



7. What is hemolymph?

8. Complete the following chart. You will find the anatomical descriptions at the beginning of Concept 34.3, Blood Vessel Structure and Function.

<b>Blood Vessel</b>	<b>Function</b>	<b>Anatomical Description</b>
Artery		
Arteriole		
Vein		
Venule		
Capillary		

9. What is the function of the atria?

10. What is the function of the ventricles?

11. In a circulatory system, exchange occurs in two general places. Blood goes to a respiratory surface (lungs, gills, skin) or to the organs and tissues of the body (systemic circulation). At which type of blood vessels does exchange actually occur?

12. Look at Figure 34.4. Note that each shows blood going to two places, as described above. Discuss the differences between the groups.

13. Why is a four-chambered heart a key adaptation required for endothermy?

14. Explain why the four-chambered hearts of birds and mammals are considered an example of convergent evolution.

## **Section 2**

15. Using Figure 34.5, trace what is happening from Point 1 to Point 11.

16. Study Figure 34.6 in your text. It is a nice artist's sketch of a mammalian heart. Draw a simple box, divide it into four compartments, label each one as a chamber of the heart, show and label all blood vessels in and out, and locate the four valves of the heart. Finally, use a colored line with arrows to trace the flow of blood through the heart.

17. Now that you have the anatomy down, it is time to look at how the heart works.

Explain each of the following terms.

cardiac cycle:

systole:

diastole:

cardiac output (Include the two factors that determine it.):

18. Heartbeat rhythm is maintained by electric impulses that are generated from modified cells found in the wall of the right atrium, called the sinoatrial (SA) node. What is the common name for the SA node?
19. Electrical impulses from the SA node cause the atria to contract and are conducted to a relay station, the atrioventricular (AV) node. When an impulse is generated by the AV node, what contracts?
20. Explain how the sympathetic and parasympathetic nerves affect the pacemaker.

### **Section 3**

21. Why is it important that the arteries are so much thicker than the veins?
22. How do structure and function correlate in the capillaries?
23. What anatomical feature of the veins maintains a unidirectional flow of blood back toward the heart?
24. As blood vessel diameter decreases, blood velocity will \_\_\_\_\_.
25. Why does blood slow as it moves from arteries to arterioles to capillaries? Why is this important?
26. Changes in blood pressure as the heart contracts and relaxes can be felt, such as a gentle throb at the wrist or neck. What is this called? \_\_\_\_\_
27. How does vasoconstriction affect blood pressure?

28. Explain how a sphygmomanometer is used to measure blood pressure.
29. If the blood pressure is reported as 110/80, what is the diastolic pressure? \_\_\_\_\_
30. What are two mechanisms that regulate blood flow in capillaries?
31. Explain the exchange of fluid at the two ends of a capillary. Include these terms in your discussion: interstitial fluid, osmotic pressure, and blood pressure.
32. Why does the presence of blood proteins tend to pull fluid back into the capillaries?
33. The capillaries “leak” about 4 liters of fluid each day. How is this returned to the blood?
34. What is lymph? Is it more like blood or more like interstitial fluid?
35. We don't have a second heart to pump lymph. What keeps it moving along?
36. Name three places you have lymph nodes. What are two functions of these nodes?

#### **Section 4**

37. Blood separates into two components, a liquid matrix called \_\_\_\_\_ and the cellular elements.

38. Name each type of cell in blood and give its function.
39. List the four major constituents of plasma. What are their functions?
40. Describe three ways in which the structure of an erythrocyte enhances its function, which is to transport oxygen.
41. What is the role of hemoglobin?
42. Blood clotting involves a pathway of several steps. It begins when platelets begin to form a plug in the blood vessel wall, and damaged platelets release a chemical that initiates a clotting cascade. Focus on what happens to the plasma proteins prothrombin and fibrinogen when this cascade begins.
- What is the name of the protein that actually forms a clot?
  - If a clot forms within a blood vessel and blocks the flow of blood, what is it called?
43. Where are blood stem cells found?
44. What is erythropoietin (EPO)? What will stimulate its production?
45. What causes the development of a plaque in atherosclerosis?
46. What are three known predictors of cardiovascular disease?

## **Section 5**

47. What is meant by the partial pressure of a gas?
48. A gas always diffuses from a region of \_\_\_\_\_ partial pressure to a region of \_\_\_\_\_ partial pressure.
49. Gas exchange with water as the respiratory medium is much more demanding than exchange with the air. What are three reasons for this?
50. There are several requirements for a respiratory surface. The first is that it must be moist. The second is that it must have a large surface area and be thin. What four different organs satisfy these requirements?
51. What is countercurrent exchange?
52. Gills serve as the respiratory organ in many aquatic animals. Figure 34.18 in your text uses arrows to show the flow of water. The most significant part of this figure is the portion that shows the countercurrent flow of water and blood. Study carefully the paragraph that describes countercurrent exchange, and then explain how oxygen is taken up over the length of a capillary.
53. Consider this question to see if you understand the advantage of a countercurrent exchange system. Without countercurrent exchange, what would be the maximum absorption percentage if  $O_2$  simply diffused from water to blood in the gills? (See Figure 34.18 in your text.)
54. What is the most common respiratory structure among terrestrial animals? What group has this system?

## **Section 6**

55. Use the following sketch to explain how pressure is changed within the thoracic cavity to bring in air.

56. Where are the two breathing control centers located in the brain?

57. How does blood pH change as CO<sub>2</sub> increases?

58. What is a bicarbonate ion? How is it formed?

59. Read carefully to answer this question: What has greater effect on the rate of respiration, low levels of O<sub>2</sub> or high levels of CO<sub>2</sub>?

## **Section 7**

60. Using Figure 34.24 in your text, trace oxygen and carbon dioxide from the point of inhalation to exhalation. Your answer will involve eight reference points.

61. What two of your eight stops in the previous question have the highest oxygen partial pressures?

62. What is the respiratory pigment in vertebrates? \_\_\_\_\_



63. Hemoglobin is a protein with quaternary structure. How many subunits does it have? What is the role of iron?

64. As pH of the blood decreases, the affinity of hemoglobin for oxygen decreases, and oxygen is released from hemoglobin. What is this called?

*Your answer to the question above should have been the Bohr shift, which occurs as a result of cooperativity between the four hemoglobin subunits. When O<sub>2</sub> binds to one subunit, the others change shape slightly; this change increases their affinity for O<sub>2</sub> and makes it easier for O<sub>2</sub> to load onto hemoglobin.*

65. Because of the effect of subunit cooperativity, a slight drop in PO<sub>2</sub> causes a(an) \_\_\_\_\_ in the amount of O<sub>2</sub> the blood unloads.

66. Study Figure 34.25a. What is the % O<sub>2</sub> saturation level of hemoglobin in the lungs?

67. What is the % O<sub>2</sub> saturation level of hemoglobin in tissues at rest? \_\_\_\_\_ When exercising? \_\_\_\_\_

68. Carbon dioxide is carried in the blood in three ways. Name each of them, and give the relative percentage of CO<sub>2</sub> transported.

69. Where is carbonic anhydrase found? What is its role in CO<sub>2</sub> transport?

70. What is myoglobin?

71. Fetal hemoglobin and adult hemoglobin are different. Here are the dissociation curves for both. Explain the reason for this difference.