

Maintaining the Body

14.1 The Circulatory System

14.2 The Path of Blood Flow

14.3 Blood

14.4 Respiration

14.5 Digestion



End of Chapter Questions

Simple Review Questions

14.1 The Circulatory System

1. What stimulates the heart to beat?

2. What makes the “lub-dubb” sound of the heartbeat?

3. Which blood vessels are responsible for nutrient and waste exchange with tissues?

14.2 How Blood Flows Around the Body

4. Trace the path of blood through the body, beginning with blood returning from the tissues to the heart. Be sure to name each of the chambers of the heart.



5. What is blood pressure?

6. What is the difference between systolic blood pressure and diastolic blood pressure?

7. What health issues are associated with high blood pressure?

14.3 Blood

8. What are the three types of blood cells, and what is the function of each?

9. What is the structure of hemoglobin? Which part of the hemoglobin molecule binds to oxygen?

10. How many oxygen molecules can one molecule of hemoglobin carry?

11. Explain how hemoglobin's oxygen affinity is affected by blood pH, and how this change in oxygen affinity is adaptive.



14.4 Respiration

12. Trace the path of air as it moves to the alveoli.

13. What structures in the trachea help keep it open?

14. How do the structures of the alveoli and their surrounding capillaries facilitate gas exchange?

15. What is the diaphragm? What is its role in inhalation and exhalation?

16. What happens to the volume of the thoracic cavity when you inhale? What about when you exhale?

14.5 Digestion

17. What does digestion accomplish?

18. What are the functions of saliva?



19. What prevents food from going into the trachea after it is swallowed?

20. What happens to food while it is in the stomach?

21. What structures increase the surface area available for nutrient absorption in the small intestine?

(CLICK TO CHECK YOUR ANSWERS)

Challenging Review Questions

14.1 The Circulatory System

22. In a developing embryo, the heart begins to beat long before developing nerves reach it. How is the embryonic heart able to beat without nervous system control?

23. Why are the atria of the heart less muscular than the ventricles? Why is the left ventricle more muscular than the right ventricle?

24. The pumping of the heart does most of the work that is required to move blood around the body. How do your voluntary movements contribute to this process?



14.2 How Blood Flows Around the Body

25. Where in the body is blood most oxygenated?

26. Why does blood pressure decrease as blood flows from arteries to capillaries to veins?

27. High blood pressure sometimes can lead to an enlargement of the left side of the heart. Why?

28. High blood pressure is usually treated with medication. Two kinds of high blood pressure medications are diuretics and ACE inhibitors. Diuretics help the body get rid of excess sodium and water. ACE inhibitors help blood vessels relax and open up. How could each of these medications help reduce blood pressure?

14.3 Blood

29. How does the structure of hemoglobin help ensure that each hemoglobin molecule carries four molecules of oxygen (the maximum number) away from the lungs?

30. How does the structure of hemoglobin help ensure that working tissues, which require more oxygen, get the oxygen they need?



31. Why is carbon monoxide toxic? What effect does it have on the body?

14.4 Respiration

32. Which functions, other than acquiring oxygen for the body, require the work of the respiratory system?

33. Describe the structure of the lungs, as well as how this structure allows the lungs to perform their function in respiration.

34. What role does diffusion play in respiration?

35. How does the shape of the diaphragm change when it contracts? What role does this play in breathing?

36. What role do the rib muscles and rib cage play in inhaling and exhaling?

37. What is the role of air pressure in inhaling and exhaling?



38. Is breathing a voluntary or involuntary action?

14.5 Digestion

39. As food moves down your esophagus, your esophagus bulges. Why doesn't this cause the trachea, which lies adjacent to it, to become closed off?

40. Having the openings to both the trachea and the esophagus in the pharynx is problematic because it can lead to choking. Are there any advantages to this arrangement?

41. What are the functions of gastric juice?

42. What happens to food in the small intestine?

43. Is it true that bacteria live in our large intestines? What do they do there?

(CLICK TO CHECK YOUR ANSWERS)



Apply & Discuss Questions

44. How do the arterioles react when you are running? When you are doing biceps curls? When you are sitting at your desk thinking and doing homework?

45. You use energy to contract your diaphragm and rib muscles when you breathe. Is energy also required for gas exchange—that is, for the transport of oxygen and carbon dioxide molecules between the air inside the alveoli and the blood in the surrounding capillaries?

46. Why shouldn't you talk with your mouth full (not just because it's impolite)?

47. If you hold a piece of cracker in your mouth without chewing it, the cracker will dissolve. However, this doesn't happen with a piece of meat. Why?

(CLICK TO CHECK YOUR ANSWERS)



End of Chapter Solutions

Simple Review Solutions

1. Heart muscle does not need a neuron to tell it to contract, the way voluntary muscles do. Instead, the heart contracts on its own. Each heartbeat begins on its own in a part of the right atrium called the sinoatrial node, or pacemaker.
3. Capillaries are tiny, thin-walled blood vessels from which molecules are exchanged between blood and body tissues.
5. Blood pressure is a measure of the pressure your blood exerts against the walls of your arteries. This pressure is what causes blood to flow through your blood vessels.
7. A person with high blood pressure has a heart that is working hard. High blood pressure is associated with many health problems, including heart disease, heart attacks, heart failure, kidney disease, and strokes.
9. A hemoglobin molecule is made up of four smaller subunits. Each subunit contains a heme group that includes an iron atom at its center. It is this iron atom that binds to oxygen.
11. Lower blood pH (a more acidic environment) decreases hemoglobin's oxygen affinity. Why is this adaptive? An active, working tissue makes and uses more ATP and so releases more carbon dioxide during cellular respiration. Because carbon dioxide reacts with water in the blood to form carbonic acid, the presence of high levels of carbon dioxide decreases blood pH. This acidity decreases the oxygen affinity of local hemoglobin molecules, making it easier for them to unload oxygen to the working tissue.
13. The trachea is a short tube stiffened by rings of cartilage. The rings keep the trachea open.
15. The bottom of the thoracic cavity is covered by a sheet of muscle called the diaphragm. The contraction and relaxation of the diaphragm cause inhalation and exhalation.
17. During the process of digestion, food is broken down into small organic molecules that can be absorbed and used by the body.
19. A small flap of cartilage at the back of your tongue—the *epiglottis*—covers the trachea when you swallow. That way, food will not get into it.
21. The small intestine's inner surface is covered with fingerlike projections called villi. The villi are covered with even tinier projections called microvilli. Both the villi and microvilli increase the surface area of the small intestine.

Challenging Review Solutions

23. The atria only pump blood to the ventricles, whereas the ventricles have to pump blood to the lungs and body. The left ventricle has to pump blood to the body, so must generate more pressure than the right ventricle, which only has to pump blood to the lungs.



25. Blood is most oxygenated at the lungs, where oxygenation occurs. It stays at this high level of oxygenation as it returns to the heart and is pumped to the body.
27. If a person has high blood pressure, that person's heart is working hard in order to pump blood with a large amount of force. In order to do this, the heart builds more muscle, causing it to become enlarged. It is often the left side of the heart that becomes enlarged because the left side does the harder work of pumping blood to all the body tissues.
29. A hemoglobin molecule is made up of four smaller subunits. Each subunit contains a heme group that includes an iron atom at its center. It is this iron atom that binds to oxygen.
31. Carbon monoxide is toxic because it binds to hemoglobin even more strongly than oxygen binds. Extended exposure to carbon monoxide "fills up" hemoglobin, leaving no place for oxygen to bind.
33. The lungs consist of a set of branching tubules. Each tiny tubule ends in a small sac of air called an alveolus. The wall of each alveolus is made up of only a single flattened cell and is surrounded by a net of capillaries. The large numbers of alveoli and their thin walls allow for effective diffusion of oxygen from the lungs to the blood.
35. The diaphragm flattens when it contracts. This increases the volume of the thoracic cavity, which causes the air pressure inside it to decrease. As a result of this decrease in air pressure, air is pulled from outside the body into the lungs.
37. Changes in the air pressure in the thoracic cavity cause air to move in and out of the lungs. When the diaphragm and rib muscles contract, the volume of the thoracic cavity increases, causing air pressure to decrease. Then, air pressure is greater outside the lungs and moves into the lungs. This is inhalation. When the muscles relax, the volume of the thoracic cavity decreases, increasing air pressure there. Air pressure is then greater inside the lungs than outside, and air is pushed out of the lungs. This is exhalation.
39. The trachea is stiffened by rings of cartilage that keep it open.
41. The digestive enzymes in gastric juice (along with the churning of the stomach's muscular walls) convert food to a thick liquid called chyme. The acidity of gastric juice kills bacteria you swallow with food. Gastric juice also contains protective mucus that helps prevent the stomach from digesting its own tissues.
43. Yes, huge numbers of bacteria live in our large intestines. They eat the food we haven't been able to digest. They also make some key vitamins we need and prevent more dangerous bacteria from being able to survive there.

Apply & Discuss Solutions

45. No -- gas exchange occurs through diffusion, a form of passive transport that does not require energy from your cells.
47. Saliva contains a digestive enzyme that breaks down the starches found in crackers. Meat is largely protein, and the digestive enzymes that break down proteins are not found in your mouth; they are further down the digestive tract.

