Amerman Active-Learning Workbook: Chapter 19 Answers

Key Concept: What are the main functions of blood?
Blood mainly functions to exchange gases, distribute solutes, immune functions, clotting, acid-base homeostasis, maintaining body temperature and blood pressure.

Key Concept: What are the four types of plasma proteins, and what are their functions?
The four types of plasma proteins are albumin (responsible for blood's colloid osmotic pressure), antibodies (defend against pathogens), transport proteins (carry molecules that would otherwise be difficult to dissolve and transport in blood), and clotting proteins (stop blood loss from damaged blood vessels).

Key Concept: How does the structure of an erythrocyte allow it to carry out its functions?
The erythrocyte's biconcave disc structure increases surface area for gas exchange. It also has no nucleus or organelles, which suggests how specialized it is for its function of carrying hemoglobin and respiratory gasses.

Complete It: Erythrocyte Structure

Fill in the blanks to complete the following paragraph that describes the structure and function of erythrocytes.

A mature erythrocyte consists of a plasma membrane surrounding cytosol filled with the protein hemoglobin. This large protein consists of four polypeptide subunits: two alpha chains and two beta chains. Each polypeptide chain has a heme group, which contains an iron ion. When this ion binds to oxygen, the overall protein is called oxyhemoglobin. Binding to oxygen causes the ion to become oxidized, which is what gives blood its red color. When this ion is not bound to oxygen, it is called deoxyhemoglobin.

Key Concept: Why is blood red? What makes venous blood darker than arterial blood?
Like rusted iron, oxidized hemoglobin (oxyhemoglobin) turns red. Venous blood has less oxyhemoglobin and more deoxyhemoglobin, making it darker and less red in color.

Key Concept: What is the stimulus for erythropoietin production and release? What action does erythropoietin trigger, and how does this return the variable to the homeostatic range?
Low blood oxygen levels as detected by kidney chemoreceptor cells triggers erythropoietin production and release. Erythropoietin speeds up the rate of erythropoiesis and reduces the

amount of time needed for new erythrocytes to mature. Additional erythrocytes entering the blood increase hematocrit and oxygen-carrying capacity of the blood.

Key Concept: What are the three causes of anemia? How does each cause decrease the oxygen-carrying capacity of the blood?
The three causes of anemia are: decreased levels of functional hemoglobin, in which erythroblasts cannot make hemoglobin without functional iron-containing heme groups; decreased hematocrit or reduced numbers of erythrocytes in the blood; and abnormal hemoglobin (e.g. sickle cell) which may result in the blood carrying less oxygen (e.g. sickle cells are destroyed or clog up capillary beds).

Key Concept: What are the key differences between erythrocytes and leukocytes?
Leukocytes are larger than erythrocytes and have prominent, sometimes unusually shaped, nuclei. Leukocytes also often do their protective work when they leave the blood, unlike erythrocytes that remain within blood vessels to function in gas transport/exchange.

Key Concept: How do lymphocytes differ from all other cells in terms of their development in the bone marrow?
Unlike the other leukocytes which develop from the myeloid cell line, lymphocytes are formed from the lymphoid cell line. They also produce two distinct types, the B and T lymphocytes, which are immature when first produced, and mature later (in bone marrow for B-lymphocytes and in the thymus gland for T-lymphocytes).

Key Concept: Are platelets cells? Explain your answer.
Platelets are not truly cells, but instead are small fragments of cells surrounded by a plasma membrane. They lack nuclei and most other organelles, and do not perform most functions typically associated with living cells.

Key Concept: What is hemostasis? What are the five steps of hemostasis?
Hemostasis is a series of mechanisms that minimize the amount of blood lost from an injured blood vessel. The five steps are: vascular spasm, platelet plug, coagulation, clot retraction, and thrombolysis.

Key Concept: How and why does vascular spasm occur?
Two factors are involved in vascular spasm: vasoconstriction and increased tissue pressure, both of which cause a decrease in the blood vessel diameter.

Key Concept: What are the fundamental differences between the intrinsic and extrinsic pathways?

In the intrinsic pathway, all of the factors required for it to proceed are located within the blood. The extrinsic pathway is initiated by a factor outside the blood – a "tissue factor" released from subendothelial cells in damaged areas.

Key Concept: What is the overall purpose of coagulation?

The overall purpose of coagulation is to produce fibrin threads that form a mesh which glues together the platelet plug (and other materials) to seal the damaged blood vessel.

Complete It: Clot Retraction and Thrombolysis

Fill in the blanks to complete the following paragraphs that describe clot retraction and fibrinolysis.

At the end of the coagulation cascade when fibrin threads "glue" the platelet plug together, the actin and myosin fibers in the platelets contract. This action, called clot retraction, brings the edges of the vessel closer together. It also squeezes serum out of the clot, which contains plasma without clotting proteins.

When the wounded vessel has healed, the clot is removed by the process of thrombolysis. The first step of this process is to break down fibrin by the process of fibrinolysis. It begins when endothelial cells release tissue plasminogen activator, which catalyzes the conversion of plasminogen to the active enzyme plasmin. This enzyme then degrades fibrin, which causes the clot to dissolve.

Key Concept: It is obviously important to clot a broken blood vessel. Why is it equally important to eventually break down that clot?

In addition to being an unnecessary partial blockage in the vessel once the vessel is healed, there is the danger that a portion of it could break off (a thromboembolus) and produce a blockage in smaller vessels.

Key Concept: What is an anticoagulant? Why is it important to regulate positive feedback loops like coagulation?

Anticoagulants are drugs that prevent one step in the blood clotting process. Positive feedback loops like coagulation can easily produce "too much of a good thing" and cause (specific to this case) thromboemboli such as pulmonary emboli which lodge in the vessels of the lungs.

Key Concept: What are antigens? What are the key antigens on erythrocytes?
Antigens are surface marker molecules. The key antigens on human erythrocytes are the A, B, and Rh antigens.

Key Concept: What happens when antibodies bind their specific antigens?
When antibodies bind their specific antigens a clumping process called agglutination occurs. Agglutination promotes hemolysis and destruction of the erythrocytes.

Key Concept: When considering blood donation, do we consider the antigens on the donor's erythrocytes, the antibodies in the donor's blood, or both? Explain.
The main concern is the donor's antigens. A patient cannot receive blood containing antigens that the immune system would recognize as foreign, or a transfusion reaction will occur. It is true that the small amount of antibodies present in the donor's blood in a compatible but not exact match would react with a small number of the recipient's erythrocytes. However, this is almost insignificant compared to the value of the blood transfusion.