

8. Jaundice is a yellowish discoloration of tissues that is caused by a buildup of bile pigments in the blood.
9. Fried foods contain fat, which is an energy rich food. Excess energy is stored, causing mass to increase.
10. Someone without a gall bladder should reduce their fat intake. Without a gall bladder to store bile produced by the liver, an individual's ability to physically break down fats prior to chemical breakdown would be inhibited. Consequently, it would take longer to break down any fats that enter the small intestine.

Practice 6.9 (page 233)

1. The basal metabolic rate is the minimum amount of energy that a resting animal requires to maintain life processes.
2. Energy output is used for growth, exercise, and normal metabolic reactions. If food intake and energy output are not balanced, you will either gain or lose mass. Mass is gained because excess energy can be converted into fat or other energy-storage compounds, and it is lost when these energy stores are used to fuel energy-consuming activities.
3. Factors that affect energy output are activity level, body mass, rate of metabolism, and thyroid gland function.
4. The thyroid gland produces a chemical messenger that regulates the rate at which food energy is converted into other forms of energy by the cells of the body. If the release of the chemical messenger from the thyroid gland increases, metabolism increases.
5. A portion of the energy from metabolism is converted into heat energy to warm the body, and the rest escapes. A person with a low metabolic rate uses food energy very efficiently, meaning little food energy is converted into heat and therefore less energy escapes from the body. Instead, the food energy is converted into the energy-storage compound fat. A person with a high metabolic rate converts a large portion of the food energy into heat, less food energy is converted into fat, and the person remains relatively thinner.
6. $73.6 \text{ kJ/kg/h} \times 3 \text{ h} \times 50 \text{ kg} = 11\,040 \text{ kJ}$
7. Assuming a mass of 50 kg:

$$11\,040 \text{ kJ} = 13.6 \text{ kJ/kg/h} \times x \text{ h} \times 50 \text{ kg}$$

$$11\,040 \text{ kJ} \div 13.6 \text{ kJ/kg/h} \div 50 \text{ kg} \approx 16.24 \text{ h}$$

Sections 6.9–6.10 Questions (page 236)

1. Energy requirements are relative to body size. Since children are smaller in size than adults, they need to eat less food in order to satisfy their energy needs.
2. Yes, the two people could have different basal metabolic rates. BMR is usually regulated by hormone levels, which have a genetic basis.
3. (a) $5.2 \text{ kJ/kg/h} \times 75 \text{ kg} \times 15 \text{ h} = 5850 \text{ kJ}$ required for a person sitting for 15 h.
 $9 \text{ kJ/kg/h} \times 75 \text{ kg} \times 15 \text{ h} = 10\,125 \text{ kJ}$ required for a person using a computer keyboard for 15 h.
 (b) $6.3 \text{ kJ/kg/h} \times 55 \text{ kg} \times 4.5 = 1559.25 \text{ kJ}$ required for a person standing for 4.5 h.
 (c) Answers will vary.
 (d) Answers will vary.
4. Twenty amino acids are needed to make proteins that make up cell structures. Of these, 8 cannot be synthesized. These are the essential amino acids that must be obtained from food.

5. Common sources of essential amino acids are meats and animal products such as cheese and eggs. A vegetarian must obtain the essential amino acids by eating specific combinations of plant foods that complement each other. For example, corn provides the essential amino acid methionine, which is missing in beans while beans contain the essential amino acid lysine, which is missing in corn.
6. Fats, often given a bad name because of their link with weight gain, are essential in the diet of humans. Fats help the body absorb many important vitamins, serve as body insulation under the skin, protect some of the delicate organs of the body, provide a protective coating around nerves, and are an important component of the cell membrane. Your diet must include appropriate amounts of the essential fatty acids needed for making and repairing cell membranes.
7. Vitamins help your body change food into energy. Vitamins are organic molecules needed in trace amounts for normal growth and metabolic processes.

8.

Vitamin	Source	Needed for	Deficiency Symptoms
A	green vegetables, yellow vegetables, carrots, tomatoes	good vision, normal growth of bones and teeth, healthy skin	poor vision, night blindness, kidney problems
B ₁	pork, liver, peas, soybeans, grains, vegetables	proper functioning of heart, nerves, muscles	poor appetite, nerve problems, beriberi
B ₂	lean meat, eggs, milk, liver, fish, poultry, leafy vegetables	healthy skin and hair, good vision, growth, reproduction	poor growth, hair problems, poor vision
C	citrus fruits, potatoes	maintaining cells and tissues	low resistance to infections
D	fish oils, eggs, milk	strong teeth and bones, growth	weak teeth and bones
E	leafy vegetables, grains, vegetable oils, liver	forming red blood cells	no symptoms
K	leafy vegetables, liver, potatoes	assisting blood clotting, healthy bones	hemorrhaging

9.

Mineral	Needed for	Deficiency Symptoms
calcium	growth and maintenance of bones and teeth, aids blood clotting	soft bones and teeth, osteoporosis
iodine	proper working of thyroid gland	swollen thyroid gland, goitre
iron	transport of oxygen through the body	lack of energy, anemia
phosphorus	growth and maintenance of bones and teeth, some cell reactions	poor development of bones and teeth
potassium	needed to make proteins	weak muscles
sodium	regulates movement of water between cells and blood	dehydration

10. Water-soluble vitamins cannot be stored in your body and must be consumed daily because when not absorbed immediately, they are excreted in the urine. Fat-soluble vitamins can be stored in the fatty tissues of your body. If you take too many of these vitamins, they can build up in your body and become harmful.
11. (a) Choosing to become a vegetarian is one lifestyle choice that could lead to a vitamin deficiency. Vegetarians must pay careful attention to their diet in order to ensure that they consume foods that supply the required amount of vitamins like D and B₁₂. Alcoholism is associated with deficiencies in vitamins A, B₁, and niacin.

- (b) See table above.
12. Cod liver oil contains vitamin D which is activated by sunlight.
 13. Vitamin A is found in milk fats. Because the fat content is reduced in 2% and skim milk, the vitamin level is decreased.
 14. Antioxidants are chemicals that reduce the danger of oxygen-free radicals. Vitamins C, E, and beta carotene (the chemical parent of vitamin A) are antioxidants. Free radicals are created in your body by exposure to sunlight, X-rays, ozone, tobacco smoke, car exhaust, and other environmental pollutants. They damage the genetic information in your body cells, causing mutations. The altered instructions found in the genetic information can cause the cell to divide at uncontrolled rates or even die. Scientists believe that these free radicals play a major role in the development of cancer, heart or lung disease, and even cataracts (a condition that makes the lens of the eye opaque). By taking these chemicals "out of commission", you would live longer and experience better health.

Chapter 6 Review (pages 238–239)

Understanding Concepts

1. In the mouth enzymes are secreted that break down protein molecules into smaller chains; teeth also break food into smaller pieces. The stomach is the site of initial protein digestion. The small intestine secretes a starch-splitting enzyme that breaks starch molecules into shorter chains, and the gall bladder releases bile salts into the small intestine which speed up fat digestion.
2. (a) The stomach, 4, is the organ that initiates protein digestion.
(b) Areas 1 and 5, the salivary glands and the small intestine, secrete enzymes that break down starch.
(c) Bacteria that manufacture vitamin K are found in the large intestine, 6.
(d) The gall bladder is 11; the esophagus is 2; the pancreas is 12.
3. Peristalsis moves water down the gastrointestinal tract, by rhythmic contractions of smooth muscle.
4. Chemicals in the stomach do not digest the stomach itself because of the protective mucus layer.
5. Pepsin and trypsin are activated by gastric fluids, which are produced when food is taken in. If they were stored in active form, they would digest proteins and long chain peptides even in the absence of food. Erepsins can be stored in active form because they only act on partially digested proteins, therefore cells with intact proteins are not at danger.
6. Hydrochloric acid activates pepsinogen to active pepsin, which is necessary for protein digestion in the stomach to occur. Hydrochloric acid stimulates the intestine to secrete the hormone secretin. Secretin stimulates the pancreas to produce pancreatic juice including the enzyme trypsinogen. Trypsinogen catalyzes the digestion of protein. If the stomach failed to secrete hydrochloric acid, there would be decreased protein digestion in the stomach and the small intestine. Hydrochloric acid also lowers the pH of the stomach, destroying some harmful living organisms ingested with food. If the stomach failed to secrete HCl, these organisms may cause harm.
7. Bile salts can emulsify the stomach lining (protein and lipid), exposing them to pepsin.
8. Fatty foods present a problem because they cause bile to be released, but the bile is unable to reach the small intestine. Emulsification of fats is all but eliminated. This slows the chemical digestion of fats because large fat droplets have a small surface area on which lipase enzymes can work.

9. Bile made in the liver fails to reach the intestine, resulting in the buildup of bile pigments in the blood.
10. Folds in the wall of the small intestine, villi and microvilli, increase the surface area, allowing for better absorption of nutrients.
11. Initial carbohydrate digestion begins in the mouth. Starches are broken down to smaller glucose-containing chains. Carbohydrate digestion continues once they enter the small intestine. Amylase enzymes from the pancreas and disaccharide enzymes from the small intestine and pancreas cleave more bonds, producing monosaccharides (mostly glucose). Assuming the spaghetti dinner contains some proteins, protein digestion is initiated by pepsin from the stomach. Proteins are hydrolyzed to long-chain peptides. This stimulates the release of the hormone gastrin which accelerates gastric secretions. Protein digestion continues in the small intestine once trypsinogen, from the pancreas, is activated by enterokinase. Trypsin causes the breakdown of long chain peptides into shorter chain peptides. Eventually, the shorter chain peptides are broken down to amino acids by erepsins from the small intestine. Meat fat is emulsified by bile salts in the small intestine. Pancreatic lipase causes chemical digestion of fats to fatty acids and glycerol in the small intestine. The presence of fats in the small intestine initiates the release of enterogasterone, which slows peristalsis, allowing greater time for fat absorption.
12.

cheese	2130 kJ
2% milk	2160 kJ
scrambled eggs	1200 kJ
ground beef	2160 kJ
bacon	1900 kJ
peas	133.5 kJ
apple	290 kJ
French fries	1950 kJ
lemonade	420 kJ
brownie	1600 kJ
cola	640 kJ
TOTAL	14 583.5 kJ

 - (a) $42 \text{ kJ/kg/h} \times 2 \text{ h} \times 75 \text{ kg} = 6300 \text{ kJ}$ required for 2 h of cross country skiing.
 - (b) John may want to consider consuming more carbohydrates and fewer fats. Carbohydrates are more easily converted into energy for exercise.
 - (c)
$$2436 \text{ kJ} = 42 \text{ kJ/kg/h} \times x \text{ h} \times 75 \text{ kg}$$

$$2436 \text{ kJ} \div 42 \text{ kJ/kg/h} \div 75 \text{ kg} \Rightarrow 0.77 \text{ h}$$

$$\Rightarrow 46 \text{ min}$$
13. Diets in wealthy nations tend to contain a greater amount of processed foods and meat and less roughage. Insufficient amounts of roughage results in fewer bowel movements, and wastes remain in the colon for longer periods of time, causing a slow build up of metabolic toxins.
14. A person could eat a balanced diet in insufficient quantities. Eating the right sorts of foods is important for good nutrition, but a person must also eat enough food to provide the food energy required for daily activity. Also, a nutritional deficiency might be the result of a physical problem, where some illnesses interfere with the body's ability to absorb particular nutrients.
15. Test tube A would remain pink, since no fatty acids are present, and no fat digestion would occur. Test tube B also remains pink; although there is physical digestion of lipids, there are no fatty acids produced since there is no chemical digestion of fats.