Nutrition Basics

Chapter 12

Components of a Healthy Diet

- Essential nutrients: about 45 nutrients we must get from food

  Proteins, fats, carbohydrates, vitamins, minerals and water

  - Macronutrients
  - Micronutrients

  These nutrients are available to the body through digestion

  Adequate diet must provide nutrients and energy

Energy

- Kilocalories (kcal) are the measure of energy in food

  2000 kcal per day typically meets a person's energy needs

  Energy is the capacity to do work; calories measure energy

  Sources of energy:

  - Fat = 9 calories per gram
  - Protein = 4 calories per gram
  - Carbohydrates = 4 calories per gram

Table 12.1 The Six Major Classes of Dietary Components

NUTRIENT	FUNCTION	MAJOR SOURCES
Proteins	Form important parts of muscles, bone, blood, enzymes, some hormones, and cell membranes, which are essential for growth and repair of tissue; regulate water and acid–base balance; help maintain a healthy immune system; used for energy supply in case of excess protein intake or insufficient energy intake	Meat (e.g., beef, pork, fish, poultry), eggs, milk, milk products, legumes, quinoa, and nuts
Carbohydrates	Provide main source of energy for cells in all body parts including the brain, nervous system, blood, and muscles at rest and during exercise	Grains in form of breads and cereals, fruits, vegetables, milk, and natural and added sugars
Fats	Supply energy; insulate, support, and cushion organs; provide medium for absorption of fat-soluble vitamins; contribute in the regulation of function of various genes (gene expression)	Animal foods, grains, nuts, seeds, fish, and vegetables
Vitamins	Promote specific chemical reactions within cells, and influence the regulation of gene expression	Abundant in fruits, vegetables, grains, liver, and dairy products; found either naturally or through food fortification
Minerals	Help regulate body functions; aid in growth and maintenance of body tissues; act as catalysts for release of energy	Found in most food groups naturally; fortified foods may contain minerals (e.g., calcium in some juices)
Water	Provides medium for chemical reactions; transports chemicals; regulates temperature; removes waste products	Beverages including water and juices, fresh fruits and vegetables, and cooked semisolid foods

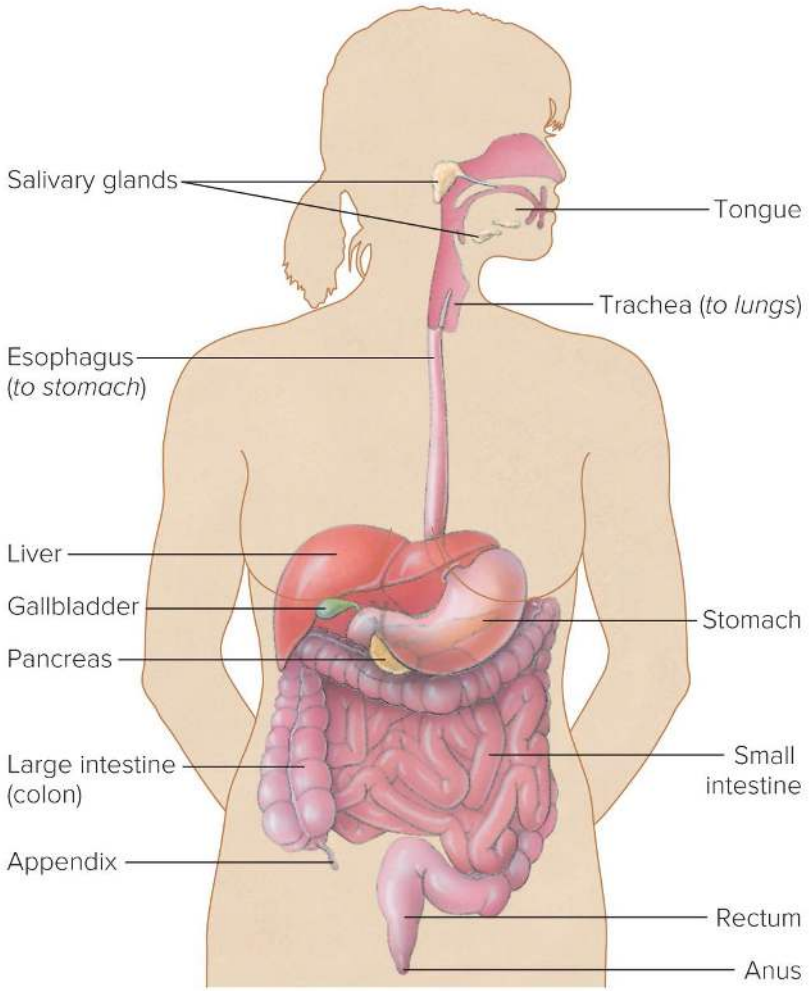


Figure 12.1
The Digestive System

Food is partially broken down by being chewed and mixed with saliva in the mouth. After traveling to the stomach via the esophagus, food is broken down further by stomach acids and other secretions. As food moves through the digestive tract, it is mixed by muscular contractions to facilitate further digestion and absorption. Most absorption of nutrients occurs via the lining of the small intestine. The large intestine reabsorbs excess water; the remaining solid wastes are collected in the rectum and excreted through the anus.

Proteins—The Basis of Body Structure

- Proteins form parts of muscle, bone, blood, enzymes, hormones, and cell membranes

  Amino acids: the building blocks of proteins

  - There are 20 common amino acids
  - 9 are essential
  - 11 are nonessential—meaning the body can produce them

Proteins—The Basis of Body Structure (2)

- Complete proteins provide all essential amino acids
  - Most animal proteins are complete proteins
  - Most plant proteins are incomplete proteins
    - Legumes, nuts
    - Certain combinations yield complete proteins
- Recommended protein intake:
  - 0.8 gram per kilogram of body weight
  - AMDR: 10–35% of total daily calorie intake

Table 12.2 Goals for Protein, Fat, and Carbohydrate Intake

NUTRIENT	DAILY ADEQUATE INTAKE DISTRIBUTION FOR MEN (GRAMS)*	DAILY ADEQUATE INTAKE DISTRIBUTION FOR WOMEN (GRAMS)	ACCEPTABLE MACRONUTRIENT DISTRIBUTION RANGE (PERCENTAGE OF TOTAL DAILY CALORIES)
Protein**	56	46	10–35
Fat: linoleic acid	17	12	Total fat: 20–35
Fat: alpha-linolenic acid	1.6	1.1	Total fat: 20–35
Carbohydrate	130	130	45–65

*To meet daily energy needs, you must consume more than the minimally adequate amounts of the energy-providing nutrients listed here, which alone supply only 800-900 calories. Use the AMDRs to set overall daily goals.

**Protein-intake goals can be calculated more specifically by multiplying your body weight in pounds by 0.36.

Note: Individuals can allocate total daily energy intake among the three classes of macronutrients to suit individual preferences. To translate percentage goals into daily-intake goals expressed in calories and grams, multiply the appropriate percentages by your total daily energy intake and then divide the results by the corresponding calories per gram. For example, a fat limit of 35% applied to a 2200-calorie diet would be calculated as follows: 0.35 × 2200 = 770 calories of total fat; 770 ÷ 9 calories per gram = 86 grams of total fat.

SOURCE: Recommendations from Food and Nutrition Board, Institute of Medicine. 2005. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC: National Academies Press.

Table 12.3 Protein Content of Common Food Items

ITEM	PROTEIN (GRAMS)*
3 ounces lean meat, poultry, or fish	20–27
¼ block (3 ounces) tofu	7
1 cup cooked beans (black, white, pinto)	15–17
1 cup yogurt	8–13
1 ounce cheese (cheddar, Swiss)	6–8
½–1 cup cereals	1–6
1 egg cooked	6
1 cup ricotta cheese	28
1 cup milk	8
1 ounce nuts	2–6

*For the specific protein content of a food, check the food label or the searchable USDA food composition database .

SOURCE: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2016. USDA National Nutrient Database for Standard Reference, Release 28 (http://www.ars.usda.gov/nea/bhnrc/ndl).

Fats—Essential in Small Amounts

- Fats (lipids) are the most concentrated source of energy
  - Store energy; provide insulation and support
    - Major fuel during rest and light activity
    - 9 calories of energy per gram
  - Linoleic acid and alpha-linolenic acid are essential
- Triglycerides: most fats in foods
  - Types: saturated or unsaturated; monounsaturated; polyunsaturated

Fats—Essential in Small Amounts (2)

- Hydrogenation and trans fats

  Hydrogenation changes some unsaturated fatty acids in trans fatty acids

  – Associated with increased LDL (“bad”) cholesterol and decreased HDL (“good”) cholesterol

- Recommended fat intake

  Limit unhealthy fats

  AMDR for fats is 25–35% of total daily calories

Table 12.4 Types of Fatty Acids

TYPE OF FATTY ACID	FOUND IN*
Saturated	• Animal fats (especially fatty meats and poultry fat and skin) • Butter, cheese, and other high-fat dairy products • Palm and coconut oils
Trans	• Some frozen pizza • Some types of popcorn • Deep-fried fast foods • Stick margarines, shortening • Packaged cookies and crackers • Processed snacks and sweets
Monounsaturated	• Olive, canola, and safflower oils • Avocados, olives • Peanut butter (without added fat) • Many nuts, including almonds, cashews, pecans, and pistachios
Polyunsaturated—omega-3†	• Fatty fish, including salmon, white albacore tuna, mackerel, anchovies, and sardines • Compared to fish, lesser amounts are found in canola and soybean oils; tofu; walnuts; flaxseeds; and dark green leafy vegetables
Polyunsaturated—omega-6†	• Corn, soybean, and cottonseed oils (often used in margarine, mayonnaise, and salad dressings)

*Food fats contain a combination of types of fatty acids in various proportions. For example, canola oil is composed mainly of monounsaturated fatty acids (62%) but also contains polyunsaturated (32%) and saturated (6%) fatty acids.

†Essential fatty acids are polyunsaturated: Linoleic acid is an omega-6 fatty acid and alpha-linolenic acid, an omega-3 fatty acid.

Carbohydrates—An Ideal Source of Energy

- Carbohydrates supply energy for body cells

  Simple carbohydrates

  - Monosaccharides: single sugar molecule

    Glucose, fructose, galactose

  - Disaccharides: pairs of single sugars

    Sucrose, maltose or malt sugar, and lactose

  Complex carbohydrates: multiple sugar units

  - Starches and fiber

  During digestion, carbohydrates are broken down into glucose for absorption

  - Glycogen: starch stored in liver and muscles

Carbohydrates— An Ideal Source of Energy (2)

- Refined carbohydrates versus whole grains

  All grains are whole before processing

  - Inner layer: germ
  - Middle layer: endosperm
  - Outer layer: bran

  During processing, the germ and bran are removed, leaving just the starch of the endosperm

  These refined carbohydrates are lower in fiber, vitamins, minerals, and other beneficial compounds

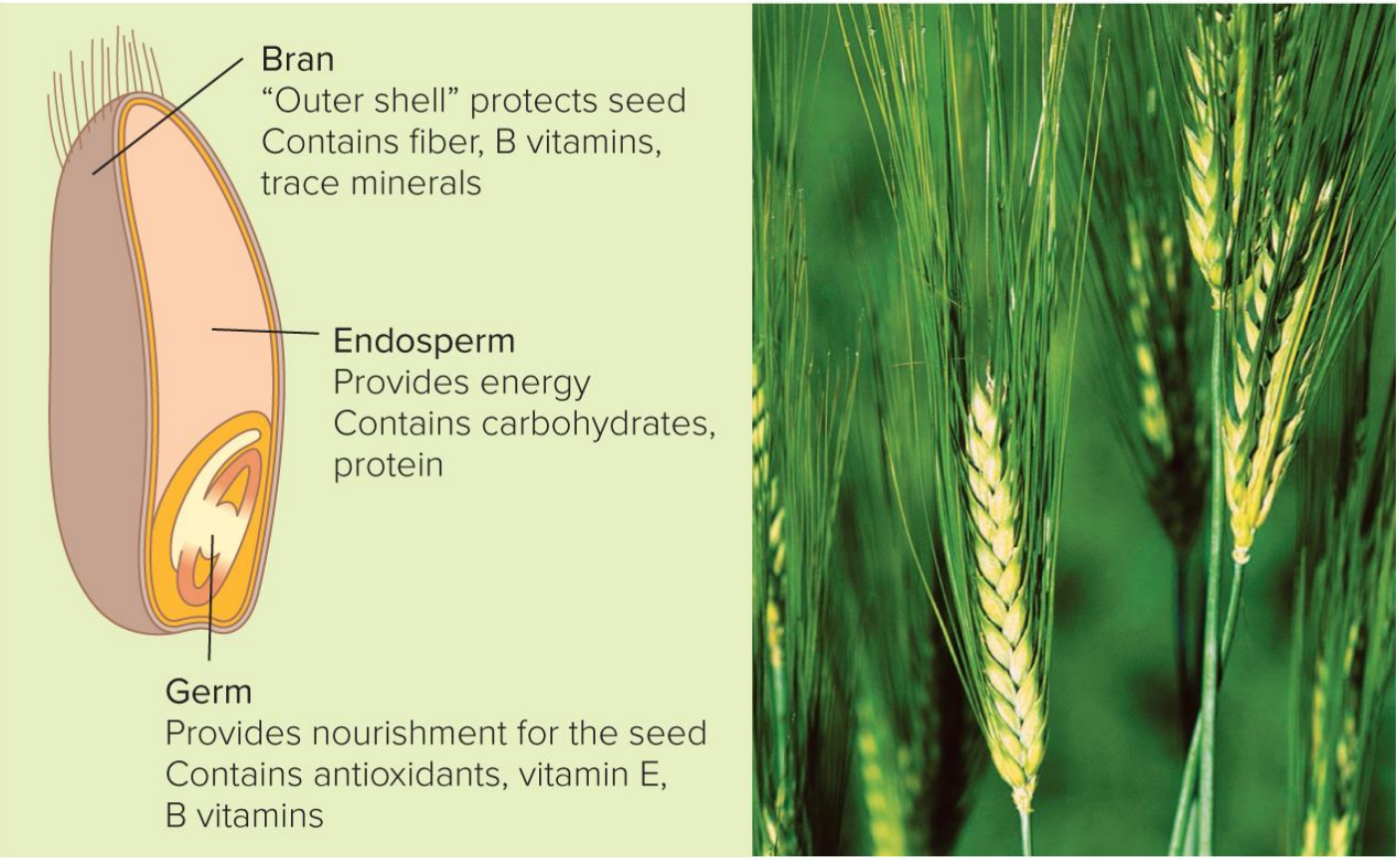


Figure 12.2 The Parts of a Whole Grain Kernel

The bran protects the seed and contains fiber, B vitamins, and trace minerals. The endosperm contains carbohydrates and protein and provides energy. The germ contains antioxidants, vitamin E, and B vitamins; and provides nourishment for the seed.

Carbohydrates—An Ideal Source of Energy (3)

- Glycemic index:

  Insulin and glucose levels rise and fall

  Quick rise in glucose and insulin levels produces a high glycemic index

  Eating high glycemic index foods:
  - May increase appetite
  - May increase risk of diabetes and heart disease

  Unrefined grains, fruits, vegetables, and legumes have a relatively low glycemic index

Carbohydrates—An Ideal Source of Energy (4)

- Added sugars:

  White sugar, brown sugar, high-fructose corn syrup, and other sweeteners added to most processed foods

  – Foods that are generally high in calories and low in essential nutrients and fiber

  High intake is associated with dental cavities, excess weight, and type 2 diabetes

- Sugars in your diet should come mainly from whole fruits and from low-fat milk and other dairy products

Carbohydrates—An Ideal Source of Energy (5)

- Recommended carbohydrate intake:

  Average American consumes 200–300 grams daily

  - 130 grams are needed to meet the body's requirements for essential carbohydrates
  - AMDR: 45–65% of total daily calories, or 225–325 grams

  Focus should be on consuming a diet rich in complex carbohydrates, especially whole grains

Fiber—A Closer Look

- Types of fiber:

  Dietary fiber: nondigestible carbohydrate that is present naturally

  - Soluble (viscous) fiber
  - Insoluble fiber

  Functional fiber: nondigestible carbohydrate that has been isolated or synthesized

  Total fiber is the sum of both

- High fiber diet can help reduce risk of type 2 diabetes, heart disease, and pulmonary disease

Fiber—A Closer Look (2)

- Sources of fiber:
  - All plant substances
- Recommended fiber intake:
  - 38 grams for adult men
  - 25 grams for adult women
  - Needs to come from foods, not supplements

Vitamins—Organic Micronutrients

- Vitamins are organic (carbon-containing) substances required in small amounts to regulate various processes in cells
- Thirteen vitamins:

  4 fat-soluble: A, D, E, and K

  9 water-soluble: C, and the B-complex vitamins thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, biotin, and pantothenic acid

Vitamins—Organic Micronutrients (2)

- Functions of vitamins:

  Help chemical reactions take place; help unleash energy; produce red blood cells; maintain nervous, skeletal, and immune systems; and act as antioxidants

- Sources of vitamins:

  Human body does not manufacture most vitamins

  Abundant in fruits, vegetables, and grains

Vitamins—Organic Micronutrients (3)

- Vitamin deficiencies

  Certain vitamin deficiencies are associated with health risks

- Vitamin excesses

  Extra vitamins can be harmful, even toxic

- To keep the nutrient value in food, store and cook food properly

Table 12.5a Facts about Vitamins: Fat-Soluble Vitamins

RECOMMENDED INTAKES*	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Vitamin A Men: 900 µg Women: 700 µg	Liver, milk, butter, cheese, fortified margarine, carrots, spinach, orange and deep green vegetables and fruits	Immune function and maintenance of vision; skin; and linings of the nose, mouth, and digestive and urinary tracts	Night blindness, scaling skin, increased susceptibility to infection, loss of appetite, anemia, kidney stones	Liver damage, miscarriage, birth defects, headache, vomiting, diarrhea, vertigo, double vision, bone abnormalities
Vitamin D Men: 15 µg Women: 15 µg	Fortified milk and margarine, fish oils, butter, egg yolks; sunlight on skin also produces vitamin D	Development and maintenance of bones and teeth, promotion of calcium absorption	Rickets (bone deformities) in children; bone softening, loss, and fractures in adults	Kidney damage, calcium deposits in soft tissues, depression, death
Vitamin E Men: 15 mg Women: 15 mg	Vegetable oils, whole grains, nuts and seeds, green leafy vegetables, asparagus, peaches	Protection and maintenance of cellular membranes	Red blood cell breakage and anemia, weakness, neurological problems, muscle cramps	Relatively nontoxic, but may cause excess bleeding or formation of blood clots
Vitamin K Men: 120 µg Women: 90 µg	Green leafy vegetables; smaller amounts widespread in other foods	Production of factors essential for blood clotting and bone metabolism	Hemorrhaging	None reported

*Recommended intakes for adults aged 19–30; to calculate your personal Dietary Reference Intakes (DRIs) based on age, sex, and other factors, visit the Interactive DRI website .

SOURCES: www.nap.edu: Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin and Choline (1998); Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000); Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001); and Dietary Reference Intakes for Calcium and Vitamin D (2011); Ross, A. C., et al., eds. 2014. Modern Nutrition in Health and Disease, 11th ed. Baltimore, MD: Lippincott Williams & Wilkins.

Table 12.5b Facts about Vitamins: Water-Soluble Vitamins

RECOMMENDED INTAKES	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Biotin Men: 30 µg Women: 30 µg	Cereals, yeast, egg yolks, soy flour, liver; widespread in foods	Synthesis of fats, glycogen, and amino acids	Rash, nausea, vomiting, weight loss, depression, fatigue, hair loss	None reported
Folate Men: 400 µg Women: 400 µg	Green leafy vegetables, yeast, oranges, whole grains, legumes, liver	Amino acid metabolism, synthesis of RNA and DNA, new cell synthesis	Anemia, weakness, fatigue, irritability, shortness of breath, swollen tongue	Masking of vitamin B-12 deficiency
Niacin Men: 16 mg Women: 14 mg	Eggs, poultry, fish, milk, whole grains, nuts, enriched breads and cereals, meats, legumes	Conversion of carbohydrates, fats, and proteins into usable forms of energy	Pellagra (symptoms include diarrhea, dermatitis, inflammation of mucous membranes, dementia)	Flushing of the skin, nausea, vomiting, diarrhea, liver dysfunction, glucose intolerance
Pantothenic acid Men: 5 mg Women: 5 mg	Animal foods, whole grains, broccoli, potatoes; widespread in foods	Metabolism of fats, carbohydrates, and proteins	Fatigue, numbness and tingling of hands and feet, gastrointestinal disturbances	None reported
Riboflavin Men: 1.3 mg Women: 1.1 mg	Dairy products, enriched breads and cereals, lean meats, poultry, fish, green vegetables	Energy metabolism; maintenance of skin, mucous membranes, and nervous system structures	Cracks at corners of mouth, sore throat, skin rash, hypersensitivity to light, purple tongue	None reported

SOURCES: www.nap.edu: Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin and Choline (1998); Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000); Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001); and Dietary Reference Intakes for Calcium and Vitamin D (2011); Ross, A. C., et al., eds. 2014. Modern Nutrition in Health and Disease, 11th ed. Baltimore, MD: Lippincott Williams & Wilkins.

Table 12.5b Facts about Vitamins: Water-Soluble Vitamins

(Continued)

RECOMMENDED INTAKES	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Thiamin Men: 1.2 mg Women: 1.1 mg	Whole-grain and enriched breads and cereals, organ meats, lean pork, nuts, legumes	Conversion of carbohydrates into usable forms of energy, maintenance of appetite and nervous system function	Beriberi (symptoms include muscle wasting, mental confusion, anorexia, enlarged heart, nerve changes)	None reported
Vitamin B-6 Men: 1.3 mg Women: 1.3 mg	Eggs, poultry, fish, whole grains, nuts, soybeans, liver, kidney, pork	Metabolism of amino acids and glycogen	Anemia, convulsions, cracks at corners of mouth, dermatitis, nausea, confusion	Neurological abnormalities and damage
Vitamin B-12 Men: 2.4 µg Women: 2.4 µg	Meat, fish, poultry, fortified cereals	Synthesis of blood cells, other metabolic reactions	Anemia, fatigue, nervous system damage, sore tongue	None reported
Vitamin C Men: 90 mg Women: 75 mg	Peppers, broccoli, spinach, brussels sprouts, citrus fruits, strawberries, tomatoes, potatoes, cabbage, other fruits and vegetables	Maintenance and repair of connective tissue, bones, teeth, and cartilage; promotion of healing; absorption of iron	Scurvy, anemia, reduced resistance to infection, loosened teeth, joint pain, poor wound healing, hair loss, poor iron absorption	Urinary stones in some people, acid stomach from ingesting supplements in pill form, nausea, diarrhea, headache, fatigue

SOURCES: www.nap.edu: Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin and Choline (1998); Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids (2000); Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001); and Dietary Reference Intakes for Calcium and Vitamin D (2011); Ross, A. C., et al., eds. 2014. Modern Nutrition in Health and Disease, 11th ed. Baltimore, MD: Lippincott Williams & Wilkins.

Minerals—Inorganic Micronutrients

- Help to regulate body functions and release energy, aid in growth, and maintain body tissues
  - About 17 essential minerals
  - Major minerals: 100 milligrams or more needed per day
    - Calcium, phosphorus, magnesium, sodium, potassium, and chloride
  - Trace minerals: minute amounts
    - Copper, fluoride, iodide, iron, selenium, zinc
  - Issues may arise if too many or too few
    - Iron-deficiency anemia
    - Osteoporosis
    - Low potassium: high blood pressure, heart disease

Table 12.6 Facts about Selected Minerals

RECOMMENDED INTAKES*	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Calcium Men: 1000 mg Women: 1000 mg	Milk and milk products, tofu, fortified orange juice and bread, green leafy vegetables, bones in fish	Formation of bones and teeth, control of nerve impulses, muscle contraction, blood clotting	Stunted growth in children, bone mineral loss in adults, urinary stones	Kidney stones, calcium deposits in soft tissues, inhibition of mineral absorption, constipation
Fluoride Men: 4 mg Women: 3 mg	Fluoridated water, tea, marine fish eaten with bones	Maintenance of tooth and bone structure	Higher frequency of tooth decay	Increased bone density, mottling of teeth, impaired kidney function
Iodine Men: 150 µg Women: 150 µg	Iodized salt, seafood, processed foods	Essential part of thyroid hormones, regulation of body metabolism	Goiter (enlarged thyroid), cretinism (birth defect)	Depression of thyroid activity, hyperthyroidism in susceptible people
Iron Men: 8 mg Women: 18 mg	Meat and poultry, fortified grain products, dark green vegetables, dried fruit	Component of hemoglobin, myoglobin, and enzymes	Iron-deficiency anemia, weakness, impaired immune function, gastrointestinal distress	Nausea, diarrhea, liver and kidney damage, joint pains, sterility, disruption of cardiac function, death
Magnesium Men: 400 mg Women: 310 mg	Widespread in foods and water (except soft water); especially found in grains, legumes, nuts, seeds, green vegetables, milk	Transmission of nerve impulses, energy transfer, activation of many enzymes	Neurological disturbances, cardiovascular problems, kidney disorders, nausea, growth failure in children	Nausea, vomiting, diarrhea, central nervous system depression, coma; death in people with impaired kidney function

*Recommended intakes for adults aged 19–30; to calculate your personal DRIs based on age, sex, and other factors, visit the Interactive DRI website .

SOURCES: www.nap.edu: Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride (1997); Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001); Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate (2005); and Dietary Reference Intakes for Calcium and Vitamin D (2011). Ross, A. C., et al., eds. 2014. Modern Nutrition in Health and Disease, 11th ed. Baltimore, MD: Lippincott Williams & Wilkins.

Table 12.6 Facts about Selected Minerals *(Continued)*

RECOMMENDED INTAKES	IMPORTANT DIETARY SOURCES	MAJOR FUNCTIONS	SIGNS OF PROLONGED DEFICIENCY	TOXIC EFFECTS OF MEGADOSES
Phosphorus Men: 700 mg Women: 700 mg	Present in nearly all foods, especially milk, cereal, peas, eggs, meat	Bone growth and maintenance, energy transfer in cells	Impaired growth, weakness, kidney disorders, cardiorespiratory and nervous system dysfunction	Drop in blood calcium levels, calcium deposits in soft tissues, bone loss
Potassium Men: 4700 mg Women: 4700 mg	Meats, milk, fruits, vegetables, grains, legumes	Nerve function, body water balance	Muscular weakness, nausea, drowsiness, paralysis, confusion, disruption of cardiac rhythm	Cardiac arrest
Selenium Men: 55 µg Women: 55 µg	Seafood, meat, eggs, whole grains	Defense against oxidative stress, regulation of thyroid hormone action	Muscle pain and weakness, heart disorders	Hair and nail loss, nausea and vomiting, weakness, irritability
Sodium Men: 1500 mg Women: 1500 mg	Salt, soy sauce, salted foods, tomato juice	Body water balance, acid– base balance, nerve function	Muscle weakness, loss of appetite, nausea, vomiting; deficiency is rarely seen	Edema (excess fluid buildup), hypertension in sensitive people
Zinc Men: 11 mg Women: 8 mg	Whole grains, meat, eggs, liver, seafood (especially oysters)	Synthesis of proteins, RNA, and DNA; wound healing; immune response; ability to taste	Growth failure, loss of appetite, impaired taste acuity, skin rash, impaired immune function, poor wound healing	Vomiting, impaired immune function, decline in blood HDL levels, impaired copper absorption

SOURCES: www.nap.edu: Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride (1997); Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc (2001); Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate (2005); and Dietary Reference Intakes for Calcium and Vitamin D (2011). Ross, A. C., et al., eds. 2014. Modern Nutrition in Health and Disease, 11th ed. Baltimore, MD: Lippincott Williams & Wilkins.

Water—Vital but Often Ignored

- Human body is 50–60% water
- Humans can live up to 50 days without food but only a few days without water

  Water is used in digestion and the absorption of food and is the medium in which chemical reactions take place

  To maintain hydration, daily:
  - Men: 3.7 total liters of water, with 3.0 liters (13 cups) coming from beverages
  - Women: 2.7 total liters of water, with 2.2 (9 cups) coming from beverages

Other Substances in Food

- Antioxidants
  - Reduction in cancers (free radicals)
  - Vitamins C and E, selenium, carotenoids
- Phytochemicals
  - Soy foods may help lower cholesterol levels
  - Cruciferous vegetables render some carcinogenic compounds harmless
  - Allyl sulfides (garlic and onions) boost cancer-fighting immune cells
  - Carotenoids in green vegetables may preserve eyesight

Nutritional Guidelines: Planning Your Diet

- Variety of tools are designed to help:
  - Dietary Reference Intakes (DRIs)
  - Dietary Guidelines for Americans
  - USDA MyPlate

Dietary Reference Intakes (DRIs)

- Standards for nutrient intakes in order to prevent deficiencies

  Set of four values used for recommended intakes and maximum safe intakes

  - Recommended Dietary Allowances (RDAs)
  - Adequate Intake (AI)
  - Estimated Average Requirement (EAR)
  - Tolerable Upper Intake Level (UL)

  Daily Values: the U.S. Food and Drug Administration uses these for food labels

  - Based on a 2000-calorie diet

Dietary Guidelines for Americans

- Designed to encourage improved nutrition and physical activity
- Five overarching guidelines:
  1. Follow a healthy eating pattern across the lifespan
  2. Focus on variety, nutrient density, and amount
  3. Limit calories from added sugars and saturated fats and reduce sodium intake
  4. Shift to healthier food and beverage choices
  5. Support healthy eating patterns for all

Dietary Guidelines for Americans (2)

- Three healthy eating patterns:
  1. Healthy U.S.-Style Pattern
  2. Healthy Vegetarian Pattern
  3. Healthy Mediterranean-Style Pattern
- All three emphasize whole fruits, vegetables, whole grains, beans and peas, fat-free and low-fat milk and milk products, and healthy oils

  Less red meat; more seafood

Dietary Guidelines for Americans (3)

- Specific recommendations:
  - Less than 10% of calories per day from added sugars
  - Less than 10% of calories per day from saturated fats
  - Less than 2300 mg per day of sodium
  - If you consume alcohol, do so in moderation
    - 1 drink per day for women
    - 2 drinks per day for men
- Also strive to meet federal physical activity guidelines and maintain a healthy body weight

Table 12.7 USDA Healthy Food Patterns at the 2000-Calorie Level

FOOD GROUP	U.S.-STYLE	VEGETARIAN	MEDITERRANEAN
VEGETABLES	**2½ c-eq/day**	**2½ c-eq/day**	**2½ c-eq/day**
Dark green	1½ c-eq/wk	1½ c-eq/wk	1½ c-eq/wk
Red and orange	5½ c-eq/wk	5½ c-eq/wk	5½ c-eq/wk
Legumes (beans and peas)	1½ c-eq/wk	3 c-eq/wk*	1½ c-eq/wk
Starchy	5 c-eq/wk	5 c-eq/wk	5 c-eq/wk
Other	4 c-eq/wk	4 c-eq/wk	4 c-eq/wk
FRUIT	**2 c-eq/day**	**2 c-eq/day**	**2½ c-eq/day**
GRAINS	**6 oz-eq/day**	**6½ oz-eq/day**	**6 oz-eq/day**
Whole grains	3 oz-eq/day	3½ oz-eq/day	3 oz-eq/day
Refined grains	3 oz-eq/day	3 oz-eq/day	3 oz-eq/day
DAIRY	**3 c-eq/day**	**3 c-eq per day**	**2 c-eq per day**
PROTEIN FOODS	**5½ oz-eq/day**	**3½ oz-eq/day**	**6½ oz-eq/day**
Seafood	8 oz-q/wk	N/A	15 oz-eq/wk
Meat, poultry, eggs	26 oz-eq/wk	3 oz-eq/wk (eggs)	26 oz-eq/wk
Nuts, seeds, soy products	5 oz-eq/wk	15 oz-eq/wk	5 oz-eq/wk
OILS	**27 g/day**	**27 g/day**	**27 g/day**
LIMIT ON CALORIES FOR OTHER USES (% of total calories)**	**270 cal/day (14%)**	**290 cal/day (15%)**	**260 cal/day (13%)**

Note: c-eq = cup-equivalent, the amount of a food or beverage product that is considered equal to 1 cup from the vegetables, fruits, or dairy food groups; oz-eq = ounce-equivalent, the amount of a food product that is considered equal to 1 ounce from the grain or protein food groups; N/A = not applicable.

*For the Vegetarian Pattern, half of total legume intake counts as vegetables and half as protein foods.

**If all food choices to meet food group recommendations are in nutrient-dense forms, a small number of calories remain within the overall calorie limit of the pattern (i.e., limit on calories for other uses). Calories up to the specified limit can be used to consume added sugars, added refined starches, solid fats, or alcohol, or to eat more than the recommended amount of food in a food group.

SOURCE: U.S Department of Health and Human Services and U.S. Department of Agriculture. 2015. 2015–2020 Dietary Guidelines for Americans, 8th ed. (http://health.gov/dietaryguidelines/2015/guidelines/).

Dietary Guidelines for Americans (4)

- Making shifts to align with healthy eating patterns
  - Most Americans need to make changes to their current food and beverage choices
- Supporting healthy eating patterns
  - People are more likely to shift their eating patterns if we make a collaborative effort
  - Social-Ecological Model (SEM) recognizes interrelated factors
  - All elements of society must work to improve the food and activity environment

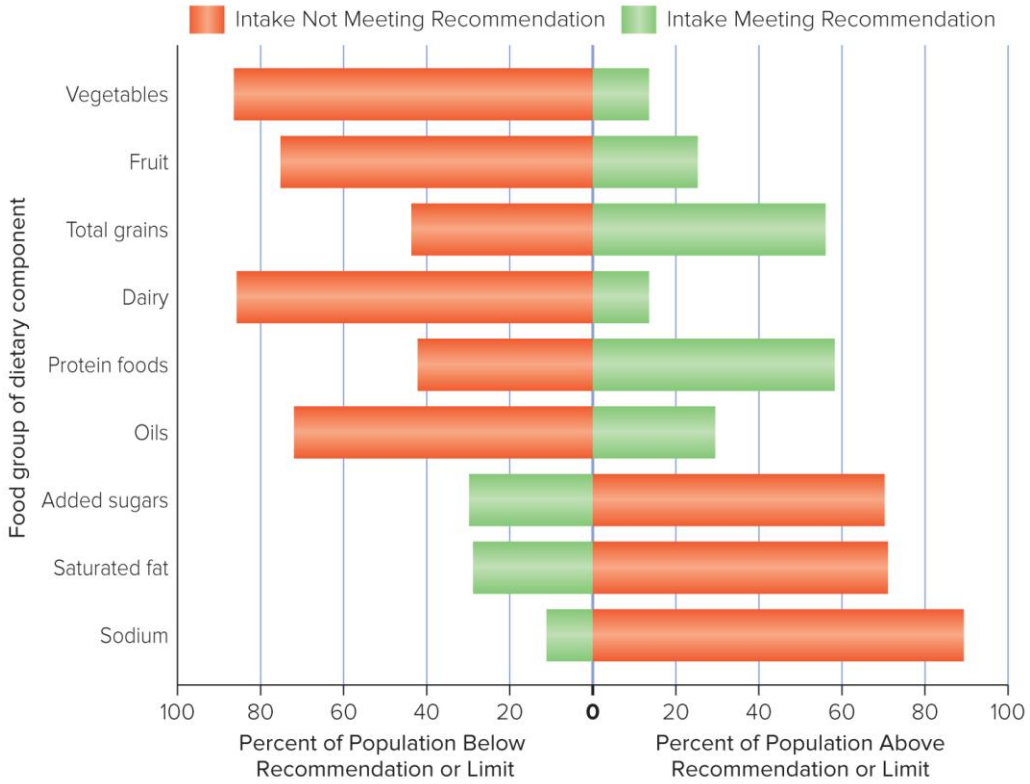


Figure 12.3 Dietary Intakes Compared to Recommendations

The bars show the percentages of the U.S. population age 1 year and over who are below, at, or above each dietary goal or limit. The center (0) line is the goal or limit. For most people, meaning those represented by the red sections of the bars, shifting toward the center line will improve eating patterns. For example, over 80% of people do not eat enough vegetables—they fall below the recommendation. Within the area of the graph demonstrating our consumption of foods we should limit—added sugars, saturated fat, and sodium—the red bars show that over 80% of people exceed the recommended limit for sodium intake.

SOURCES: What We Eat in America, NHANES 2007–2010 for average intakes by age-sex group. Healthy U.S.-Style Food Patterns, which vary based on age, sex, and activity level, for recommended intakes and limits. (see 2015–2020 Dietary Guidelines, https://health.gov/dietaryguidelines/2015/guidelines/chapter-2/current-eating-patterns-in-theunited-states/)

Table 12.8 Estimated Daily Calorie Needs

AGE (YEARS)	SEDENTARY	MODERATELY ACTIVE	ACTIVE
Female 16–18	1800	2000	2400
Female 19–25	2000	2200	2400
Female 26–30	1800	2000	2400
Female 31–50	1800	2000	2200
Female 51–60	1600	1800	2200
Female 61 & up	1600	1800	2000
Male 16–18	2400	2800	3200
Male 19–20	2600	2800	3000
Male 21–25	2400	2800	3000
Male 26–35	2400	2600	3000
Male 36–40	2400	2600	2800
Male 41–45	2200	2600	2800
Male 46–55	2200	2400	2800
Male 56–60	2200	2400	2600
Male 61–65	2000	2400	2600
Male 66–75	2000	2200	2600
Male 76 & up	2000	2200	2400

Sedentary means a lifestyle that includes only the physical activity of independent living.

Moderately active means a lifestyle that includes physical activity equivalent to walking about 1.5–3 miles per day at 3–4 miles per hour, in addition to the activities of independent living.

Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3–4 miles per hour, in addition to the activities of independent living.

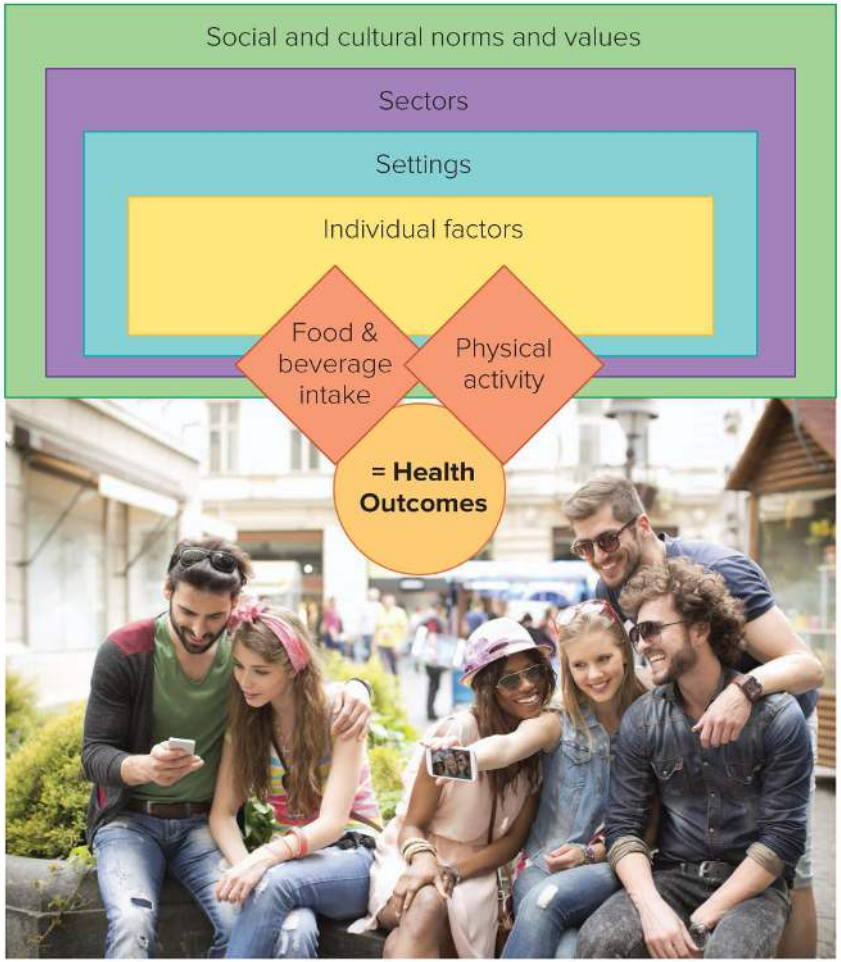
Estimates for females do not include women who are pregnant or breastfeeding.

SOURCES: U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015. 2015–2020 Dietary Guidelines for Americans, 8th ed. (http://health.gov/dietaryguidelines/2015/guidelines/); Food and Nutrition Board, Institute of Medicine. 2002. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC: National Academies Press.

Figure 12.4 A Social-ecological Model (SEM) for Food and Physical Activity Decisions

The model shows that various factors influence food and beverage intake, physical activity patterns, and ultimately health outcomes.

- Social and cultural norms and values, including traditions, religion, lifestyle, body image, and priorities
- Sectors, including government, education, health care, and transportation systems; public health and community organizations; and business and industries related to agriculture, food and beverage, entertainment, marketing, and media
- Settings, such as home, school, worksite, and food retail
- Individual factors, such as age, sex, socioeconomic status, race /ethnicity, knowledge and skills, and food preferences



SOURCE: U.S Department of Health and Human Services and U.S. Department of Agriculture. 2015. 2015–2020 Dietary Guidelines for Americans, 8th ed. (http://health.gov/dietaryguidelines/2015/guidelines/chapter-3 /social-ecological-model/). / © svetikd/Getty Images

USDA's MyPlate

- MyPlate shows how to use the five food groups at each meal

  Balance calories: enjoy your food, but eat less; and avoid oversized portions

  Foods to increase:

  - Make half your plate fruits and vegetables
  - Make at least half your grains whole grains
  - Switch to fat-free or low-fat milk

  Foods to reduce:

  - Choose food with lower amounts of sodium
  - Drink water instead of sugary drinks

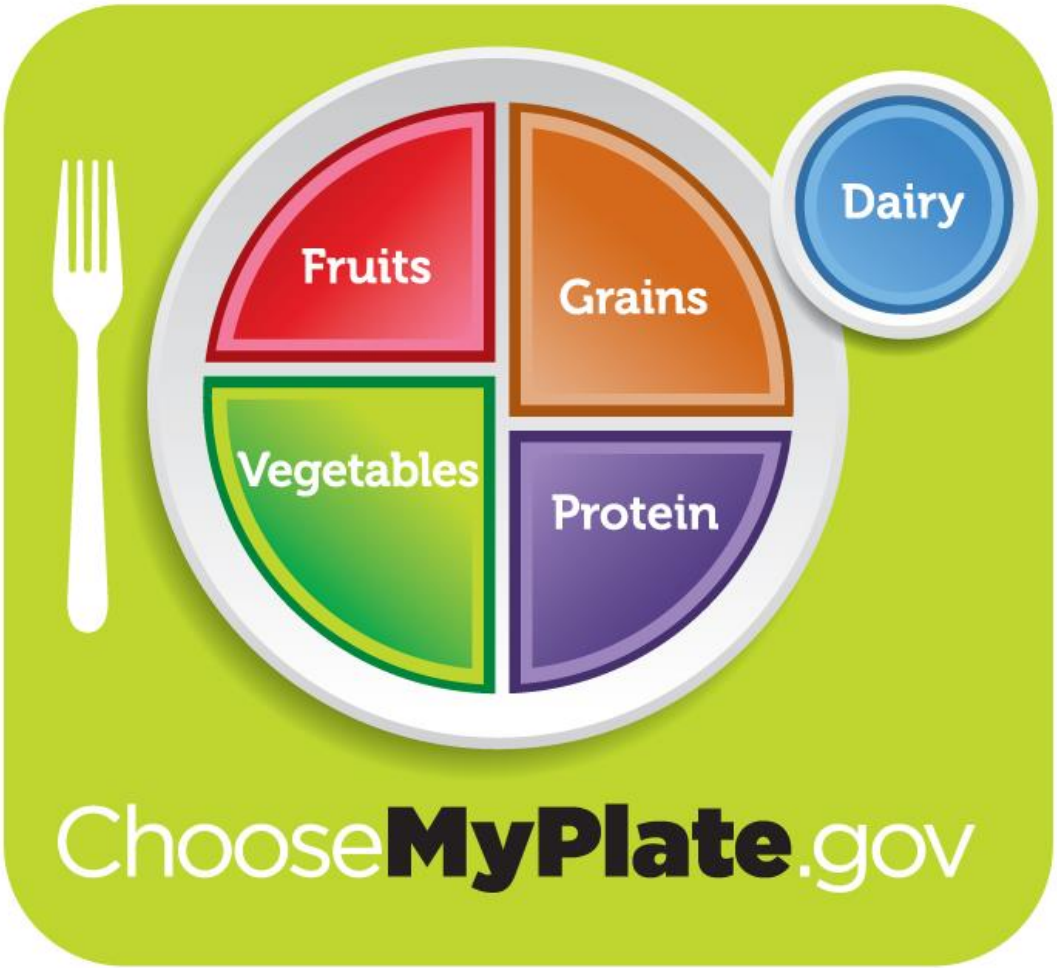


Figure 12.5 MyPlate

The USDA's MyPlate is designed as a simple graphic to help Americans apply the Dietary Guidelines to their own diets.

SOURCE: U.S. Department of Agriculture. Accessed July 2016. ChooseMyPlate (http://www.choosemyplate.gov). / © USDA

USDA's MyPlate (2)

- Energy intake and portion sizes

  Food group goals should be based on an appropriate level of energy intake

  When your weight is stable, your current energy intake is sufficient

  To lose weight, most people have to reduce the number of calories and increase physical activity

USDA's MyPlate (3)

- Focus on whole fruits

  Rich in carbohydrates, dietary fiber, and many vitamins (especially vitamin C)

  2 cups of fruit daily

  - Make half your plate fruits and vegetables
  - Choose whole fruits over fruit juices

  Serving size—1 cup equivalent

  - 1 cup fresh, canned, or frozen fruit
  - 1 cup 100% fruit juice
  - 1 small whole fruit
  - 1/2 cup dried fruit

USDA's MyPlate (4)

- Vegetables
  - Naturally low in calories and fat
  - Contain carbohydrates, dietary fiber, carotenoids, vitamin C, folate, potassium, and other nutrients
  - 2 ½ cups of vegetables a day
    - Half your plate should be fruits and vegetables
  - Serving size—1 cup equivalent
    - 1 cup cooked or raw vegetables
    - 2 cups raw leafy salad greens
    - 1 cup of vegetable juice
  - Vary your vegetable types

USDA's MyPlate (5)

- Make half your grains whole grains

  Low in fat and rich in complex carbohydrates, dietary fiber, vitamins, and minerals

  6 ounce-equivalents each day—with half from whole grains

  Serving size—1 ounce-equivalent

  - 1 slice of bread
  - 1 small muffin (2.5 diameter)
  - 1 cup of ready-to-eat cereal flakes
  - Half-cup of cooked cereal, rice, grains, or pasta
  - 1 6-inch tortilla

USDA's MyPlate (6)

- Vary your protein routine

  Meat, poultry, fish, dried beans and peas, eggs, nuts, seeds, and processed soy foods

  Provide protein, niacin, iron, vitamin B-6, zinc, and thiamin

  - Animal foods contain B-12

  5 ½ ounce-equivalents daily

  Serving size—1 ounce equivalent

  - 1 ounce cooked lean meat, poultry, fish
  - 1/4 cup cooked dry beans or tofu
  - 1 egg
  - 1 tablespoon peanut butter
  - 1/2 ounce nuts or seeds

USDA's MyPlate (7)

- Dairy: move to low-fat and fat-free

  High in protein, carbohydrate, calcium, potassium, riboflavin, and vitamin D

  3 cups of milk or the equivalent daily

  Serving size—1 cup equivalent

  - 1 cup milk or yogurt
  - 1/2 cup ricotta cheese
  - 1 ½ oz. natural cheese
  - 2 oz. processed cheese

USDA's MyPlate (8)

- Oils:

  Oils and fats that are liquid at room temperature

  – Mostly from plant and fish sources

  Major sources of vitamin E and unsaturated fatty acids, including essential fatty acids

  6 teaspoons (27g) per day

  Serving size—1 teaspoon equivalent

  – 1 teaspoon of vegetable oil or soft margarine
  – 1 tablespoon mayonnaise-type salad dressing

USDA's MyPlate (9)

- If your diet is consistently nutrient-rich, a small amount of additional calories in the form of solid fats and added sugars can be consumed
- Physical activity is important

  2 ½ hours of moderate physical activity or 1 ¼ hours of vigorous physical activity per week

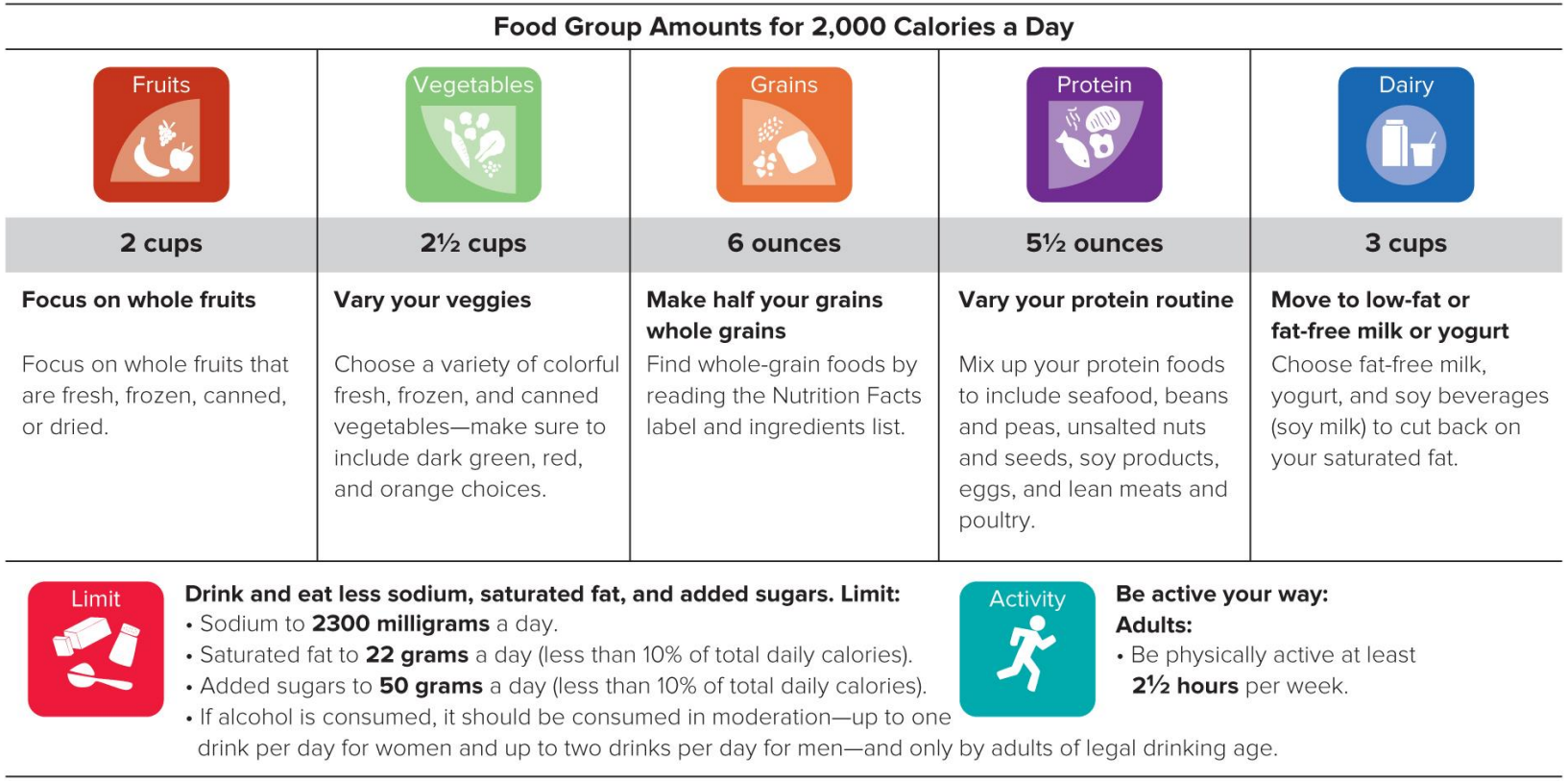


Figure 12.6 MyPlate Food Group Amounts and Recommendations for a 2000-Calorie Diet

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SOURCE: MyPlate.gov. 2016. MyPlate Daily Checklist for 2,000 Calories (http://www.choosemyplate.gov/MyPlate-Daily-Checklist).

DASH Eating Plan

- Dietary Approaches to Stop Hypertension (DASH) eating plan was developed to help people control high blood pressure
    - Tailored with special attention to sodium, potassium, and other nutrients of special concern

The Vegetarian Alternative

- Vegetarians restrict or exclude foods of animal origin
  - Vegans
  - Lacto-vegetarians
  - Lacto-ovo-vegetarians
  - Partial vegetarians
  - Semivegetarians
  - Pesco-vegetarians
- Food plan for vegetarians needs to include vitamin B-12, vitamin D, calcium, iron, and zinc

Dietary Challenges for Various Population Groups

- Children and teenagers
- College students
- Pregnant and breastfeeding women
- Older adults
- Athletes
- People with special health concerns

Global Nutrition Transitions

- Quality and quantity of our diet is changing with globalization
  - Increased availability of cheap food
  - Urbanization
  - Increased sedentary activities
- Increases in fats and sugars are implicated in cardiovascular disease, obesity, and diabetes

A Personal Plan: Making Informed Choices About Food

- Reading food labels
- Calorie labeling: restaurants and vending machines
- Dietary supplements

  Can be dangerous when taken in excess

  Not authorized or tested by the FDA

  Not a substitute for a healthy diet

  People who benefit from supplements:

  - Women capable of getting pregnant—folic acid
  - People over 50—vitamin B-12
  - Smokers—vitamin C

Table 12.9 Food Package Nutrient Claims

TERM	DEFINITION
Healthy	A food that is low in total fat, is low in saturated fat; has no more than 360–480 mg sodium and 60 mg cholesterol; and provides 10% or more of the Daily Value for vitamin A, vitamin C, protein, calcium, iron, or dietary fiber
Light or lite	33% fewer calories or 50% less fat than a similar product Reduced or fewer At least 25% less of a nutrient than a similar product; can be applied to fat (“reduced fat”), saturated fat, cholesterol, sodium, and calories
Extra or added	10% or more of the Daily Value per serving when compared to a similar product
Good source	10–19% of the Daily Value for a particular nutrient per serving
High, rich in, or excellent source of	20% or more of the Daily Value for a particular nutrient per serving
Low calorie	40 calories or less per serving
High fiber	5 grams or more of fiber per serving
Good source of fiber	2.5–4.9 grams of fiber per serving
Fat-free	Less than 0.5 gram of fat per serving
Low-fat	3 grams or less of fat per serving
Saturated- or trans-fat-free	Less than 0.5 gram of saturated fat and 0.5 gram of trans fatty acids per serving
Low saturated fat	1 gram or less of saturated fat per serving and no more than 15% of total calories
Low sodium	140 mg or less of sodium per serving
Very low sodium	35 mg or less of sodium per serving
Lean	Cooked seafood, meat, or poultry with less than 10 grams of fat, 4.5 grams or less of saturated fat, and less than 95 mg of cholesterol per serving
Extra lean	Cooked seafood, meat, or poultry with less than 5 grams of fat, 2 grams of saturated fat, and 95 mg of cholesterol per serving

SOURCE: U.S. Food and Drug Administration. 2013. Food Labeling Guide (http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm2006828.htm).

Protecting Yourself against Foodborne Illness

- Most foodborne illness is caused by pathogens
  - *Salmonella*
  - Norovirus
  - *Campylobacter jejuni*
  - *Toxoplasma*
  - *Shigella*
  - *Escherichia coli* (*E. coli*) O157:H7
  - *Listeria monocytogenes*
  - *Clostridium perfringens*
  - *Staphylococcus aureus*—most often resulting from improper hand washing

Protecting Yourself against Foodborne Illness (2)

- Preventing and treating foodborne illnesses:

  Raw foods are the most common source of foodborne illnesses

  Food safety principles:

  - Clean hands
  - Separate raw, cooked, and ready-to-eat foods while shopping, storing, and preparing foods
  - Cook foods to a safe temperature
  - Chill (refrigerate) perishable foods promptly

Environmental Contaminants

- Various minerals, antibiotics, hormones, pesticides, industrial chemicals (PCBs), metal, naturally occurring substances, and certain molds
- When these enter the food-growing environment, their effects depend on:
  - Concentration
  - Length of exposure
  - Age and health status of the person affected

Organic Foods; Fish Consumption

- Organic foods:
  - These must meet certain criteria to be USDA certified
  - Whether or not they are more healthy, they are better for the environment
- Guidelines for fish consumption:
  - Mercury contamination is a concern, especially for women who are or may become pregnant, nursing mothers, and children

Additives in Food

- Most widely used food additives are sugar, salt, and corn syrup
- Health concerns have appeared over certain additives
    - Nitrates and nitrites
    - BHA and BHT
    - Sulfites
    - Monosodium glutamate (MSG)

Functional Foods

- These are foods with added ingredients to improve health
- Examples:
  - Calcium-fortified orange juice
  - Margarine enriched with sterols and stanols
  - Enriched soy milk

Food Biotechnology

- Irradiation kills potentially harmful pathogens

  There are few irradiated foods on the market due to consumer skepticism

- Genetically modified (GM) foods

  Supporters cite improved yields, increased disease resistance, better nutritional content, lower prices, and less pesticide use

  Most Americans want to know if their food contains genetically modified organisms (GMOs)

  Foods certified as organic do not contain GM ingredients

Food Allergies and Food Intolerances

- Food allergies:

  These are a reaction of the body's immune system to a food ingredient

  90% of food allergies are due to 8 foods:

  - Cow's milk, eggs, peanuts, tree nuts, soy, wheat, fish, and shellfish

- Food intolerances:

  This problem usually lies with metabolism rather than with the immune system

Review

- List the components of a healthy diet
- Explain how to make informed choices about foods
- Put together a personal nutrition plan

Long image descriptions

APPENDIX A

Figure 12.6 MyPlate Food Group Amounts and Recommendations for a 2000-Calorie Diet Appendix

Each day:

- Focus on whole fruits: 2 cups of fruit, with a focus on whole fruits that are fresh, frozen, canned, or dried
- Vary your veggies: 2.5 cups of vegetables; choose a variety of colorful fresh, frozen, and canned vegetables, making sure to include dark green, red, and orange choices
- Make half your grains whole grains: 6 ounces of grains; find whole-grain foods by reading the Nutrition-Facts label and ingredients list
- Vary your protein routine: 5.5 ounces of protein; mix up your protein foods to include seafood, beans and peas, unsalted nuts and seeds, soy products, eggs, and lean meats and poultry
- Move to low-fat or fat-free milk or yogurt: 3 cups of dairy; choose fat-free milk, yogurt, and soy beverages (soy milk) to cut back on your saturated fat

Drink and eat less sodium, saturated fat, and added sugars

Limit:

- Sodium to 2300 milligrams per day
- Saturated fat to 22 grams a day (less than 10% of total daily calories)
- Added sugars to 50 grams a day (less than 10% of total daily calories)
- If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and up to two drinks per day for men—and only by adults of legal drinking age

Be active your way

- Adults: be physically active at least 2.5 hours per week

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