Unit 4 Anatomy of Mammals

Answers to Unit 4 Preparation Questions
(Student textbook pages 260–61)

1. c

2. oxygen + glucose → carbon dioxide + water + energy

3. a) true  
   b) true  
   c) false: Cellular respiration generates carbon dioxide as a waste gas in both plant and animal cells.

4. b

5. a) Flowchart should show: individual → family/household → population of a city → population of a province/territory → population of a country  
   b) Flowchart should show: cell → tissue → organ → organ system → human

6. e

7. b

8. b

9. All cells need oxygen and nutrients for cellular respiration, which produces energy, and they need to rid themselves of carbon dioxide and other wastes. As a key part of the circulatory system, blood carries oxygen, carbon dioxide, nutrients, and waste to or from cells throughout the body, in all body systems. The lymphatic/immune system uses blood to carry the cells and molecules that defend the body against infection.

10. 

11. a) The respiratory system carries out gas exchange, so that oxygen is available for cellular respiration within the cells of digestive organs, and carbon dioxide waste from the digestive system is expelled from the body.
   b) The circulatory system transports oxygen from the lungs, through the bloodstream, to cells in other organ systems. The circulatory system also carries carbon dioxide waste from body cells back to the lungs.
   c) The digestive system breaks down food into molecules that can be used to provide energy to the cells of the muscular system, through the process of cellular respiration.

12. a) B, C, D, E, A  
   b) A cell is part of the tissues that make up an organ, and the organ is part of an organ system; organ systems make up a mammalian organism.

Chapter 8 Body Systems and Circulation

Answers to Pause and Check Questions
(Student textbook page 266)

1. digestive system, circulatory system, respiratory system, nervous system, endocrine system, skeletal system, muscular system, urinary system, integumentary system, immune and lymphatic systems, reproductive system

2. • The digestive system chemically breaks food down into molecules that the body can use for energy and as raw material for the cells to use. Then it eliminates the unusable portion as solid waste.  
   • The circulatory system carries oxygen from the lungs to the cells and then carries carbon dioxide from cells to lungs. It also transports food molecules from the digestive system to all cells in the body.  
   • The respiratory system brings oxygen into the lungs and then expels carbon dioxide.  
   • The nervous system detects, interprets, and responds to events occurring inside and outside the body.  
   • The endocrine system secretes molecules called hormones that guide the development, reproduction, and reactions of the body to stimuli.
• The **skeletal system** structurally supports the body. Muscles are attached to the ends of the bones.
• The **muscular system** moves the skeleton and organs of the body.
• The **urinary system** filters and eliminates waste molecules from the body.
• The **integumentary system** provides a waterproof barrier for internal organs, prevents disease-carrying organisms from penetrating the body surface, and assists in cooling the body.
• The **immune system** and **lymphatic system** protect the body from disease-carrying organisms that have entered the body.
• The **reproductive system** produces and transports egg cells and sperm cells that make it possible to have children.

(Student textbook page 267)

3. Homeostasis is the ability of the body to maintain constant internal conditions. For example, mammals maintain a constant temperature. The pH of the blood and tissues is also kept stable.

4. Sample answers: If a mammal's body temperature drops, the body organs cannot carry out their functions properly and the organism can eventually die. If the pH of the blood or body tissues is not correct, the chemical reactions critical to the body cannot continue at the proper speed.

(Student textbook page 269)

5. The blood carries oxygen and nutrients to all of the cells of the body and carries carbon dioxide and other waste products away from the cells to the lungs or kidneys.

6. red blood cells; white blood cells, platelets, and plasma

7. Red blood cells contain hemoglobin which binds oxygen and carries it through the bloodstream. White blood cells fight infection and disease. Platelets help prevent blood loss by assisting in the clotting of blood. Plasma is the fluid in which the blood cells, platelets, and nutrient molecules are suspended or dissolved.

(Student textbook page 271)

8. systemic circuit

9. pulmonary circuit: It carries oxygen-poor blood from the heart to the lungs where the blood picks up oxygen and eliminates carbon dioxide.

10. Veins carry blood to the heart whereas arteries carry blood away from the heart.

(Student textbook page 272)

11. The pressure created by the heart pushes blood into the arteries where the blood exerts a lot of pressure on the walls of the arteries. They must remain strong and elastic to tolerate the pulses of pressure.

12. The walls of the capillaries are only one cell thick. Substances can readily pass through the thin walls of the capillaries.

13. There is very little pressure in the veins so veins are located among skeletal muscles which, when they contract, help push blood back to the heart. Also, veins have valves which prevent blood from going backwards.

(Student textbook page 275)

14. 1. pumping blood; 2. keeping oxygen-rich blood and oxygen-poor blood separate; 3. keeping the blood moving in one direction

15. The coronary arteries carry oxygen-rich blood to the cells of the heart muscle itself.

16. The cardiac cycle consists of all the events that occur during one heartbeat. The cycle begins with the contraction of atria, which pushes blood into the ventricles. Then the ventricles contract, pumping the blood to the lungs and body.

(Student textbook page 281)

17. Causes of arrhythmia include smoking, drugs, caffeine, alcohol, and stress. It might also be caused by an inherited condition.

18. Leukemia is treated with chemotherapy (medication) and radiation. If severe, a bone marrow transplant is performed in which bone marrow is intentionally destroyed and replaced with healthy bone marrow that produces healthy blood cells.

19. Doctors check for problems involving vision, movement, or speech. They might also take an angiogram to look for blocked arteries in the brain.

(Student textbook page 283)

20. sphygmomanometer; blood pressure cuff

21. Systolic pressure is the pressure on the artery walls at the peak of the pressure surge after the ventricles contract. Diastolic pressure is the lowest pressure on the walls of the artery walls when the ventricles relax and the heart is resting between beats.
22. 110/75

23. Pressure receptors in the walls of the aorta detect the blood pressure. If it is too high, a message is sent to the smaller blood vessels to relax and widen, thus decreasing the blood pressure. If the blood pressure is too low, a message is sent to the smaller blood vessels to contract and become narrower, thus increasing the blood pressure.

(Student textbook page 284)

24. A pacemaker is implanted in the chest where it sends electrical signals to the heart to correct faulty electrical signals sent by the heart. The pacemaker’s signals prevent incorrect heart rhythms.

25. The da Vinci robot reduces the size of the surgical incisions (cuts) and reduces the time taken for the surgery. These improvements help reduce surgical pain and recovery time. They also reduce the patient’s chances of getting an infection.

(Student textbook page 285)

26. Answer should name any three of: integumentary system, skeletal system, muscular system, nervous system, endocrine system, respiratory system, lymphatic/immune system, digestive system, or the urinary system.

27. The circulatory system interacts with the immune system by transporting white blood cells to help defend the body from disease and injury.

Answers to Caption Questions

Figure 8.2 (Student textbook page 267): When the room becomes too cool, the thermostat senses the drop in temperature and turns the furnace on. The furnace heats the room until it becomes too warm. The thermostat senses the higher temperature and turns the furnace off. As a result, the room remains at a nearly constant, comfortable temperature.

Figure 8.7 (Student textbook page 272): Because artery walls are thick and strong, it would be difficult for a needle to penetrate the wall. When it does penetrate the artery wall, the pressure of the blood would be so high that there could be leakage of blood around the needle as well as after the needle was removed.

Figure 8.9 (Student textbook page 273): The ventricles are much more muscular than the atria because the ventricles must pump blood out of the heart and through a long series of blood vessels. The atria simply pump the blood through a valve into the ventricles.

Figure 8.10 (Student textbook page 274): If the septum did not separate the two ventricles, oxygen-rich and oxygen-poor blood would mix. Only part of the blood that would then go to the systemic circulation would carry oxygen and it would not be enough oxygen for the cells. As well, only part of the blood that would go to the lungs would be able to pick up oxygen and the process would not be efficient.

Figure 8.13 (Student textbook page 282): High blood pressure exerts excessive pressure on the artery walls and can damage them. Low blood pressure can result in a decrease of blood flow to vital organs such as the brain. In both instances, the heart must work harder than it would have to if blood pressure was in the normal range.

Figure 8.14 (Student textbook page 282): Pressing too hard on the artery that carries blood to the brain could reduce the blood supply to the brain, which would eventually harm brain cells. (Explanation: The arteries in the neck also contain pressure receptors. These receptors will sense the increased pressure when you try to take a pulse. In order to maintain homeostasis, the receptors send out a signal that leads to a reduced heart rate and lowered blood pressure. However, this could result in the heart rate and blood pressure dropping to dangerously low levels.)

Answers to Questions Reviewing Concepts 8.1 and 8.2

(Student textbook page 268)

1. The shapes (anatomy) of body organs have the characteristics that are necessary for them to perform their functions (physiology). Structure and function are very closely related.

2. A fork has a flat surface that can slip under and pick up some pieces of food. A fork also has tines that can push into other types of food and enable the user to pick up pieces. The tines are slightly rounded so they will not injure the mouth when the fork carries food into the mouth.

3. a) the muscular system
   b) the digestive system
   c) any of the following: integumentary system; immune system and lymphatic system.
   d) either of the following two: the nervous system; the endocrine system.

4. The circulatory system carries nutrients from the digestive system and oxygen from the respiratory system to all of the cells of the body. The nutrients and oxygen are used in chemical reactions inside the cells. These reactions, such as cellular respiration, provide the cells with energy.
5. Sample answer: The glands of the endocrine system secrete chemical signals called hormones to different parts of the body. The circulatory system carries these chemicals to the appropriate parts of the body.

6. Sample answers: (1) The integumentary system prevents most disease-causing organisms from getting inside the body. If such organisms do manage to get into the body, the immune system seeks out and destroys them. (2) The nervous system detects information from the outside environment about, for example, something hot. It then sends messages to the muscular system, which moves the body away from the hot object.

7. Shivering is a rapid contraction of muscles, which generates heat. The heat warms the body to counteract the cold. When more blood than usual flows near the surface of the skin, it can release heat through the skin to the external environment and cool the body to counteract the excess heat in the house. Both of these examples are ways that the body maintains a constant internal temperature regardless of the external conditions. In each case, the response of the body causes the opposite (negative) effect that the environment was causing.

8. If any condition, such as temperature, blood pH, ATP concentration, blood sugar level, or blood pressure, is not maintained within the limits that allow the functioning of organ systems, the body system(s) will begin to function poorly or not at all. When one body system ceases to function, it will prevent other systems from functioning correctly until the life of the organism cannot be sustained.

9. If the temperature of a room or house changes, the thermostat senses it and starts a series of events which cause the temperature to change in the opposite direction. That is, the change in temperature is the negative of whatever it was previously.

10. The body is being maintained at a constant temperature, regardless of the external temperature. Maintaining a constant temperature is one of the ways in which the body carries out homeostasis. In this example, the organ that is functioning like a thermostat is the hypothalamus. When the temperature is too high or too low, the hypothalamus initiates mechanisms that cause the temperature to go in the opposite (negative) direction. This is why the overall process is called negative feedback.

Answers to Questions Reviewing Concepts 8.3, 8.4, 8.5, and 8.6

(Student textbook page 276)

1. Red blood cells, white blood cells, and platelets are found in the blood.

2. a) The two circuits in the circulatory system are the systemic circuit and the pulmonary circuit.
   b) The pulmonary circuit carries blood to and from the lungs.
   c) The systemic circuit carries blood to and from all other body cells.

3. The walls of arteries are thick and elastic and contain muscle tissue, which allows them to stretch under the blood pressure generated by the heart.

4. When the heart beats, it expels blood in pulses of high pressure. If arteries could not expand, the pressure would damage them. The arteries must be able to expand when the pressure increases and relax and push the blood forward between the pulses of pressure.

5. a) Venn diagram should show:
   Arteries only: muscle layer is very thick; layer of connective tissue is very thick; walls are very strong and elastic
   Veins only: thin muscle layer; thin connective tissue layer
   Capillaries only: wall is only one cell thick; oxygen, carbon dioxide and nutrients can diffuse through walls
   Arteries and veins: has a layer of muscle cells; outer layer of connective tissue
   Arteries, veins, and capillaries: lined with special cells

   b) Oxygen, nutrients, carbon dioxide, and wastes enter and leave the capillaries by diffusion. In order for this process to be efficient, the capillary walls must be very thin. Because the capillary cells are only one cell thick, they are thin enough for materials to pass through easily.

6. The two chambers of the heart that pump oxygen-poor blood from the body cells to the lungs are completely separated from the two chambers that pump oxygen-rich blood from the lungs to the body, via the septum.

7. superior vena cava → right atrium → right ventricle → lungs → left atrium → left ventricle → aorta

8. a) Answers could cite the fact that highways, main roads, and side roads are about transport (as are blood vessels), or that they are a series of connected routes (as are blood vessels), or that they, like blood vessels, carry smaller loads on smaller routes as the
distance from the main highway increases and the final destination is reached.

b) Analogies need to be related to transport and reflect a broad network of distribution. Sample answer: A water supply network for a city or town is an analogy for blood vessels. A pumping station generates pressure that sends out clean water through a large pipe. This large pipe has many connections to smaller and smaller pipes which eventually supply water to every building in the city or town. The sewage system could be compared to the veins. Small pipes carry sewage away from each individual building. These pipes combine with others and finally carry the sewage to a treatment plant.

9. Arteries have thick, strong walls. It would be difficult to penetrate an artery with a needle and when penetrated, the blood might leak out due to the high pressure in arteries. It would also be difficult to stop the leakage of blood after the needle was removed.

10. Answer should reflect some or all of the following. If capillaries became as large as veins (even the smaller veins):
   • it is unlikely that they would be able to exchange oxygen and carbon dioxide efficiently because of the lower surface area to volume ratio
   • the capillaries would become too big and take up too much space compared to the other organs. And if you reduced the number of capillaries so they wouldn’t take up so much space, it would result in not enough blood flow to tissues.
   • alternatively, the parts of the body currently supported by capillaries would have to become much larger than they are now in order to accommodate the extra space taken up by the enlarged blood vessels.

11. The rhythmic beating of the heart is initiated by electric signals within the heart muscle itself. If the heart is not beating properly or is not beating at all, an external electrical signal can overpower the internal signals and cause the heart to restart its normal cycle.

Answers to Questions Reviewing Concepts
8.7, 8.8, 8.9, 8.10, and 8.11
(Student textbook page 287)

1. Student answers should refer to choices related to diet, exercise, and/or avoiding risky behaviour such as smoking. Some may also refer to the need for adequate sleep.

2. A pacemaker sends electrical signals to the heart to correct faulty signals.

3. a) atherosclerosis
   b) The opening in the artery is much smaller than that of a healthy artery, which restricts blood flow. Consequently, the tissues fed by this artery do not get enough oxygen.
   c) A person with atherosclerosis will easily become short of breath and feel fatigued.

4. Venn diagram should show:
   • Systolic pressure only: highest blood pressure; stretches artery walls; healthy level is near 120 mmHg
   • Diastolic pressure only: lowest blood pressure; allows walls to contract; healthy level is near 80 mmHg
   • Systolic pressure and Diastolic pressure: refer to blood pressure in arteries; measured in mmHg

5. a) pacemaker, balloon angioplasty, da Vinci surgical robot
   b) pacemaker: A pacemaker is implanted in the chest and sends electrical signals to the heart to correct irregular beats.
      balloon angioplasty: A deflated balloon on a tube is inserted into the blocked artery. When inserted, the balloon is inflated, pressing the plaque toward the artery wall and opening the clogged artery so blood can flow.
      da Vinci surgical robot: This robot has arms that hold surgical instruments that are inserted into small cuts in the skin. The arms are manipulated from a machine outside the body that allows the surgeon to perform the surgery.
   c) pacemaker: It corrects arrhythmias.
      balloon angioplasty: It opens clogged arteries, or atherosclerosis.
      da Vinci surgical robot: It can perform heart surgery or several other types of surgery through very small openings in the patient’s chest.

6. the integumentary system and the immune system/the lymphatic system

7. Sample answers: No. People will still order what they want, even if it isn’t healthy. This is the reason that people need to learn about heart and circulatory illnesses.
   Yes. As people become more aware of how much fat and salt are in the foods they eat, they will make better choices.

8. a) stroke
   b) A paramedic would test the person’s speech and vision.
9. Possible symptoms: feeling light-headed and tired; becoming dizzy; fainting; experiencing chest pain. The reason for these symptoms is that the brain is not getting enough oxygen.

10. Disagree. Your pulse is an expression of your changing (pulsating) blood pressure, caused by the contraction and then relaxation of your heart as it is beating.

11. By the time your blood has passed through your capillaries and reached your veins, the pressure is very low. As well, there is no pulsating of the blood flow in your veins.

12. atherosclerosis

13. The answer could depend on whether the student lives in an area where there is a large or small population. If robot-assisted surgeries are commonly done, it might be worth the cost, whereas if very few of these surgeries are done, it would not be worth the cost. The student should consider these ideas.

Answers to Chapter 8 Review Questions
(Student textbook page 295)

1. b 5. d 9. d 13. A
2. c 6. a 10. b 14. E

17. vein

18. “Capillaries allow substances to be exchanged between the blood and body cells.”

19. right atrium, right ventricle, left atrium, left ventricle

20. a) Valves prevent the blood from flowing backwards. b) Valves are found in the heart and in the veins.

21. a) oxygen-rich b) both c) oxygen-poor

22. Step 1. Blood is flowing into the atria.
   Step 2. The atria are contracting, pushing blood into the ventricles.
   Step 3. The ventricles are contracting and pushing blood into the aorta and the pulmonary artery.

23. a) Nicotine causes the blood vessels to constrict, raising the blood pressure. This makes the heart beat more strongly. As well, smoking can interfere with the contraction and relaxation of the heart.
   b) Stimulants can cause an irregular heartbeat and thus damage the heart muscle. Drugs given intravenously can damage the veins and cause blood clots to form and thus impair circulation.
   c) Too little activity can reduce the effectiveness of contractions. Subsequent exercise can stress the heart. Weight gain adds extra stress to the heart.

24. a) arrhythmia
   b) The caffeine in the tea is a stimulant and can increase the heart rate.

25. A blood pressure of 112/70 means that the systolic pressure, or the highest pressure in the cycle, is 112 mmHg (millimetres of mercury), and the diastolic pressure, the lowest pressure in the cycle, is 70 mmHg.

26. Disagree. “Diastolic pressure is the lowest blood pressure that occurs in arteries when the ventricles relax.”

27. When you feel your wrist, you feel a brief push on your fingers. That pressure is the systolic, or peak of pressure. In between the pushing sensation, you do not feel any specific pressure. This is the diastolic pressure, or lowest pressure caused by the cardiac cycle.

28. arrhythmia; a pacemaker sends electrical signals to the heart to correct arrhythmia

29. systemic circuit; The blood flow to the legs is part of the systemic circuit, in which oxygen-rich blood is carried to all of the body cells.

30. The person should avoid lifestyle choices that increase stress on the weakened heart muscle. For example, smoking increases heart rate and blood pressure; drug and alcohol use can lead to arrhythmia; unhealthy eating can result in high blood pressure and atherosclerosis. Combined with little physical activity, an unhealthy diet leads to weight gain, which puts additional stress on the heart.

31. a) Normal white blood cells fight disease. In leukemia, there are lots of white blood cells, but they are abnormal and cannot function properly to fight disease.
   b) An excess of white blood cells will reduce the number of red blood cells, which reduces the amount of oxygen the blood can carry. Reduced oxygen levels make a person feel tired.

32. The farther blood gets from the heart, the lower the blood pressure. The values of the systolic and diastolic pressures would be different in locations other than the upper arm. It is important to measure blood pressure in the same place so the results can be compared to the normal, healthy values among individuals.
33. a) The circulatory system picks up nutrients from the digestive system and delivers them to all body cells. It transports nutrients to the cells where they are used for energy and cell maintenance. The circulatory system cleans waste products from the cells and removes them. As a result, the level of nutrients in the blood, and therefore, in the cells remains relatively constant. 

b) The circulatory system picks up oxygen from the respiratory system and delivers it to the cells. Oxygen enters the cells and is used to help cells get energy from nutrients. The circulatory system picks up carbon dioxide from the cells and carries it back to the respiratory system, where it is expelled from the body. In this way, the level of oxygen in the blood, and therefore, in the cells remains relatively constant. Gas exchange helps to keep blood pH constant as well.

34. a) and b) 

35. Skit should include the following points:
- red blood cells carry oxygen
- red blood cells reach every organ and cell in the body
- white blood cells fight disease
- the number of white blood cells increases when an infection occurs.
- platelets rush to the scene of an injury and create a clot to stop bleeding.

36. Venn diagram should show:
* Pulmonary circuit only: arteries carry oxygen-poor blood; passes through lungs; veins carry oxygen-rich blood back to the heart.
* Systemic circuit only: arteries carry oxygen-rich blood; has pathways to every living cell in the body; veins carry oxygen-poor blood back to heart.
* Pulmonary and systemic circuit: contain arteries, capillaries, and veins; start at a ventricle and return to an atrium of the heart.

37. The blog should mention most of the following points:
- moving from a vein with a rather smooth flow into the right atrium where blood collects
- being pushed into right ventricle with a lot of turbulence
- large pressure while being squeezed out of the right ventricle into pulmonary artery
- going into a lung to get rid of carbon dioxide and pick up oxygen
- smoothly flowing back into left atrium
- being pushed into left ventricle where there is a lot of turbulence
- intense pressure when left ventricle contracts while being thrust into aorta
- “seeing” many possible pathways
- describing the particular part of the body that the cell eventually passes through
- going through the very narrow capillary and releasing oxygen and picking up carbon dioxide
- joining other red blood cells in the veins while being carried back to the heart.

38. The e-mail should discuss the negative effects of high-fat junk food on the circulatory system. For example, high-fat junk food can lead to fatty deposits inside blood vessels (atherosclerosis). These deposits result in the narrowing or blockage of blood vessels. Blood flow to the body becomes limited. This can lead to serious complications such as strokes and heart attacks. High-fat junk food also leads to weight gain, which stresses the heart and increases the risk for cardiovascular diseases.
39. If the body does not have enough iron, it cannot make enough hemoglobin for the red blood cells. The red blood cells will not be able to carry the normal amount of oxygen. Decreased amounts of oxygen can affect all cells. For example, muscles will get tired faster. The person would probably feel sleepy because the brain was not getting enough oxygen. All of the organs would probably function more slowly than they normally do.

40. The technician is measuring the person's blood pressure as part of a test of the person's circulatory health.

41. The explanation should include the following:
   - The high number is a measure of the highest pressure in the blood vessels leaving the heart.
   - The low number is a measure of the lowest pressure in those blood vessels.
   - 110/70 is a healthy blood pressure because it falls within the normal range expected for a healthy person. It is neither too high nor too low.

The student could use an analogy for pressure. For example, the student might use a long narrow balloon and squeeze one end and show how the pressure increases in other parts of the balloon.

42. a) Normally, valves in the veins keep blood flowing toward the heart. The valves close to prevent the blood from flowing back in the wrong direction. When a valve breaks down, the blood might pool and cause the veins to stretch. Varicose veins could cause bulges in the skin. This causes pain.

   b) When a person is standing, the blood in the leg veins is moving against the force of gravity. This situation causes a lot of pressure on the valves, and they can break down. This is why varicose veins are visible in the back of the legs, especially at the knee.

43. Blood is under great pressure in the aorta because the aorta is the largest artery in the body, carrying blood to all other body parts, and because it receives blood directly from the heart. Therefore a burst aorta results in severe bleeding—blood would be pushed out through the opening very rapidly. Blood would leave the circulatory system rather than being pumped to the body cells. Cells and organs would deteriorate rapidly without oxygen.

44. Answer could include: exercising regularly, eating a balanced diet, not smoking, maintaining a healthy weight, avoiding high-fat foods, or getting enough sleep. Answers could also link certain behaviours to specific health conditions: For example, smoking, and alcohol and drug use can cause arrhythmia so it is healthier to avoid them. A healthy diet and exercise both reduce the risk of conditions such as atherosclerosis.

45. Answers are not limited to any two of:
   - An external pacemaker that had to be wheeled on a cart would severely limit the patient's ability to go anywhere and participate in any activities, particularly if it was plugged into a wall.
   - A plugged-in pacemaker would be vulnerable to power outages.
   - The patient would have to be near someone who knew how to use the instrument and to service it.

46. a) The artificial artery must be able to carry blood under high pressure and connect to the heart and other blood vessels without leaking.

   b) The material for the artificial artery must be able to stretch and return to its original shape. It would have to be strong enough to undergo constant changes in pressure without wearing out.

   c) The artificial artery could be used to replace or bypass an artery that is blocked with cholesterol. It could replace an artery that has an aneurism, which is a weak spot in an artery wall.

   d) People might have less fear of circulatory problems because there would be a way to treat them. However, there could be a negative aspect because people might not feel the need to maintain a healthy lifestyle.

Chapter 9 The Respiratory System

Answers to Pause and Check Questions
(Student textbook page 300)

1. The main function of the human respiratory system is to carry out gas exchange (move oxygen into the body and carbon dioxide out).

2. Air containing oxygen is inhaled through the nose and/or mouth into the lungs; oxygen moves from the lungs into the blood via diffusion; carbon dioxide moves from the blood into the lungs via diffusion; air containing carbon dioxide is exhaled through the nose and/or mouth.

(Student textbook page 302)

3. Air enters through the nasal cavity and sometimes through the mouth. It then passes through the pharynx, past the epiglottis, then through the larynx, and the trachea.
4. The pharynx is shared by the respiratory system and the digestive system.

5. Air passes from the trachea through the bronchi, and then the bronchioles, and finally into the alveoli of the lungs.

6. Gas exchange takes place in the alveoli, where oxygen passes through the walls and into the capillaries while carbon dioxide leaves the capillaries and passes into the alveoli.

7. An injured lung may still be able to function because each lung has more than one lobe. If one lobe is damaged, the other lobes can still function because each lobe is served by its own portion of the bronchiole network.

(Student textbook page 305)

8. The process of diffusion is responsible for the exchange of gases in the lungs and body tissues. The differences in concentration of oxygen or carbon dioxide on either side of a cell membrane result in diffusion of gas across the membrane from high concentration to low concentration.

9. Red blood cells carry 99% of the oxygen and 95% of the carbon dioxide back and forth between the lungs and body cells.

10. Sensory cells detect the carbon dioxide levels in the blood. Nerve cells in the brain then trigger an increase or a decrease in the breathing rate, depending on whether the carbon dioxide concentration in the blood is too high or too low.

(Student textbook page 306)

11. When the diaphragm contracts, or moves downward, it causes the lungs and the chest cavity to expand. This causes the air pressure in the lungs to be lower than that of the atmosphere outside the body, so air moves into the lungs.

12. When the diaphragm relaxes, or moves upward, it reduces the volume of the lungs. The air pressure in the lungs becomes greater than that outside the body, so air moves out of the lungs.

13. When the volume of the lungs is changed by either contraction of the diaphragm and rib muscles or their relaxation, the change in capacity (size) changes the air pressure inside the chest cavity. When air pressure in the chest cavity differs from air pressure outside the body, air flows from the higher pressure to the lower pressure.

(Student textbook page 309)

14. Factors such as exposure to diseases or pollution in the environment and a person’s genetic background are difficult or impossible for an individual to control.

15. People can control factors that involve choices, such as the choice to smoke or stop smoking.

16. a) laryngitis  
    b) pneumonia, cystic fibrosis, and lung cancer

(Student textbook page 310)

17. In the early stages, lung cancer is contained within the chest cavity and can be surgically removed. If it has spread to places outside of the lung cavity, surgery might not be able to reach and remove it all. Then it has to be treated with chemical or radiation therapy or both.

18. arterial blood gas test, listening to the chest with a stethoscope, pulmonary function test

Answer to Caption Question

Figure 9.5 (Student textbook page 305): This is a negative feedback loop because the nervous system (sensor) has detected a change that upsets a balanced state (a high concentration of carbon dioxide is disrupting homeostasis) and signals the brain (the control centre) to activate the lungs to inhale and restore the level of oxygen needed to maintain homeostasis. Similarly, when the concentration of carbon dioxide is low, the brain makes breathing slow down. The negative feedback loop can be identified by how it restores homeostasis: it opposes the changes that have taken place in the body.

Answers to Questions Reviewing Concepts 9.1, 9.2, 9.3, and 9.4

(Student textbook page 307)

1. Breathing is necessary to obtain oxygen that cells need for cellular respiration. Breathing is also necessary to remove carbon dioxide, which is a waste product of cellular respiration.

2. The upper respiratory tract consists of the nose (nasal cavity), mouth, the pharynx, the epiglottis, the larynx, and the trachea.

3. The lower respiratory tract consists of the the lungs, bronchi, bronchioles, and alveoli. (Answers may also mention the rib muscles and the diaphragm, which support the function of the lower respiratory tract.)
4. a) 1. inhalation; 2. diffusion of oxygen from lungs into the blood; 3. diffusion of carbon dioxide into the lungs from the blood; 4. exhalation.

b) inhalation: air enters the body through the nose and mouth; hairs in the nostrils catch dust and bacteria as air passes into the nasal cavity and it is warmed, moistened, and cleaned by sticky mucus. From the nasal cavity, air moves to the pharynx (throat) and then through the larynx and trachea for further cleaning before it arrives in the lungs. Inside the lungs, the air passes through the bronchi, to bronchioles and then to the alveoli

diffusion of oxygen from lungs into the blood: oxygen in the air moves through the walls of the alveoli into the capillaries and their red blood cells; oxygen moves due to the difference in the concentration gradient (it moves from a higher concentration of oxygen to a lower concentration of oxygen)

diffusion of carbon dioxide into the lungs from the blood: carbon dioxide moves from the blood in the capillaries to the air in the alveoli due to the difference in the concentration gradient of carbon dioxide

exhalation: carbon dioxide in the air in the alveoli follows the reverse path back out through the alveoli, bronchioles, bronchi, trachea, larynx, pharynx, and nasal cavity

Answers may also note that sensors in the body detect an increase in levels of carbon dioxide to trigger respiration. In addition, students can describe how the diaphragm and the rib muscles contract during inhalation to expand the chest cavity and lower the air pressure to allow air to enter the body. During exhalation the diaphragm and rib muscles relax to contract the chest cavity, increase the air pressure in the chest, and expel the air.

5. During strenuous exercise, muscle cells need ATP to provide energy for muscle contraction. Breathing faster brings more oxygen to these cells, so cellular respiration occurs faster and provides a rapid supply of energy to the cells. (This can also be looked at in terms of homeostasis. When cellular respiration increases, more carbon dioxide is produced and released into the blood. Sensory cells respond to the high carbon dioxide concentration and send a signal to the brain's nerve cells. The brain adjusts the breathing rate to decrease the concentration of carbon dioxide.)

6. Structures and Events in Inhaling and Exhaling

<table>
<thead>
<tr>
<th></th>
<th>Inhaling</th>
<th>Exhaling</th>
</tr>
</thead>
<tbody>
<tr>
<td>air movement</td>
<td>into lungs</td>
<td>out of lungs</td>
</tr>
<tr>
<td>diaphragm and rib muscles</td>
<td>diaphragm moves downward, ribs move up and out</td>
<td>diaphragm moves upward, ribs move down and in</td>
</tr>
<tr>
<td>chest cavity</td>
<td>expands</td>
<td>contracts</td>
</tr>
<tr>
<td>air pressure</td>
<td>decreases (causing air to move into lungs)</td>
<td>increases (causing air to move out of lungs)</td>
</tr>
<tr>
<td>lungs</td>
<td>expand, taking in O₂-rich air</td>
<td>contract, releasing CO₂-rich air</td>
</tr>
</tbody>
</table>

7. Cilia help trap debris as air moves through the trachea, sweeping this debris away from the lungs. If cilia are damaged, debris can pass more freely through the trachea and into the lungs where it can cause damage.

8. a) Answers could cite exercise such as running and/or sport activities or fight-or-flight responses to danger or fear.

b) Increased activity increases cellular metabolism, which will increase the amount of carbon dioxide in the blood. Sensors detect the high carbon dioxide and send messages to the brain, which will then send messages to the body to breathe faster. The increased breathing rate will increase the rate at which carbon dioxide is breathed out and oxygen is breathed in. This will restore homeostasis by bringing the oxygen and carbon dioxide levels back toward the normal levels.

9. Just as the trunk of a tree splits into smaller and smaller branches with leaves on the smallest branches, the trachea splits into the two bronchi, and then smaller and smaller bronchioles branch off, each ending at an alveolus.

10. a) Supporting answers may note that this is a good metaphor, since both grapes and alveoli are small spheres arranged in clusters, attached to branch-like structures—a branched stem in the case of grapes, and branched tubes, or bronchioles, in the case of alveoli.

Answers that disagree with the metaphor’s appropriateness may note that alveoli are hollow, gas-filled spheres while grapes are filled with semi-solid matter. Also, alveoli are surrounded by a network of capillaries, while grapes are covered only by a thin layer of skin. Finally, alveoli are contained within the lungs, while grapes are not protected by an outer structure.
b) Alternatives can be any fruit or vegetable that features a branched structure with elements that are smaller and smaller; it should end with clusters of small spheres. Samples: Broccoli has a branched appearance, with a thick stalk (like the trachea) separating off into thinner and thinner stems (like the bronchus and bronchioles), ending in clusters of tiny, green, roundish structures that resemble alveoli. The tiny, thin-skinned, fluid-filled spheres found in a pomegranate resemble the alveoli. The flesh and outer skin of the pomegranate are comparable to the lung tissue surrounding the alveoli. Raspberries are another good example.

11. The characteristic that enables gas exchange between alveoli and capillaries is the very thin wall of each structure, consisting of a single layer of cells. Gases can diffuse easily through this layer, crossing the cell membrane once to enter the cell and once to exit the cell.

**Answers to Questions Reviewing Concepts 9.5, 9.6, and 9.7**
(Student textbook page 313)

1. The condition is **chronic** because it has lasted for a long period of time.

2. a) lower respiratory tract  
   b) A sputum test can be used to test for bacteria that cause such diseases as pneumonia or tuberculosis or to test for cancer cells.

3. a) **circulatory system**: The respiratory system exchanges oxygen and carbon dioxide with the circulatory system, keeping levels of these gases in the cells constant; it also controls blood pH.  
   b) **nervous system**: Sensors of the nervous system detect carbon dioxide levels in the blood and send messages to the brain. The brain's nerve cells respond by increasing or decreasing the rate of respiration as needed to bring oxygen and carbon dioxide levels back to normal.

4. a) The arterial blood gas test determines the amount of oxygen and carbon dioxide in the arteries that feed the systemic circuit.  
   b) The arterial blood gas test can be used to monitor asthma and cystic fibrosis.

5. a) laryngitis  
   b) **main features**: inflammation of the larynx, which causes a raspy or hoarse voice  
   symptoms: sore throat, fever, hoarseness or loss of voice  
   how it is diagnosed: throat is inspected for inflammation; samples of throat tissue are examined for infection from bacteria  
   how it is treated: resting the voice and drinking fluids to ease inflammation; antibiotics (if infection is caused by bacteria)  
   how it can be prevented: good hygiene, resting the voice, avoiding cigarette smoke

6. Students can choose one of the following:  
   a) **pneumonia**  
   b) **main features**: an inflammation of alveoli, which decreases gas exchange and reduces oxygen levels in the blood  
   symptoms: fever, chills, cough, shortness of breath, tiredness  
   how it is diagnosed: chest X rays; collect and test sputum samples for bacterial or viral infection  
   how it is treated: antibiotics (if infection is caused by bacteria); anti-viral medicine (if infection is caused by a virus); drinking fluids and breathing warm air to reduce symptoms; hospitalization may be required in some cases  
   how it can be prevented: Since the bacteria and viruses that cause most cases are contagious, good hygiene is the best way to avoid pneumonia.

7. a) **cystic fibrosis**  
   b) **main features**: a build-up in the lungs of thick, sticky mucus that makes it hard to clear out both the mucus and harmful bacteria it contains; excess mucus also prevents the pancreas from secreting digestive enzymes  
   symptoms: pneumonia infections, chronic cough, shortness of breath  
   how it is diagnosed: blood test on newborn babies; DNA test of blood or saliva of parents to see if they carry the gene for CF; test of sweat to see if it is saltier than normal
how it is treated: taking antibiotics each day, as well as drugs that open up airways and thin out mucus; inhalation therapy and exercise
how it can be prevented: Since CF is a genetic disorder, it cannot be prevented.

a) lung cancer
b) main features: abnormal cells form in the lungs and grow uncontrollably, creating a large mass called a tumour
symptoms: shortness of breath, chest pain, loss of appetite, chronic cough that may contain blood, tiredness, chest infections
how it is diagnosed: chest X rays, CT scans, and tests on sputum and blood to look for evidence of tumours; samples of lung tissue also may be examined
how it is treated: radiation therapy to destroy cancer cells; chemotherapy (drugs) to destroy cancer cells; surgery to remove tumours
how it can be prevented: stop smoking, avoid second-hand smoke

7. Paragraphs should briefly note the facts of lung cancer and respiratory health as presented in the student textbook. The science linking tobacco use and lung cancer is not in dispute and questioning this should not be part of the answer. Statements in favour of or against advertising tobacco products must include a supporting argument.

8. Answers should include:

a) You have two lungs that fill the inside of your chest. When you breathe in, the lungs fill with fresh air. Your body uses oxygen from that air to help make energy. When you breathe out, your lungs get rid of a waste gas called carbon dioxide. The exchange of oxygen and carbon dioxide happens in your lungs. To work properly, your lungs must be very soft and flexible. The surface must be very clean so oxygen can go in and carbon dioxide can go out.

b) Smoking damages the surface of the airways and the lungs, killing tiny hairs that clean the air on its way to the lungs and causing the growth of cancer cells in the lungs, which do not help your body get oxygen. The white areas of the lung in photo B are cancer cells. There are more cancer cells than healthy cells in the lung on the right, which means that that lung won’t be very effective in bringing oxygen into the body.

Answers to Chapter 9 Review Questions
(Student textbook pages 319)

3. b  7. a  11. B  15. C

17. The main function of the human respiratory system is to carry out gas exchange (move oxygen into the body and carbon dioxide out).

18. 1: inhalation: Air enters the body through the nose and mouth. From the nasal cavity, air moves to the pharynx (throat) and then through the larynx and trachea before arriving in the lungs. Inside the lungs, the air passes through the bronchi, to bronchioles, and then to the alveoli.

2: diffusion of oxygen from lungs into the blood: Oxygen in the air moves through the walls of the alveoli into the capillaries and their red blood cells due to the difference in the concentration gradient (it moves from a higher concentration of oxygen to a lower concentration of oxygen)

3: diffusion of carbon dioxide into the lungs from the blood: carbon dioxide moves from the blood in the capillaries to the air in the alveoli due to the difference in the concentration gradient of carbon dioxide

4: exhalation: carbon dioxide in the air in the alveoli follows the reverse path back out through the alveoli, bronchioles, bronchi, trachea, larynx, pharynx, and nasal cavity

Answers may also note that sensors in the body detect an increase in levels of carbon dioxide to trigger an inhalation. In addition, students can describe how the diaphragm and the rib muscles contract during inhalation to expand the chest cavity and lower the air pressure to allow air to enter the body. During exhalation, the diaphragm and rib muscles relax to contract the chest cavity, increase the air pressure in the chest, and expel the air.

19. During strenuous exercise, muscle cells need ATP to provide energy for muscle contraction. Breathing faster brings more oxygen to these cells, so cellular respiration occurs faster and provides a rapid supply of energy to the cells. Carbon dioxide is a waste product of these energy-generating reactions. This gas is breathed out in order to eliminate it from the body.
20. Mucus is found in the nasal cavity and in the trachea. It helps trap dust particles, bacteria, and debris, preventing them from travelling into the lungs.

21. a) The diagram shows inhaling; the diaphragm is moving downward and the rib cage is moving upward and outward, which is what happens during inhalation.
   b) Diagram for exhalation should show the rib cage moving down and in and the diaphragm moving up.

22. a) Most oxygen—about 99%—is transported by red blood cells. The remaining 1% is dissolved in plasma, the fluid portion of blood.
   b) Most carbon dioxide—about 95%—is transported by red blood cells. The remaining 5% is dissolved in the plasma.

23. a) A chronic respiratory disorder is a long-term disorder that persists (i.e., is present for a long time) or recurs periodically throughout the life of the person with the disorder. An acute respiratory disorder is a severe, sudden-onset, usually short-term occurrence brought on by injury, infection, or disease. Classification of the condition often depends on its progression in the patient.
   b) Chronic respiratory disorders include asthma, cystic fibrosis (CF), chronic bronchitis, or emphysema. Acute respiratory disorders include laryngitis, acute bronchitis, pneumonia, tuberculosis, blood clot in the lungs, and lung cancer.

24. MRI stands for magnetic resonance imaging and uses magnetic fields to form cross-section images of bones and soft tissues in the body. MRIs can be used to diagnose blood clots in the lungs, lung cancer, or cystic fibrosis.

25. The respiratory system and the circulatory system interact to complete the exchange of oxygen and carbon dioxide gases and regulate blood pH levels. The blood vessels and blood cells of the circulatory system transport gases to the lungs of the respiratory system to perform gas exchange. Breathing speeds up or slows down to increase or decrease the rate of gas exchange, as needed to maintain homeostasis. Breathing rate helps to control levels of oxygen, carbon dioxide, and ATP in cells and in the bloodstream. Controlling carbon dioxide levels helps to control blood pH levels. Breathing speeds up to increase oxygen levels and decrease carbon dioxide levels, or slows down to decrease oxygen levels and increase carbon dioxide levels in the blood as needed to maintain homeostasis.

26. The larynx, which contains the vocal cords, is located above the trachea. If a tube were inserted into a person’s trachea, it would allow air to move in and out of the lungs without passing through the vocal cords. This would prevent any vibration of the vocal cords and thus prevent speech.

27. a) The trachea is the wrong tube for swallowed food, since it is a passageway for air to enter the lungs.
   b) The epiglottis prevents food from entering the trachea.

28. The lungs are vital to the body because of their role in gas exchange, which supplies oxygen to and disposes of carbon dioxide waste from cellular respiration in body cells. When cancer attacks the lungs, this process is harmed; if the cancer is not stopped, lung function is destroyed and the patient cannot survive. Students may also note that the lungs are deep within the body and that by the time symptoms of lung cancer are obvious, the cancer may be well advanced and difficult to treat.

29. A sputum test uses mucus from the lower respiratory tract. Sputum is tested for evidence of bacteria or viral infection. A blood clot in the lungs must be seen, and a sputum test would not detect it.

30. a) The prevalence of smoking among Canadians aged 15 to 19 years was about 28% in 1999, compared to about 12% in 2010.
   b) Answers should include the increase in awareness of the effects of smoking on respiratory health. They might mention that the learning occurred in biology classes, through warning labels on cigarette packages, television and radio commercials, or government programs to encourage Canadians to quit smoking.

31. If airways are constricted, breathing will be difficult, and the amount of air entering and leaving the lungs will be reduced. Less oxygen will enter the bloodstream; therefore, less oxygen will be available to body cells for cellular respiration. Since the amount of carbon dioxide leaving the body will also be reduced, there will be a build-up of carbon dioxide in the bloodstream and in body cells.

32. a) Running requires faster and more strenuous movement of leg muscles than walking does, so muscle cells need more energy for running than for walking. Breathing is faster during running to provide a greater supply of oxygen for cellular respiration, so ATP can be supplied to the muscles at a faster rate. In addition, carbon dioxide is produced more rapidly and must be removed faster.
b) Males, on average, breathe a larger amount of air than females.

c) There seems to be a greater difference in amount of air breathed between genders in more strenuous activities such as running and doing yard work. This is because males are, on the average, taller and heavier than females, and thus require more energy to fuel strenuous activity. (They also likely have larger lungs.) Additional energy comes from ATP production via cellular respiration, which requires an increased oxygen supply.

d) Age, overall health, weight, and lifestyle factors (smoking, exercise) could all affect the amount of air breathed.

33. As shown in the diagram below, the structures of the lower respiratory tract resemble a tree. The trachea resembles the trunk of a tree. The trachea splits into two smaller tubes called bronchi, which resemble two large branches in a tree. The bronchi divide further into smaller and smaller tubes, called bronchioles, which resemble smaller branches and twigs on a tree. Finally, the bronchioles end in clustered spherical air sacs called alveoli, which resemble fruit or leaves on a tree.

34. **Upper Respiratory Tract**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>nasal cavity</td>
<td>warms, moistens, and filters air entering the body</td>
</tr>
<tr>
<td>pharynx</td>
<td>conducts air toward the larynx</td>
</tr>
<tr>
<td>larynx</td>
<td>contains the vocal cords</td>
</tr>
</tbody>
</table>

35. a) Answers should clearly state an opinion on the effectiveness of warning labels and state why the opinion is held. Reasons will likely touch on theories related to communication and/or human behaviour.

b) The label or ad campaign should include both text and graphics. Text should deal with how smoking affects the respiratory system, what disorders or diseases can result from smoking, and could include information about ways to stop smoking. Graphics could illustrate the respiratory system, evidence of disease, or personal stories.

36. This slogan emphasizes how important the role of the lungs is to a person’s overall health. It suggests that maintaining good respiratory health should be a priority for everyone. Of course, if you can't breathe at all, you will die.

37. When people hold their breath, carbon dioxide levels in the blood build up as a result of cellular respiration. When carbon dioxide cannot be expelled from the lungs by breathing, its level in the blood can become toxic. When carbon dioxide levels are too high, the brain actually triggers breathing as an involuntary response.

38. a) Reasons could include: surgery or drugs used will interfere with or suppress respiration; surgical team wants to ensure that cells are getting a steady supply of oxygen and having carbon dioxide removed reliably and steadily throughout the surgery.

b) If the condition suppresses respiration, it is important to keep the rate of gas exchange constant in order to ensure a steady recovery.

c) Sick or injured people are often put on respirators before doctors know what the illness is or the extent of damage that an accident has done. Also, in some cases, it is difficult to definitively say whether the patient’s condition is fatal or incurable.

d) When patients with a condition that is likely fatal or incurable are on respirators, the main issues relate to the decision to turn off a respirator. Unless explicit, written instructions have been left by the patient, the decision is one for the medical care team and any family or guardians who have power of attorney for personal care. Along with a concern over best use of medical and financial resources, religious, cultural, or personal beliefs will be part of any such decision. It is a difficult decision because it relates to the end of a life.
39. a) Some points to be considered are: Younger patients are likely to be in better overall health than older ones, since they have had fewer years of exposure to harmful environmental factors or negative lifestyle factors. Therefore, their bodies will be stronger and more likely to survive a lung transplant without complications.

b) Lifestyle factors, such as whether a patient smokes or how active a patient is, should be considered, since these factors will affect a person’s respiratory health and chances of a successful recovery after he/she gets a transplant. If a patient gets a successful lung transplant but continues to smoke or does not engage in enough activity to promote respiratory and cardiovascular health, the risk of a second occurrence of lung dysfunction will be higher.

40. Suggestions could include shifting the cost to patients, smokers in general (via a tax), or the tobacco companies (via a tax). Answers should reflect some understanding of how practical the measure would be in terms of putting it into action and an explanation of why it might be successful. (For example, if the answer suggests making smoking illegal, consideration should be given to the cost of enforcing the ban.)

**Chapter 10 The Digestive System**

**Answers to Pause and Check Questions**

(Student textbook page 325)

1. Food supplies nutrients such as carbohydrates, fats, proteins, vitamins, and minerals that maintain and sustain life.

2. Nutrients are chemical substances that provide body cells with energy and building materials.

3. The function of the digestive system is to provide a way for animals to obtain and use food. The stages of digestion are:
   - **Ingestion**: Food is taken in by the mouth.
   - **Digestion**: Food is broken down mechanically and chemically.
   - **Absorption**: Digested molecules pass through the walls of the digestive system and into the bloodstream.
   - **Elimination**: Waste products of digestion leave the body.

4. mouth, pharynx, esophagus, stomach, small intestine, large intestine, rectum, anus

(Student textbook page 327)

5. The teeth bite, tear, crush, and grind the food to convert it into small pieces. The saliva moistens the food, and an enzyme in saliva begins to break carbohydrates (starch) down into glucose.

6. The esophagus is between the mouth and the stomach. It is a muscular tube that contracts in waves and pushes the food along in the process called peristalsis.

7. Physically: The muscles of the stomach mix food mechanically.

   Chemically: The gastric juice in the stomach contains an enzyme that begins to break down proteins in the food.

(Student textbook page 329)

8. **Digestion**: The small intestine has many enzymes that break down food particles into monomers.

   **Absorption**: These molecules are small enough to pass through the lining of the intestine and pass into the bloodstream.

9. The three accessory organs aid digestion.
   - **Pancreas**: The enzymes that act in the small intestine are made in the pancreas. The pancreas also sends sodium bicarbonate to the small intestine so it can neutralize the acid from the stomach.
   - **Liver**: The liver makes bile, which is used to help digest fats in the small intestine. The bile emulsifies the fat, which means bile disperses it into small globules.
   - **Gall bladder**: The gall bladder stores the bile made in the liver and releases it into the small intestine when chyme enters the intestine from the stomach.

10. The inner surface of the small intestine contains many finger-like projections called villi. Villi, in turn, have many microvilli projecting from them. Because there are so many of them, the villi and microvilli aid absorption by making the surface area for absorption very large. This allows more digested molecules to pass through the walls of the intestines into the bloodstream very efficiently.

(Student textbook page 330)

11. The large intestine concentrates and eliminates waste material.

12. Bacteria in the large intestine break down undigested material.
13. Three causes of cirrhosis are fatty liver disease, alcoholism, and hepatitis C.

14. Medication or ultrasound vibrations can sometimes break down gall stones. Otherwise, the entire gall bladder is surgically removed.

15. Samples of blood and feces are tested for the presence of the bacterium.

16. A person with lactose intolerance can take the missing enzyme orally or just avoid eating dairy products that contain lactose.

17. Answer can be any one of:

   * **Barium swallow**: The person swallows a liquid containing barium sulfate, which will make the shape of the digestive tract (esophagus, stomach, small intestine) visible on an X ray; this will help the doctors look for and diagnose conditions such as tumours.

   * **Blood test**: Blood samples could be tested for enzymes and chemicals that are typically present when the digestive system is infected.

18. Answer can be any one of:

   * **Gastroscopy**: An endoscope is passed through the mouth into the esophagus and stomach to visually observe the tissues.

   * **Colonoscopy**: An endoscope is passed through the anus into the large intestine to visually observe the tissues.

   * **Biopsy**: A small piece of tissue is removed from the organ, such as the liver, and is examined under a microscope.

   * **24-hour pH study**: A thin tube inserted through the nose into the esophagus remains in place for 24 hours to measure the pH for acid levels.

19. The kidneys filter soluble waste materials from the blood for excretion from the body.

20. When blood passes through the capillaries in the filter of the nephron, water and small, water-soluble molecules are pushed out of the capillaries, whereas large molecules, blood cells, and platelets remain in the bloodstream. The water and materials that have been pushed (filtered) out of the capillaries are the first stage of the formation of urine.

21. Nephrons are the individual units in the kidneys that filter the blood and start the formation of urine.
### 3. Organs of the Digestive System

<table>
<thead>
<tr>
<th>Digestive Organ</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>mouth</td>
<td>The mouth physically breaks down food and begins to chemically break down carbohydrates.</td>
</tr>
<tr>
<td>pharynx</td>
<td>The pharynx connects the mouth to the esophagus.</td>
</tr>
<tr>
<td>esophagus</td>
<td>The esophagus uses peristalsis to move the food into the stomach.</td>
</tr>
<tr>
<td>stomach</td>
<td>The stomach mixes and moistens food. It also has enzymes that begin the chemical breakdown of proteins.</td>
</tr>
<tr>
<td>small intestine</td>
<td>The small intestine has a variety of enzymes that break down all large-molecule nutrients. The small intestine also absorbs nutrients.</td>
</tr>
<tr>
<td>large intestine</td>
<td>The large intestine condenses waste materials and forms feces.</td>
</tr>
<tr>
<td>rectum</td>
<td>The rectum stores feces.</td>
</tr>
<tr>
<td>anus</td>
<td>The anus eliminates feces.</td>
</tr>
</tbody>
</table>

### 4. Accessory Organs of the Small Intestine

<table>
<thead>
<tr>
<th>Accessory Organ</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>liver</td>
<td>The liver makes bile, which emulsifies fat to make it easier to digest.</td>
</tr>
<tr>
<td>gall bladder</td>
<td>The gall bladder stores the bile from the liver and releases it into the small intestine when chyme from the stomach reaches the small intestine.</td>
</tr>
<tr>
<td>pancreas</td>
<td>The pancreas makes digestive enzymes and sodium bicarbonate and sends them into the small intestine.</td>
</tr>
</tbody>
</table>

### 5. a) Peristalsis is a wave of muscular contractions.  
   b) Peristalsis moves chewed food down the esophagus to the stomach. Peristalsis churns the stomach contents to break down food. Peristalsis also moves feces out of the body when the rectum is full.

### 6. The mucus in the stomach protects the stomach lining from the enzymes.

### 7. Sample diagram:

#### e) The main organs of digestion are represented by the middle column; the accessory organs of digestion are on the left. The labels on the right indicate the stages of digestion and which organs are involved at each stage.

### 8. Food is physically churned and broken down during peristalsis in the stomach, while the stomach lining produces gastric juices (made up of water, hydrochloric acid, mucus, and enzymes) that chemically break down the food. The result of the physical and chemical breakdown of food is known as chyme, a mixture of food and gastric juices.

### 9. a) Emulsion of fats, which is similar to the process shown in the photograph, occurs in the small intestine.  
   b) The liver makes a solution called bile that is sent to the gall bladder to be stored between meals. During and after a meal, when chyme is passed from the stomach to the small intestine, it triggers the gall bladder to release some bile. The bile emulsifies any fat in the chyme, making it easier for the enzymes to digest the fat.

### 10. Saliva from the salivary gland is added to food in the mouth. Gastric juice is added to the food in the stomach. A solution of enzymes and bicarbonate from the pancreas, and bile from the liver (via the gall bladder) is added to the food in the small intestine.
Answers to Questions Reviewing
Concepts 10.5, 10.6, 10.7, and 10.8
(Student textbook page 339)

1. a) In the digestive system, mucus coats the lining of the stomach and protects it from the strong acid and enzymes in the stomach.
   b) In the respiratory system, mucus linings, especially of the nose and trachea, trap pollutants, dust particles, and bacteria to prevent them from reaching the lungs where they could cause damage or disease. Mucus protects the respiratory and digestive systems from very different types of potential damage.

2. a) The digestive system provides nutrients for building cells, including blood cells and cells that make up the blood vessels.
   b) Breathing through the mouth is possible because the digestive system and respiratory system share the mouth and pharynx.
   c) The digestive system provides nutrients needed by the cells of the urinary system organs. It also works with the urinary system organs to eliminate waste through urine.

3. a) The circulatory system picks up the nutrients absorbed by the digestive system and carries them to all parts of the body via blood vessels.
   b) Gas exchange in the lungs provides oxygen to and removes carbon dioxide from the cells of the digestive organs so they can function.
   c) The urinary system works with the digestive system to remove soluble waste from all the cells of the body.

4. Answers should show one of the following:
   a) ulcer
   b) Features: sore in lining of stomach
      Symptoms: burning stomach pain, weight loss, loss of appetite, nausea, blood in feces, vomiting
      Diagnosed: blood and feces tested for bacteria, endoscopy, special X rays
      Treatment: antibiotics, medication to decrease production of stomach acid, surgery
      Prevention: don't smoke, limit alcohol intake, avoid non-steroidal anti-inflammatory drugs (Aspirin™)
   a) lactose intolerance
   b) Features: lack of enzymes that break down lactose
      Symptoms: cramping, nausea, gas, diarrhea
      Diagnosed: by symptoms, testing breath for gas released by lactose-digesting bacteria

Treatment: taking enzymes orally before a meal, avoidance of dairy products containing lactose
Prevention: cannot be prevented because it is genetically inherited

5. Students should choose one of the following:
   a) cirrhosis
   b) Features: Scar tissue prevents the liver from functioning properly.
      Symptoms: fatigue, nausea, abdominal pain, yellow or itchy skin, fever
      Diagnosed: blood tests, CT or ultrasound scan, biopsy
      Treatment: medication to reduce symptoms, liver transplant
      Prevention: drink less alcohol, treat underlying diseases quickly
   a) gall stones
   b) Features: Pebble-like masses form in the gall bladder.
      Symptoms: intense abdominal pain, fever, yellow skin or eyes
      Diagnosed: CT or ultrasound scan, scan using radioactive material to find blocked bile duct
      Treatment: medication or ultrasound to break up small gall stones, surgically remove gall bladder
      Prevention: maintain healthy weight, good diet

6. When chyme reaches the small intestine, it triggers the release of bile from the gall bladder. If a gall stone is released with the bile, it will cause pain while passing through the bile duct. The gall stone could also become stuck in the duct. Both of these situations cause intense pain.

7. a) Absence of carbohydrates in the diet will reduce the amount of glucose in the body, making it difficult for the body to generate energy. More specifically, an absence of fruit such as citrus fruit will deprive the body of Vitamin C, which is necessary for tissue growth and repair.
   b) An absence of meat and grains in the diet causes a lack of iron in the diet. Iron is needed for hemoglobin to carry oxygen in the bloodstream.
       In children, this could lead to learning difficulties. In anyone, it would reduce the amount of oxygen reaching all organs, reducing the functioning of all organs.

8. When the kidneys filter the blood, soluble waste materials are removed from the blood to be excreted in the urine.
9. a) blood  
b) The blood is being filtered.  
c) In the region labelled C, water, glucose, salts, and some useful substances are being reabsorbed from the filtered fluid back into the bloodstream. In the region labelled D, toxins and excess ions are being secreted from the blood into the urine.  
d) The fluid beside the arrow labelled E is urine. It contains only soluble waste materials and excess ions that were in the blood, whereas the blood at A contains blood cells, platelets, nutrients, and waste before it passes through the nephron.  
e) The diagram shows the processes that occur in one nephron. Kidneys contain more than a million nephrons.

Answers to Chapter 10 Review Questions  
(Student textbook page 353)  
1. c  5. b  9. c  13. A, C  
3. e  7. a  11. a  15. A, D  
4. d  8. c  12. b  16. B  

17. a) During ingestion, food enters the digestive system through the mouth.  
b) During digestion, food is broken down physically and chemically into small molecules that can be used by the body cells.  
c) During absorption, the small molecule nutrients are passed through the walls of the digestive system and into the bloodstream.  
d) During elimination, solid waste leaves the body in the form of feces.  

18. a) A: mouth  
B: liver  
C: gall bladder  
D: large intestine  
E: esophagus  
F: stomach  
G: pancreas  
H: small intestine  
b) part of digestive tract: A, D, E, F, H  
accessory organs: B, C, G  

19. Some teeth are shaped like chisels, which are good for biting off a piece of food. Some teeth are pointed, which is good for tearing food. Some teeth are flat, which is good for crushing and grinding food.  

20. a) Crackers contain carbohydrates. Digestion of carbohydrates starts in the mouth.  
b) Olive oil consists mostly of fats so it is digested in the small intestine. (Students may also note that digestion begins in the mouth with saliva initiating chemical digestion. This is not discussed in the chapter.)  
c) Tuna contains a lot of protein so it begins to be digested in the stomach.  

21. The two functions of the small intestine are digestion and absorption.  
22. a) The liver produces bile.  
b) The gall bladder releases bile.  
c) An emulsion is a suspension of tiny fat globules in a water solution.  
d) Fat-digesting enzymes are water soluble and can only act on fat molecules on the surface between water and fat. When fat is broken up into many tiny globules, a very large surface area is available to the enzyme.  

23. Bacteria in the colon break down undigested material.  
24. The kidneys filter the blood and remove soluble waste, excess salts, and water. The resulting solution, urine, leaves the body.  

25. Fluid and small molecules of dissolved nutrients leave the blood and enter the nephron during filtration. During reabsorption, water, glucose, and ions such as Na⁺ and Cl⁻ return to the blood. This all takes place in the capillary network of the nephron.  

26. A pH probe is inserted through the nose and down the esophagus. The probe measures the pH (acidity) in the esophagus to test whether any acid is coming up from the stomach.  

27. The kidney tubules reabsorb water, glucose, ions, and other useful substances back into the bloodstream to regulate the balance between water, nutrients, and salts in the body.  

28. The enzymes are not active before they enter the stomach because the environment in which they are produced is not acidic enough to activate them. If the enzymes were active while in the cell where they are formed, they would start to digest the proteins that make up the cell and destroy the cell.
29. a) A sphincter is a circular muscle that surrounds a tube and can contract to close the tube.
   b) If the sphincter between the esophagus and the stomach were weakened, when the muscles in the stomach contracted the contraction would push the acid up into the esophagus, seriously damaging the esophagus walls.
30. Villi are finger-like projections in the wall of the small intestines. They increase the surface area of the intestine, thus creating more space through which nutrients can be absorbed.
31. Possible criteria:
   • Models must include all eight parts of the digestive tract (mouth, liver, gall bladder, large intestine, esophagus, stomach, pancreas, small intestine)
   • Models must be labelled properly.
   • Models should show organs sized accurately.
   • Models should include information about the function of each organ in the digestive system.
   • Models should include information about the accessory organs.
   • Models should show a cutaway section of the small intestine to show the folds and the villi.
32. If students know that one kidney is sufficient to filter all of the blood, they will say that waste removal will not be affected. If they do not know, they will probably say that a person would have to have a special diet or drink more water or some such explanation. In either case, as long as the reasoning is clearly stated and logical, full credit should be given.
33. Stopping smoking likely had the greatest effect of her recovery because it is one of the risk factors for developing an ulcer.
34. Answers should include the following:
   Disadvantages:
   • Increases the chance that the intestines will become dehydrated.
   • Increases the danger of infection.
   • Increases the danger of damage to the intestines.
   Advantages:
   • It makes it easier to diagnose any potential problems.
   • It would be easier to treat diseases or injury.
35. The digestive system eliminates solid wastes that do not ever leave the intestines and reach the bloodstream. The circulatory system carries soluble wastes to the kidneys where they are filtered out of the blood and excreted from the body as urine in the urinary system. Together, the systems eliminate nearly all waste materials from the body. (Optional: The respiratory system eliminates carbon dioxide, the gaseous waste material.)
36. a) The digestive system provides nutrients for all cells, including those of the nervous system. The nervous system sends signals to the muscles of the digestive system, causing them to churn the food in the stomach and to carry out peristalsis to move food through the digestive system.
   b) The digestive system provides nutrients for all cells, including those of the muscular system. The skeletal muscles support the body, helping to protect the organs of the digestive system. The smooth muscles around the digestive system help it to function properly.
   c) The respiratory system provides oxygen and the digestive system provides the glucose used to produce energy for all cells, including those of both the respiratory and digestive systems. The respiratory system rids the body of carbon dioxide waste while the digestive system rids the body of solid waste.
37. Venn diagram should show:
   Chemical digestion only: occurs mostly in small intestine; requires enzymes; enzymes and food must be dissolved in water
   Physical digestion only: requires the use of muscles; in the mouth, it requires teeth
   Chemical and physical digestion: break down food; occurs in mouth and stomach; food is moist
38. a) The name accessory organ is a good name for the liver, pancreas, and gall bladder because, although they do not come in contact with food, they all help the digestive system process food.
   b) Any term that indicates that the organs act in a supporting capacity is acceptable. Some possible answers are: helping organs, assisting organs, necessary organs
39. a) Outlines must include a process that happens in all organs in the digestive system (i.e., mouth, pharynx, esophagus, stomach, small intestine, large intestine, rectum, anus; accessory organs: salivary glands, liver, gall bladder, pancreas).
   b) Outline should include a number of hazards, such as being: ground by teeth, squeezed by esophagus during peristalsis, burned by acid in the stomach, attacked by chopping enzymes in the small intestine, pushed through tiny holes in the walls of the small
intestine, remnants dehydrated in large intestine, stored with awful stuff in rectum, squeezed out through anus
c) Outline should note that the grape is transformed from a plump, juicy orb to a mass of nutrients, fluid, and solid waste.

40. The words and diagrams should indicate that peristalsis first moves food from the mouth to the stomach via the esophagus, and that peristalsis breaks food into small pieces in the stomach. The word description should note that role of muscles in the process and the squeezing action that takes place. Figure 10.4 on page 326 in the student textbook can be the model:

41. The web page should have at least four questions about any one of the disorders discussed in the textbook: cirrhosis, gall stones, ulcers, or lactose intolerance.

42. Blood entering the kidney through the renal artery has picked up waste materials from throughout the body. Blood leaving the kidney carries filtered blood that has been cleansed of toxins back to the heart.

43. Stomach acid can kill most bacteria. If there is insufficient stomach acid, some bacteria might get through the stomach and into the intestines without being killed.

44. Answer must include the information about how bile emulsifies fat for digestion. The gall bladder stores bile that has been produced by the liver. If the gall bladder has been removed, the bile will constantly, but slowly, travel to the small intestine. If a meal has a lot of fat in it, there will not be enough bile to emulsify all of it and it will not all be digested. As a result those who have had their gall bladders removed need to ensure that they do not eat too much fat at one meal.

45. The recommendation could include supplying the enzyme to the digestive system orally or avoiding dairy products containing lactose.

46. The barium sulfate solution ensures that the gastrointestinal tract will be clearly visible on the X ray.

47. The diagram A is the digestive system of a plant-eating animal and diagram B is that of a meat-eating animal. Plant material has cell walls and a lot of fibrous matter. Therefore, it is difficult to digest, so the animal with the stomach compartments and very long intestines must be the plant-eating animal. The plant material spends a much longer time in the digestive tract so it can be more fully digested. In contrast, meat contains no cell walls and little fibrous material, making it easier to digest. The animal with the shorter digestive tract can easily digest meat.

48. Excess amino acids are removed from the body in urine. OR Excess amino acids are broken down and removed from the body in urine. OR Unused amino acids are chemically broken down and eliminated from the body. The urea and ammonia found in urine are byproducts from the breakdown of the amino acids in proteins.

49. Answers must have a clear and logical explanation based on an understanding of how the digestive system works and reflect a clear understanding of the term “healthy, balanced diet.” A “no” answer may draw on information from Chapter 1 concerning the role of macronutrients. A “yes” answer should include reference to a digestive system disorder that might prevent the absorption of key nutrients.

Answers to Unit 4 Review Questions (Student textbook pages 358–61)

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18. a) Homeostasis is the maintenance of balanced internal conditions within a cell, organ, organ system, or body.

b) Maintaining homeostasis is necessary for you to survive. If conditions such as temperature, pH, or blood glucose level are outside a certain range, your cells and organs will not be able to function, and you could die.

19. Blood carries water, nutrients, and oxygen to body cells, and carries carbon dioxide from body cells back to the lungs.

20. It is important that capillaries have thin walls so substances such as oxygen, nutrients, and carbon dioxide can pass easily from the capillaries into body cells or from the body cells into capillaries.

21. a) The first number, 118, is the systolic pressure.

b) The second number, 80, is the diastolic pressure.

c) Systolic pressure is the blood pressure during contraction of the ventricles, when blood is being pumped out and artery walls are stretched. Diastolic pressure is the lower blood pressure between contractions, when the ventricles relax and the artery walls contract.

22. a) The pulmonary circuit is labelled as A. The systemic circuit is labelled as B.

b) In the pulmonary circuit, blood moves from the right ventricle to the lungs, and then back to the left atrium. In the systemic circuit, blood moves from the left ventricle to the body cells, and then back to the right atrium.

23. Respiration begins when air containing oxygen is inhaled. Then, oxygen diffuses from the lungs into the blood, and carbon dioxide diffuses from the blood into the lungs. Finally, air containing carbon dioxide is exhaled.

24. The body cells need oxygen so they can carry out energy-releasing reactions (cellular respiration). Carbon dioxide must be eliminated from the body cells because it is a waste product of the energy-releasing reactions (cellular respiration).

25. The blood in the capillaries surrounding the alveoli has a greater concentration of carbon dioxide than the air in the alveoli. The air that is inhaled into the alveoli has a higher concentration of oxygen than in the blood. This creates concentration gradients for carbon dioxide and oxygen. As a result, carbon dioxide diffuses out of the blood into the air in the alveoli and oxygen diffuses from the air in the alveoli into the blood.

26. The circulatory system pumps oxygen-rich blood to body cells and returns oxygen-poor (carbon dioxide-rich) blood from the body cells to the lungs, where respiration occurs.

27. a) A nutrient is a molecule that provides energy or materials to cells.

b) Nutrients are important because they provide the energy that is needed to power the cell's activities and/or materials that the cell uses to build molecules it needs.

28. a) The diagram shows peristalsis.

b) Waves of contractions in the smooth muscle of the esophagus move food downward toward the stomach. A sphincter controls the movement of food from the esophagus into the stomach.

29. Villi and microvilli increase the surface area of the small intestine's inner surface. This increases the amount of nutrients that can be absorbed by the small intestine.

30. a) Any one of the following: salivary glands, liver, gall bladder, pancreas

b) Any one of the following:

- The salivary glands aid digestion by secreting enzymes that help to break down carbohydrates.
- The liver aids digestion by producing bile, which helps to emulsify fats.
- The gall bladder aids digestion by storing bile, which helps to break down fats.
- The pancreas aids digestion by producing and releasing digestive enzymes and bicarbonate ions (to neutralize acid from the stomach) into the small intestine.

31. The main function of the kidneys is to filter wastes, water, and salts from the blood. (The kidneys form urine from the waste materials that are removed from the blood.)

32. Nutrients that are absorbed into the blood by the digestive system are then carried by the circulatory system to body cells where they are needed. Waste materials that diffuse into the blood from body cells are carried by the circulatory system to the kidneys, where wastes are filtered out of the blood. The urinary system disposes of these wastes in the form of urine.

33. The patient has a high white blood cell count, which supports the diagnosis of a bacterial infection because white blood cells fight infection and disease in the body.
34. Any one of the following answers is acceptable:
   • The heart needs to pump oxygen-rich blood to body cells where it is needed, while pumping oxygen-poor blood to the lungs.
   • If oxygen-rich blood were not separated from oxygen-poor blood, a mixture of oxygen-rich and oxygen-poor blood would be pumped to both the body cells and the lungs.
   • If oxygen-rich blood were not separated from oxygen-poor blood, gas exchange would be inefficient because there would be much smaller concentration gradients for oxygen and carbon dioxide.

35. Systolic pressure would be higher, since the pressure of blood being pumped from the heart would be the same, but the diameter of the arteries would be reduced if they couldn’t stretch.

36. a) During exercise, your muscles require more energy (ATP), so your cells need more oxygen. Your heart beats faster to pump oxygen to your cells more quickly and remove carbon dioxide from your cells more quickly.

b) During exercise, your lungs need to supply more oxygen to your cells so that the cells can produce more energy. By speeding up breathing, more oxygen enters the lungs and more carbon dioxide is exhaled.

37. Thickened alveolar walls would make gas exchange less efficient because it would be more difficult for oxygen to diffuse out of the alveoli into the capillaries in the lungs and for carbon dioxide to diffuse into the alveoli from the capillaries.

38. a) Breathing would be more difficult, because air would have a narrower pathway to pass through during inhalation and exhalation.

b) Asthma can be diagnosed by an arterial blood gas test or a pulmonary function test.

39. Antibiotics can kill the helpful bacteria that live in the colon and break down undigested material.

40. The enzyme likely works by breaking down lactose into sugars that can be absorbed by the small intestine.

41. Urine production would be affected. Wastes would not be properly filtered out of the blood, so urea, ammonia, and other waste substances might remain in the person's blood, or useful substances such as nutrients might be removed from the blood and eliminated in the urine.

42. One circulatory disorder, one respiratory disorder, and one digestive disorder from the following:
   • Circulatory disorders associated with smoking: arrhythmia, stroke, atherosclerosis
   • Respiratory disorders associated with smoking: laryngitis, lung cancer, emphysema
   • Digestive disorder associated with smoking: ulcer

43.

<table>
<thead>
<tr>
<th>Blood vessel</th>
<th>Diagram</th>
<th>Structure</th>
<th>Function</th>
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<tbody>
<tr>
<td>artery</td>
<td><img src="image" alt="artery_diagram" /></td>
<td>• thin inner lining, thick and strong layer of muscle tissue that can stretch under pressure, outer layer of connective tissue</td>
<td>• transport blood pumped at high pressure from the heart to capillaries around body cells</td>
</tr>
<tr>
<td>vein</td>
<td><img src="image" alt="vein_diagram" /></td>
<td>• thin inner lining, layer of muscle tissue, outer layer of connective tissue • contain valves that keep blood flowing toward the heart</td>
<td>• transport blood at low pressure from capillaries near body cells to the heart</td>
</tr>
<tr>
<td>capillary</td>
<td><img src="image" alt="capillary_diagram" /></td>
<td>• single layer of cells • branched extensively</td>
<td>• allow diffusion of molecules into or out of the blood</td>
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44. a) The diagram shows the path blood takes through the chambers of the heart.
   b) A – right atrium; B – right ventricle; C – left atrium; D – left ventricle
c) right atrium, right ventricle – oxygen-poor blood
   left atrium, left ventricle – oxygen-rich blood

45. Diagrams should be similar to Figure 8.12 on page 275:

Since the presentation is for a group of Grade 8 students, it is not necessary to include terms like “atria” and “ventricles.” Terms such as “upper chambers” and “lower chambers” are more appropriate.

46. Flowchart should show most of the following structures, in order: nose → nasal cavity → pharynx/throat → larynx → trachea/windpipe → bronchi → bronchioles → alveoli.

47. Brochure should describe the nature of the disorder, the cause(s) or contributing factors, symptoms, tests used to diagnose the disorder, treatments, and ways to prevent the disorder (if applicable).

48. Physical digestion
   • occurs in the mouth and the stomach
   • teeth tear, crush, and grind food into smaller pieces
   • the tongue moves food and mixes it with saliva
   • the stomach churns and mixes the food with gastric juices
   (Students may use a diagram of the mouth to show how the teeth are suited to breaking food into smaller pieces.)

Chemical digestion
   • occurs in the mouth, stomach, and small intestine
   • enzymes and other substances such as stomach acid and bile help to break down different types of molecules
   (Students may include a diagram of the stomach or the small intestine.)

49. a) Food selections and descriptions should demonstrate an understanding of the information in Table 10.2 regarding the importance of various micronutrients for a healthy diet. Knowledge from Unit 1 regarding the importance of protein-rich foods and “good fats” (unsaturated fatty acids) should also influence students’ food choices for the menu.

b) The presentation (poster, video, or website) should present the nutrition information from part (a) clearly and accurately, while promoting the selected menu items. Students may include information about the negative effects of nutrient deficiencies on the body.

50. The script should address methods of prevention, such as eating a balanced diet, quitting smoking, exercising regularly, maintaining a healthy weight, and reducing stress. It should reflect the demands of the patient’s work life.

51. Diagrams should be similar to the ones in Figure 9.6 on page 306.

The caption for inhalation should include contraction of the diaphragm/rib muscles, expansion of the lungs/chest cavity, and a decrease in air pressure. The caption for exhalation should include relaxation of the diaphragm/rib muscles, contraction of the lungs/chest cavity, and an increase in air pressure.
52. | Test           | Description                                                                 | Diagnosis                        |
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<tbody>
<tr>
<td>Barium swallow</td>
<td>X-ray taken after drinking barium sulfate solution; shows esophagus, stomach, and intestines</td>
<td>ulcers, cancer, and polyps (non-cancerous growths)</td>
</tr>
<tr>
<td>Gastroscopy</td>
<td>Endoscope passes through the mouth into the esophagus and stomach</td>
<td>Ulcers and injury to esophagus due to acid reflux</td>
</tr>
<tr>
<td>Colonoscopy</td>
<td>Endoscope is passed through the anus into the large intestine</td>
<td>Damaged tissues, cancer, ulcers, and intestinal bleeding</td>
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53. Diagrams should reflect the information in Figure 9.5 on page 305 of the student textbook.

54. a) The percent of deaths due to circulatory system disorders decreased by 5.8% from 2000 to 2009.

b) Answers could refer to anti-smoking campaigns, advancements in research related to circulatory system disorders, greater public knowledge of healthy food choices (e.g., avoiding trans fats, saturated fats) and the benefits of regular exercise, advancements in diagnostic and surgical techniques, availability of new treatments, or any other well-reasoned answer.

55. a) Any well-reasoned answer that addresses average lifestyles or economic issues is acceptable.

b) Any reasonable suggestions to encourage prevention are acceptable. Answer could suggest making people aware of the consequences of smoking, lack of exercise, improper diet, stress, or excessive consumption of caffeine and/or alcohol.

56. Since red blood cells carry oxygen to body cells, a greater number of red blood cells would provide a greater supply of oxygen to the cells. This would allow body cells to carry out cellular respiration more rapidly and provide more energy to the cells. This would be particularly important in the muscle cells of an athlete.

57. Answer should include a comparison of the causes of drowning and cystic fibrosis (i.e., the lungs filling with water vs. the lungs filling with mucus).

58. a) Calcium is necessary for bone and tooth structure, blood clotting, nerve signalling, and muscle contraction.

b) Calcium deficiency affects the digestive system, the skeletal system, the circulatory system, and the muscular system. (Answers could also include the nervous system and all other body systems due to the effects of faulty nerve signalling.)

c) Answer should reflect an understanding of food sources of calcium that are eaten regularly and the eating habits of the average teen.

d) Eating more milk and other dairy products, as well as green leafy vegetables will increase the amount of calcium in your diet. (Other sources of calcium include fortified rice and soy beverages, tofu, almonds, baked beans, navy beans, edamame, okra, and fortified orange juice.)

59. a) Answer should identify two lifestyle changes.

b) Answer should include an explanation of obstacles associated with the lifestyle changes identified in part (a), as well as a logical plan to overcome these obstacles.

60. a) Answer should include well-reasoned support for the opinion expressed.

b) A “yes” answer should be supported by mention of the benefits of good nutrition on health or the potential negative consequences of poor nutrition. A “no” answer should clearly explain the reasoning behind this opinion.

61. a) Answers should demonstrate a clear understanding of the nature of the career as well as the way in which knowledge of human body systems applies to the carrying out of the demands of the career.

b) Answers should link the work involved in the career with specific fields of knowledge about human body systems.

c) The educational requirements should be linked to the requirements listed in the literature from an accredited college or university.
62. The personal data must be accurate. The discussion must exhibit a clear understanding of the impact of the discoveries.

- Charles Best, United States (1899–1978): co-discoverer of insulin (1921)
- Ray Chu-Jeng Chiu, Japan (1934–): pioneered surgical technique of cardiology for failing hearts
- Sylvia Fedoruk, Canada (1927–2012): involved in the development of the world's first Cobalt-60 unit and one of the first nuclear medicine scanning machines.
- Gail Anderson, England (n.a.): present-day researcher, forensic biology, famous for her pioneering work using insects as a forensic tool