

10. (a) The breathing rate would likely be greatest at approximately time 2.2, when the level of carbon dioxide is greatest.
- (b) The subject began exercising at approximately time 1.0, when oxygen levels began to decrease and carbon dioxide levels began to rise.
- (c) The breathing rate would return to normal at approximately time 3.0, when carbon dioxide levels (the major factor in the regulation of breathing movements) return to about 40 mm Hg, the original resting level. Shortly thereafter the breathing rate will drop slightly below normal.
11. The higher CO₂ level would be beneficial because CO₂ in controlled amounts stimulates the breathing centre. The CO₂ in exhaled air is reasonably low, usually less than 7%. Very high concentrations of CO₂ would be harmful, but this would not occur during mouth-to-mouth resuscitation.
12. The diver is saturating plasma and red blood cells with as much oxygen as possible, and removing the maximum amount of CO₂ by hyperventilating. Breathing impulses will not be signaled until CO₂ levels are elevated. Note that this is a dangerous activity because the individual may lower CO₂ levels to the point that O₂ runs out before the impulse signal to breathe occurs. This means that brain cells can start to die, since they are very sensitive to oxygen levels.
13. Fetal hemoglobin is more effective at absorbing oxygen. The fetus secures oxygen from the mother's blood by way of placental circulation. Oxygen readily combines with hemoglobin because of its composition; hemoglobin is composed of 4 iron molecules and a protein structure, which allows oxygen to easily bind to the molecule.
14. (a) The experiment is designed to identify CO₂ as a product of cellular respiration.
- (b) The first flask with the limewater is the control. It will indicate that all of the carbon dioxide has been removed from the air.
- (c) It removes carbon dioxide from the air.
15. This patient should be advised to take extra precautions when eating or drinking. Swallowing could cause a foreign object or fluids to move into the trachea, since the function of the epiglottis is inhibited. This would cause choking.
16. Many possible answers. Less oxygen delivery means less available energy for cellular processes, including cell growth and repair.
17. Destroyed cilia means that fewer particles are prevented from entering the lower respiratory tract and thus more particles accumulate on the walls of the alveoli, reducing surface area for gas exchange and allowing less oxygen to diffuse into the blood. When the cilia are destroyed, particles that do lodge in the sticky mucus of the passageways are not swept into the back of the throat and are swallowed so that a cough develops to dislodge the mucous with the debris.
Decreased diameter of the bronchioles causes less air to be inhaled and exhaled with each breath (tidal volume is decreased), therefore the oxygen supply is diminished to the body cells and the rate of breathing would increase.
Ruptured alveoli walls decreases the surface area available for diffusion of oxygen and carbon dioxide. Consequently, the breathing rate would increase.
18. Answers will vary.

Performance Task (pages 316–317)

Sample lab report to be provided.

- (c) Determining the concentration of oxygen and carbon dioxide in arterial and venous blood would be very useful. However, most schools do not have equipment that enables blood analysis.
- (e) Body mass cannot be used exclusively to determine fitness. To some degree, body type is determined by genetics and not activity level.
- (f) Dieting tends to slow body metabolism and encourages the storage of fats during fasting. Exercise will offset this effect, as it increases metabolism and helps increase weight loss.
- (g) Sports are a combination of strength and endurance. Different sports have different benefits. Weight training, for example, will increase the strength component needed for a sport, but has few benefits for aerobic fitness.

Unit 3 Review (pages 318–321)

Understanding Concepts

1. (b)
2. (a) Capillaries are the site of diffusion of oxygen and nutrients.
(b) The aorta is the blood vessel with the highest blood pressure.
3. (b)
4. (d)
5. (c)
6. (a)
7. (a) The diaphragm, 10, relaxes during exhalation.
(b) The left bronchus, 5, conducts air into the left lung.
(c) The epiglottis, 2, prevents food from entering the trachea.
(d) The lung, 9, is the structure in which pressure changes associated with inhalation and exhalation occur.
8. (d)
9. They are both homeostatic mechanisms, or negative feedback loops, with receptors (temperature receptors; sensory nerves), control centres which effect responses (thermostat; brain) and machinery to carry out instructions (switches and furnace; sweat glands).
10. (a) (i)
(b) Iodine would indicate the presence of starch in flasks 2 and 3. In flask 2 there is no enzyme that will initiate the hydrolysis of starch. The amylase in flask 3 has denatured and will not work.
11. (a) (iii)
(b) The independent variable is the type of milk product; the dependent variable is the amount of food energy.
(c) Whipping cream and evaporated milk have very high energy values because of the high fat content.
12. (c)
13. (a) Test tube 1 is the control. It indicates that pancreatin and bile salts are needed for the digestion of fats and proteins.
(b) Fats are digested to fatty acids and proteins are broken down to amino acids. Both acids lower the pH of the solution.
(c) Bile salts cause emulsification (physical digestion) and pancreatin initiates chemical digestion. In test tube 2 only chemical digestion occurs.
(d) In test tube 3 fats are emulsified but no fatty acids are produced, chemical.
14. (a) (iii)
(b) (ii)
15. (a) x (vital capacity) = inspiratory reserve volume + tidal volume + expiratory reserve volume
= 2400 mL + 400 mL + 1500 mL
= 4300 mL

$$\begin{aligned}
 y \text{ (expiratory reserve volume)} &= \text{vital capacity} - \text{inspiratory reserve volume} - \text{tidal volume} \\
 &= 5000 \text{ mL} - 2500 \text{ mL} - 500 \text{ mL} \\
 &= 2000 \text{ mL}
 \end{aligned}$$

$$\begin{aligned}
 z \text{ (tidal volume)} &= \text{vital capacity} - \text{expiratory reserve volume} - \text{inspiratory reserve volume} \\
 &= 5000 \text{ mL} - 1700 \text{ mL} - 2700 \text{ mL} \\
 &= 600 \text{ mL}
 \end{aligned}$$

(b) Subject 1 has the smallest tidal volume and vital capacity and yet also the slowest breathing rate, which indicates that less oxygen is needed for tissues.

16. (a) Myoglobin accepts oxygen more readily than hemoglobin.
 (b) Hemoglobin becomes saturated at approximately 55 mm Hg.
 (c) Myoglobin becomes saturated at approximately 40 mm Hg.
 (d) Myoglobin picks up oxygen more easily than hemoglobin. This ensures that the muscles receive the needed oxygen for exercise.
17. (a) Three step procedure:
1. First, test all the unknown red blood cells with the serum from type B blood. Type B contains antibody A, which reacts with antigen A. If the sample reacts with the serum (forms clumps), then the sample contains antigen A, and the sample is either type A or type AB. If no clumping occurs, then the sample is either type O or B. Further testing must be done.
 2. Next, test the serum from the samples that have antigen A with the type B red blood cells. If there is no reaction, then the sample is type AB. If there is a reaction, then the sample is type A, because type A blood serum contains antibody B, which reacts with type B antigen.
 3. Next, test the serum from the samples that do not have antigen A with the type B red blood cell sample. If there is no reaction, then the blood type is type B, as there is no antibody B in the serum to react with the B antigens. If there is a reaction, the sample is type O, as the serum of this sample will contain the antibody B.
- (b) Serum was used instead of plasma so that the sample would not have fibrinogen in it, which causes clotting.
18. Lactose is digested into monosaccharides by enzymes in the small intestine and absorbed as monosaccharides.
 Proteins digestion begin to be digested by by pepsin in the stomach, protein digestion is completed by trypsin and erepsin in the small intestine.
 Butterfat is emulsified by bile and chemically digested by lipase in the small intestine; it is absorbed by lacteals as fatty acids and glycerol and recombines into fat in the blood.
 Vitamins and minerals do not digest, they absorbed through the stomach.
19. Avoid fats, especially animal fats. The accumulation of fats cause a number of circulatory problems. Recommend minerals (e.g., calcium, to prevent osteoporosis), and fruits and vegetables rich in vitamins and antioxidants. Vitamins are needed for a variety of biochemical reactions. Antioxidants help limit cellular damage by oxidation.
20. Enterogasterone is released in response to fats in the digestive tract. The hormone slows peristalsis, allowing greater time for fat digestion. However, it also means that other foods will remain in the digestive tract for more time. The buildup of stomach acids and other digestive enzymes can lead to heartburn.

21. (a) It takes time for carcinogens to build up and cause problems. The DNA may not be affected at the site that regulates cell division.
- (b) It was not fashionable for woman to smoke until later.
- (c) Death rates for men will decline. According to the graph the rates for women will continue to increase unless there is a marked decline in the number of women who smoke.
- (d) Rates for men began to decline and rates for women continued to increase. More males die than females.
- (e)

Table 4: Survival of Cancer Patients After Five Years

Type of cancer	New cases	Deaths	Survival rate
lung	19 600	16 600	15.3%
breast	17 000	5 400	68.2%
colon	16 300	6 300	61.3%
prostate	14 300	4 100	71.3%
bladder	4 800	1 350	71.9%
kidney	3 700	1 350	63.5%
leukemia	3 200	1 110	65.3%

- (f) Based on the data lung cancer is the most deadly.
22. (a) Two diseases that could be reduced by lifestyle changes include lung cancer, which could be reduced by reducing smoking; and some forms of hypertension, which could be reduced by altering diet and exercise habits.
- (b) Answers will vary. Students should consider pro and cons for the statement. Many people need help to change their lifestyle.
23. (a) Blood builds up in the pulmonary veins. Blood pressure in the lung capillaries increases, thus pushing more plasma into the alveoli. The alveoli fill with fluid.
- (b) Fluid in the alveoli prevents air from entering the alveoli, thus the diffusion of oxygen into the blood and carbon dioxide out of the blood is impaired. Breathing becomes difficult.
- (c) A heart transplant could provide a solution, if the situation is extreme. A faulty left AV valve would cause the enlargement of the left side of the heart. The valve may be faulty and need replacing.
24. (a) Lack of protein in the blood results in lowered osmotic pressure. As a result, blood pressure forces more fluid out of the capillaries than is returned by osmotic pressure of the plasma. The result is an excess of ECF which gathers in the abdomen and lower limbs.
- (b) A short-term solution is a transfusion of plasma. But a long-term solution requires increasing the protein content of the diet. This solution isn't always possible in poorer nations, because of the expense of meat, fish, poultry, etc.