also cause damage to the kidneys and can cause the ventricles of the heart to enlarge and weaken.

11. Salts increase the osmotic pressure in the capillaries, causing more fluids to move from the ECF into the blood. Increased fluid volume elevates blood pressure.
12. Inactivity of skeletal muscles decreases the amount of blood returning to the heart. When standing, blood pools in the lower extremities of the body. Eventually, a lower diastolic pressure means less blood will be pumped to the tissues.
13. The cut reduces blood volume, which will manifest itself as reduced blood flow and a weaker pulse. In an attempt to compensate for lower blood pressure and decreased delivery of oxygen and nutrients, heart rate increases. Students should reason that because the circulatory system distributes heat throughout the body, a decreased blood flow means lower body temperatures. Students might also reason that lower body temperatures might reflect slower rates of metabolism, a compensating mechanism for hemorrhage.
14. Since proteins can no longer be removed from the ECF, an osmotic pressure is established outside of the capillary. The osmotic pressure inside of the capillary is opposed by the new osmotic pressure and fluids begin to accumulate in the ECF, causing swelling.
15. Deoxygenated blood from the right ventricle moves to the left side of the heart and begins to mix with the oxygenated blood. When the left ventricle contracts, some deoxygenated blood is pumped to the tissues along with the oxygenated blood, thereby lowering oxygen delivery and the efficiency of the circulatory system.
16. Type A blood would cause the formation of antibodies in those with types O or B blood. This would not happen in people with blood types A and AB.
17 Multicellular organisms require a circulatory system because diffusion is too slow as a transport mechanism. Each cell of a multicellular organism is too far away from the environment to obtain nutrients and get rid of wastes by diffusion.
18. Capillaries are represented by W and Y. Area W represents a body capillary, because oxygen diffuses from the blood to the surrounding cells. (Note oxygen levels decrease.) Area Y represents a pulmonary capillary. (Note: oxygen levels increase).
19. One advantage of an open circulatory system is that blood loss due to injury is reduced because low blood pressure is maintained; a disadvantage is a limited ability to divert blood to needed tissues.
    The advantage of a closed circulatory system is that blood can efficiently be diverted to the areas that need it; a disadvantage is the risk of more blood loss due to injury because of higher blood pressures.
20. (a) The heart pumps with greater force during exercise in an attempt to deliver more blood to the tissues.
    (b) Because the heart rate is high, the time it takes for the heart to fill is reduced, so filling pressure is reduced.
21. Granulocytes are produced in the bone marrow. The problem might have been caused by a variety of factors which stimulate white blood cell production, such as tumors, allergic reactions, chorea, scarlet fever, and rheumatic fever.
22. (a) Subject C has recently moved from Calgary to Halifax, because the subject's hemoglobin level is higher than normal. People living at higher altitudes have higher red blood cell counts and more hemoglobin to compensate for air with less oxygen.

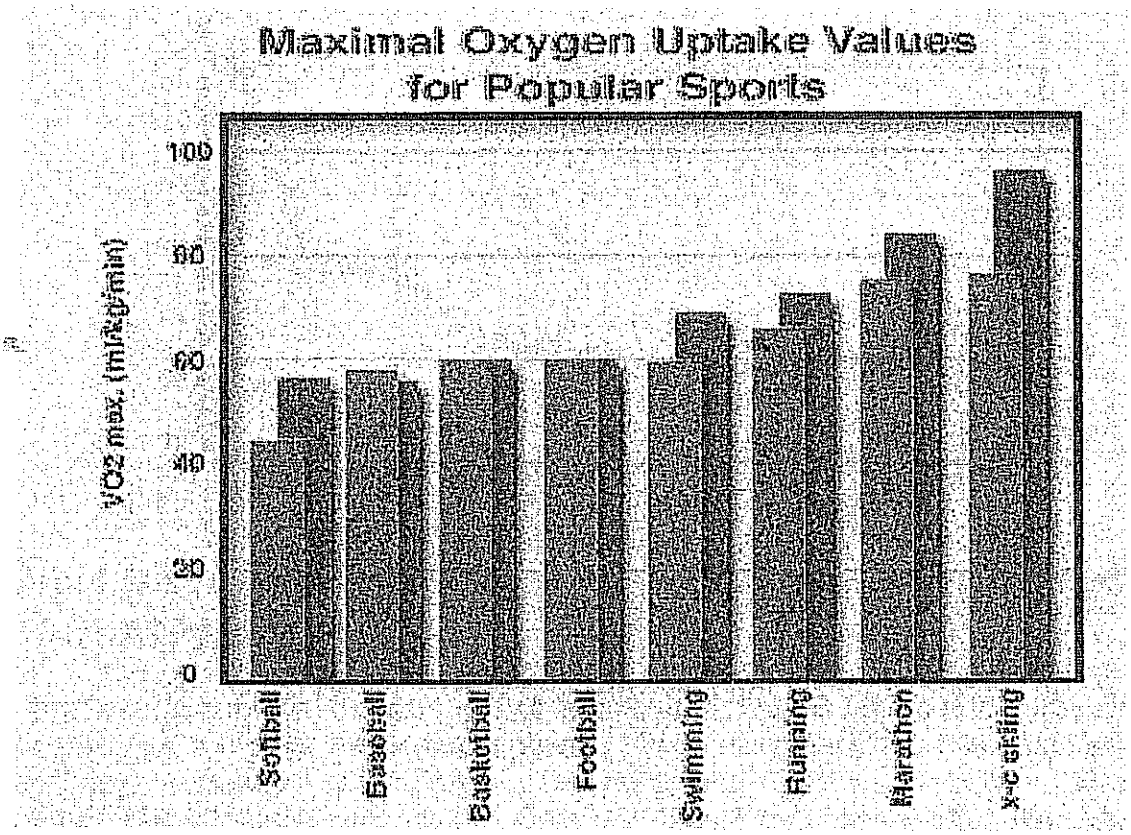
(b) Subject B is suffering from a dietary iron deficiency, because the hemoglobin level is lower than normal. Iron is a component of hemoglobin involved in the absorption of oxygen.

23. The circulatory system picks up oxygen and releases carbon dioxide in the lungs.
24. (a) Constriction of the arterioles reduces blood flow to the placenta, the area of nutrient exchange between mother and baby.
    (b) Although the two circulatory systems remain separate, nutrients diffuse from the mother's blood into the fetus's through adjoining capillary beds of the placenta. Restricted blood flow means less nutrient delivery and hence less chemical energy is made available to sustain life and growth.
25. Answers will vary. Many opinions can be explored. Students should be encouraged to listen to other viewpoints. Most importantly, students should recognize that the answer to the question is found not within the discipline of science but that of ethics. The question illustrates the limits of using a scientific paradigm for problem solving.
26. Answers will vary. Many designs are possible; however students should identify a control and attempt to limit the number of variables within their study. The methodology should attempt to uncover a cause and effect relationship.
27. Answers will vary. Speculation and prediction are promoted in this question. It is possible that the further you have to pump blood the greater is the force of heart contraction; however many large people do not suffer from high blood pressure. The most common factor appears to be a genetic link.
28. The chemicals may have initiated allergic reactions or even caused leukemia. This question is designed to encourage logic-based predictions.
29. Answers will vary.
30. Answers will vary. This question can be treated as a journal writing activity since sharing these answers openly in class could make some students feel uncomfortable.

Chapter 8
Respiratory System

Reflect On Your Learning (page 281)

1. Many possible answers. Colds and other respiratory problems (e.g., asthma) and low levels of oxygen associated with changes in altitude limit oxygen and activity.
2.



8.1 Practice (page 285)

1. Oxygen is essential for survival because the cells of the body obtain energy through oxidation.
2. Breathing is the movement of gases between the external environment and the location where they can enter and leave the body. Cellular respiration involves the oxidation of glucose within cells of the body into ATP, a compound that can be used by the cell for life activities.
3. Increasing the size of the respiratory membrane provides more surface area for the diffusion of gases.
4. Earthworms diffuse gases through the outer surface of the skin. Gills in fish are folded branching membranes which increase surface area, and thus they can provide more oxygen to the tissues. Fish also use a countercurrent flow to speed the extraction of oxygen.
5. Exposing the increased surface of the respiratory membrane to air would cause too much evaporation. If the gills dried out, the membrane would become impermeable to the diffusion of gases.

6. Insects have a series of tubes, called tracheae, that deliver oxygen to the tissues of the body. Blood from the open circulatory system flows over the branching respiratory tubes and helps provide cells of the body with oxygen. The tracheal system does not provide enough oxygen for larger animals.
   The frog respiratory system consists of a windpipe or trachea that branches into the two lungs. The lungs are balloon-like structures with internal folds that allow a much greater surface area for gas exchange. The internal location helps solve the problem of evaporation. Frogs can also absorb oxygen through their skin, like the earthworm. The frog has a three chambered heart that delivers the blood and the oxygen contained in it to the tissues more quickly than the tracheal system of the grasshopper.

8.2 Practice (page 289)

1. Cilia remove foreign particles which become entrapped in the mucous that lines the respiratory tract.
2. The nasal cavities open into an air-filled channel in the mouth called the pharynx. Two openings branch from the pharynx: the trachea, or windpipe, and the esophagus, which carries food to the stomach. The epiglottis is a flaplike structure that covers the opening of the trachea when food is swallowed, so that food enters the esophagus rather than the trachea.
3. Oxygen moves through the mouth, pharynx, larynx, trachea, bronchus, and bronchiole into an alveolus and pulmonary capillary. The oxygen molecule diffuses through the moist alveolar membrane into the plasma. Oxygen, from the plasma, attaches to a hemoglobin molecule.

Sections 8.1–8.2 Questions (pages 289–290)

1. Bronchi and bronchioles are tube shaped and both have many layers of cells. Only the bronchi have cartilaginous rings. The alveoli have a single layer of cells, and are blind-ended sacs, not tube-shaped. The tube-shaped bronchi and bronchioles are well suited as air passages, the sac shape of the alveoli provides an increased surface area that permits rapid gas exchange.
2. Oxygen moves from atmospheric air across the alveoli into the blood. Carbon dioxide moves from the blood across the alveoli into the atmosphere. These gas exchanges occur because oxygen and carbon dioxide diffuse, moving from areas of high concentration to areas of low concentration.
3. The swelling of the larynx caused by the infection produces lower pitched sounds.
4. In healthy lungs, a film of fat and protein called lipoprotein lines the alveoli, preventing the membranes from sticking together. Some newborn babies, especially premature babies, do not produce enough of the lipoprotein, resulting in a condition known as respiratory distress syndrome. Extreme force is required to overcome the surface tension created, and the baby experiences tremendous difficulty inhaling.
5. Pleurisy is the inflammation of the pleural membranes and the build-up of fluids in the chest cavity. It is most often caused when the two membranes rub together. This build-up of fluids puts great pressure on the lungs, making expiration easier, but inspiration much more difficult.
6. During inspiration the ribs move upward and the diaphragm moves downward, increasing the volume of the chest cavity. During expiration the ribs move downward and the diaphragm moves upward, decreasing the volume of the chest cavity.

7. Many possible answers. Birds and mammals tend to be very active and thus require greater levels of oxygen. Flight has an especially high-energy demand. Animals with lower energy demands tend to be less active and larger in size.
   Students should identify small mammals or birds that have a high surface area to body volume ratio. These animals lose heat quickly and must restore the heat by increasing the metabolic rate, which in turn increases oxygen demand.
8. Narrower airways decreases airflow during inhalation and expiration.
9. Less blood flow means fewer blood cells deliver oxygen to the cells of the body. Less oxygen means a decrease in the amount of cellular respiration and a drop in energy reserves.
10. Answers will vary.

8.3 Practice (page 292)

1. Dalton's law of partial pressure states that the total pressure of nonreactive gases is equal to the sum of the partial pressures of the individual gases.
2. (a) The partial pressure of oxygen is highest in the atmosphere and lowest in the cells.
   (b) Oxygen diffuses from an area of high partial pressure to an area of low partial pressure. The difference or drop in partial pressure causes the oxygen to dissociate from the hemoglobin and diffuse down its concentration gradient into the tissues.
3. The partial pressure of carbon dioxide is highest in the cells and lowest in the atmosphere

Section 8.3 Questions (page 294)

1. Diffusion of a gas occurs from an area of high pressure to an area of low pressure.
2. Some CO_2 combines with hemoglobin to form carbaminohemoglobin. The remainder of the body's CO_2 combines with water from plasma to form carbonic acid. This decreases carbon dioxide concentration, ensuring that carbon dioxide continues to diffuse into the blood. Carbonic acid dissociates into HCO_3^- and H^+. Hemoglobin releases oxygen and combines with H^+, and HCO_3^- ions are transported into the plasma. When venous blood reaches the lungs, H^+ ions are released from the hemoglobin, and H^+ and HCO_3^- ions combine to form CO_2 and water. CO_2 diffuses from the blood into the alveoli and is eliminated through exhalation.
3. CO_2 combines with water to form carbonic acid. Being unstable, the carbonic acid dissociates to HCO_3^- and H^+ ions. The carbonic acid must be buffered. The hydrogen ions dislodge oxygen from hemoglobin, and then combine with the hemoglobin to form reduced hemoglobin. By removing the hydrogen ions from solution, hemoglobin serves as a buffer.
4. Oxygen moves from the atmosphere, the area of highest partial pressure, to the alveoli. Boosted by its partial pressure, oxygen diffuses from the alveoli into the blood and dissolves in the plasma. Hemoglobin forms a weak bond with the oxygen molecule to form oxyhemoglobin. Once oxyhemoglobin is formed, other oxygen molecules can dissolve in the plasma. The blood leaving the lungs is nearly saturated with oxygen. As blood enters the capillaries, the drop in partial pressure causes the dissociation of oxygen from the hemoglobin, and oxygen diffuses into the tissues. Oxygen is released from the hemoglobin until the partial pressure of oxygen reaches 5.3 kPa. This ensures that most of the oxygen remains bound to the hemoglobin until it gets to the tissue capillaries.
5. Carbon dioxide stimulates the medulla oblongata, the breathing centre of the brain.