

11

Blood

FOCUS: Blood consists of plasma and formed elements. The plasma is 91% water with dissolved or suspended molecules, including albumin, globulins, and fibrinogen. The formed elements include erythrocytes, leukocytes, and platelets. The erythrocytes transport oxygen

and carbon dioxide, whereas the leukocytes protect the body against microorganisms and remove dead cells and debris from the body. Platelets prevent bleeding by forming platelet plugs and by producing factors involved in clotting.

CONTENT LEARNING ACTIVITY

Plasma

“The liquid part of blood is called plasma.”

Match these terms with the correct statement or definition:

Albumin and sodium ions Plasma
Fibrinogen Water
Globulins

- _____ 1. Pale yellow fluid; forms more than half the blood volume.
- _____ 2. The major component of plasma.
- _____ 3. Primarily responsible for the osmotic pressure of blood.
- _____ 4. Molecules that function in immunity.
- _____ 5. Responsible for the formation of blood clots.



The total blood volume in the average adult is about 4 to 5 liters in females and 5 to 6 liters in males. Blood makes up about 8% of the total body weight.

Formed Elements

“The formed elements are cells or parts of cells.”

Match these terms with the correct statement or definition:

Erythrocytes
Hematopoiesis

Leukocytes
Platelets

- _____ 1. Red blood cells; 95% of the volume of the formed elements.
- _____ 2. Also called thrombocytes.
- _____ 3. The process of blood cell production.

Erythrocytes

“Erythrocytes live for about 120 days in males and 110 days in females.”

A. Using the terms provided, complete these statements:

Carbonic anhydrase
Globin
Heme

Hemoglobin
Nucleus

1. _____
2. _____
3. _____
4. _____
5. _____

A normal erythrocyte loses its (1) and most of its organelles during development. The main component of an erythrocyte is the pigmented protein (2), which accounts for the red color of erythrocytes. The part of hemoglobin that contains an iron atom and transport oxygen is (3), and the part that is a protein chain and transports carbon dioxide is (4). Carbon dioxide is also transported as a bicarbonate ion because of a chemical reaction catalyzed by the enzyme (5).

B. Match these terms with the correct statement or definition:

Bilirubin
Erythropoietin
Decreases
Jaundice

Increases
Macrophages
Proerythroblasts

- _____ 1. Derived from stem cells; give rise to erythrocytes.
- _____ 2. When blood oxygen levels decrease the kidneys release this substance.
- _____ 3. The effect of erythropoietin on erythrocyte production in the red bone marrow.
- _____ 4. Cells in the liver and spleen; remove erythrocytes from the blood.
- _____ 5. Derived from heme and excreted in bile.
- _____ 6. A buildup of bilirubin in the blood.

C. Match these terms with the correct parts labeled in figure 11.1:

Bilirubin
Globin
Heme

Hemoglobin
Iron

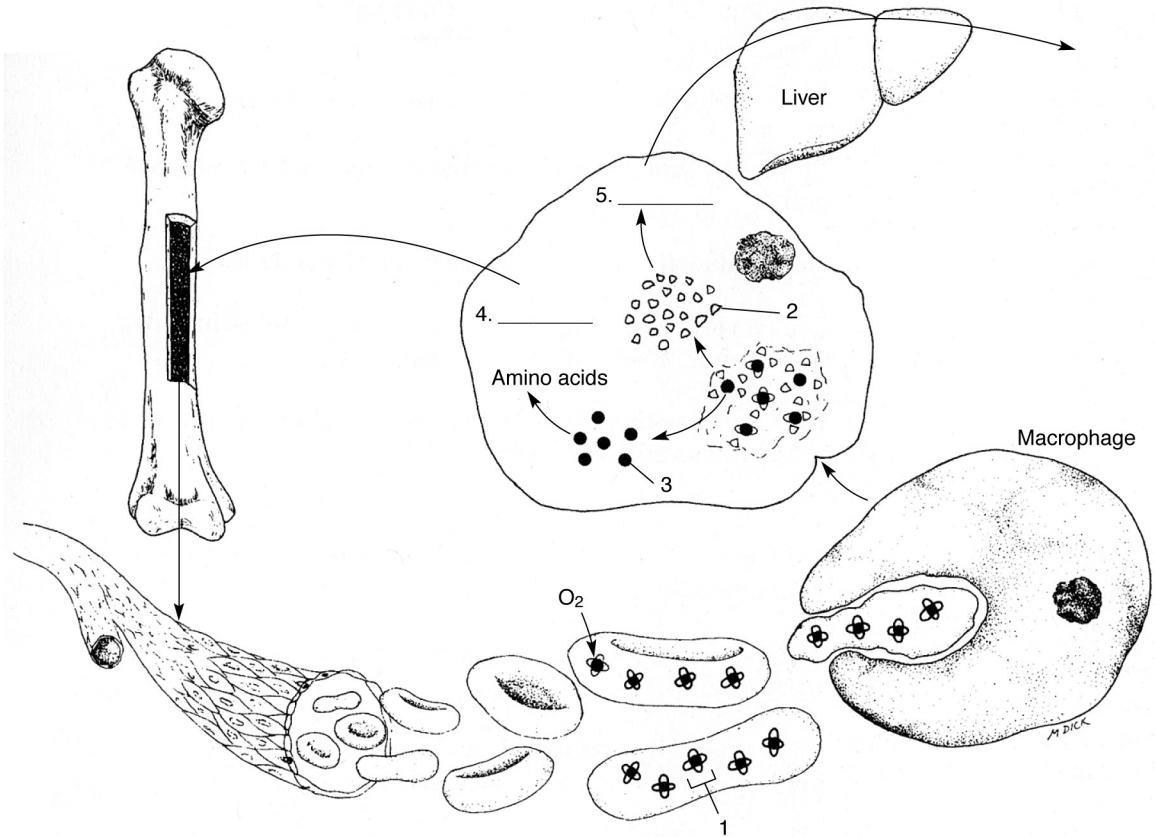


Figure 11.1

1. _____ 3. _____ 5. _____
 2. _____ 4. _____

Leukocytes and Platelets

“Leukocytes, or white blood cells, are nucleated cells that lack hemoglobin.”

Match these terms with the correct statement or definition:

- | | |
|------------------|----------------|
| Agranulocytes | Lymphocyte |
| Ameboid movement | Megakaryocytes |
| Basophil | Monocyte |
| Eosinophil | Neutrophil |
| Granulocytes | Platelet |

- | | |
|-------|---|
| _____ | 1. Used by leukocytes to leave blood and move through tissues. |
| _____ | 2. Leukocytes containing large cytoplasmic granules that stain. |
| _____ | 3. Granulocyte that phagocytizes microorganisms; form pus when they accumulate and die. |
| _____ | 4. Granulocyte that promotes inflammation; releases histamine. |
| _____ | 5. Granulocyte that reduces inflammation |
| _____ | 6. Agranulocyte involved in immunity; produces antibodies. |
| _____ | 7. This cell enters tissues and is transformed into a macrophage. |
| _____ | 8. Small amounts of cytoplasm surrounded by a cell membrane; function in blood loss prevention. |
| _____ | 9. The cells from which platelets are produced. |

Preventing Blood Loss

“Platelet plug and clot formation are very important to the maintenance of homeostasis.”

A. Using the terms provided, complete these statements:

- | | |
|------------|----------------|
| Clot | Prothrombinase |
| Fibrin | Smooth muscle |
| Fibrinogen | Thrombin |
| Integrins | Thromboxane |

Blood loss from blood vessels can be stopped or reduced by contraction of (1) in the blood vessel wall. Exposure of collagen in damaged tissue can result in platelet adhesion to collagen by (2). In the platelet release reaction, platelets release ADP and (3), which activate other platelets. In platelet aggregation, platelets are connected to each other by (4) to form a platelet plug, which can seal small tears in blood vessels. Exposed collagen or chemicals released from injured tissues can start a series of chemical reactions that result in the production of (5). This substance converts prothrombin to (6) which in turn converts fibrinogen into (7). This network of protein fibers traps blood cells, platelets, and fluid, and is called a (8). This structure can prevent blood loss from large tears in blood vessels.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

B. Match these terms with the correct statement or definition:

Anticoagulant
Clot retraction
Embolus
Fibrinolysis

Plasmin
Serum
Thrombus
t-PA

1. Substance such as antithrombin that prevents clots from forming.
2. The process by which a clot becomes denser and more compact.
3. Plasma without its clotting factors.
4. The process by which a clot is dissolved.
5. Formed from plasminogen, this substance breaks down fibrin.
6. Stimulates the conversion of plasminogen to plasmin.
7. A clot that forms in a blood vessel.
8. A detached clot or substance that floats through the circulatory system and becomes lodged in a blood vessel.

Blood Grouping

“Erythrocytes can be grouped according to the types of molecules they have on the outside of their cell membranes.”

A. Match these terms with the correct statement or definition:

Agglutination
Antibodies
Antigens

Blood groups
Hemolysis
Transfusion

1. The transfer of blood, parts of blood, or solutions into the blood of a patient.
2. Molecules on the surface of erythrocytes that can bind to antibodies.
3. Molecules in the plasma that can combine with antigens on erythrocytes; activate mechanisms that destroy the erythrocytes.
4. A clumping together of erythrocytes caused by antibodies combining with antigens.
5. The rupture of erythrocytes.
6. The classes of erythrocytes based on their surface antigens.

B. Match these terms with the correct statement or definition:

Donor
No reaction
Recipient
Transfusion reaction

Type A blood
Type B blood
Type AB blood
Type O blood

1. The type of blood that has A antigens and B antibodies.
2. The type of blood that does not have A or B antigens, but does have A and B antibodies.
3. A person who receives blood.
4. People with this type of blood have been called universal donors.
5. The result of giving a transfusion of type A blood to a person with type A blood.
6. The result of giving a transfusion of type A blood to a person with type B blood.

C. Match these terms with the correct statement or definition:

Anti-Rh₀(D)
Hemolytic disease
of the newborn

Rh-negative
Rh-positive

1. The type of blood that has certain Rh antigens on the surface of the erythrocytes.
2. The disorder that results in agglutination and hemolysis of fetal blood because of different types of Rh blood in the mother and fetus; erythroblastosis fetalis
3. The type of blood the fetus has in hemolytic disease of the newborn.
4. The type of blood the mother has in hemolytic disease of the newborn.
5. Given to prevent hemolytic disease of the newborn.

Diagnostic Blood Tests

“Blood tests can prevent transfusion reactions and provide useful information about a patient’s health.”

Match these terms with the correct statement or definition:

Blood chemistry
Complete blood count
Hematocrit
Hemoglobin
Platelet count

Prothrombin time
Red blood cell count
Type and cross match
White blood cell count
White blood cell differential

1. The test used to prevent transfusion reactions.
2. Includes a red blood cell count, hemoglobin and hematocrit measurements, and white blood cell count.
3. This test would detect polycythemia.
4. Measures the volume of the formed elements.
5. This test would detect leukemia.
6. Test that determines the percentages of each of the five kinds of leukocytes.
7. This test would detect thrombocytopenia.
8. Measures how long it takes for blood to start clotting.
9. Determines the composition of materials dissolved or suspended in plasma, such as glucose and bilirubin.

QUICK RECALL

1. List seven functions of blood.

2. Name the parts of a hemoglobin molecule, give the function of each part, and state the fate of each part when hemoglobin is broken down.

3. List the events that lead to increased erythrocyte production when blood oxygen levels decrease.

4. List the five types of leukocytes and give a function of each.

5. Give two ways that platelets prevent blood loss.

6. Starting with the production of prothrombinase, list the chemicals that result in the formation of a clot.

7. Describe the basic mechanism responsible for transfusion reactions.

WORD PARTS

Give an example of a new vocabulary word that contains each word part.

WORD PART	MEANING	EXAMPLE
erythro-	red	1. _____
leuko-	white	2. _____
thrombo-	clot	3. _____
poie-	to make or produce	4. _____
hem-	blood	5. _____
-phil	loving	6. _____

MASTERY LEARNING ACTIVITY

Place the letter corresponding to the correct answer in the space provided.

- _____ 1. Which of the following is a function of blood?
a. prevents fluid loss
b. transports hormones
c. carries oxygen to cells
d. involved in regulation of body temperature
e. all of the above
- _____ 2. Which of the following is NOT a component of plasma?
a. albumin
b. globulin
c. fibrinogen
d. platelets
e. glucose
- _____ 3. Erythrocytes
a. are the least numerous formed element in blood.
b. are cylindrically shaped cells.
c. are produced in yellow bone marrow.
d. do not have a nucleus
- _____ 4. Which of the following components of an erythrocyte is correctly matched with its function?
a. heme - oxygen transport
b. globin - carbon dioxide transport
c. carbonic anhydrase - carbon dioxide transport
d. all of the above
- _____ 5. Erythropoietin
a. is produced mainly by red bone marrow.
b. inhibits the production of erythrocytes.
c. production increases when blood oxygen levels decrease.
d. all of the above.
- _____ 6. Which of the components of hemoglobin is correctly matched with its fate following the destruction of an erythrocyte?
a. heme - reused to form new hemoglobin molecule
b. globin - broken down into amino acids
c. iron - mostly secreted in bile
d. all of the above
- _____ 7. The most common type of leukocyte, which functions to phagocytize microorganisms and other substances?
a. lymphocyte
b. macrophage
c. neutrophil
d. thrombocyte
- _____ 8. Monocytes
a. are the smallest-sized leukocytes.
b. give rise to macrophages.
c. are a type of granulocyte.
d. all of the above
- _____ 9. The type of leukocyte that functions to inhibit inflammation?
a. basophil
b. eosinophil
c. lymphocyte
d. thrombocyte
- _____ 10. Given the following events:
1. Fibrinogen forms bridges between fibrinogen receptors.
2. Platelets stick to collagen.
3. Platelets release ADP and thromboxane.
- Choose the arrangement that lists the events in the order they occur during platelet plug formation.
a. 2, 1, 3
b. 2, 3, 1
c. 3, 2, 1
d. 3, 1, 2

- _____ 11. Given the following events:
1. fibrin
 2. prothrombinase
 3. thrombin

Choose the arrangement that lists the chemicals in the order they are formed during clot formation.

- a. 1, 2, 3
 - b. 1, 3, 2
 - c. 2, 1, 3
 - d. 2, 3, 1
 - e. 3, 2, 1
- _____ 12. The chemical that is involved in the breakdown of a clot (fibrinolysis)?
- a. fibrinogen
 - b. antithrombin
 - c. heparin
 - d. plasmin

- _____ 13. Type AB blood
- a. has type A antigens.
 - b. has type B antibodies.
 - c. will NOT cause a transfusion reaction if given to a person with type O blood.
 - d. all of the above

- _____ 14. Rh-negative mothers are given anti-Rh_o(D) immune globulin (RhoGam) injections in order to
- a. initiate the synthesis of Rh antibodies in the mother.
 - b. initiate the synthesis of Rh antibodies in the fetus.
 - c. prevent the mother from producing Rh antibodies.
 - d. prevent the fetus from producing Rh antibodies.

- _____ 15. The diagnostic blood test that detects anemia is
- a. type and cross match.
 - b. hemoglobin measurement.
 - c. white blood cell count.
 - d. prothrombin time.



FINAL CHALLENGES



Use a separate sheet of paper to complete this section.

1. Patients with advanced kidney diseases that impair kidney function often become anemic. On the other hand, patients with kidney tumors sometimes develop polycythemia. Explain these symptoms (Hint: Tumors often cause overactivity of the tissue affected.)
2. When track athletes from low altitudes (e.g., sea level) are going to compete at a high altitude (e.g., Denver, Colorado), they try to spend a few weeks training at a high altitude. Explain how high altitude training improves the athlete's ability to compete.
3. An Rh-positive baby is suffering from hemolytic disease of the newborn. An exchange transfusion is performed, in which some of the baby's blood is removed and replaced with blood from a donor. Why would the chosen donor's blood be Rh-negative?
4. During pregnancy the developing fetus must manufacture many new erythrocytes. What precautions should the mother take with her diet to prevent the development of anemia in herself and the fetus?