factors to cause a reaction cascade.

2. What determines a person's blood type?

a. The antigens dissolved in plasma

b. The antibodies on the surface of cells

c. The plasma

d. Molecules that may be on the surface of cells to mark the cell as self

e. Inherited genes

3. What happens to a red blood cell after it is formed?

a. It migrates to the thymus.

b. It migrates to lymphoid tissues.

c. It stays in circulation.

d. It is eventually broken down by the liver and spleen.

e. It becomes a macrophage.

4. What keeps blood clots from forming in the absence of an injury?

a. Circulating blood allows thrombin to form.

b. Circulating blood keeps thrombin from accumulating.

c. Basophils release histamine.

d. Basophils release heparin.

e. The liver releases prothrombin activator.

5. What is (are) the function(s) of blood?

a. To provide defense against foreign pathogens

b. To transport carbon monoxide

c. To transport amino acids

d. To transport heat

e. To prevent bleeding

6. A drop of Sara's blood was mixed with anti-A serum. Another drop was mixed with anti-B serum. And a third drop was mixed with anti-Rh serum. Clumping was not seen in any of the tests. What does this indicate?

a. The sera must have been defective because clumping should have been seen in at least one test.

b. None of the antigens in the serum reacted to the antibodies in Sara's plasma.

c. Sara is type AB–.

d. Sara is O+.

e. Sara does not have any ABO or Rh antigens on her cells.

7. What is the composition of blood?

a. Blood is composed mostly of formed elements.

b. Blood is composed mostly of plasma.

c. The buff-color layer in a hematocrit shows that less than 1 percent of blood is composed of leukocytes and platelets.

d. Blood is a connective tissue composed of cells in a fluid matrix.

e. Blood contains a solution called plasma.

8. Which of the following statements describe(s) a function of a formed element?

a. Erythrocytes carry oxygen.

b. Basophils secrete histamine.

c. Eosinophils attack worms.

d. Monocytes become macrophages.

e. Platelets secrete growth factors to stimulate mitosis in broken blood vessel walls.

9. Which of the following statements describe(s) a form of hemopoiesis?

a. Myeloid hemopoiesis produces any of the formed elements in the red bone marrow.

b. Lymphoid hemopoiesis produces any of the formed elements in lymphoid tissue, such as the lymph nodes and spleen.

c. Thrombopoiesis is started by a chemical from the liver and spleen.

d. Leukopoiesis is started by chemicals secreted by macrophages and lymphocytes.

e. Erythropoiesis is started by a chemical produced by the kidneys.

10. Which of the following statements is (are) true concerning hemoglobin?

a. Hemoglobin is composed of four amino acid chains and a heme group.

b. Hemoglobin is a complex protein.

c. Hemoglobin contains iron.

d. Hemoglobin is found in leukocytes.

e. Hemoglobin is a solute in the cytoplasm of erythrocytes.

Matching:

Match each example with the type of solute found in plasma. Some answers may be used more than once.

___*c*__ 1. Bilirubin	a. Albumins
___*e*__ 2. Oxygen	b. Globulins
___*d*__ 3. Glucose	c. Waste products
___*a*__ 4. Transport protein	d. Nutrients
___*b*__ 5. Anti-A antibodies	e. Gases

Matching:

Match the nutrient with its function in blood. Some answers may be used more than once.

___*e*__ 6. Copper	a. Needed for clotting
___*d*__ 7. Iron	b. Needed for cell division
___*b*__ 8. Folic acid	c. Needed to carry oxygen
__*b*__ 9. Vitamin B_{12}	d. Needed for hemoglobin
__*a*__ 10. Calcium	e. Needed for enzymes to form hemoglobin

Completion:

Fill in the blanks to complete the following statements.

1. __*Hemolytic disease of the newborn/erythroblastosis fetalis* ___is a disorder caused by a blood-type incompatibility between a mother and her fetus.

2. __*Fibrinolysis*_____ is the process of dissolving a clot when it is no longer useful.

3. __*Polycythemia*_____ can result from overproduction of red blood cells or dehydration.

4. In a transfusion, the donor's ___*antigens*_____ must survive the recipient's ___*antibodies*_____.

5. In blood typing, __*antibodies*_____ seek out and attack foreign _*antigens*_____.

Critical Thinking

1. Explain four reasons why blood clotting might be slower than normal.

_*(1) Not enough Vitamin K in the diet, (2) Liver disease so less clotting factors are produced, (3) Prolonged antibiotics have killed bacteria production of Vitamin K, (4) Thrombocytopenia.*

2. George has tapeworms. His only symptom is mild abdominal discomfort. His physician ordered routine blood tests. What do you predict the results will show? Explain.

_*Increased WBC with high eosinophils to fight worm parasites*

3. How would the white blood count and white blood cell differential differ for a person with leukemia and a person with leukocytosis? Why is there a difference?

_*The WBC count would be high in both conditions, but in leukocytosis there are mature cells to fight immune challenges, in leukemia there would only be immature cells.*

Case Study:

1. Yes, MaryAnn began to make anti-Rh antibodies after the delivery of her Rh+ baby.

2. If MaryAnn's second baby is Rh-, nothing will happen. If MaryAnn's baby is Rh+, the now present Anti-Rh antibodies in MaryAnn's blood will cross the placenta and attack all of the fetal blood cells. The agglutinated cells are then cleared away.

3. The incompatible blood types between mother and fetus can cause hemolytic disease of the newborn or erythroblastosis fetalis which may result in anemia (the condition of too few red blood cells) so severe as to cause the death of the fetus.