

Review the key points of this chapter below, then take the practice quiz on the back of this card.

1.1 Food Choices

- People select foods based on such factors as taste and convenience, but selections based on nutrition knowledge may better support good health.
- Individual foods are neither “good” nor “bad”; daily food choices made over a lifetime may improve or impair a person’s health.

1.2 The Nutrients

- Foods provide nutrients—substances that provide energy, structural materials, and regulating agents to support the growth, maintenance, and repair of the body’s tissues. Essential nutrients *must* be obtained from foods.
- The six classes of nutrients include carbohydrates, lipids (fats), proteins, vitamins, minerals, and water. Carbohydrates, lipids, proteins, and vitamins are organic, meaning they contain carbon; minerals and water are inorganic, meaning they do not contain carbon.
- Energy is measured in calories—a measure of heat energy. One calorie is the amount of heat necessary to raise the temperature of 1 kg water 1°C.
- The energy-yielding nutrients are carbohydrate (4 kcal/g), fat (9 kcal/g), and protein (4 kcal/g). Alcohol provides 7 kcal/g, but it is not considered a nutrient.
- Vitamins, minerals, and water do not provide energy; instead, they facilitate a variety of activities in the body.

1.3 The Science of Nutrition

- The science of nutrition is the study of nutrients and other substances in foods and the body’s handling of them.
- Researchers follow the scientific method (review Figure 1-3, p. 12). They randomly assign control and experimental groups, use large sample sizes, provide placebos, and are blind to treatments. Their findings are reviewed and replicated by other scientists before being accepted as valid.
- Correlations indicate an association between variables, not a cause.

1.4 Dietary Reference Intakes

- Dietary Reference Intakes (DRI) are a set of nutrient intake values used to plan and evaluate diets for healthy people.
- Estimated Average Requirement (EAR) defines the amount of a nutrient that supports a specific function in the body for half of the population. Recommended Dietary Allowance (RDA) is based on the

EAR and establishes a goal for dietary intake that will meet the needs of almost all healthy people. Adequate Intake (AI) serves a similar purpose when an RDA cannot be determined.

- Estimated Energy Requirement (EER) defines the average amount of energy intake needed to maintain energy balance, and Acceptable Macronutrient Distribution Ranges (AMDR) define the proportions contributed by carbohydrate, fat, and protein to a healthy diet. Carbohydrates should consist of 45 to 65 percent of calories, fat 20 to 35 percent, and protein 10 to 35 percent.
- Tolerable Upper Intake Level (UL) establishes the highest amount that appears safe for regular consumption.

1.5 Nutrition Assessment

- Malnutrition develops when people get too little, too much, or an imbalance of energy or nutrients.
- Four nutrition assessment methods include historical information on diet and health, anthropometric measurements, physical examinations, and laboratory tests. Together, these methods reveal the stages of a nutrient deficiency (review Figure 1-7, p. 23).
- A primary deficiency is caused by an inadequate intake of a nutrient; a secondary deficiency is caused by a condition that reduces absorption, accelerates use, increases excretion, or destroys the nutrient.

1.6 Diet and Health

- Risk factors such as obesity and cigarette smoking increase the likelihood of disease development (review Table 1-6).
- Some risk factors, such as genetics, are important but cannot be changed. Recommendations focus on changeable, personal life choices such as diet and activity habits.
- Diet has no influence on some diseases but is linked closely to others (review Table 1-5).

TABLE 1-5 Leading Causes of Death in the United States

	Percentage of Total Deaths
1. Heart disease	24.1
2. Cancers	23.3
3. Chronic lung diseases	5.6
4. Strokes	5.2
5. Accidents	4.8
6. Alzheimer’s disease	3.4
7. Diabetes mellitus	2.8
8. Pneumonia and influenza	2.0
9. Kidney disease	2.0
10. Suicide	1.5

NOTE: The diseases highlighted in bold have relationships with diet.

SOURCE: Deaths: Preliminary data for 2010, *National Vital Statistics Reports*, January 11, 2012, Centers for Disease Control and Prevention, www.cdc.gov/nchs.

TABLE 1-6 Factors Contributing to Deaths in the United States

Factors	Percentage of Deaths
Tobacco	18
Poor diet/inactivity	15
Alcohol	4
Microbial agents	3
Toxic agents	2
Motor vehicles	2
Firearms	1
Sexual behavior	1
Illicit drugs	1

SOURCE: A. H. Mokdad and coauthors, Actual causes of death in the United States, 2000, *Journal of the American Medical Association* 291 (2004): 1238–1245, with corrections from *Journal of the American Medical Association* 293 (2005): 298.

Take the quiz below to test your mastery of the key chapter concepts.

1.1 Food Choices (pp. 4–6)

LEARN IT Describe how various factors influence personal food choices.

1. When people eat the foods typical of their families or geographic region, their choices are influenced by:
 - a. habit.
 - b. nutrition.
 - c. personal preference.
 - d. heritage or tradition.

1.2 The Nutrients (pp. 6–12)

LEARN IT Name the six major classes of nutrients and identify which are organic and which yield energy.

2. What is the difference between organic and inorganic?
3. How much energy do carbohydrates, fats, and proteins yield per gram? How is energy measured?
4. Describe how alcohol resembles nutrients. Why is alcohol not considered a nutrient?
5. The nutrient found most abundantly in both the human body and most foods is:
 - a. fat.
 - b. water.
 - c. minerals.
 - d. proteins.
6. The inorganic nutrients are:
 - a. proteins and fats.
 - b. vitamins and minerals.
 - c. minerals and water.
 - d. vitamins and proteins.
7. The energy-yielding nutrients are:
 - a. fats, minerals, and water.
 - b. minerals, proteins, and vitamins.
 - c. carbohydrates, fats, and vitamins.
 - d. carbohydrates, fats, and proteins.

1.3 The Science of Nutrition (pp. 12–17)

LEARN IT Explain the scientific method and how scientists use various types of research studies and methods to acquire nutrition information.

8. What is the science of nutrition?
9. Explain how variables might be correlational but not causal.
10. Studies of populations that reveal correlations between dietary habits and disease incidence are:
 - a. clinical trials.
 - b. laboratory studies.
 - c. case-control studies.
 - d. epidemiological studies.
11. An experiment in which neither the researchers nor the subjects know who is receiving the treatment is known as:
 - a. double blind.
 - b. double control.
 - c. blind variable.
 - d. placebo control.

1.4 Dietary Reference Intakes (pp. 17–21)

LEARN IT Define the four categories of the DRI and explain their purposes.

12. What judgment factors are involved in setting the energy and nutrient recommendations?
13. An RDA represents the:
 - a. highest amount of a nutrient that appears safe for most healthy people.
 - b. lowest amount of a nutrient that will maintain a specified criterion of adequacy.
 - c. average amount of a nutrient considered adequate to meet the known nutrient needs of practically all healthy people.
 - d. average amount of a nutrient that will maintain a specific biochemical or physiological function in half the people.

1.5 Nutrition Assessment (pp. 21–25)

LEARN IT Explain how the four assessment methods are used to detect energy and nutrient deficiencies and excesses.

14. What methods are used in nutrition surveys? What kinds of information can these surveys provide?
15. Historical information, physical examinations, laboratory tests, and anthropometric measurements are:
 - a. techniques used in diet planning.
 - b. steps used in the scientific method.
 - c. approaches used in disease prevention.
 - d. methods used in a nutrition assessment.
16. A deficiency caused by an inadequate dietary intake is called a(n):
 - a. overt deficiency.
 - b. covert deficiency.
 - c. primary deficiency.
 - d. secondary deficiency.

1.6 Diet and Health (pp. 25–27)

LEARN IT Identify several risk factors and explain their relationships to chronic diseases.

17. Behaviors such as smoking, dietary habits, physical activity, and alcohol consumption that influence the development of disease are known as:
 - a. risk factors.
 - b. chronic causes.
 - c. preventive agents.
 - d. disease descriptors.

Multiple Choice Answers
1.d 5.b 6.c 7.d 10.d 11.a 13.c 15.d 16.c 17.a

Review the key points of this chapter below, then take the practice quiz on the back of this card.

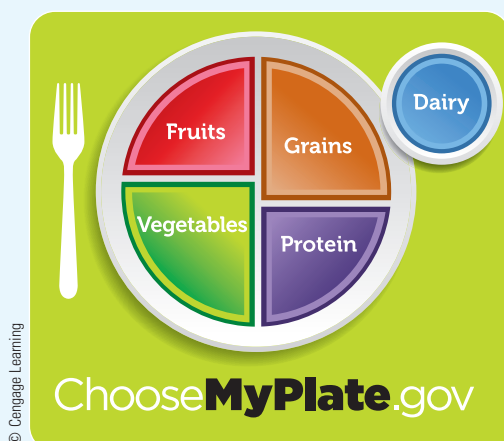
2.1 Principles and Guidelines

- A well-planned diet delivers *adequate* nutrients, a *balanced* array of nutrients, and an appropriate amount of *energy* (*kcalories*). It is based on *nutrient-dense* foods, *moderate* in substances that can be detrimental to health, and *varied* in its selections.
- The *Dietary Guidelines for Americans* offer practical advice on how to eat for good health (review Table 2-1, p. 39).

2.2 Diet-Planning Guides

- The USDA Food Patterns help consumers select the types and amounts of foods to provide adequacy, balance, and variety in the diet. It makes it easier to plan a diet that includes a balance of grains, vegetables, fruits, protein foods, and milk products. In making any food choice, remember to view the food in the context of the total diet.
- The combination of many different foods provides the array of nutrients that are essential to a healthy diet (review Figure 2-2, pp. 42–43).
- MyPlate reminds consumers to make healthy choices from the five food groups (review Figure 2-4).

> FIGURE 2-4 MyPlate

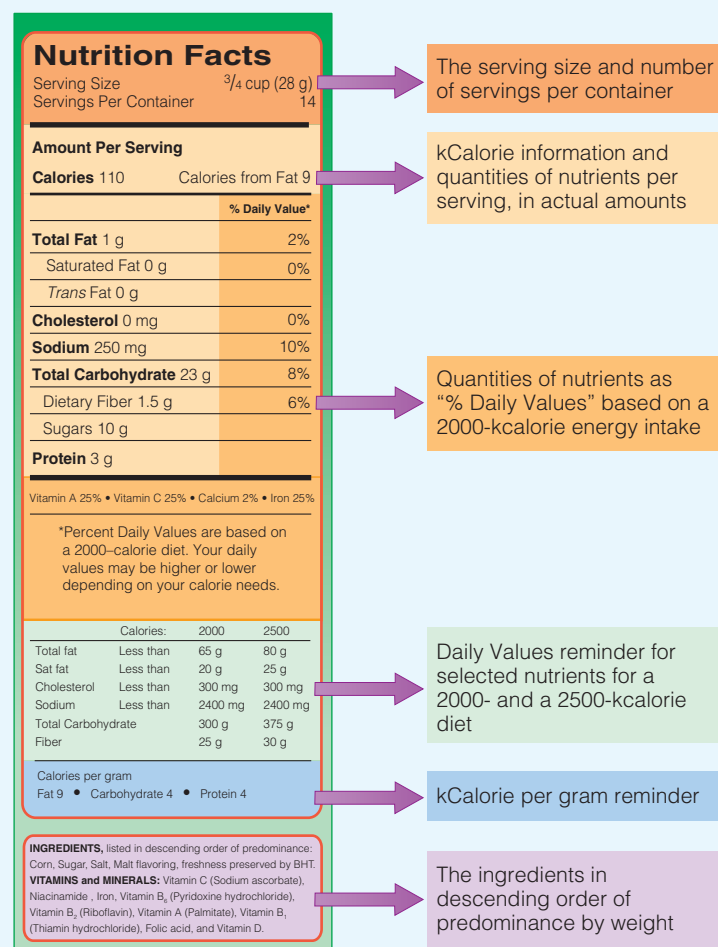


SOURCE: USDA, www.choosemyplate.gov.

2.3 Food Labels

- Food labels list ingredients in descending order of predominance by weight, nutrition facts based on standard serving sizes, and Daily Values based on a 2000-kcalorie diet (review Figure 2-8).
- Nutrient claims reflect the quantity of a nutrient (high or low), health claims reflect relationships between a nutrient and a disease (potassium reduces risk of hypertension), and structure-function claims reflect relationships between a nutrient and its function in the body (calcium builds bones).

> FIGURE 2-8 Example of a Food Label



Take the quiz below to test your mastery of the key chapter concepts.

2.1 Principles and Guidelines (pp. 35–40)

LEARN IT Explain how each of the diet-planning principles can be used to plan a healthy diet.

1. What recommendations appear in the *Dietary Guidelines for Americans*?
2. The diet-planning principle that provides all the essential nutrients in sufficient amounts to support health is:
 - a. balance.
 - b. variety.
 - c. adequacy.
 - d. moderation.
3. A person who chooses a chicken leg that provides 0.5 milligram of iron and 95 kcalories instead of 2 tablespoons of peanut butter that also provides 0.5 milligram of iron but 188 kcalories is using the principle of nutrient:
 - a. control.
 - b. density.
 - c. adequacy.
 - d. moderation.
4. Which of the following is consistent with the *Dietary Guidelines for Americans*?
 - a. Choose a diet restricted in fat and cholesterol.
 - b. Balance the food you eat with physical activity.
 - c. Choose a diet with plenty of milk products and meats.
 - d. Eat an abundance of foods to ensure nutrient adequacy.

2.2 Diet-Planning Guides (pp. 40–53)

LEARN IT Use the USDA Food Patterns to develop a meal plan within a specified energy allowance.

5. Review the *Dietary Guidelines*. What types of grocery selections would you make to achieve those recommendations?
6. According to the USDA Food Patterns, cheese is grouped as a:
 - a. meat.
 - b. protein food.
 - c. milk product.
 - d. miscellaneous fat.
7. Foods within a given food group of the USDA Food Patterns are similar in their contents of:
 - a. energy.
 - b. proteins and fibers.
 - c. vitamins and minerals.
 - d. carbohydrates and fats.

8. In the exchange system, each portion of food on any given list provides about the same amount of:
 - a. energy.
 - b. satiety.
 - c. vitamins.
 - d. minerals.
9. Enriched grain products are fortified with:
 - a. fiber, folate, iron, niacin, and zinc.
 - b. thiamin, iron, calcium, zinc, and sodium.
 - c. iron, thiamin, riboflavin, niacin, and folate.
 - d. folate, magnesium, vitamin B₆, zinc, and fiber.

2.3 Food Labels (pp. 53–60)

LEARN IT Compare and contrast the information on food labels to make selections that meet specific dietary and health goals.

10. What information can you expect to find on a food label? How can this information help you choose between two similar products?
11. What are the Daily Values? How can they help you meet health recommendations?
12. Describe the differences between nutrient claims, health claims, and structure-function claims.
13. Food labels list ingredients in:
 - a. alphabetical order.
 - b. ascending order of predominance by weight.
 - c. descending order of predominance by weight.
 - d. manufacturer's order of preference.
14. "Milk builds strong bones" is an example of a:
 - a. health claim.
 - b. nutrition fact.
 - c. nutrient content claim.
 - d. structure-function claim.
15. Daily Values on food labels are based on a:
 - a. 1500-kcalorie diet.
 - b. 2000-kcalorie diet.
 - c. 2500-kcalorie diet.
 - d. 3000-kcalorie diet.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

3.1 Digestion

- Digestion breaks down foods into nutrients. Absorption brings the nutrients into the cells of the small intestine for transport to the body's cells.
- Food enters the mouth and travels down the esophagus and through the upper and lower esophageal sphincters to the stomach, then through the pyloric sphincter to the small intestine, on through the ileocecal valve to the large intestine, past the appendix to the rectum, ending at the anus (review Figure 3-1).
- The wavelike contractions of peristalsis and the periodic squeezing of segmentation keep things moving at a reasonable pace. Along the way, secretions from the salivary glands, stomach, pancreas, liver (via the gallbladder), and small intestine deliver fluids and digestive enzymes (review Table 3-1).

3.2 Absorption

- The many folds and villi of the small intestine increase its surface area, making nutrient absorption efficient.
- Nutrients pass through the cells of the intestinal villi and enter either the blood (if they are water soluble or small fat fragments) or the lymph (if they are fat soluble).

3.3 The Circulatory Systems

- Nutrients leaving the digestive system via the blood are routed directly to the liver before being transported to the body's cells.
- Nutrients leaving via the lymphatic system bypass the liver at first, but eventually enter the vascular system via the thoracic duct, which opens into the subclavian vein.

3.4 The Health and Regulation of the GI Tract

- A diverse and abundant bacteria population supports GI health.
- The regulation of GI processes depends on the coordinated efforts of the hormonal system and the nervous system.
- Together, digestion and absorption break down foods into nutrients for the body's use.
- To function optimally, a healthy GI tract needs a balanced diet, adequate rest, and regular physical activity.

FIGURE 3-1 The Gastrointestinal Tract

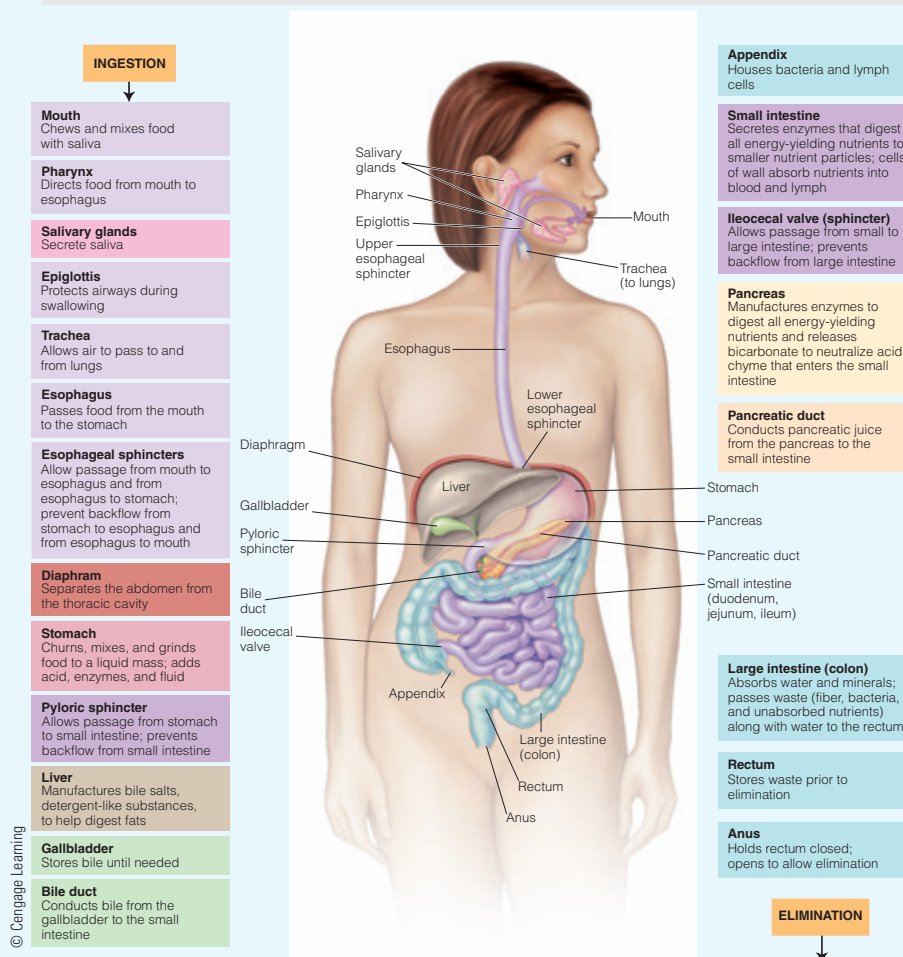


TABLE 3-1 Summary of Digestive Secretions and Their Major Actions

Organ or Gland	Target Organ	Secretion	Action
Salivary glands	Mouth	Saliva	Fluid eases swallowing; salivary enzyme breaks down some carbohydrate .*
Gastric glands	Stomach	Gastric juice	Fluid mixes with bolus; hydrochloric acid uncoils proteins ; enzymes break down proteins; mucus protects stomach cells.*
Pancreas	Small intestine	Pancreatic juice	Bicarbonate neutralizes acidic gastric juices; pancreatic enzymes break down carbohydrates, fats, and proteins .
Liver	Gallbladder	Bile	Bile is stored until needed.
Gallbladder	Small intestine	Bile	Bile emulsifies fat so that enzymes can have access to break it down.
Intestinal glands	Small intestine	Intestinal juice	Intestinal enzymes break down carbohydrate, fat, and protein fragments; mucus protects the intestinal wall.

*Saliva and gastric juice also contain lipases, but most fat breakdown occurs in the small intestine.

Take the quiz below to test your mastery of the key chapter concepts.

3.1 Digestion (pp. 69–77)

LEARN IT Explain how foods move through the digestive system, describing the actions of the organs, muscles, and digestive secretions along the way.

- Describe the challenges associated with digesting food and the solutions offered by the human body.
- Name five organs that secrete digestive juices. How do the juices and enzymes facilitate digestion?
- The semiliquid, partially digested food that travels through the intestinal tract is called:
 - bile.
 - lymph.
 - chyme.
 - secretin.
- The muscular contractions that move food through the GI tract are called:
 - hydrolysis.
 - sphincters.
 - peristalsis.
 - bowel movements.
- The main function of bile is to:
 - emulsify fats.
 - catalyze hydrolysis.
 - slow protein digestion.
 - neutralize stomach acidity.
- The pancreas neutralizes stomach acid in the small intestine by secreting:
 - bile.
 - mucus.
 - enzymes.
 - bicarbonate.
- Which nutrient passes through the GI tract mostly undigested and unabsorbed?
 - fat
 - fiber
 - protein
 - carbohydrate

3.2 Absorption (pp. 77–79)

LEARN IT Describe the anatomical details of the intestinal cells that facilitate nutrient absorption.

- The fingerlike projections on the small intestine that dramatically increase its surface area are called:
 - villi.
 - crypts.
 - goblet cells.
 - chylomicrons.

- Absorption occurs primarily in the:
 - mouth.
 - stomach.
 - small intestine.
 - large intestine.

3.3 The Circulatory Systems (pp. 80–82)

LEARN IT Explain how nutrients are routed in the circulatory systems from the GI tract into the body and identify which nutrients enter the blood directly and which must first enter the lymph.

- All blood leaving the GI tract travels first to the:
 - heart.
 - liver.
 - kidneys.
 - pancreas.
- Which nutrients leave the GI tract by way of the lymphatic system?
 - water and minerals
 - proteins and minerals
 - all vitamins and minerals
 - fats and fat-soluble vitamins

3.4 The Health and Regulation of the GI Tract (pp. 82–86)

LEARN IT Describe how bacteria, hormones, and nerves influence the health and activities of the GI tract.

- How does the composition of the diet influence the functioning of the GI tract?
- What steps can you take to help your GI tract function at its best?
- Digestion and absorption are coordinated by the:
 - pancreas and kidneys.
 - liver and gallbladder.
 - hormonal system and the nervous system.
 - vascular system and the lymphatic system.
- Gastrin, secretin, and cholecystokinin are examples of:
 - crypts.
 - enzymes.
 - hormones.
 - goblet cells.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

4.1 The Chemist's View of Carbohydrates

- Carbohydrates include monosaccharides, disaccharides, and polysaccharides (review Table 4-1).
- Carbohydrates are made of carbon (C), oxygen (O), and hydrogen (H); each atom forms a specified number of chemical bonds: carbon forms four, oxygen forms two, and hydrogen forms one (review Figure 4-1, p. 96).
- Monosaccharides (glucose, fructose, and galactose) all have the same chemical formula ($C_6H_{12}O_6$), but their structures differ. Disaccharides (maltose, sucrose, and lactose) each contain a glucose paired with one of the three monosaccharides.
- A condensation reaction can bond two monosaccharides together to form a disaccharide and water (review Figure 4-4, p. 98). A hydrolysis reaction can use water to split a disaccharide into its two monosaccharides (review Figure 4-5, p. 98).
- Chains of monosaccharides are called polysaccharides and include glycogen, starches, and dietary fibers. Both glycogen and starch are storage forms of glucose—glycogen in the body, and starch in plants—and both yield energy.
- Dietary fibers contain glucose (and other monosaccharides), but their bonds cannot be broken by human digestive enzymes; they yield little, if any, energy.
- Soluble fibers dissolve in water to form gels and are easily digested by bacteria in the colon. Insoluble fibers do not dissolve in water or form gels and are less readily fermented.

TABLE 4-1 The Carbohydrate Family

Monosaccharides

Glucose

Fructose

Galactose

Disaccharides

Maltose (glucose + glucose)

Sucrose (glucose + fructose)

Lactose (glucose + galactose)

Polysaccharides

Glycogen^a

Starches (amylose and amylopectin)

Fibers (soluble and insoluble)

^aGlycogen is a polysaccharide, but not a common dietary source of carbohydrate.

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4.2 Digestion and Absorption of Carbohydrates

- The body digests starches into the disaccharide maltose. Maltose and the other disaccharides (lactose and sucrose) from foods are broken down into monosaccharides, which are absorbed (review Figure 4-9, p. 103)

- Fibers help to regulate the passage of food through the GI tract and slow the absorption of glucose.
- Lactose intolerance occurs when there is insufficient lactase to digest the disaccharide lactose found in milk and milk products. Symptoms include GI distress.

4.3 Glucose in the Body

- Dietary carbohydrates provide glucose that can be used by the cells for energy, stored by the liver and muscles as glycogen, or converted into fat if intakes exceed needs.
- All of the body's cells depend on glucose; those of the central nervous system are especially dependent on it.
- Without glucose, the body is forced to break down its protein tissues to make glucose and to alter energy metabolism to make ketone bodies from fats.
- Blood glucose regulation depends on two pancreatic hormones: insulin to move glucose from the blood into the cells when levels are high and glucagon to free glucose from glycogen stores and release it into the blood when levels are low (review Figure 4-10, p. 107).

4.4 Health Effects and Recommended Intakes of Sugars

- Excessive intakes of sugars may increase the risk of dental caries, displace needed nutrients and fiber, and contribute to obesity when energy intake exceeds needs.
- Concentrated sweets are relatively low in nutrients, high in calories, and may need to be limited; sugars that occur naturally in fruits, vegetables, and milk are acceptable.
- To control weight gain, blood glucose, and dental caries, consumers may use alternative sweeteners (artificial sweeteners, herbal products, and sugar alcohols) to limit calories and minimize sugar intake (review Table 4-4, p. 114).

4.5 Health Effects and Recommended Intakes of Starch and Fibers

- Adequate intake of fiber fosters weight management, lowers blood cholesterol, and may help prevent colon cancer, diabetes, hemorrhoids, appendicitis, and diverticulosis.
- Excessive intake of fiber displaces energy- and nutrient-dense foods, causes intestinal discomfort and distention, and may interfere with mineral absorption.
- Because starches and fibers help control body weight and prevent heart disease, cancer, diabetes, and GI disorders, the *Dietary Guidelines* suggest plenty of whole grains, vegetables, legumes, and fruits—enough to provide 45 to 65 percent of the daily energy intake from carbohydrate.

Take the quiz below to test your mastery of the key chapter concepts.

4.1 The Chemist's View of Carbohydrates

(pp. 96–101)

LEARN IT Identify the monosaccharides, disaccharides, and polysaccharides common in nutrition by their chemical structures and major food sources.

1. What happens in a condensation reaction? In a hydrolysis reaction?
2. How are starch and glycogen similar, and how do they differ? How do the fibers differ from the other polysaccharides?
3. Disaccharides include:
 - a. starch, glycogen, and fiber.
 - b. amylose, pectin, and dextrose.
 - c. sucrose, maltose, and lactose.
 - d. glucose, galactose, and fructose.
4. The making of a disaccharide from two monosaccharides is an example of:
 - a. digestion.
 - b. hydrolysis.
 - c. condensation.
 - d. gluconeogenesis.
5. The significant difference between starch and cellulose is that:
 - a. starch is a polysaccharide, but cellulose is not.
 - b. animals can store glucose as starch, but not as cellulose.
 - c. hormones can make glucose from cellulose, but not from starch.
 - d. digestive enzymes can break the bonds in starch, but not in cellulose.

4.2 Digestion and Absorption of Carbohydrates

(pp. 101–104)

LEARN IT Summarize carbohydrate digestion and absorption.

6. What role does fiber play in digestion and absorption?
7. Describe lactose intolerance and its symptoms.
8. The ultimate goal of carbohydrate digestion and absorption is to yield:
 - a. fibers.
 - b. glucose.
 - c. enzymes.
 - d. amylase.
9. The enzyme that breaks a disaccharide into glucose and galactose is:
 - a. amylase.
 - b. maltase.
 - c. sucrase.
 - d. lactase.

4.3 Glucose in the Body

(pp. 104–109)

LEARN IT Explain how the body maintains its blood glucose concentration and what happens when blood glucose rises too high or falls too low.

10. What are the possible fates of glucose in the body? What is the protein-sparing action of carbohydrate?
11. The storage form of glucose in the body is:
 - a. insulin.
 - b. maltose.
 - c. glucagon.
 - d. glycogen.
12. With insufficient glucose in metabolism, fat fragments combine to form:
 - a. dextrins.
 - b. mucilages.
 - c. phytic acids.
 - d. ketone bodies.
13. What does the pancreas secrete when blood glucose rises? When blood glucose falls?
 - a. insulin; glucagon
 - b. glucagon; insulin
 - c. insulin; glycogen
 - d. glycogen; epinephrine

4.4 Health Effects and Recommended Intakes of Sugars

(pp. 109–115)

LEARN IT Describe how added sugars can contribute to health problems.

14. What are the dietary recommendations regarding concentrated sugar intakes?
15. Describe the risks and benefits of using alternative sweeteners.

4.5 Health Effects and Recommended Intakes of Starch and Fibers

(pp. 115–121)

LEARN IT Identify the health benefits of, and recommendations for, starches and fibers.

16. What foods provide starches and fibers?
17. Carbohydrates are found in virtually all foods except:
 - a. milks.
 - b. meats.
 - c. breads.
 - d. fruits.
18. What percentage of the daily energy intake should come from carbohydrates?
 - a. 15 to 20
 - b. 25 to 30
 - c. 45 to 50
 - d. 45 to 65

Review the key points of this chapter below, then take the practice quiz on the back of this card.

5.1 The Chemist's View of Fatty Acids and Triglycerides

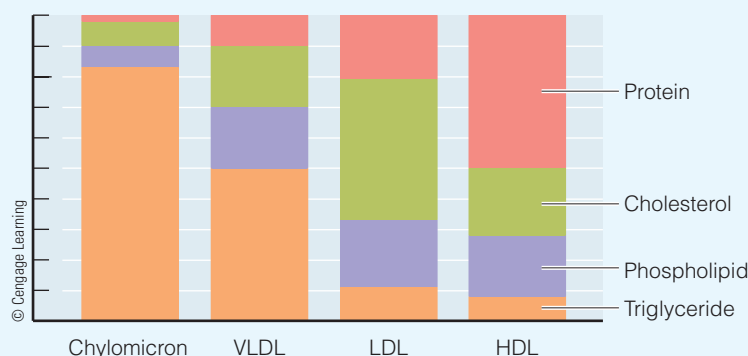
- The predominant lipids both in foods and in the body are triglycerides: glycerol with three fatty acids attached by way of condensation reactions (review Figure 5-3, p. 133). Other lipids include phospholipids and sterols (review Table 5-2).
- Fatty acids vary in the length of their carbon chains, their degrees of unsaturation, and the location of their double bond(s). Saturated fatty acids are fully loaded with hydrogens; unsaturated (monounsaturated or polyunsaturated) fatty acids are missing hydrogens and have double bonds.
- Hydrogenation protects against oxidation (thereby promoting shelf-life) and alters the texture of foods by making liquid vegetable oils more solid. This process makes polyunsaturated fats more saturated and creates *trans*-fatty acids.

5.2 The Chemist's View of Phospholipids and Sterols

- The chemical structure of phospholipids, including lecithin, allows them to be soluble in both water and fat. In the body, phospholipids are part of cell membranes; in foods, phospholipids act as emulsifiers to mix fats with water.
- Sterols have a multiple-ring structure that differs from the structure of other lipids. In the body, sterols include cholesterol, bile, vitamin D, and some hormones. Animal-derived foods contain cholesterol.

5.3 Digestion, Absorption, and Transport of Lipids

- Bile emulsifies fats, making them accessible to the lipases that dismantle triglycerides to monoglycerides and fatty acids for absorption (review Figure 5-12, p. 140).
- Four types of lipoproteins carry triglycerides, phospholipids, and cholesterol throughout the body: *chylomicrons* are the largest



and contain mostly dietary triglycerides, *VLDL* are smaller and are about half triglycerides, *LDL* are smaller still and contain mostly cholesterol, and *HDL* are the densest and are rich in protein (review Figure 5-16, p. 142).

5.4 Lipids in the Body

- In the body, triglycerides provide energy, insulate against temperature extremes, protect against shock, and help the body use carbohydrate and protein efficiently.
- Linoleic acid (18 carbons, omega-6) and linolenic acid (18 carbons, omega-3) are essential fatty acids, serving as structural parts of cell membranes and as precursors to the longer fatty acids that can make eicosanoids.
- The body stores fat if given excesses, and uses body fat for energy when needed. (The liver can also convert excess carbohydrate and protein into fat.) Fat breakdown requires carbohydrate for maximum efficiency; without carbohydrate, fatty acids break down to ketone bodies.

5.5 Health Effects and Recommended Intakes of Saturated Fats, *Trans* Fats, and Cholesterol

- Some fat in the diet is necessary, but too much fat provides energy (kcalories) without nutrients, which leads to obesity and nutrient inadequacies.
- Too much saturated fat, *trans* fat, and cholesterol increases the risk of heart disease and possibly cancer.
- Recommendations advise that a diet be moderate in total fat and low in saturated fat, *trans* fat, and cholesterol.

5.6 Health Effects and Recommended Intakes of Monounsaturated and Polyunsaturated Fats

- Some fat in the diet has health benefits, especially the monounsaturated and polyunsaturated fats that protect against heart disease and possibly cancer.
- The *Dietary Guidelines* recommend replacing saturated fats with monounsaturated and polyunsaturated fats, particularly omega-3 fatty acids from foods such as fatty fish, not from supplements.
- Many selection and preparation strategies can help bring these goals within reach, and food labels help to identify foods consistent with these guidelines.

TABLE 5-2 The Lipid Family

Triglycerides

- 1 Glycerol (per triglyceride) and
- 3 Fatty acids (per triglyceride); depending on the number of double bonds, fatty acids may be:
 - *Saturated* (no double bonds)
 - *Monounsaturated* (one double bond)
 - *Polyunsaturated* (more than one double bond); depending on the location of the double bonds, polyunsaturated fatty acids may be:
 - ◆ *Omega-3* (double bond closest to methyl end is 3 carbons away)
 - ◆ *Omega-6* (double bond closest to methyl end is 6 carbons away)

Phospholipids (such as lecithin)

Sterols (such as cholesterol)

Take the quiz below to test your mastery of the key chapter concepts.

5.1 The Chemist's View of Fatty Acids and Triglycerides (pp. 129–136)

LEARN IT Recognize the chemistry of fatty acids and triglycerides and differences between saturated and unsaturated fats.

1. Name three classes of lipids found in the body and in foods. What are some of their functions in the body? What features do fats bring to foods?
2. What features distinguish fatty acids from each other?
3. What does the term *omega* mean with respect to fatty acids? Describe the roles of the omega fatty acids in disease prevention.
4. Describe the structure of a triglyceride.
5. What does hydrogenation do to fats? What are *trans*-fatty acids, and how do they influence heart disease?
6. Saturated fatty acids:
 - a. are always 18 carbons long.
 - b. have at least one double bond.
 - c. are fully loaded with hydrogens.
 - d. are always liquid at room temperature.
7. A triglyceride consists of:
 - a. three glycerols attached to a lipid.
 - b. three fatty acids attached to a glucose.
 - c. three fatty acids attached to a glycerol.
 - d. three phospholipids attached to a cholesterol.
8. The difference between *cis*- and *trans*-fatty acids is:
 - a. the number of double bonds.
 - b. the length of their carbon chains.
 - c. the location of the first double bond.
 - d. the configuration around the double bond.

5.2 The Chemist's View of Phospholipids and Sterols (pp. 136–137)

LEARN IT Describe the chemistry, major food sources, and roles of phospholipids and sterols.

9. Which of the following is *not* true? Lecithin is:
 - a. an emulsifier.
 - b. a phospholipid.
 - c. an essential nutrient.
 - d. a constituent of cell membranes.

5.3 Digestion, Absorption, and Transport of Lipids (pp. 137–144)

LEARN IT Summarize fat digestion, absorption, and transport.

10. What do lipoproteins do? What are the differences among the chylomicrons, VLDL, LDL, and HDL?
11. Chylomicrons are produced in the:
 - a. liver.
 - b. pancreas.
 - c. gallbladder.
 - d. small intestine.

12. Transport vehicles for lipids are called:
 - a. micelles.
 - b. lipoproteins.
 - c. blood vessels.
 - d. monoglycerides.

5.4 Lipids in the Body (pp. 144–147)

LEARN IT Outline the major roles of fats in the body, including a discussion of essential fatty acids and the omega fatty acids.

13. Which of the following is *not* true? Fats:
 - a. contain glucose.
 - b. provide energy.
 - c. protect against organ shock.
 - d. carry vitamins A, D, E, and K.
14. The essential fatty acids include:
 - a. stearic acid and oleic acid.
 - b. oleic acid and linoleic acid.
 - c. palmitic acid and linolenic acid.
 - d. linoleic acid and linolenic acid.

5.5 Health Effects and Recommended Intakes of Saturated Fats, Trans Fats, and Cholesterol (pp. 147–149)

LEARN IT Explain the relationships among saturated fats, *trans* fat, and cholesterol and chronic diseases, noting recommendations.

15. How does excessive fat intake influence health? What factors influence LDL, HDL, and total blood cholesterol?
16. What are the dietary recommendations regarding fat and cholesterol intake? List ways to reduce intake.
17. The lipoprotein most associated with a high risk of heart disease is:
 - a. CHD.
 - b. HDL.
 - c. LDL.
 - d. LPL.

5.6 Health Effects and Recommended Intakes of Monounsaturated and Polyunsaturated Fats (pp. 149–157)

LEARN IT Explain the relationships between monounsaturated and polyunsaturated fats and health, noting recommendations.

18. List foods that are high in saturated fats and those that are high in unsaturated fats.
19. What is the Daily Value for fat (for a 2000-kcalorie diet)?
20. A person consuming 2200 calories a day who wants to meet health recommendations should limit daily fat intake to:
 - a. 20 to 35 grams.
 - b. 50 to 85 grams.
 - c. 75 to 100 grams.
 - d. 90 to 130 grams.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

6.1 The Chemist's View of Proteins

- Proteins are more chemically complex than carbohydrates or lipids; they are made of 20 different amino acids, 9 of which the body cannot make. These 9 are the essential amino acids—histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.
- Each amino acid contains an amino group, an acid group, a hydrogen atom, and a distinctive side group, all attached to a central carbon atom.
- Cells link amino acids together in a series of condensation reactions to create proteins (review Figure 6-3, p. 169). The distinctive sequence of amino acids in each protein determines its unique shape and function.

6.2 Digestion and Absorption of Proteins

- The stomach's hydrochloric acid first denatures dietary proteins, then enzymes cleave them into smaller polypeptides and some amino acids.
- Pancreatic and intestinal enzymes split polypeptides further, to oligo-, tri-, and dipeptides, and then split most of these to single amino acids that can be absorbed into the intestinal cells (review Figure 6-6, p. 172).

6.3 Proteins in the Body

- Cells synthesize proteins according to the genetic information provided by the DNA in the nucleus of each cell (review Figure 6-7, p. 174). This information dictates the sequence in which amino acids are linked together to form a given protein. Sequencing errors occasionally occur, sometimes with significant consequences.
- A sampling of protein functions are summarized in Table 6-3.
- Proteins are constantly being synthesized and broken down as needed.
- The body's assimilation of amino acids into proteins and its release of amino acids via protein degradation and excretion can be tracked by measuring nitrogen balance, which should be positive during growth and steady in adulthood. An energy deficit or an inadequate protein intake may force the body to break down lean body tissue and use amino acids as fuel, creating a negative nitrogen balance.
- Protein eaten in excess of need is degraded and stored as body fat.

6.4 Protein in Foods

- High-quality proteins deliver all of the essential amino acids in adequate amounts, which ensures protein synthesis. Mixtures of foods containing complementary proteins can each supply the amino acids missing in the other.
- In addition to its amino acid content, the quality of a protein is measured by its digestibility and its ability to support growth.

6.5 Health Effects and Recommended Intakes of Protein

- Protein deficiency impairs the body's ability to grow and function optimally.
- Excess protein offers no advantage and may incur health problems as well.
- The optimal diet is adequate in energy from carbohydrate and fat and delivers 0.8 grams of protein per kilogram of healthy body weight each day.
- Healthy people do not need protein or amino acid supplements.

TABLE 6-3 Protein Functions in the Body

Structural materials	Proteins form integral parts of most body tissues and provide strength and shape to skin, tendons, membranes, muscles, organs, and bones.
Enzymes	Proteins facilitate chemical reactions.
Hormones	Proteins regulate body processes. (Some, but not all, hormones are proteins.)
Fluid balance	Proteins help to maintain the volume and composition of body fluids.
Acid-base balance	Proteins help to maintain the acid-base balance of body fluids by acting as buffers.
Transportation	Proteins transport substances, such as lipids, vitamins, minerals, and oxygen, around the body.
Antibodies	Proteins inactivate foreign invaders, thus protecting the body against diseases.
Energy and glucose	Proteins provide some fuel, and glucose if needed, for the body's energy needs.
Other	The protein fibrin creates blood clots; the protein collagen forms scars; the protein opsin participates in vision.

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Take the quiz below to test your mastery of the key chapter concepts.

6.1 The Chemist's View of Proteins

(pp. 168–171)

LEARN IT Recognize the chemical structures of amino acids and proteins.

1. Explain how the sequence of amino acids affects protein shape.
2. What are essential amino acids?
3. Which part of its chemical structure differentiates one amino acid from another?
 - a. its side group
 - b. its acid group
 - c. its amino group
 - d. its double bonds
4. Isoleucine, leucine, and lysine are:
 - a. proteases.
 - b. polypeptides.
 - c. essential amino acids.
 - d. complementary proteins.

6.2 Digestion and Absorption of Proteins

(pp. 171–172)

LEARN IT Summarize protein digestion and absorption.

5. In the stomach, hydrochloric acid:
 - a. denatures proteins and activates pepsin.
 - b. hydrolyzes proteins and denatures pepsin.
 - c. emulsifies proteins and releases peptidase.
 - d. condenses proteins and facilitates digestion.

6.3 Proteins in the Body

(pp. 173–180)

LEARN IT Describe how the body makes proteins and uses them to perform various roles.

6. What are enzymes? What roles do they play in chemical reactions? Describe the differences between enzymes and hormones.
7. How does the body use amino acids? What is deamination? Define *nitrogen balance*. What conditions are associated with zero, positive, and negative balance?
8. Proteins that maintain the acid-base balance of the blood and body fluids by accepting and releasing hydrogen ions are:
 - a. buffers.
 - b. enzymes.
 - c. hormones.
 - d. antigens.

9. If an essential amino acid that is needed to make a protein is unavailable, the cells must:
 - a. deaminate another amino acid.
 - b. substitute a similar amino acid.
 - c. break down proteins to obtain it.
 - d. synthesize the amino acid from glucose and nitrogen.
10. Protein turnover describes the amount of protein:
 - a. found in foods and the body.
 - b. absorbed from the diet.
 - c. synthesized and degraded.
 - d. used to make glucose.

6.4 Protein in Foods

(pp. 181–182)

LEARN IT Explain the differences between high-quality and low-quality proteins, including notable food sources of each.

11. How can vegetarians meet their protein needs without eating meat?
12. Which of the following foods provides the highest quality protein?

a. egg	c. gelatin
b. corn	d. whole grains

6.5 Health Effects and Recommended Intakes of Protein

(pp. 182–188)

LEARN IT Identify the health benefits of, and recommendations for, protein.

13. How might protein excess, or the type of protein eaten, influence health?
14. What factors are considered in establishing recommended protein intakes?
15. What are the benefits and risks of taking protein and amino acid supplements?
16. The protein RDA for a healthy adult who weighs 180 pounds is:
 - a. 50 milligrams/day.
 - b. 65 grams/day.
 - c. 180 grams/day.
 - d. 2000 milligrams/day.
17. Which of these foods has the least protein per ½ cup?

a. rice	c. pinto beans
b. broccoli	d. orange juice

Review the key points of this chapter below, then take the practice quiz on the back of this card.

7.1 Chemical Reactions in the Body

- During digestion, the energy-yielding nutrients—carbohydrates, lipids, and proteins—are broken down to glucose (and other monosaccharides), glycerol, fatty acids, and amino acids. These compounds may enter metabolic pathways to yield energy (review Figure 7-5).
- Enzymes with their coenzymes help cells use nutrients to build compounds (anabolism) or break them down to release energy (catabolism)—review Figure 7-2, p. 200.
- ATP—a high-energy compound—captures the energy released during catabolism (review Figure 7-4, p. 201).

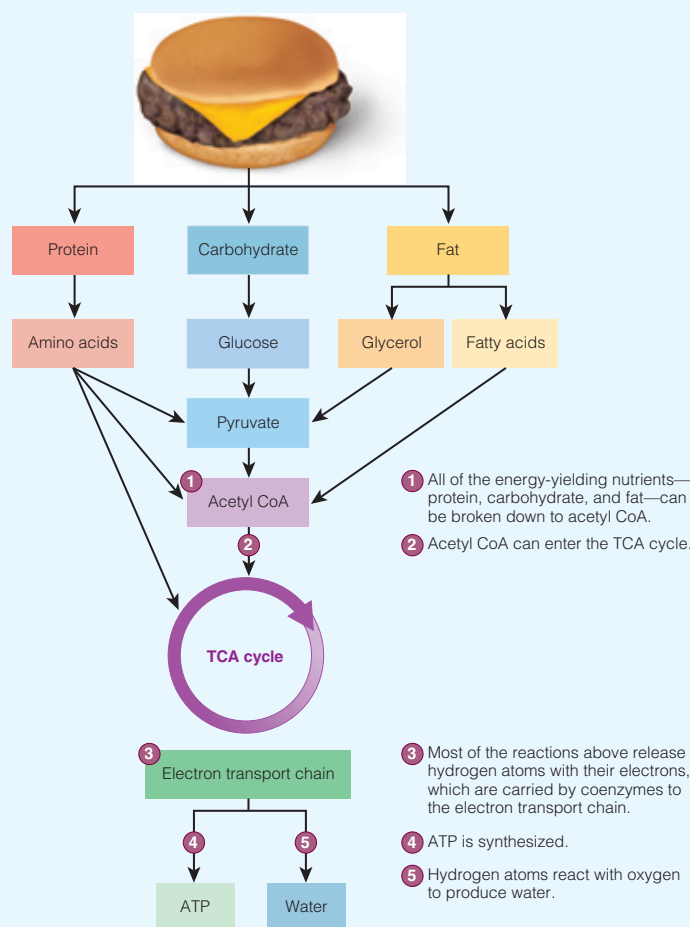
7.2 Breaking Down Nutrients for Energy

- Glucose breakdown begins with glycolysis, a pathway that produces pyruvate (review Figure 7-6, p. 204).
- Pyruvate may be converted to lactate anaerobically (without oxygen) or to acetyl CoA aerobically (with oxygen).
- Pyruvate can make glucose; acetyl CoA cannot make glucose (review Figure 7-9, p. 206).
- The glycerol part of a triglyceride can make either pyruvate (and then glucose) or acetyl CoA. The fatty acids of a triglyceride *cannot* make glucose; they can provide abundant acetyl CoA (review Figure 7-11, p. 208).
- Some amino acids can be used to make glucose; others can be used either to provide energy or to make fat. Before an amino acid enters these metabolic pathways, its nitrogen-containing amino group must be removed through deamination.
- The digestion of carbohydrate yields glucose (and other monosaccharides); some glucose is stored as glycogen, and some is broken down to pyruvate and acetyl CoA.
- The digestion of fat yields glycerol and fatty acids; some are reassembled and stored as body fat, and others are broken down to acetyl CoA.
- The digestion of protein yields amino acids; most amino acids are used to build body protein or other nitrogen-containing compounds, some are broken down to acetyl CoA, and others enter the TCA cycle directly.
- Acetyl CoA may enter the TCA cycle to release energy (review Figure 7-16, p. 212) or combine with other molecules of acetyl CoA to make body fat.

7.3 Feasting and Fasting

- If energy intake exceeds energy needs, the result will be weight gain—regardless of whether the excess is from protein, carbohydrate, or fat (review Table 7-2). The body is most efficient at storing excess energy from dietary fat.
- When fasting, the body adapts to conserve energy and minimize losses by increasing fat

> **FIGURE 7-5** Simplified Overview of Energy-Yielding Pathways



breakdown to fuel most cells, using glycerol and amino acids to make glucose for the brain and red blood cells, producing ketones for the brain, suppressing appetite, and slowing metabolism.

TABLE 7-2 Review of Energy-Yielding Nutrient Endpoints

Nutrient	Yields energy?	Yields glucose?	Yields amino acids and body proteins?	Yields fat stores?
Carbohydrates (glucose)	Yes	Yes	Yes—when nitrogen is available, can yield <i>nonessential</i> amino acids	Yes
Lipids (fatty acids)	Yes	No	No	Yes
Lipids (glycerol)	Yes	Yes—when carbohydrate is unavailable	Yes—when nitrogen is available, can yield <i>nonessential</i> amino acids	Yes
Proteins (amino acids)	Yes	Yes—when carbohydrate is unavailable	Yes	Yes

Take the quiz below to test your mastery of the key chapter concepts.

7.1 Chemical Reactions in the Body

(pp. 198–201)

LEARN IT Identify the nutrients involved in energy metabolism and the high-energy compound that captures the energy released during their breakdown.

1. Define *metabolism*, *anabolism*, and *catabolism*; give an example of each.
2. What are coenzymes, and what service do they provide in metabolism?
3. Hydrolysis is an example of a(n):
 - a. coupled reaction.
 - b. anabolic reaction.
 - c. catabolic reaction.
 - d. synthesis reaction.
4. During metabolism, released energy is captured and transferred by:
 - a. enzymes.
 - b. pyruvate.
 - c. acetyl CoA.
 - d. adenosine triphosphate.

7.2 Breaking Down Nutrients for Energy

(pp. 201–213)

LEARN IT Summarize the main steps in the energy metabolism of glucose, glycerol, fatty acids, and amino acids.

5. Name the four basic units, derived from foods, that are used by the body in energy metabolism. How many carbons are in the “backbones” of each?
6. Define *aerobic* and *anaerobic*. How does insufficient oxygen influence metabolism?
7. How does the body dispose of excess nitrogen?
8. The body derives most of its energy from:
 - a. proteins and fats.
 - b. vitamins and minerals.
 - c. glucose and fatty acids.
 - d. glycerol and amino acids.
9. Glycolysis:
 - a. requires oxygen.
 - b. generates abundant energy.
 - c. converts glucose to pyruvate.
 - d. produces ammonia as a by-product.
10. The pathway from pyruvate to acetyl CoA:
 - a. produces lactate.
 - b. is known as gluconeogenesis.
 - c. is metabolically irreversible.
 - d. requires more energy than it produces.

11. For complete oxidation, acetyl CoA enters:
 - a. glycolysis.
 - b. the TCA cycle.
 - c. the Cori cycle.
 - d. the electron transport chain.
12. Deamination of an amino acid produces:
 - a. vitamin B₆ and energy.
 - b. pyruvate and acetyl CoA.
 - c. ammonia and a keto acid.
 - d. carbon dioxide and water.
13. Before entering the TCA cycle, each of the energy-yielding nutrients is broken down to:
 - a. ammonia.
 - b. pyruvate.
 - c. electrons.
 - d. acetyl CoA.

7.3 Feasting and Fasting (pp. 213–219)

LEARN IT Explain how an excess of any of the three energy-yielding nutrients contributes to body fat and how an inadequate intake of any of them shifts metabolism.

14. What adaptations does the body make during a fast? What are ketone bodies? Define *ketosis*.
15. Distinguish between a loss of *fat* and a loss of *weight*, and describe how each might happen.
16. The body stores energy for future use in:
 - a. proteins.
 - b. acetyl CoA.
 - c. triglycerides.
 - d. ketone bodies.
17. During a fast, when glycogen stores have been depleted, the body begins to synthesize glucose from:
 - a. acetyl CoA.
 - b. amino acids.
 - c. fatty acids.
 - d. ketone bodies.
18. During a fast, the body produces ketone bodies by:
 - a. hydrolyzing glycogen.
 - b. condensing acetyl CoA.
 - c. transaminating keto acids.
 - d. converting ammonia to urea.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

8.1 Energy Balance

- When energy consumed equals energy expended, a person is in energy balance and body weight is stable.
- If more energy is taken in than is expended, a person gains weight. If more energy is expended than is taken in, a person loses weight.

8.2 Energy In: The kCalories Foods Provide

- Scientists use a bomb calorimeter to estimate the potential energy of foods by measuring the heat energy released when foods are burned.
- Hunger and appetite initiate eating, whereas satiation and satiety stop and delay eating, respectively (review Figure 8-2, p. 234). Each responds to messages from the nervous and hormonal systems. Superimposed on these signals are complex factors involving emotions, habits, and other aspects of human behavior.

8.3 Energy Out: The kCalories the Body Expend

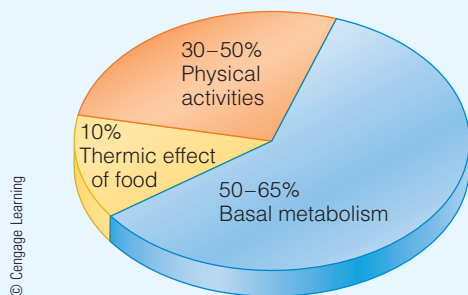
- A person in energy balance takes in energy from food and expends much of it on basal metabolic activities, some of it on physical activities, and a little on the thermic effect of food (review Figure 8-4).
- Energy requirements vary from person to person based on such factors as gender, age, weight, and height as well as the intensity and duration of physical activity.

8.4 Body Weight and Body Composition

- Body weight standards are based on a person's weight in relation to height, called the body mass index (BMI), and reflect disease risks. BMI does not identify body fat or its distribution, and it may misclassify muscular people as overweight.

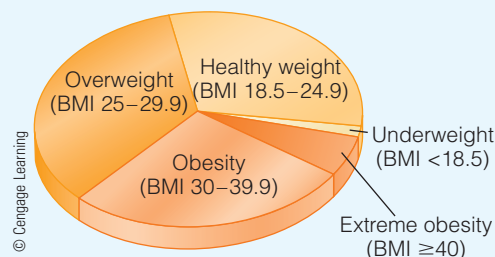
> FIGURE 8-4 Components of Energy Expenditure

The amount of energy expended in voluntary physical activities has the greatest variability, depending on a person's activity patterns. For a sedentary person, physical activities may account for less than half as much energy as basal metabolism, whereas an extremely active person may expend as much on activity as for basal metabolism.



The amount of energy expended in a day differs for each individual, but in general, basal metabolism is the largest component of energy expenditure and thermic effect of food is the smallest.

> FIGURE 8-7 Distribution of Body Weights in US Adults



$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m)}^2} \text{ or } \frac{\text{weight (lb)}}{\text{height (in)}^2} \times 703.$$

Underweight: BMI <18.5
Healthy: BMI 18.5 to 24.9
Overweight: BMI 25 to 29.9
Obese: BMI ≥30

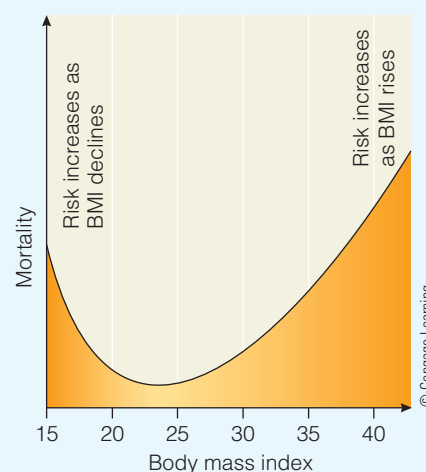
- Two-thirds of US adults have a BMI greater than 25 (review Figure 8-7).
- The ideal amount of body fat varies from person to person, but excess body fat poses health risks.
- Central obesity—excess abdominal fat distributed around the trunk of the body—presents greater health risks than excess fat distributed on the lower body (review Figure 8-8 and Figure 8-9, p. 245).
- Women with a waist circumference greater than 35 inches and men with a waist circumference greater than 40 inches have a high risk of central obesity-related health problems.

8.5 Health Risks Associated with Body Weight and Body Fat

- The healthiest weight for an individual depends on personal factors such as body fat distribution, family health history, and current health status. At the extremes, both overweight and underweight impose health risks (review Figure 8-11).

> FIGURE 8-11 BMI and Mortality

This J-shaped curve describes the relationship between body mass index (BMI) and mortality and shows that both underweight and overweight present risks of a premature death.



Take the quiz below to test your mastery of the key chapter concepts.

8.1 Energy Balance (p. 232)

LEARN IT Describe energy balance and the consequences of not being in balance.

1. A person who consistently consumes 1700 kcalories a day and expends 2200 kcalories a day for a month would be expected to:
 - a. lose ½ to 1 pound.
 - b. gain ½ to 1 pound.
 - c. lose 4 to 5 pounds.
 - d. gain 4 to 5 pounds.

8.2 Energy In: The kCalories Foods Provide

(pp. 232–236)

LEARN IT Discuss some of the physical, emotional, and environmental influences on food intake.

2. A bomb calorimeter measures:
 - a. physiological fuel.
 - b. energy available from foods.
 - c. kcalories a person derives from foods.
 - d. heat a person releases in basal metabolism.
3. The psychological desire to eat that accompanies the sight, smell, or thought of food is known as:
 - a. hunger.
 - b. satiety.
 - c. appetite.
 - d. palatability.
4. A person watching television after dinner reaches for a snack during a commercial in response to:
 - a. external cues.
 - b. hunger signals.
 - c. stress arousal.
 - d. satiety factors.

8.3 Energy Out: The kCalories the Body Expend

LEARN IT List the components of energy expenditure and factors that might influence each.

5. The largest component of energy expenditure is:
 - a. basal metabolism.
 - b. physical activity.
 - c. indirect calorimetry.
 - d. thermic effect of food.

6. A major factor influencing BMR is:
 - a. hunger.
 - b. food intake.
 - c. body composition.
 - d. physical activity.
7. The thermic effect of an 800-kcalorie meal is about:
 - a. 8 kcalories.
 - b. 80 kcalories.
 - c. 160 kcalories.
 - d. 200 kcalories.

8.4 Body Weight and Body Composition

(pp. 241–246)

LEARN IT Distinguish between body weight and body composition, including methods to assess each.

8. What problems are involved in defining “ideal” body weight?
9. What is central obesity, and what is its relationship to disease?
10. For health’s sake, a person with a BMI of 21 might want to:
 - a. lose weight.
 - b. maintain weight.
 - c. gain weight.
11. Which of the following reflects height and weight?
 - a. body mass index
 - b. central obesity
 - c. waist circumference
 - d. body composition

8.5 Health Risks Associated with Body Weight and Body Fat

(pp. 246–249)

LEARN IT Identify relationships between body weight and chronic diseases.

12. Which of the following increases disease risks?
 - a. BMI 19–21
 - b. BMI 22–25
 - c. lower-body fat
 - d. central obesity

Review the key points of this chapter below, then take the practice quiz on the back of this card.

9.1 Overweight and Obesity

- Fat cells develop by increasing in number and size (review Figure 9-2, p. 263).
- Preventing weight gain depends on limiting the number of fat cells; weight loss depends on decreasing the size of fat cells.
- Lipoprotein lipase (LPL) removes triglycerides from the blood for storage in both adipose tissue and muscle cells. LPL activity is influenced by weight and gender.
- With weight gains or losses, the body adjusts in an attempt to return to its previous weight (set point theory).

9.2 Causes of Overweight and Obesity

- Obesity has multiple causes and different combinations of causes in different people.
- Some environmental causes, such as overeating and physical inactivity, may be within a person's control, and some, such as genetics, may be beyond it.
- Proteins such as ghrelin and leptin regulate food intake and energy homeostasis.

9.3 Problems of Overweight and Obesity

- Whether a person should lose weight depends on factors such as the extent of overweight, age, health risks, and genetics.
- Not all obesity will cause disease or shorten life expectancy. Just as there are unhealthy, normal-weight people, there are healthy, overweight people.
- Some people risk more in the process of losing weight than in remaining overweight.
- Fad diets and weight-loss supplements can be as physically and psychologically damaging as excess body weight.

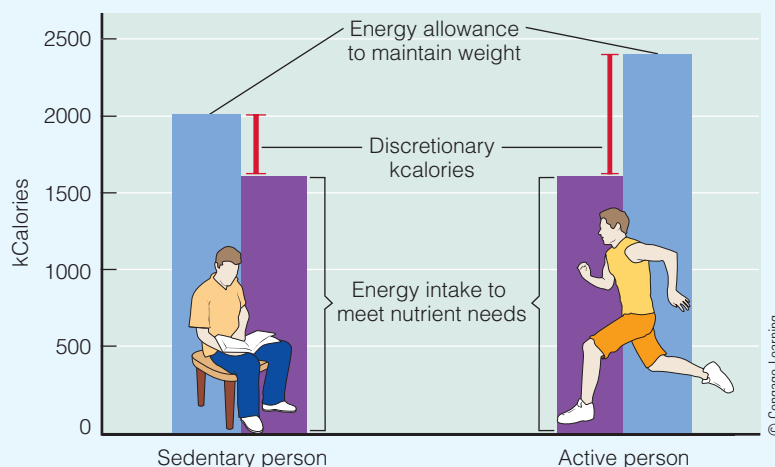
9.4 Aggressive Treatments for Obesity

- Obese people with high risks of medical problems may need aggressive treatment, including drugs or surgery.
- Others may benefit most from improving eating and physical activity habits.

9.5 Weight-Loss Strategies

- A person who adopts a lifelong "eating plan for good health" rather than a "diet for weight loss" will be more likely to keep the lost weight off.
- Table 9-3 (p. 277) provides several tips for successful weight management.

> **FIGURE 9-8** *Animated* Influence of Physical Activity on Discretionary kCalories



- Physical activity can increase energy expenditure (review Figure 9-8), improve body composition, help control appetite, reduce stress and stress eating, and enhance physical and psychological well-being.
- A surefire remedy for obesity has yet to be found; a combination of approaches is most effective.
- Weight loss depends on adjusting diet and physical activity so that more energy is expended than is taken in.
- For weight loss, energy intake should be reduced by 500 to 1000 kcalories per day, depending on starting body weight and usual food intake.
- Safe rate for weight loss is $\frac{1}{2}$ to 2 pounds per week or 10 percent body weight per 6 months.
- Behavior modification and cognitive restructuring retrain habits to support a healthy eating and activity plan.
- Treatment requires time, individualization, and sometimes the assistance of a registered dietitian or support group.
- Preventing weight gains and maintaining weight losses require vigilant attention to diet and physical activity; taking care of oneself is a lifelong responsibility.

9.6 Underweight

- Both the incidence of underweight and the health problems associated with it are less prevalent than overweight and its associated problems.
- To gain weight, a person must train physically and increase energy intake by selecting energy-dense foods, eating regular meals, taking larger portions, and consuming extra snacks and beverages.
- Table 9-5 (p. 287) includes a summary of weight-gain strategies.

Take the quiz below to test your mastery of the key chapter concepts.

9.1 Overweight and Obesity (pp. 261–263)

LEARN IT Describe how body fat develops and why it can be difficult to maintain weight gains and losses.

- With weight loss, fat cells:
 - decrease in size only.
 - decrease in number only.
 - decrease in both number and size.
 - decrease in number, but increase in size.
- Describe the role of lipoprotein lipase (LPL).

9.2 Causes of Overweight and Obesity

(pp. 264–267)

LEARN IT Review some of the causes of obesity.

- Obesity is caused by:
 - overeating.
 - inactivity.
 - defective genes.
 - multiple factors.
- The protein produced by the fat cells under the direction of the *ob* gene is called:
 - leptin.
 - serotonin.
 - sibutramine.
 - phentermine.

9.3 Problems of Overweight and Obesity

(pp. 268–270)

LEARN IT Discuss the physical, social, and psychological consequences of overweight and obesity.

- Which of the following is *not* used to evaluate the risks to health from obesity?
 - body mass index
 - blood leptin levels
 - waist circumference
 - disease risk profiles

9.4 Aggressive Treatments for Obesity

(pp. 270–272)

LEARN IT Explain the risks and benefits, if any, of several aggressive ways to treat obesity.

- Gastric bypass surgery:
 - is the best noninvasive treatment for obesity.
 - limits food intake by reducing the capacity of the stomach.
 - allows a person to eat unlimited amounts of food without weight gain.
 - suppresses hunger by increasing production of gastrointestinal hormones.

9.5 Weight-Loss Strategies (pp. 272–285)

LEARN IT Outline reasonable strategies for achieving and maintaining a healthy body weight.

- What are the benefits of increased physical activity in a weight-loss program?
- Describe the behavioral strategies for changing an individual's dietary habits. What role does personal attitude play?
- A realistic goal for weight loss is to reduce body weight:
 - down to the weight a person was at age 25.
 - down to the ideal weight in the weight-for-height tables.
 - by 10 percent over 6 months.
 - by 15 percent over 3 months.
- A nutritionally sound weight-loss diet might restrict daily energy intake to create a:
 - 1000-kcalorie-per-month deficit.
 - 500-kcalorie-per-month deficit.
 - 500-kcalorie-per-day deficit.
 - 3500-kcalorie-per-day deficit.
- Successful weight loss depends on:
 - avoiding fats and limiting water.
 - taking supplements and drinking water.
 - increasing proteins and restricting carbohydrates.
 - reducing energy intake and increasing physical activity.
- Physical activity does *not* help a person to:
 - lose weight.
 - retain muscle.
 - maintain weight loss.
 - lose fat in trouble spots.
- Which strategy would *not* help an overweight person to lose weight?
 - Exercise.
 - Eat slowly.
 - Limit high-fat foods.
 - Eat energy-dense foods regularly.

9.6 Underweight (pp. 285–287)

LEARN IT Summarize strategies for gaining weight.

- Which strategy would *not* help an underweight person to gain weight?
 - Exercise.
 - Drink plenty of water.
 - Eat snacks between meals.
 - Eat large portions of foods.

Multiple Choice Answers
1.a 3.d 4.a 5.b 6.b 9.c 10.c 11.d 12.d 13.d 14.b

Review the key points of this chapter below, then take the practice quiz on the back of this card.

10.1 The Vitamins—An Overview

- The vitamins are organic, essential nutrients needed in tiny amounts in the diet both to prevent deficiency diseases and to support optimal health. The body handles the vitamins differently depending on whether they are water- or fat-soluble (review Table 10-2).
- The water-soluble vitamins are the B vitamins and vitamin C; the fat-soluble vitamins are vitamins A, D, E, and K. The B vitamins include thiamin, niacin, riboflavin, vitamin B₆, folate, vitamin B₁₂, pantothenic acid, and biotin.

10.2 The B Vitamins

- The B vitamins serve as coenzymes—small organic molecules closely associated with enzymes that facilitate the work of cells (review Figure 10-2).
- Thiamin is part of the coenzyme TPP, which assists in energy metabolism. Deficiency can result in beriberi. Thiamin occurs in small quantities in many nutritious foods; pork is an exceptionally good source.
- Riboflavin is part of the coenzymes FMN and FAD that accept and donate hydrogens during energy metabolism. Milk and milk products are good sources.
- Niacin is part of the coenzymes NAD and NADP that participate in many metabolic reactions. The deficiency disease, pellagra, causes diarrhea, dermatitis, dementia, and eventually death (“the 4 Ds”). Toxicity produces “niacin flush”—a tingling, painful sensation. The amino acid tryptophan can be converted to niacin in the body: 60 mg tryptophan = 1 NE (niacin equivalent). Good sources of niacin are protein-rich foods.
- Biotin plays a critical role in energy metabolism, replenishing oxaloacetate in the TCA cycle. Biotin is widespread in foods; deficiencies and toxicities are rare.
- Pantothenic acid is part of coenzyme A that forms acetyl CoA in many metabolic pathways. Pantothenic acid is widespread in foods; deficiencies and toxicities are rare.
- Vitamin B₆ occurs as pyridoxal, pyridoxine, and pyridoxamine; all can become part of the coenzyme PLP, which is active in amino acid metabolism. Deficiency causes convulsions; toxicity causes nerve damage.
- Folate is part of the coenzyme THF that activates vitamin B₁₂, synthesizes DNA, and regenerates the amino acid methionine from homocysteine. Folate helps prevent neural tube defects. Excessive folate can mask the anemia of a vitamin B₁₂ deficiency, but it will not prevent the associated nerve damage. Folate is abundant in legumes, fruits, and vegetables.

TABLE 10-2 Water-Soluble and Fat-Soluble Vitamins Compared

	Water-Soluble Vitamins: B Vitamins and Vitamin C	Fat-Soluble Vitamins: Vitamins A, D, E, and K
Absorption	Directly into the blood	First into the lymph, then the blood
Transport	Travel freely	Many require transport proteins
Storage	Circulate freely in water-filled parts of the body	Stored in the cells associated with fat
Excretion	Kidneys detect and remove excess in urine	Less readily excreted; tend to remain in fat-storage sites
Toxicity	Possible to reach toxic levels when consumed from supplements	Likely to reach toxic levels when consumed from supplements
Requirements	Needed in frequent doses (perhaps 1 to 3 days)	Needed in periodic doses (perhaps weeks or even months)

NOTE: Exceptions occur, but these differences between the water-soluble and fat-soluble vitamins are valid generalizations.

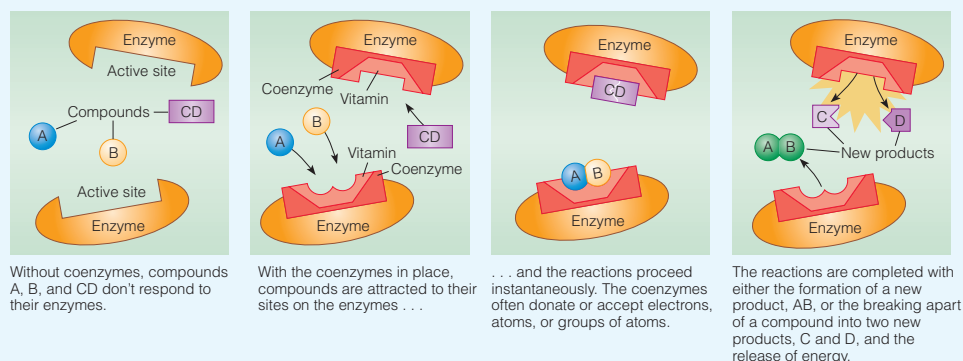
- Vitamin B₁₂ activates folate, synthesizes DNA, regenerates methionine from homocysteine, and maintains the sheath that protects nerve fibers. Deficiencies typically occur when either hydrochloric acid or intrinsic factor is lacking. Vitamin B₁₂ is found primarily in foods derived from animals.
- Many substances that people claim as B vitamins are not. Fortunately, a variety of foods from each food group provides an adequate supply of all B vitamins.

10.3 Vitamin C

- Vitamin C acts as an antioxidant—a substance that decreases the adverse effects of free radicals in the body.
- Vitamin C works as a cofactor in the synthesis of collagen, neurotransmitters (serotonin and norepinephrine), hormones (thyroxin), and other compounds.
- Vitamin C deficiency causes scurvy.

> FIGURE 10-2 Coenzyme Action

Some vitamins form part of the coenzymes that enable enzymes either to synthesize compounds (as illustrated by the lower enzymes in this figure) or to dismantle compounds (as illustrated by the upper enzymes).



Take the quiz below to test your mastery of the key chapter concepts.

10.1 The Vitamins—An Overview

(pp. 297–300)

LEARN IT Describe how vitamins differ from the energy nutrients and how fat-soluble vitamins differ from water-soluble vitamins.

1. Vitamins:
 - a. are inorganic compounds.
 - b. yield energy when broken down.
 - c. are soluble in either water or fat.
 - d. perform best when linked in long chains.
2. The rate at and the extent to which a vitamin is absorbed and used in the body is known as its:
 - a. bioavailability.
 - b. intrinsic factor.
 - c. physiological effect.
 - d. pharmacological effect.

10.2 The B Vitamins (pp. 300–322)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for each of the B vitamins (thiamin, riboflavin, niacin, biotin, pantothenic acid, vitamin B₆, folate, and vitamin B₁₂).

3. Which B vitamins are involved in energy metabolism? Protein metabolism? Cell division?
4. What is the relationship of tryptophan to niacin?
5. Describe the relationship between folate and vitamin B₁₂.
6. What risks are associated with high doses of niacin? Vitamin B₆? Vitamin C?
7. Many of the B vitamins serve as:
 - a. coenzymes.
 - b. antagonists.
 - c. antioxidants.
 - d. serotonin precursors.
8. With respect to thiamin, which of the following is the most nutrient dense?
 - a. 1 slice whole-wheat bread (69 kcalories and 0.1 milligram thiamin)
 - b. 1 cup yogurt (144 kcalories and 0.1 milligram thiamin)
 - c. 1 cup snow peas (69 kcalories and 0.22 milligram thiamin)
 - d. 1 chicken breast (141 kcalories and 0.06 milligram thiamin)

9. The body can make niacin from:
 - a. tyrosine.
 - b. serotonin.
 - c. carnitine.
 - d. tryptophan.

10. The vitamin that protects against neural tube defects is:
 - a. niacin.
 - b. folate.
 - c. riboflavin.
 - d. vitamin B₁₂.

11. A lack of intrinsic factor may lead to:
 - a. beriberi.
 - b. pellagra.
 - c. pernicious anemia.
 - d. atrophic gastritis.

12. Which of the following is a B vitamin?
 - a. inositol
 - b. carnitine
 - c. vitamin B₁₅
 - d. pantothenic acid

10.3 Vitamin C (pp. 322–327)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for vitamin C.

13. Vitamin C serves as a(n):
 - a. coenzyme.
 - b. antagonist.
 - c. antioxidant.
 - d. intrinsic factor.
14. The requirement for vitamin C is highest for:
 - a. smokers.
 - b. athletes.
 - c. alcoholics.
 - d. the elderly.

See p. 328 for a summary of the water-soluble vitamins.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

11.1 Vitamin A and Beta-Carotene

- Vitamin A is found in the body in three forms: retinol, retinal, and retinoic acid. Together, they are essential to vision, healthy epithelial tissues, and growth.
- Vitamin A deficiency is a major health problem worldwide, leading to infections, blindness, and keratinization.
- Toxicity can also cause problems and is most often associated with supplement abuse.
- Animal-derived foods such as liver and whole or fortified milk provide retinoids, whereas brightly colored plant-derived foods such as spinach, carrots, and pumpkins provide beta-carotene and other carotenoids.
- In addition to serving as a precursor for vitamin A, beta-carotene may act as an antioxidant in the body.

11.2 Vitamin D

- Vitamin D can be synthesized in the body with the help of sunlight (see Figure 11-9) or obtained from fortified milk.
- Vitamin D sends signals to three primary target sites: the GI tract to absorb more calcium and phosphorus, the bones to release more, and the kidneys to retain more. These actions maintain blood calcium concentrations and support bone formation.

- A vitamin D deficiency causes rickets in childhood and osteomalacia in later life.

11.3 Vitamin E

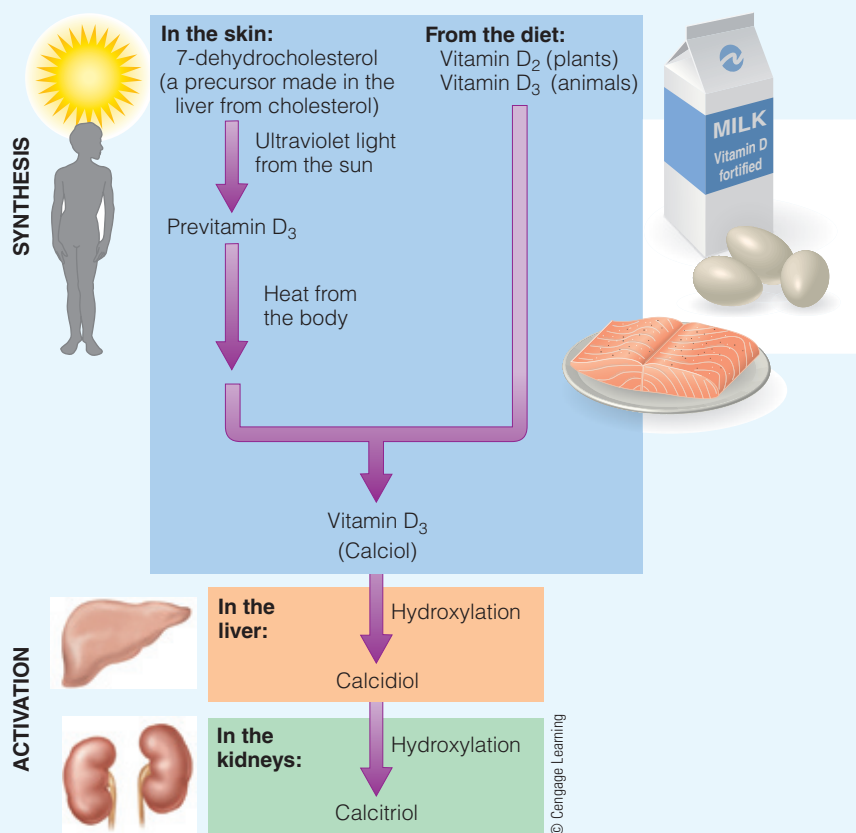
- Vitamin E (alpha-tocopherol) acts as an antioxidant, defending lipids and other components of the cells against oxidative damage.
- Deficiencies are rare, but they do occur in premature infants, the primary symptom being erythrocyte hemolysis (red blood cell breakage).
- Vitamin E is found predominantly in vegetable oils and appears to be one of the least toxic of the fat-soluble vitamins.

11.4 Vitamin K

- Vitamin K helps with blood clotting (review Figure 11-12, p. 355), and its deficiency causes hemorrhagic disease (uncontrolled bleeding).
- Bacteria in the GI tract can make vitamin K; people typically receive about half of their requirements from bacterial synthesis and half from foods such as green vegetables and vegetable oils.
- Because people depend on bacterial synthesis for vitamin K, deficiency is most likely in newborn infants and in people taking antibiotics.

> FIGURE 11-9 Vitamin D Synthesis and Activation

The final activation step in the kidneys is tightly regulated by hormones.



Take the quiz below to test your mastery of the key chapter concepts.

11.1 Vitamin A and Beta-Carotene

(pp. 340–347)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for vitamin A.

- What are vitamin precursors? Name the precursors of vitamin A, and tell in what classes of foods they are located. Give examples of foods with high vitamin A activity.
- The form of vitamin A active in vision is:
 - retinal.
 - retinol.
 - rhodopsin.
 - retinoic acid.
- Vitamin A—deficiency symptoms include:
 - rickets and osteomalacia.
 - hemorrhaging and jaundice.
 - night blindness and keratomalacia.
 - fibrocystic breast disease and erythrocyte hemolysis.
- Good sources of vitamin A include:
 - oatmeal, pinto beans, and ham.
 - apricots, turnip greens, and liver.
 - whole-wheat bread, green peas, and tuna.
 - corn, grapefruit juice, and sunflower seeds.

11.2 Vitamin D (pp. 347–352)

LEARN IT Identify the main roles, deficiency symptoms, and sources for vitamin D.

- How is vitamin D unique among the vitamins?
- To keep minerals available in the blood, vitamin D targets:
 - the skin, the muscles, and the bones.
 - the kidneys, the liver, and the bones.
 - the intestines, the kidneys, and the bones.
 - the intestines, the pancreas, and the liver.
- Vitamin D can be synthesized from a precursor that the body makes from:
 - bilirubin.
 - tocopherol.
 - cholesterol.
 - beta-carotene.

11.3 Vitamin E (pp. 353–354)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for vitamin E.

- Vitamin E's most notable role is to:
 - protect lipids against oxidation.
 - activate blood-clotting proteins.
 - support protein and DNA synthesis.
 - enhance calcium deposits in the bones.
- The classic sign of vitamin E deficiency is:
 - rickets.
 - xerophthalmia.
 - muscular dystrophy.
 - erythrocyte hemolysis.

11.4 Vitamin K (pp. 354–356)

LEARN IT Identify the main roles, deficiency symptoms, and sources for vitamin K.

- What conditions may lead to vitamin K deficiency?
- Without vitamin K:
 - muscles atrophy.
 - bones become soft.
 - skin rashes develop.
 - blood fails to clot.
- A significant amount of vitamin K comes from:
 - vegetable oils.
 - sunlight exposure.
 - bacterial synthesis.
 - fortified grain products.

See p. 357 for a summary of the fat-soluble vitamins.

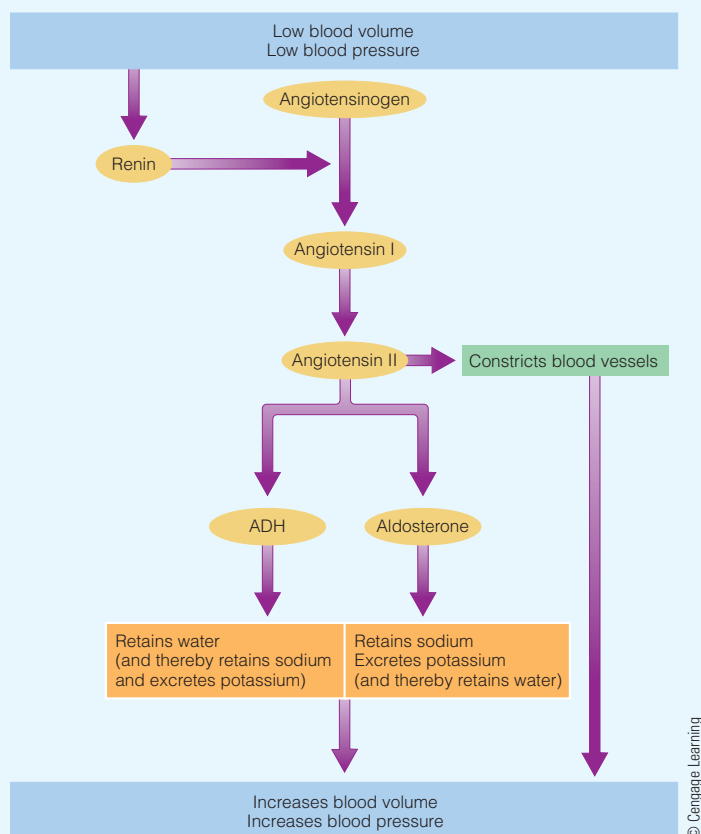
Review the key points of this chapter below, then take the practice quiz on the back of this card.

12.1 Water and the Body Fluids

- Water makes up about 60 percent of an adult's body weight.
- Water assists with the transport of nutrients and waste products throughout the body, participates in chemical reactions, acts as a solvent, serves as a shock absorber, and regulates body temperature.
- To maintain water balance, intake from liquids, foods, and metabolism must equal losses from the kidneys, skin, lungs, and GI tract (review Table 12-3, p. 370).
- Whenever the body experiences low blood volume, low blood pressure, or highly concentrated body fluids, the actions of ADH, renin, angiotensin, and aldosterone restore homeostasis (review Figure 12-3).
- Electrolytes (charged minerals) in the fluids help distribute the fluids inside and outside the cells, thus ensuring the appropriate water balance and acid-base balance to support all life processes.
- Excessive losses of fluids and electrolytes upset these balances, and the kidneys play a key role in restoring homeostasis.

> FIGURE 12-3 *Animated* How the Body Regulates Blood Volume and Blood Pressure

The renin-angiotensin-aldosterone system helps regulate blood volume and therefore blood pressure.



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12.2 The Minerals—An Overview

- The major minerals are needed in the diet and found in the body in larger quantities than the trace minerals (review Figure 12-9, p. 378).
- Minerals are inorganic elements that retain their chemical identities; receive special handling and regulation in the body; and may bind with other substances or interact with other minerals, thus limiting their absorption.
- The major minerals, especially sodium, chloride, and potassium, influence the body's fluid balance; whenever an anion moves, a cation moves—always maintaining homeostasis.
- Sodium, chloride, potassium, calcium, and magnesium are key members of the team of nutrients that direct nerve impulse transmission and muscle contraction. They are also the primary nutrients involved in regulating blood pressure.
- Phosphorus and magnesium participate in many reactions involving glucose, fatty acids, amino acids, and the vitamins. Calcium, phosphorus, and magnesium combine to form the structure of the bones and teeth. Each major mineral also plays other specific roles in the body.

12.3 The Major Minerals

- Sodium is the main cation outside cells and one of the primary electrolytes responsible for maintaining fluid balance. Dietary deficiency is rare; excesses seem to aggravate hypertension, and so health professionals advise a diet moderate in salt and sodium.
- Chloride is the major anion outside cells, and it associates closely with sodium. In addition to its role in fluid balance, chloride is part of the stomach's hydrochloric acid.
- Potassium is the primary cation inside cells and plays an important role in maintaining fluid balance. Fresh foods, notably fruits and vegetables, are its best sources.
- Calcium is found primarily in the bones where it provides a rigid structure and a reservoir of calcium for the blood. Blood calcium participates in muscle contraction, blood clotting, and nerve impulses, and it is closely regulated by a system of hormones and vitamin D (review Figure 12-12, p. 386). Milk and milk products are good sources of calcium, but certain vegetables and tofu also provide calcium. Even when calcium intake is inadequate, blood calcium remains normal, but at the expense of bone loss, which can lead to osteoporosis.
- Phosphorus accompanies calcium both in the crystals of bone and in many foods such as milk. Phosphorus is also important in energy metabolism, as part of phospholipids, and as part of the genetic materials DNA and RNA.
- Magnesium supports bone mineralization and participates in numerous enzyme systems and in heart function. It is found abundantly in legumes and dark green, leafy vegetables and, in some areas, in water.
- Sulfate is found in all protein-containing foods. Its primary role in amino acids is to stabilize proteins by forming disulfide bridges.

Take the quiz below to test your mastery of the key chapter concepts.

12.1 Water and the Body Fluids (pp. 368–377)

LEARN IT Explain how the body regulates fluid balance.

1. List the roles of water in the body.
2. List the sources of water intake and routes of water excretion.
3. What is ADH? Where does it exert its action? What is aldosterone? How does it work?
4. How does the body use electrolytes to regulate fluid balance?
5. The body generates water during the:
 - a. buffering of acids.
 - b. dismantling of bone.
 - c. metabolism of minerals.
 - d. oxidation of energy nutrients through the electron transport chain.
6. Regulation of fluid and electrolyte balance and acid-base balance depends primarily on the:
 - a. kidneys.
 - b. intestines.
 - c. sweat glands.
 - d. specialized tear ducts.

12.2 The Minerals—An Overview (pp. 377–378)

LEARN IT List some of the ways minerals differ from vitamins and other nutrients.

7. What do the terms *major* and *trace* mean when describing the minerals in the body?
8. Describe some characteristics of minerals that distinguish them from vitamins.
9. The distinction between the major and trace minerals reflects the:
 - a. ability of their ions to form salts.
 - b. amounts of their contents in the body.
 - c. importance of their functions in the body.
 - d. capacity to retain their identity after absorption.

12.3 The Major Minerals (pp. 379–394)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for each of the major minerals (sodium, chloride, potassium, calcium, phosphorus, magnesium, and sulfate).

10. What is the major function of sodium in the body? Describe how the kidneys regulate blood sodium. Is a dietary deficiency of sodium likely? Why or why not?
11. List calcium's roles in the body. How does the body keep blood calcium constant regardless of intake?

12. Name significant food sources of calcium. What are the consequences of inadequate intakes?
13. List the roles of phosphorus in the body. Discuss the relationships between calcium and phosphorus. Is a dietary deficiency of phosphorus likely? Why or why not?
14. State the major functions of chloride, potassium, magnesium, and sulfur in the body. Are deficiencies of these nutrients likely to occur in your own diet? Why or why not?
15. The principal cation in extracellular fluids is:
 - a. sodium.
 - b. chloride.
 - c. potassium.
 - d. phosphorus.
16. The role of chloride in the stomach is to help:
 - a. support nerve impulses.
 - b. convey hormonal messages.
 - c. maintain a strong acidity.
 - d. assist in muscular contractions.
17. Which would provide the most potassium?
 - a. bologna
 - b. potatoes
 - c. pickles
 - d. whole-wheat bread
18. Calcium homeostasis depends on:
 - a. vitamin K, aldosterone, and renin.
 - b. vitamin K, parathyroid hormone, and renin.
 - c. vitamin D, aldosterone, and calcitonin.
 - d. vitamin D, calcitonin, and parathyroid hormone.
19. Calcium absorption is hindered by:
 - a. lactose.
 - b. oxalates.
 - c. vitamin D.
 - d. stomach acid.
20. Phosphorus assists in many activities in the body, but *not*:
 - a. energy metabolism.
 - b. the clotting of blood.
 - c. the transport of lipids.
 - d. bone and teeth formation.
21. Most of the body's magnesium can be found in the:
 - a. bones.
 - b. nerves.
 - c. muscles.
 - d. extracellular fluids.

See p. 394 for a summary of the major minerals.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

13.1 The Trace Minerals—An Overview

- The body needs tiny amounts of the trace minerals.
- The trace minerals can be toxic at levels not far above estimated requirements—a consideration for supplement users (review Figure 13-1, p. 404).
- Like the other nutrients, the trace minerals are best obtained by eating a variety of foods.

13.2 The Trace Minerals—As Individuals

- Iron is found in hemoglobin and myoglobin where it carries oxygen for energy metabolism; iron also acts as a cofactor for some enzymes. Iron deficiency is most common among infants and young children, teenagers, women of childbearing age, and pregnant women. Symptoms include fatigue and anemia. Iron overload is most common in men. Heme iron, which is found only in meat, fish, and poultry, is better absorbed than nonheme iron, which occurs in most foods (review Figure 13-4). Nonheme iron absorption is improved by eating iron-containing foods with foods containing the MFP factor and vitamin C; absorption is limited by phytates and oxalates.
- Zinc-requiring enzymes participate in reactions affecting growth, vitamin A activity, and pancreatic digestive enzyme synthesis. Both dietary zinc and zinc-rich pancreatic secretions (via enteropancreatic circulation) are available for absorption. Absorption is monitored by a special binding protein (metallothionein) in the small intestine. Protein-rich foods derived from animals are the best sources of bioavailable zinc. Fiber and phytates in cereals bind zinc, limiting absorption. Symptoms of deficiency include growth retardation and sexual immaturity.
- Iodide, the iodine ion, is an essential component of the thyroid hormone. A deficiency can lead to goiter (enlargement of the thyroid gland) and can impair fetal development, causing cretinism. Iodization of salt has largely eliminated iodine deficiency in the United States and Canada.
- Selenium is an antioxidant nutrient that works closely with the glutathione peroxidase enzyme and vitamin E. Selenium is found with protein in foods. Deficiencies are associated with a predisposition to a type of heart abnormality known as Keshan disease.
- Copper is a component of several enzymes, all of which are involved with oxygen or oxidation. Some act as antioxidants; others

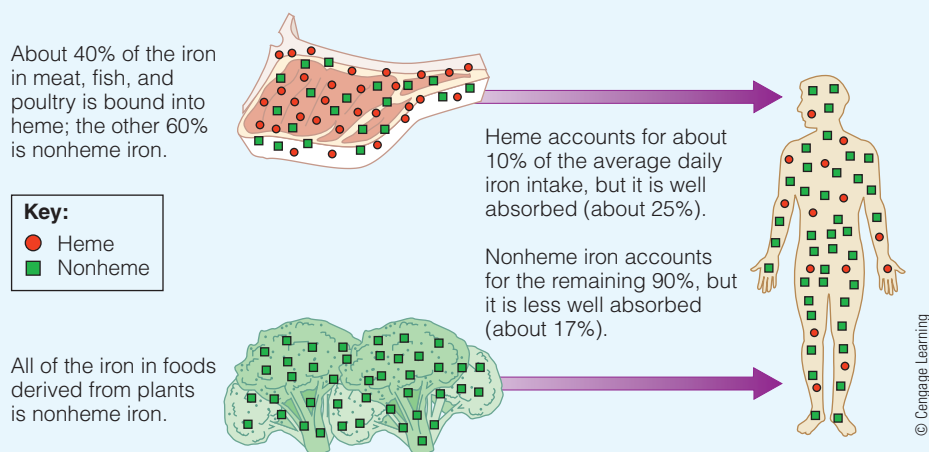
are essential to iron metabolism. Legumes, whole grains, and shellfish are good sources of copper.

- Manganese-dependent enzymes are involved in bone formation and various metabolic processes. Because manganese is widespread in plant foods, deficiencies are rare, although regular use of calcium and iron supplements may limit manganese absorption.
- Fluoride makes teeth more resistant to decay. Fluoridation of public water reduces the incidence of dental caries; excess fluoride during tooth development can discolor and pit tooth enamel (fluorosis).
- Chromium enhances insulin's action. Deficiency can result in a diabetes-like condition. Chromium is widely available in unrefined foods including brewer's yeast, whole grains, and liver.
- Molybdenum is a part of many metalloenzymes. Deficiencies are unknown and toxicity is rare. It is found in a variety of foods.

13.3 Contaminant Minerals

- Contaminant minerals include the heavy metals lead, mercury, and cadmium that enter the food supply by way of soil, water, and air pollution.
- Lead typifies the ways all heavy metals behave in the body: they interfere with nutrients that are trying to do their jobs. The “good guy” nutrients are shoved aside by the “bad guy” contaminants. Then, when the contaminants cannot perform the role of the nutrients, health diminishes.
- To safeguard our health, we must defend ourselves against contamination by eating nutrient-rich foods and preserving a clean environment.

> **FIGURE 13-4** Heme and Nonheme Iron in Foods



Take the quiz below to test your mastery of the key chapter concepts.

13.1 The Trace Minerals—An Overview

(pp. 403–405)

LEARN IT Summarize key factors unique to the trace minerals.

1. Discuss the importance of balanced and varied diets in obtaining the essential minerals and avoiding toxicities.
2. Describe some of the ways trace minerals interact with one another and with other nutrients.

13.2 The Trace Minerals (pp. 405–424)

LEARN IT Identify the main roles, deficiency symptoms, and food sources for each of the trace minerals (iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, and molybdenum).

3. Distinguish between heme and nonheme iron. Discuss the factors that enhance iron absorption.
4. Iron absorption is impaired by:
 - a. heme.
 - b. phytates.
 - c. vitamin C.
 - d. MFP factor.
5. Which of these people is *least* likely to develop an iron deficiency?
 - a. 3-year-old boy
 - b. 52-year-old man
 - c. 17-year-old girl
 - d. 24-year-old woman
6. Which of the following would *not* describe the blood cells of a severe iron deficiency?
 - a. anemic
 - b. microcytic
 - c. pernicious
 - d. hypochromic
7. Which provides the most absorbable iron?
 - a. 1 apple
 - b. 1 cup milk
 - c. 3 ounces steak
 - d. ½ cup spinach
8. What causes iron overload? What are its symptoms?
9. Describe the similarities and differences in the absorption and regulation of iron and zinc.
10. Discuss possible reasons for a low intake of zinc. What factors affect the bioavailability of zinc?
11. The intestinal protein that helps to regulate zinc absorption is:
 - a. albumin.
 - b. ferritin.
 - c. hemosiderin.
 - d. metallothionein.

12. A classic sign of zinc deficiency is:
 - a. anemia.
 - b. goiter.
 - c. mottled teeth.
 - d. growth retardation.
13. What public health measure has been used in preventing simple goiter?
14. Cretinism is caused by a deficiency of:
 - a. iron.
 - b. zinc.
 - c. iodine.
 - d. selenium.
15. The mineral best known for its role as an antioxidant is:
 - a. copper.
 - b. selenium.
 - c. manganese.
 - d. molybdenum.
16. What measure has been recommended for protection against tooth decay?
17. Fluorosis occurs when fluoride:
 - a. is excessive.
 - b. is inadequate.
 - c. binds with phosphorus.
 - d. interacts with calcium.
18. Which mineral enhances insulin activity?
 - a. zinc
 - b. iodine
 - c. chromium
 - d. manganese

See p. 425 for a summary of the trace minerals.

13.3 Contaminant Minerals (p. 424)

LEARN IT Describe how contaminant minerals disrupt body processes and impair nutrition status.

19. Which of the following does lead *not* compete with?
 - a. iron
 - b. zinc
 - c. fluoride
 - d. calcium

Multiple Choice Answers
4.b 5.b 6.c 7.c 11.d 12.d 14.c 15.b 17.a 18.c 19.c

Review the key points of this chapter below, then take the practice quiz on the back of this card.

14.1 Fitness

- Physical activity promotes good health and reduces the risk of developing a number of diseases.
- The components of fitness are flexibility, muscle strength and endurance, and cardiorespiratory endurance; these are obtained by conditioning the body, through training, to adapt to the activity performed.
- Participating in cardiorespiratory, strength, and flexibility activities improves fitness and benefits health (review Table 14-2, p. 440).

14.2 Energy Systems and Fuels to Support Activity

- ATP and CP are high-energy compounds used by the body to provide energy to the muscle cells.
During rest: $\text{ATP} + \text{creatine} \rightarrow \text{CP}$
During activity: $\text{CP} \rightarrow \text{ATP} + \text{creatine}$
- Fuel mixture during physical activity depends on diet, the intensity and duration of activity, and training (review Table 14-4).
- During intense activity, the fuel mix is mostly glucose; during less intense activity, fat makes a greater contribution.
- With endurance training, muscle cells adapt to store more glycogen and to rely less on glucose and more on fat for energy.
- Active athletes may need more protein than sedentary people do; they typically eat more food and therefore obtain enough protein without supplements (review Table 14-5, p. 451).

14.3 Vitamins and Minerals to Support Activity

- With the possible exception of iron for women, well-nourished active people and athletes do not need dietary supplements.

14.4 Fluids and Electrolytes to Support Activity

- Active people need to drink plenty of water (review Table 14-6, p. 454).
- Symptoms of dehydration and heat stroke:
 - Headache
 - Nausea
 - Dizziness
 - Clumsiness
 - Stumbling
 - Sudden cessation of sweating (hot, dry skin)
 - Confusion or other mental changes
- Endurance athletes need to drink both water and carbohydrate-containing beverages, especially during training and competition.
- During events lasting longer than 3 hours, athletes may need to replace sodium losses to prevent hyponatremia.

14.5 Diets for Physically Active People

- To enhance athletic performance and overall health, a diet should provide ample fluid and a variety of nutrient-dense foods in quantities to meet energy needs.
- Carbohydrate-rich foods that are light and easy to digest are best for pregame and postgame meals.

TABLE 14-4 Primary Fuels Used for Activities of Different Intensities and Durations

Activity Intensity	Activity Duration	Preferred Fuel Source	Oxygen Needed?	Activity Example
Extreme ^a	8 to 10 sec	ATP-CP (immediate availability)	No (anaerobic)	100-yard dash, shot put
Very high	20 sec to 3 min	ATP from carbohydrate (lactate)	No (anaerobic)	¼-mile run at maximal speed
High	3 min to 20 min	ATP from carbohydrate	Yes (aerobic)	Cycling, swimming, or running
Moderate	More than 20 min	ATP from fat	Yes (aerobic)	Hiking

^aAll levels of activity intensity use the ATP-CP system initially; extremely intense short-term activities rely solely on the ATP-CP system.

Take the quiz below to test your mastery of the key chapter concepts.

14.1 Fitness (pp. 438–444)

LEARN IT Describe the health benefits of being physically fit and explain how to develop the components of fitness.

1. Explain the overload principle.
2. Define *cardiorespiratory conditioning* and list some of its benefits.
3. Physical inactivity is linked to all of the following diseases except:
 - a. cancer.
 - b. diabetes.
 - c. emphysema.
 - d. hypertension.
4. The progressive overload principle can be applied by performing:
 - a. an activity less often.
 - b. an activity with more intensity.
 - c. an activity in a different setting.
 - d. a different activity each day of the week.

14.2 Energy Systems and Fuels to Support Activity (pp. 444–451)

LEARN IT Identify the factors that influence fuel use during physical activity and the types of activities that depend more on glucose or fat, respectively.

5. What types of activity are anaerobic? Which are aerobic? Describe the relationships among energy expenditure, type of activity, and oxygen use.
6. The process that regenerates glucose from lactate is known as the:
 - a. Cori cycle.
 - b. ATP-CP cycle.
 - c. adaptation cycle.
 - d. cardiac output cycle.
7. “Hitting the wall” is a term runners sometimes use to describe:
 - a. dehydration.
 - b. competition.
 - c. indigestion.
 - d. glucose depletion.
8. The technique endurance athletes use to maximize glycogen stores is called:
 - a. aerobic training.
 - b. muscle conditioning.
 - c. carbohydrate loading.
 - d. progressive overloading.
9. Conditioned muscles rely less on _____ and more on _____ for energy.
 - a. protein; fat
 - b. fat; protein
 - c. glycogen; fat
 - d. fat; glycogen

14.3 Vitamins and Minerals to Support Activity (pp. 451–453)

LEARN IT List which vitamins and mineral supplements, if any, athletes may need and why.

10. Why are some athletes likely to develop iron-deficiency anemia? Compare iron-deficiency anemia and sports anemia, explaining the differences.
11. Vitamin or mineral supplements taken just before an event are useless for improving performance because the:
 - a. athlete sweats the nutrients out during the event.
 - b. stomach can’t digest supplements during physical activity.
 - c. nutrients are diluted by all the fluids the athlete drinks.
 - d. body needs hours or days for the nutrients to do their work.
12. Physically active young women, especially those who are endurance athletes, are prone to:
 - a. energy excess.
 - b. iron deficiency.
 - c. protein overload.
 - d. vitamin A toxicity.

14.4 Fluids and Electrolytes to Support Activity (pp. 453–457)

LEARN IT Identify the factors that influence an athlete’s fluid needs and describe the differences between water and sports drinks.

13. Discuss the importance of hydration during training, and list recommendations to maintain fluid balance.
14. The body’s need for _____ far surpasses its need for any other nutrient.
 - a. water
 - b. protein
 - c. vitamins
 - d. carbohydrate

14.5 Diets for Physically Active People (pp. 457–460)

LEARN IT Discuss an appropriate daily eating pattern for athletes and list one example of a recommended pre- or post-game meal.

15. A recommended pregame meal includes plenty of fluids and provides between:
 - a. 300 and 800 kcalories, mostly from fat-rich foods.
 - b. 50 and 100 kcalories, mostly from fiber-rich foods.
 - c. 1000 and 2000 kcalories, mostly from protein-rich foods.
 - d. 300 and 800 kcalories, mostly from carbohydrate-rich foods.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

15.1 Nutrition prior to Pregnancy

- Prior to pregnancy, the health and behaviors of both men and women can influence fertility and fetal development. In preparation, they can achieve and maintain a healthy body weight, choose an adequate and balanced diet, be physically active, receive regular medical care, manage chronic conditions, and avoid harmful influences.

15.2 Growth and Development during Pregnancy

- The infant develops through three stages—the zygote, embryo, and fetus (review Figure 15-2, p. 472). Each organ and tissue grows on its own schedule (review Figure 15-4, p. 473).
- Times of intense development are critical periods that depend on nutrients (review Figure 15-3, p. 473).
- Without folate, the neural tube fails to develop completely during the first month of pregnancy; all women of childbearing age should take folate daily.

15.3 Maternal Weight

- A healthy pregnancy depends on a sufficient weight gain.
- Women who begin their pregnancies at a healthy weight need to gain about 30 pounds to cover the growth and development of the placenta, uterus, blood, breasts, and infant (review Figure 15-8, p. 479).
- Physical activity throughout pregnancy can help a woman develop the strength she needs to carry the extra weight and maintain habits that will help her lose it after the birth.

15.4 Nutrition during Pregnancy

- Energy and nutrient needs are high during pregnancy; the diet should include an extra serving from each of the five food groups.
- Supplements of iron and folate are recommended.
- Nausea, constipation, and heartburn commonly accompany pregnancy and can

usually be alleviated with a few simple strategies (review Table 15-2, p. 483). Food cravings do not typically reflect physiological needs.

15.5 High-Risk Pregnancies

- High-risk pregnancies (review Table 15-3) threaten the life and health of both mother and infant and are likely to produce an infant with a low birth weight.
- Proper nutrition and abstinence from smoking, alcohol, and other drugs improve the outcome as can prenatal care to monitor for gestational diabetes and preeclampsia.

15.6 Nutrition during Lactation

- Lactating women need extra fluid and enough energy and nutrients to produce about 25 ounces of milk a day.
- Breastfeeding is contraindicated for those with HIV/AIDS.
- Alcohol, other drugs, smoking, and contaminants may reduce milk production or enter breast milk and impair infant development.

TABLE 15-3 High-Risk Pregnancy Factors

Factor	Condition that Raises Risk
Maternal weight <ul style="list-style-type: none">• Prior to pregnancy• During pregnancy	Prepregnancy BMI either <18.5 or ≥25 Insufficient or excessive pregnancy weight gain (see Table 15-1, p. 477)
Maternal nutrition	Nutrient deficiencies or toxicities; eating disorders
Socioeconomic status	Poverty, lack of family support, low level of education, limited food available
Lifestyle habits	Smoking, alcohol or other drug use
Age	Teens, especially 15 years or younger; women 35 years or older
Previous pregnancies <ul style="list-style-type: none">• Number• Interval	Many previous pregnancies (3 or more to mothers younger than age 20; 4 or more to mothers age 20 or older) Short or long intervals between pregnancies (<18 months or >59 months)
Outcomes <ul style="list-style-type: none">• Multiple births• Birthweight	Previous history of problems Twins or triplets Low- or high-birthweight infants
Maternal health <ul style="list-style-type: none">• High blood pressure• Diabetes• Chronic diseases	Development of gestational hypertension Development of gestational diabetes Diabetes; heart, respiratory, and kidney disease; certain genetic disorders; special diets and medications

Take the quiz below to test your mastery of the key chapter concepts.

15.1 Nutrition prior to Pregnancy

(pp. 469–470)

LEARN IT List the ways men and women can prepare for a healthy pregnancy.

1. The health and behaviors of men and women prior to pregnancy can influence all of the following except:
 - a. fertility.
 - b. infant's gender.
 - c. placenta development.
 - d. infant's mental development.

15.2 Growth and Development during Pregnancy (pp. 470–475)

LEARN IT Describe fetal development from conception to birth and explain how maternal malnutrition can affect critical periods.

2. Describe the placenta and its function.
3. Explain why women of childbearing age need folate in their diets. How much is recommended, and how can women ensure that these needs are met?
4. The spongy structure that delivers nutrients to the fetus and returns waste products to the mother is called the:
 - a. embryo.
 - b. uterus.
 - c. placenta.
 - d. amniotic sac.

15.3 Maternal Weight (pp. 475–479)

LEARN IT Explain how both underweight and overweight can interfere with a healthy pregnancy and how weight gain and physical activity can support maternal health and infant growth.

5. Which of these strategies is *not* a healthy option for an overweight woman?
 - a. Limit weight gain during pregnancy.
 - b. Postpone weight loss until after pregnancy.
 - c. Follow a weight-loss diet during pregnancy.
 - d. Try to achieve a healthy weight before becoming pregnant.
6. A reasonable weight gain during pregnancy for a normal-weight woman is about:
 - a. 10 pounds.
 - b. 20 pounds.
 - c. 30 pounds.
 - d. 40 pounds.

15.4 Nutrition during Pregnancy

(pp. 479–484)

LEARN IT Summarize the nutrient needs of women during pregnancy.

7. Which nutrients are needed in the greatest amounts during pregnancy? Why are they so important? Describe wise food choices for the pregnant woman.

15.5 High-Risk Pregnancies (pp. 484–491)

LEARN IT Identify factors predicting low-risk and high-risk pregnancies and describe ways to manage them.

8. What is the significance of infant birthweight in terms of the child's future health?
9. Describe some of the special problems of the pregnant adolescent. Which nutrients are needed in increased amounts?
10. What practices should be avoided during pregnancy? Why?
11. To help prevent neural tube defects, grain products are now fortified with:
 - a. iron.
 - b. folate.
 - c. protein.
 - d. vitamin C.
12. Pregnant women should *not* take supplements of:
 - a. iron.
 - b. folate.
 - c. vitamin A.
 - d. vitamin C.
13. The combination of high blood pressure, protein in the urine, and edema signals:
 - a. jaundice.
 - b. preeclampsia.
 - c. gestational diabetes.
 - d. gestational hypertension.

15.6 Nutrition during Lactation (pp. 492–497)

LEARN IT Summarize the nutrient needs of women during lactation.

14. To facilitate lactation, a mother needs:
 - a. about 5000 kcalories a day.
 - b. adequate nutrition and rest.
 - c. vitamin and mineral supplements.
 - d. a glass of wine or beer before each feeding.
15. A breastfeeding woman should drink plenty of water to:
 - a. produce more milk.
 - b. suppress lactation.
 - c. prevent dehydration.
 - d. dilute nutrient concentration.
16. A woman may need iron supplements during lactation:
 - a. to enhance the iron in her breast milk.
 - b. to provide iron for the infant's growth.
 - c. to replace the iron in her body's stores.
 - d. to support the increase in her blood volume.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

16.1 Nutrition during Infancy

- The primary food for infants during the first 12 months is either breast milk or iron-fortified formula.
- Breast milk offers both nutrients and immunological protection.
- Protective factors in breast milk:
 - Antibodies
 - Oligosaccharides
 - Bifidus factors
 - Lactoferrin
 - Lactadherin
 - Growth factor
 - Lipase enzyme
- At 4 to 6 months of age, infants should gradually begin eating solid foods, including iron-fortified cereals and vitamin-C rich fruits and vegetables.
- By 1 year, infants are drinking from a cup and eating a variety of foods.
- Infants may benefit from supplements containing vitamin D, iron, and fluoride (review Table 16-2, p. 510).

16.2 Nutrition during Childhood

- Children's appetites and nutrient needs reflect their stage of growth.
- Children who are chronically hungry and malnourished suffer growth retardation; temporary hunger and mild nutrient deficiencies produce more subtle problems—such as poor academic performance.
- Iron deficiency is widespread and has many physical and behavioral consequences.
- "Hyper" behavior is not caused by poor nutrition; misbehavior may be due to lack of sleep, too little physical activity, or too much television, among other factors.
- Some children have food allergies—adverse reactions that involve an immune response—

most often caused by peanuts, tree nuts, milk, eggs, wheat, soybeans, fish, or shellfish.

- Childhood obesity is a major health problem (review Figure 16-9, p. 526).
- Children need to eat nutrient-dense foods and learn how to make healthful diet and activity choices.

16.3 Nutrition during Adolescence

- The need for iron increases during adolescence for both males and females; blood losses incurred through menstruation increase iron needs for females further.
- Sufficient calcium intake during adolescence supports optimal bone growth and density.
- The adolescent growth spurt increases the need for energy and nutrients.
- Adolescents who drink soft drinks regularly have a higher energy intake and a lower calcium intake; they are also more likely to be overweight.

TABLE 16-7 Recommended Eating and Physical Activity Behaviors to Prevent Obesity

The Expert Committee of the American Medical Association recommends the following healthy habits for children 2 to 18 years of age to help prevent childhood obesity:

- Limit consumption of sugar-sweetened beverages, such as soft drinks and fruit-flavored punches.
- Eat the recommended amounts of fruits and vegetables every day (2 to 4.5 cups per day based on age).
- Learn to eat age-appropriate portions of foods.
- Eat foods low in energy density such as those high in fiber and/or water and moderate in fat.
- Eat a nutritious breakfast every day.
- Eat a diet rich in calcium.
- Eat a diet balanced in recommended proportions for carbohydrate, fat, and protein.
- Eat a diet high in fiber.
- Eat together as a family as often as possible.
- Limit the frequency of restaurant meals.
- Limit television watching or other screen time to no more than 2 hours per day and do not have televisions or computers in bedrooms.
- Engage in at least 60 minutes of moderate to vigorous physical activity every day.

SOURCE: S. E. Barlow, Expert Committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report, *Pediatrics* 120 (2007): S164–S192.

Take the quiz below to test your mastery of the key chapter concepts.

16.1 Nutrition during Infancy (pp. 505–516)

LEARN IT List some of the immune factors in breast milk and describe the appropriate foods for infants during the first year of life.

- What are the appropriate uses of formula feeding? What criteria would you use in selecting an infant formula?
- Why are solid foods not recommended for an infant during the first few months of life? When is an infant ready to start eating solid food?
- Identify foods that are inappropriate for infants and explain why they are inappropriate.
- A reasonable weight for a healthy 5-month-old infant who weighed 8 pounds at birth might be:
 - 12 pounds.
 - 16 pounds.
 - 20 pounds.
 - 24 pounds.
- Dehydration can develop quickly in infants because:
 - much of their body water is extracellular.
 - they lose a lot of water through urination and tears.
 - only a small percentage of their body weight is water.
 - they drink lots of breast milk or formula, but little water.
- An infant should begin eating solid foods between:
 - 2 and 4 weeks.
 - 1 and 3 months.
 - 4 and 6 months.
 - 8 and 10 months.

16.2 Nutrition during Childhood (pp. 517–536)

LEARN IT Explain how children's appetites and nutrient needs reflect their stage of growth and why iron deficiency and obesity are often concerns during childhood.

- What nutrition problems are most common in children? What strategies can help prevent these problems?
- Describe the relationships between nutrition and behavior. How does television influence nutrition?
- Describe a true food allergy. Which foods most often cause allergic reactions? How do food allergies influence nutrition status?
- Describe the problems associated with childhood obesity and the strategies for prevention and treatment.
- List strategies for introducing nutritious foods to children.
- What impact do school meal programs have on the nutrition status of children?
- Among US and Canadian children, the most prevalent nutrient deficiency is of:
 - iron.
 - folate.
 - protein.
 - vitamin D.

- A true food allergy always:
 - elicits an immune response.
 - causes an immediate reaction.
 - creates an aversion to the offending food.
 - involves symptoms such as headaches or hives.
- Which of the following strategies is *not* effective?
 - Play first, eat later.
 - Provide small portions.
 - Encourage children to help prepare meals.
 - Use dessert as a reward for eating vegetables.

16.3 Nutrition during Adolescence (pp. 536–540)

LEARN IT Discuss some of the challenges in meeting the nutrient needs of adolescents.

- Describe the changes in nutrient needs from childhood to adolescence. Why is an adolescent girl more likely to develop an iron deficiency than an adolescent boy?
- How do adolescents' eating habits influence their nutrient intakes?
- To help teenagers consume a balanced diet, parents can:
 - monitor the teens' food intake.
 - give up—parents can't influence teenagers.
 - keep the pantry and refrigerator well stocked.
 - forbid snacking and insist on regular, well-balanced meals.
- During adolescence, energy and nutrient needs:
 - reach a peak.
 - fall dramatically.
 - rise, but do not peak until adulthood.
 - fluctuate so much that generalizations can't be made.
- The nutrients most likely to fall short in the adolescent diet are:
 - sodium and fat.
 - folate and zinc.
 - iron and calcium.
 - protein and vitamin A.
- To balance the day's intake, an adolescent who eats a hamburger, fries, and cola at lunch might benefit most from a dinner of:
 - fried chicken, rice, and banana.
 - ribeye steak, baked potato, and salad.
 - pork chop, mashed potatoes, and apple juice.
 - spaghetti with meat sauce, broccoli, and milk.

Multiple Choice Answers
4.b 5.a 6.c 13.a 14.a 15.d 18.c 19.a 20.c 21.d

Review the key points of this chapter below, then take the practice quiz on the back of this card.

17.1 Nutrition and Longevity

- Life expectancy in the United States increased dramatically in the 20th century.
- Factors that enhance longevity include limited or no alcohol use, regular balanced meals, weight control, abstinence from smoking, regular physical activity, and adequate sleep.
- Energy restriction in animals seems to lengthen their lives; whether such dietary intervention in human beings is beneficial remains unknown.
- Nutrition—especially when combined with regular physical activity—can influence aging and longevity by supporting good health and preventing disease.

17.2 The Aging Process

- Changes that accompany aging can impair nutrition status. Among physiological changes, hormone activity alters body composition, immune system changes raise the risk of infections, atrophic gastritis interferes with digestion and absorption, and tooth loss limits food choices.
- Psychological changes such as depression, economic changes such as loss of income, and social changes such as loneliness contribute to poor food intake.

17.3 Energy and Nutrient Needs of Older Adults

- Some nutrients need special attention in the diet, but supplements are not routinely recommended.
- Table 17-5 helps determine the risk of malnutrition in older adults.

17.4 Nutrition-Related Concerns of Older Adults

- Senile dementia and cognitive losses afflict many older adults; some face loss of vision due to cataracts or macular degeneration or cope with the pain of arthritis.

TABLE 17-5 Risk Factors for Malnutrition in Older Adults

	These questions help <i>determine</i> the risk of malnutrition in older adults:
Disease	• Do you have an illness or condition that changes the types or amounts of foods you eat?
Eating poorly	• Do you eat fewer than two meals a day? Do you eat fruits, vegetables, and milk products daily?
Tooth loss or mouth pain	• Is it difficult or painful to eat?
Economic hardship	• Do you have enough money to buy the food you need?
Reduced social contact	• Do you eat alone most of the time?
Multiple medications	• Do you take three or more different prescribed or over-the-counter medications daily?
Involuntary weight loss or gain	• Have you lost or gained 10 pounds or more in the last 6 months?
Needs assistance	• Are you physically able to shop, cook, and feed yourself?
Elderly person	• Are you older than 80?

NOTE: A complete description of DETERMINE and its scoring system are available online from the American Academy of Family Physicians: www.aafp.org/afp/980301ap/edits.html.

- Table 17-2 provides a summary of the nutrient concerns of aging.
- Some problems may be inevitable, but others are preventable and good nutrition may play a key role.

17.5 Food Choices and Eating Habits of Older Adults

- Congregate meals provide older adults with both nutrients and social interactions; those who are homebound receive delivered meals.
- Adults living alone can prepare nutritious, inexpensive meals with a little creativity and careful shopping.

TABLE 17-2 Nutrient Concerns of Aging

Nutrient	Effect of Aging	Comments
Water	Lack of thirst and decreased total body water make dehydration likely.	Mild dehydration is a common cause of confusion. Difficulty obtaining water or getting to the bathroom may compound the problem.
Energy	Need decreases as muscle mass decreases (sarcopenia).	Physical activity moderates the decline.
Fiber	Likelihood of constipation increases with low intakes and changes in the GI tract.	Inadequate water intakes and lack of physical activity, along with some medications, compound the problem.
Protein	Needs may stay the same or increase slightly.	Low-fat, high-fiber legumes and grains meet both protein and other nutrient needs.
Vitamin B ₁₂	Atrophic gastritis is common.	Deficiency causes neurological damages; supplements may be needed.
Vitamin D	Increased likelihood of inadequate intake; skin synthesis declines.	Daily sunlight exposure in moderation or supplements may be beneficial.
Calcium	Intakes may be low; osteoporosis is common.	Stomach discomfort commonly limits milk intake; calcium substitutes or supplements may be needed.
Iron	In women, status improves after menopause; deficiencies are linked to chronic blood losses and low stomach acid output.	Adequate stomach acid is required for absorption; antacid or other medicine use may aggravate iron deficiency; vitamin C and meat increase absorption.
Zinc	Intakes are often inadequate and absorption may be poor, but needs may also increase.	Medications interfere with absorption; deficiency may depress appetite and sense of taste.

Take the quiz below to test your mastery of the key chapter concepts.

17.1 Nutrition and Longevity (pp. 553–556)

LEARN IT Describe the role nutrition plays in longevity.

- Life expectancy in the United States is about:
 - 48 to 60 years.
 - 58 to 70 years.
 - 68 to 80 years.
 - 78 to 90 years.
- The human life span is about:
 - 85 years.
 - 100 years.
 - 115 years.
 - 130 years.
- A 72-year-old person whose physical health is similar to that of people 10 years younger has a(n):
 - chronological age of 62.
 - physiological age of 72.
 - physiological age of 62.
 - absolute age of minus 10.
- Rats live longest when given diets that:
 - eliminate all fat.
 - provide lots of protein.
 - allow them to eat freely.
 - restrict their energy intakes.

17.2 The Aging Process (pp. 556–560)

LEARN IT Summarize how nutrition interacts with the physical, psychological, economic, and social changes involved in aging.

- Which characteristic is *not* commonly associated with atrophic gastritis?
 - inflamed stomach
 - vitamin B₁₂ toxicity
 - bacterial overgrowth
 - lack of intrinsic factor

17.3 Energy and Nutrient Needs of Older Adults (pp. 560–563)

LEARN IT Explain why the needs for some nutrients increase or decrease during aging.

- Why does the risk of dehydration increase as people age?
- Why do energy needs usually decline with advancing age?
- Identify some factors that complicate the task of setting nutrient standards for older adults.

- On average, adult energy needs:
 - decline 5 percent per year.
 - decline 5 percent per decade.
 - remain stable throughout life.
 - rise gradually throughout life.

17.4 Nutrition-Related Concerns of Older Adults (pp. 564–568)

LEARN IT Identify how nutrition might contribute to, or prevent, the development of age-related problems associated with vision, arthritis, the brain, and alcohol use.

- Which nutrients seem to protect against cataract development?
 - minerals
 - lecithins
 - antioxidants
 - amino acids
- The best dietary advice for a person with osteoarthritis might be to:
 - avoid milk products.
 - take fish oil supplements.
 - take vitamin E supplements.
 - lose weight, if overweight.

17.5 Food Choices and Eating Habits of Older Adults (pp. 568–572)

LEARN IT Instruct an adult on how to shop for groceries and prepare healthy meals for one person on a tight budget.

- What characteristics contribute to malnutrition in older people?
- Congregate meal programs are preferable to Meals on Wheels because they provide:
 - nutritious meals.
 - referral services.
 - social interactions.
 - financial assistance.
- The OAA Nutrition Program is available to:
 - all people 65 years and older.
 - all people 60 years and older.
 - homebound people only, 60 years and older.
 - low-income people only, 60 years and older.

Review the key points of this chapter below, then take the practice quiz on the back of this card.

18.1 Nutrition and Infectious Diseases

- Public health measures such as purification of water and safe handling of food help prevent the spread of infection in populations; immunizations and antibiotics protect individuals.
- Nutrition cannot prevent or cure infectious diseases, but adequate intakes of all the nutrients can help support the immune system as the body defends against disease-causing agents.
- If the immune system is impaired because of malnutrition or diseases such as AIDS, a person becomes vulnerable to infectious disease.
- Inflammation underlies many chronic diseases.

18.2 Nutrition and Chronic Diseases

- Heart disease, cancers, and strokes are the three leading causes of death in the United States, and diabetes also ranks among the top 10.
- These four chronic diseases have significant links with nutrition and with one another (review Figure 18-3); other lifestyle risk factors and genetics also play a role.

18.3 Cardiovascular Disease

- Atherosclerosis is characterized by a build-up of plaque in an artery wall.
- Rupture of plaque or abnormal blood clotting can cause heart attacks and strokes.
- Dietary recommendations to lower the risks of cardiovascular disease are summarized in Table 18-5 (p. 593); quitting smoking and engaging in regular physical activity also improve heart health.

18.4 Hypertension

- The most effective dietary strategy for preventing hypertension is weight control.
- The DASH eating plan is rich in fruits, vegetables, nuts, and low-fat milk products and low in fat, saturated fat, and sodium (review Table 18-7, p. 597).

> FIGURE 18-3 Interrelationships among Chronic Diseases

Notice that many chronic diseases are themselves risk factors for other chronic diseases and that all of them are linked to obesity. The risk factors highlighted in blue define the metabolic syndrome.

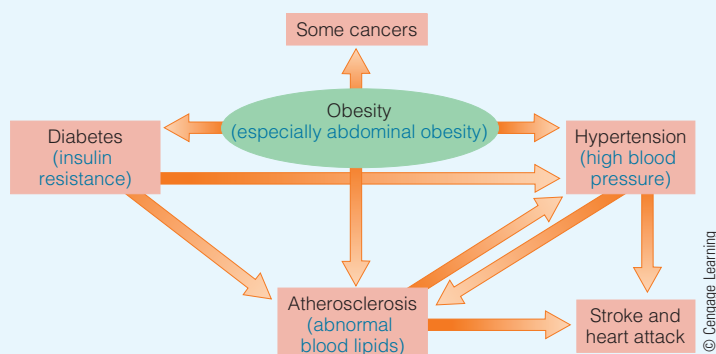


TABLE 18-11 Dietary Guidelines and Recommendations for Chronic Diseases Compared

Dietary Guidelines 2010	Heart Disease	Hypertension	Diabetes	Cancer
Prevent and/or reduce overweight and obesity.	✓	✓	✓	✓
Increase physical activity and reduce time spent in sedentary behaviors.	✓	✓	✓	✓
Keep total fat 20 to 35 percent of calories.	✓			
Consume less than 10 percent of calories from saturated fatty acids and keep <i>trans</i> -fatty acid consumption as low as possible.	✓		✓	✓
Increase vegetable and fruit intake. Consume at least half of all grains as whole grains.	✓	✓	✓	✓
Reduce the intake of calories from added sugars.	✓		✓	
Reduce daily sodium intake to less than 2300 milligrams. ^a	✓	✓	✓	✓
If alcohol is consumed, it should be consumed in moderation.	✓	✓	✓	✓

aFurther reduce daily sodium intake to 1500 milligrams among persons who are 51 and older and those of any age who are African American or have hypertension, diabetes, or chronic kidney disease.

18.5 Diabetes Mellitus

- Diabetes is characterized by high blood glucose and either insufficient insulin, ineffective insulin, or a combination of the two.
- People with type 1 diabetes coordinate diet, insulin, and physical activity to help control their blood glucose.
- People with type 2 diabetes benefit most from a diet and physical activity program that controls glucose fluctuations and promotes weight loss.

18.6 Cancer

- Some dietary factors, such as alcohol and heavily smoked foods, may initiate cancer development; others, such as animal fats, may promote cancer once it develops; and still others, such as fiber, antioxidant nutrients, and phytochemicals, may serve as antipromoters that protect against cancer development.
- To obtain the best possible nutrition at the lowest possible cancer risk, eat many fruits, vegetables, legumes, and whole grains and little saturated fat; minimize weight gain through regular physical activity and a healthy diet (review Table 18-10, p. 606).

18.7 Recommendations for Chronic Diseases

- Optimal nutrition keeps people healthy and reduces the risk of chronic diseases.
- Dietary recommendations are aimed at populations and focus on controlling weight; limiting saturated and *trans* fat; increasing fiber-rich fruits, vegetables, and whole grains; and balancing food intake with physical activity (review Table 18-11).

Take the quiz below to test your mastery of the key chapter concepts.

18.1 Nutrition and Infectious Diseases

(pp. 582–584)

LEARN IT Identify factors that protect people from the spread of infectious diseases and describe the role of nutrition in immunity.

1. The immune cells of the body do *not* include:
 - a. B-cells.
 - b. T-cells.
 - c. antigens.
 - d. phagocytes.
2. Which of the following produce antibodies?
 - a. phagocytes
 - b. T-cells
 - c. antigens
 - d. B-cells

18.2 Nutrition and Chronic Diseases

(pp. 585–586)

LEARN IT List the leading nutrition-related causes of death in the United States.

3. The leading cause of death in the United States is:
 - a. AIDS.
 - b. cancer.
 - c. diabetes.
 - d. heart disease.

18.3 Cardiovascular Disease (pp. 586–594)

LEARN IT Describe how atherosclerosis develops and strategies to lower blood cholesterol levels.

4. Plaques in the arteries contribute to the development of:
 - a. cancer.
 - b. diabetes.
 - c. atherosclerosis.
 - d. infectious diseases.
5. Which blood lipid correlates directly with heart disease?
 - a. HDL
 - b. LDL
 - c. VLDL
 - d. triglycerides
6. Weight loss and physical activity may protect against heart disease by:
 - a. raising LDL and insulin levels.
 - b. raising HDL and lowering blood pressure.
 - c. lowering LDL and increasing clot formation.
 - d. improving insulin sensitivity and raising blood pressure.

18.4 Hypertension (pp. 595–597)

LEARN IT Present strategies to lower blood pressure.

7. What is the most effective strategy for most people to lower their blood pressure?
 - a. lose weight
 - b. restrict salt
 - c. monitor glucose
 - d. supplement protein

18.5 Diabetes Mellitus (pp. 597–602)

LEARN IT Compare the dietary strategies to manage type 1 diabetes with those to prevent and treat type 2 diabetes.

8. Describe the differences between type 1 diabetes and type 2 diabetes.
9. All of the following factors increase the risk of type 2 diabetes *except*:
 - a. aging.
 - b. inactivity.
 - c. obesity.
 - d. smoking.
10. The most important dietary strategy in diabetes is to:
 - a. provide for a consistent carbohydrate intake.
 - b. restrict fat to 30 percent of daily kcalories.
 - c. limit carbohydrate intake to 300 milligrams a day.
 - d. take multiple vitamin and mineral supplements daily.

18.6 Cancer (pp. 602–606)

LEARN IT Differentiate among cancer initiators, promoters, and antipromoters and describe how nutrients or foods might play a role in each category.

11. Describe the characteristics of a diet that might offer the best protection against the onset of cancer.
12. Which of the following help(s) to protect against cancer?
 - a. alcohol
 - b. pickled foods
 - c. phytochemicals
 - d. omega-6 fatty acids

18.7 Recommendations for Chronic Diseases

(pp. 606–609)

LEARN IT Summarize dietary recommendations to prevent chronic diseases.

13. Describe the dietary choices that best protect against the development of most chronic diseases.

Multiple Choice Answers
1. c 2. d 3. d 4. c 5. b 6. b 7. a 8. d 9. d 10. a 12. c

Review the key points of this chapter below, then take the practice quiz on the back of this card.

19.1 Foodborne Illnesses

- Maintaining a safe food supply requires everyone's efforts (review Figure 19-1).
- Millions of people suffer mild to life-threatening symptoms caused by foodborne illnesses (review Table 19-1, p. 625).
- The "How To" (pp. 628–629) describes how these illnesses can be prevented by storing and cooking foods at their proper temperatures and by preparing them in sanitary conditions.
- Irradiation of certain foods protects consumers from foodborne illness, but also raises some concerns.

19.2 Nutritional Adequacy of Foods and Diets

- In the marketplace, food labels, the *Dietary Guidelines for Americans*, and MyPlate all help consumers learn about nutrition and how to plan healthy diets.
- At home, consumers can minimize nutrient losses from fruits and vegetables by refrigerating them, washing them before cutting them, storing them in airtight containers, and cooking them for short times in minimal water.

19.3 Environmental Contaminants

- Environmental contamination of foods is a concern, but so far, the hazards appear relatively small.
- Remain alert to the possibility of contamination, and keep an ear open for public health announcements and advice.
- Eat a variety of foods to protect against the accumulation of toxins in the body. Each food eaten dilutes contaminants that may be present in other components of the diet.

19.4 Natural Toxicants in Foods

- Natural toxicants include the goitrogens in cabbage, cyanogens in lima beans, and solanine in potatoes.
- Any substance can be toxic when consumed in excess.

- Poisons are poisons, whether made by people or by nature. The source of a chemical does not make it hazardous; its chemical structure and the quantity consumed do.

19.5 Pesticides

- Pesticides can safely improve crop yields when used according to regulations, but they can also be hazardous when used inappropriately.
- The FDA tests both domestic and imported foods for pesticide residues in the fields and in market basket surveys of foods prepared table ready.
- Consumers can minimize their ingestion of pesticide residues on foods by following the suggestions in Table 19-4 (p. 641).
- Alternative farming methods may allow farmers to grow crops with few or no pesticides.

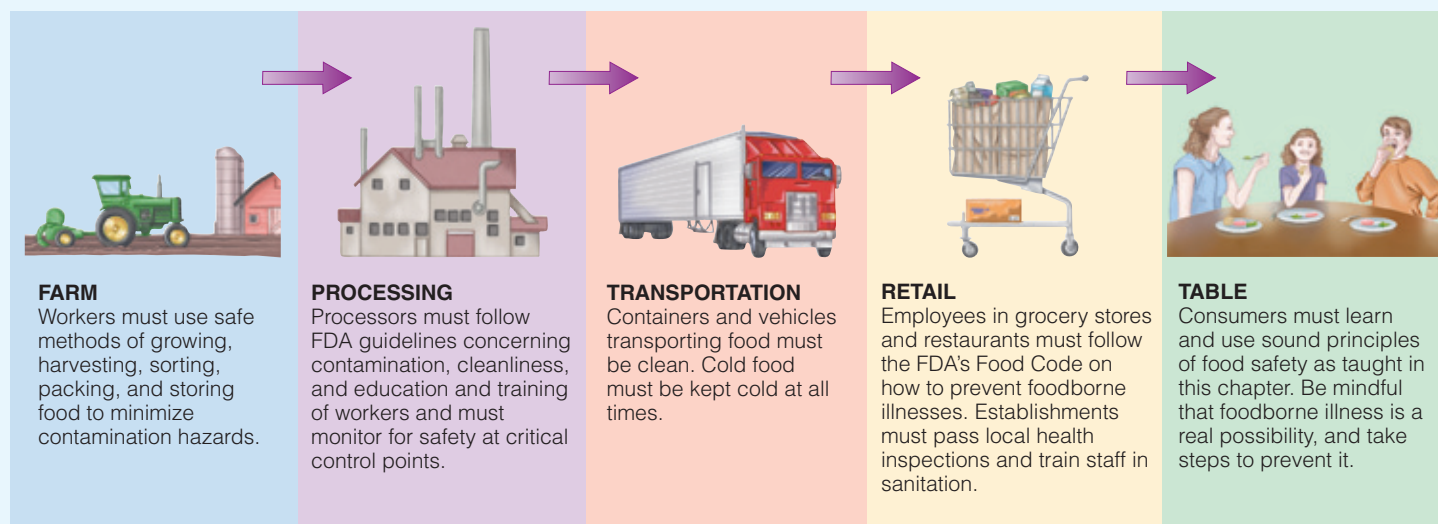
19.6 Food Additives

- The benefits of food additives seem to justify the risks associated with their use.
- The FDA regulates the use of these intentional additives: antimicrobial agents (such as nitrites) to prevent microbial spoilage; antioxidants (such as vitamins C and E, sulfites, and BHA and BHT) to prevent oxidative changes; colors (such as tartrazine) and flavor enhancers (such as MSG) to appeal to senses; and nutrients (such as iodine in salt) to enrich or fortify foods (see Table 19-5, p. 646).
- Incidental additives sometimes get into foods during processing, but rarely present a hazard; some processes such as treating livestock with hormones and antibiotics raise consumer concerns.

19.7 Consumer Concerns about Water

- Like foods, water may contain infectious microorganisms, environmental contaminants, pesticide residues, and additives.
- The EPA monitors the safety of the public water system, but many consumers choose home water treatment systems or bottled water instead of tap.

> **FIGURE 19-1** Food Safety from Farm to Table



Take the quiz below to test your mastery of the key chapter concepts.

19.1 Foodborne Illnesses (pp. 625–633)

LEARN IT Describe how foodborne illnesses can be prevented.

1. Distinguish between the two types of foodborne illnesses and provide an example of each.
2. What special precautions apply to meats? To seafood?
3. Eating a contaminated food such as undercooked poultry or unpasteurized milk might cause a:
 - a. food allergy.
 - b. food infection.
 - c. food intoxication.
 - d. botulinum reaction.
4. The temperature danger zone for foods ranges from:
 - a. -20°F to 120°F .
 - b. 0°F to 100°F .
 - c. 20°F to 120°F .
 - d. 40°F to 140°F .
5. Examples of foods that frequently cause foodborne illness are:
 - a. canned foods.
 - b. steaming-hot foods.
 - c. fresh fruits and vegetables.
 - d. raw milk, seafood, meat, and eggs.
6. Irradiation can help improve our food supply by:
 - a. cooking foods quickly.
 - b. killing microorganisms.
 - c. minimizing the use of preservatives.
 - d. improving the nutrient content of foods.

19.2 Nutritional Adequacy of Foods and Diets (pp. 633–634)

LEARN IT Explain how to minimize nutrient losses in the kitchen.

7. Describe which nutrients are most vulnerable to destruction.

19.3 Environmental Contaminants (pp. 634–636)

LEARN IT Explain how environmental contaminants get into foods and how people can protect themselves against contamination.

8. How does bioaccumulation of toxins occur and how does that influence the safety of foods?

19.4 Natural Toxicants in Foods (p. 637)

LEARN IT Identify natural toxicants and determine whether they are hazardous.

9. Solanine is an example of a(n):
 - a. heavy metal.
 - b. artificial color.
 - c. natural toxicant.
 - d. animal hormone.

19.5 Pesticides (pp. 637–642)

LEARN IT Debate the risks and benefits of using pesticides.

10. How do pesticides become a hazard to the food supply, and how are they monitored? In what ways can people reduce the concentrations of pesticides in and on foods that they prepare?

19.6 Food Additives (pp. 642–648)

LEARN IT List common food additives, their purposes, and examples.

11. What is the difference between a GRAS substance and a regulated food additive? Give examples of each.
12. The standard that deems additives safe if lifetime use presents no more than a one-in-a-million risk of cancer is known as the:
 - a. Delaney Clause.
 - b. zero-risk policy.
 - c. GRAS list of standards.
 - d. negligible-risk policy.
13. Common antimicrobial additives include:
 - a. salt and nitrites.
 - b. carrageenan and MSG.
 - c. dioxins and sulfites.
 - d. vitamin C and vitamin E.
14. Common antioxidants include:
 - a. BHA and BHT.
 - b. tartrazine and MSG.
 - c. sugar and vitamin E.
 - d. nitrosamines and salt.
15. Incidental additives that may enter foods during processing include:
 - a. dioxins and BGH.
 - b. dioxins and folate.
 - c. beta-carotene and agar.
 - d. nitrites and irradiation.

19.7 Consumer Concerns about Water (pp. 648–651)

LEARN IT Discuss consumer concerns about water.

16. Chlorine is added to water to:
 - a. protect against dental caries.
 - b. destroy harmful minerals such as lead and mercury.
 - c. kill pathogenic microorganisms.
 - d. remove the sulfur that produces a “rotten egg” odor.

Multiple Choice Answers
3. b 4. d 5. d 6. b 9. c 12. d 13. a 14. a 15. a 16. c

Review the key points of this chapter below, then take the practice quiz on the back of this card.

20.1 Hunger in the United States

- Food insecurity and hunger are widespread in the United States among those living in poverty (review Figure 20-1).
- Ironically, hunger and malnutrition can occur among obese people (review Figure 20-2).
- Government assistance programs help to relieve poverty and hunger; food recovery programs and other community efforts are equally important.

20.2 World Hunger

- Natural causes such as drought, flood, and pests and political causes such as armed conflicts and government policies all contribute to the extreme hunger and poverty seen in the developing countries.
- More people means more mouths to feed, which worsens the problems of poverty and hunger.
- Poverty and hunger encourage parents to have more children; breaking this cycle requires improving the economic status of the people and providing them with health care, education, and family planning.
- Hunger leads to malnutrition, which appears most evident in nutrient deficiencies and growth failure.

20.3 Malnutrition

- Inadequate food intake in children leads to poor growth and nutrient deficiencies.
- Children suffering from acute malnutrition (recent severe food deprivation) may be underweight for their height, whereas

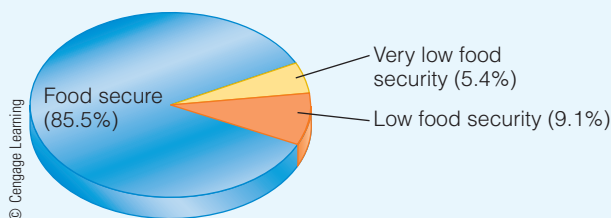
those experiencing chronic malnutrition (long-term food deprivation) are short for their age.

- Problems resulting from nutrient deficiencies include preterm births and low birth weights (iron), stillbirths and cretinism (iodine), blindness (vitamin A), and growth failure (zinc).
- Treatment for malnutrition should be individualized to ensure rapid weight gain and to correct nutrient deficiencies.

20.4 The Global Environment

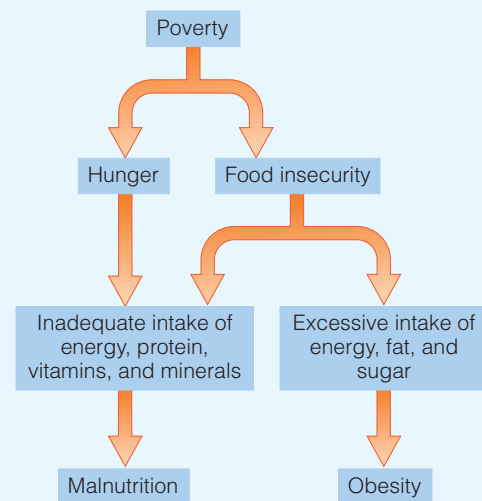
- The global environment is deteriorating, largely because of our irresponsible use of resources and energy.
- Environmental degradation reduces our ability to produce enough food to feed the world's people.
- The rapid increase in the world's population exacerbates the situation.
- Governments, businesses, and all individuals can make environmentally conscious choices to help solve the hunger problem, improve the quality of life, and generate jobs.
- Personal choices, made by many people, can have a great impact.

> **FIGURE 20-1** Prevalence of Food Security in US Households, 2010



SOURCE: Economic Research Service, U.S. Department of Agriculture, www.ers.usda.gov, updated September 2011.

> **FIGURE 20-2** The Poverty-Obesity Paradox



Take the quiz below to test your mastery of the key chapter concepts.

20.1 Hunger in the United States

(pp. 660–663)

LEARN IT Identify some reasons why hunger is present in a country as wealthy as the United States.

1. Food insecurity refers to the:
 - a. uncertainty of foods' safety.
 - b. fear of eating too much food.
 - c. limited availability of foods.
 - d. reliability of food production.
2. The most common cause of hunger in the United States is:
 - a. poverty.
 - b. alcohol abuse.
 - c. mental illness.
 - d. lack of education.
3. SNAP debit cards cannot be used to purchase:
 - a. tomato plants.
 - b. birthday cakes.
 - c. cola beverages.
 - d. laundry detergent.
4. Which action is not typical of a food recovery program?
 - a. gathering potatoes from a harvested field
 - b. collecting overripe tomatoes from a wholesaler
 - c. offering SNAP debit cards to low-income people
 - d. delivering restaurant leftovers to a community shelter

6. Which of the following is most critical in providing food to all the world's people?
 - a. decreasing air pollution
 - b. increasing water supplies
 - c. decreasing population growth
 - d. increasing agricultural land

20.3 Malnutrition (pp. 667–670)

LEARN IT Describe the consequences of nutrient and energy inadequacies.

7. The most likely cause of death in malnourished children is:
 - a. growth failure.
 - b. diarrheal disease.
 - c. simple starvation.
 - d. vitamin A deficiency.

20.4 The Global Environment (pp. 670–675)

LEARN IT Explain why relieving environmental problems will also help to alleviate hunger and poverty.

8. Discuss the different paths by which rich and poor countries can attack the problems of world hunger and the environment.

20.2 World Hunger (pp. 664–667)

LEARN IT Identify some reasons why hunger is present in the developing countries of the world.

5. The primary cause of the worst famine in the 20th century was:
 - a. armed conflicts.
 - b. natural disasters.
 - c. food contaminations.
 - d. government policies.