Personal Nutrition Notes

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October 16, 2024

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1 Chapter 1: What is Nutrition?

1.1 What Drives Our Food Choices?

- We need to eat and drink to obtain:
  - **Nutrients:** chemical compounds in foods to provide fuel for energy, growth, and maintenance, and to regulate body processes
    - Six classes:
      - Carbohydrates, fats, protein: provide energy in the form of **kilocalories**. (**Kilocalories = calories**)
      - Vitamins, minerals, water: help regulate many body processes, including **metabolism**
  - Food also provides nonnutrient compounds that contribute to health and may play a role in fighting chronic diseases
- We choose foods for many other reasons beyond the basic need to obtain nutrients:
  - Taste and Culture
  - Social reasons and trends
  - Cost, time, and convenience
  - Habits and emotions

1.2 What is Nutrition and Why is Good Nutrition So Important?

- **Nutrition:** the science that studies how nutrients and compounds in foods nourish and affect body functions and health
- Chronic deficiencies, excesses, and imbalances of nutrients can affect health
- Good nutrition plays a role in reducing the risk of many chronic diseases and conditions, including heart disease, cancer, and stroke

1.3 What Are the Essential Nutrients and Why Do You Need Them?

- The size classes of nutrients are all essential in the diet to maintain bodily functions
- **Macronutrients:** energy-yielding nutrients needed in higher amounts
  - Carbohydrates, lipids (fats), and proteins
- **Micronutrients:** needed in smaller amounts
  - Vitamins and minerals
- Water: copious amounts needed daily for hydration
- Carbohydrates, fats, and proteins
  - Provide energy
  - One kilocalorie equals the amount of energy needed to raise the temperature of 1 kilogram of water 1 degree Celsius
    - Carbohydrates and protein provide 4kcal/gram
    - Fats provide 9kcal/gram
  - Are **organic** compounds (contain Carbon atoms)
  - Also contain Hydrogen and Oxygen atoms
  - Proteins also contain Nitrogen atoms (unlike carbs and fats)
- Carbohydrates supply glucose, a major energy source
- Fats are another major fuel source and also:
  - Cushion organs
  - Insulate body to maintain body temperature
- Proteins can provide energy but are better suited for:
  - Growth and maintenance of muscle, tissues, organs
  - Making hormones, enzymes, healthy immune system
  - Transporting other nutrients

- To calculate the amount of energy a food provides:
  - Multiply the total grams of a nutrient by the number of calories per gram
    - 1 gram of carbohydrate or protein = 4 calories
    - 1 gram of fat = 9 calories
- Vitamins and minerals are essential for metabolism
  - Many assist **enzymes** in speeding up chemical reactions in the body
    - Example: B vitamins are coenzymes in carbohydrate and fat metabolism
  - Vitamins are organic compounds that usually have to be obtained from food
  - Minerals are inorganic substances
    - Key roles in body processes and structures
- Water is vital for many processes in your body
  - Part of fluid medium inside and outside of cells
  - Helps chemical reactions, such as those involved in energy production
  - Helps maintain body temperature
  - Key role in transporting nutrients and oxygen to cells and removing waste products
  - Lubricant for joints, eyes, mouth, intestinal tract
  - Protective cushion for organs

1.4 How Should You Get These Important Nutrients?

- The best way to meet your nutrient needs is with a well-balanced diet that includes essential nutrients from all six classes
- A well balanced diet will also include **fiber** and **phytochemicals**, which have been shown to help fight many diseases

  - **Phytochemicals**
    * Nonnutritive compounds in plants foods that may play a role in fighting chronic diseases
  - **Fiber**
    * The portion of plant foods that isn't digested in the small intestine
  - Whole grains, fruits, and vegetables are rich sources

- A supplement can be beneficical:
  - When nutrient needs are higher
    * Example: pregnant women need an iron supplement to meet increased needs
  - When diet restrictions exist
    * Example: lactose-intolerant individuals (difficulty digesting milk products) may choose a calcium supplement to help meet needs

- Well-balanced diet and supplements are not mutually exclusive; they can be partnered for good health

1.5 How Does the Average American Diet Stack Up?

- High in:
  - Added sugar, sodium, saturated fat, calories
    * Americans consume 17 teaspoons of added sugar

- Low in:
  - Vitamin D, calcium, potassium, fiber
    * Iron: women fall short

- Lack of healthy diet may also be due to where we eat - Americans currently spend 40 percent of their food budget consuming food outside the home

- Incidence of overweight and obesity is on the rise

- Adults
  - 70 percent are overweight and of those, approximately 40 percent are obese
- Children
  - 16 percent of children ages 2-19 are overweight
  - 17 percent are considered obese
- High rates of overweight and obesity
  - Obesity is ubiquitous, non-discriminatory
- Causes
  - Consume more calories than needed
  - Burn fewer calories due to sedentary lifestyles
- Effects
  - Increased rate of type 2 diabetes (especially children), heart disease, cancer, and stroke
- Improving Americans' diets is one goal of **Healthy People 2020**
  - Disease prevention and health promotion objectives for Americans to meet in the second decade of twenty-first century
  - Focuses on several overarching goals:
    * Attain high-quality, longer lives free of preventable disease, disability, injury, and premature death
    * Achieve healthy equity, eliminate disparities, and improve the health of all groups
    * Create social and physical environments that promote good health for all
    * Promote quality of life, healthy development, and healthy behaviors across every stage of life

1.6 Poor, Obese, and Malnourished: A Troubling Paradox

- Americans living near or below the poverty level have much higher rates of obesity than affluent Americans
- Children who are food insecure are more likely to be deficient in iron, have colds and headaches, have delayed cognitive development, and be at risk for behavioral problems
- Some factors that lead to obesity:
  - Inconsistent meal patterns
  - Household stress
  - Limited access to supermarkets
  - Convenience stores and fast-food restaurants

1.7 What's the Real Deal When It Comes to Nutrition Research and Advice

- Newspaper headlines and television news items that report results of a single research study can be misleading
- In contrast, advice from authoritative health and nutrition organizations is based on:
  - **Consensus:** the opinion of a group of experts based on collective information

1.8 How Can I Evaluate Nutrition News?

- Before making dietary and lifestyle changes based on media reports, read with a critical eye and ask:
  - Was the research finding published in a peer-reviewed journal?
  - Was the study done using animals or humans?
  - Do the study participants resemble me?
  - Is this the first time I've heard about this?

- Wait until research findings are confirmed and consensus is reached by reputable health organizations before making changes

1.9 Sound Nutrition Research Begins with the Scientific Method

- **Scientific Method:** process used by scientists to generate sound research findings

    1. Observe, ask questions, and formulate a **hypothesis** (idea based on observation)
    2. Conduct an experiment to test the hypothesis
    3. Share findings in a **peer-reviewed journal** (research publication for scientists)

1.10 Research Studies and Experiments Confirm Hypotheses

- **Observational research:** involves looking at factors in two or more groups of subjects to see if there is a relationship to certain health outcomes
    - **Epidemiological research:** study of populations of people
        - Example: Relationship of sun exposure and incidence of rickets in Norway compared with Australia
            - May be due to other unidentified diet or lifestyle factors
- **Experimental research:** involves at least two groups of subjects
    - **Experimental group:** given a specific treatment
    - **Control group:** given a placebo ("sugar pill")
    - Double-blind placebo-controlled experiments is "gold standard"
        - Neither scientists nor subjects know which group is receiving which treatment
        - All variables held the same and controlled for both groups

1.11 What is Nutritional Genomics?

- Genes determine your inherited, specific traits
  - With the completion of the **Human Genome Project**, the complete sequencing of **deoxyribonucleic acid (DNA)** in your cells is now known.
  - Your DNA contains the genetic instructions for making proteins that direct activities in the body
- **Nutritional genomics:** a field of study that researches the relationship between nutrition and genomics (the study of genes and **gene expression**)
  - Example: certain dietary components in foods can cause a different response in another person

1.12 You Can Trust the Advice of Nutrition Experts

- **Registered dietitian nutritionist (RDN):** completed at least a bachelor's degree at an accredited U.S. college or university and a supervised practice, and passed a national exam administered by the Academy of Nutrition and Dietetics
  - They have an understanding of **medical nutrition therapy**, which is an integration of nutrition counseling and dietary changes based on an individual's medical history and current health needs to improve that person's health.
- **Public health nutritionist:** has a degree in nutrition but is not an RDN (if s/he didn't cokplete supervised practice, s/he is not eligible to take the AND exam)
- **Licensed dietitian nutritionist(LDN):** licensed by state licensing agencies
- Be wary of anyone who calls him/herself a **nutritionist**, as this is a generic term, which means s/he may have taken few or no accredited courses in nutrition

1.13 You Can Obtain Accurate Nutrition Information on the Internet

- National Institutes of Health (NIH) 10 questions to consider when viewing a health-related website:

    1. Who runs the site?
    2. Who pays for the site?
    3. What is the purpose of the site?
    4. Where does the information come from?
    5. What is the basis of the information?
    6. Is the information reviewed by experts?
    7. How current is the information?
    8. How does the site choose links to other sites?
    9. How does the site collect and handle personal information? Is the site secure?
    10. Can you communicate with the owner of the website?
    11. Is it safe to link to Twitter or Facebook through a website?

1.14 Nutrion in the Real World: Don't Be Scammed!

- Beware of health quackery and fraud
    - To avoid falling for scams, watch for "red falgs" that try to convince you that:
        * There is a quick fix for what ails you
        * Their product causes miraculous cures
        * One product does it all
        * You can lose weight in a short amount of time without dieting or exercise
        * Other folks are claiming that the product worked for them
- The FDA's health fraud website helps consumers identify scams and fraud (https://www.consumer.ftc.gov/scams)

2 Chapter 2: Tools for Healthy Eating

2.1 What is Healthy Eating and What Tools Can Help?

- Key principles of healthy eating:
  - Balance
  - Variety
  - Moderation
- **Undernutrition:** not meeting nutrient needs
- **Overnutrition:** excess nutrients and/or calories in diet
- **Malnourished:** long-term outcome of consuming a diet that doesn't meet nutrient needs
  - Can result fromm both under and over nutrition
- Tools to help avoid under and over nutrition
  1. Dietary Reference Intakes (DRIs)
     - Nutrient recommendations
  2. **Dietary Guidelines for Americans**
     - General dietary and lifestyle advice
  3. MyPlate
     - Food recommendations based on DRIs and the advice from the **Dietary Guidelines**
  - **Nutrition Facts Panel** on food labels
    - Contain Daily Values which can help you decide which foods to buy

2.2 What Are the Dietary Reference Intakes?

- DRIs tell you how much of each nutrient you need to consume to:
  - Maintain good health

  - Prevent chronic diseases
  - Avoid unhealthy excesses
- Issued by U.S. National Academy of Sciences' Institute of Medicine
- Updated periodically based on latest scientific research

2.3 DRIs Encompass Several Reference Values

- **Estimated Average Requirement (EAR)**
  - Average amount of a nutrient known to meet the needs of **50 percent of individuals** of same age and gender
  - Starting point for determining the other values
- **Recommended Dietary Allowance (RDA)**
  - Based on the EAR, but set higher
  - Average amount of a nutrient that meets the needs of **nearly all individuals (97 to 98 percent)**
- **Adequate Intake (AI)**
  - Used if scientific data to determine EAR and RDA are insufficient
  - Next best estimate of amount of nutrients needed to maintain good health
- **Tolerable Upper Intake Level (UL)**
  - Highest amount of nutrient that is unlikely to cause harm if consumed daily
  - Consuming amount higher than the UL daily may cause **toxicity**
- **Acceptable Macronutrient Distribution Range (AMDR)**
  - Recommended range of intake for energy-containing nutrients
    * Carbohydrates: 45 to 65 percent of daily caloric intake
    * Fat: 20 to 35 percent of daily caloric intake
    * Proteins: 10 to 35 percent of daily caloric intake

- **Estimated Energy Requirement (EER)**
  - Amount of daily energy needed to maintain healthy body weight and meet energy needs
  - Different approach than RDAs or AIs
  - Takes into account age, gender, height, weight, and activity level

2.4 Table 2.1 How Many Calories Do You Need Daily? TODO

2.5 How to Use the DRIs

- To plan a quality diet and make healthy food choices
  - Goal:
    * Meet the RDA or AI for all nutrients
    * Do not exceed the UL
    * Consume the energy-yielding nutrients within the ranges of the AMDR

2.6 What Are the Dietary Guidelines for Americans

- **The Dietary Guidelines for Americans reflect the most current** nutrition and physical activity recommendations.
  - Set by the USDA and Department of Health and Human Services
  - Updated every five years
  - Allow healthy individuals over the age of 2 to maintain good health and prevent chronic disease

2.7 Dietary Guidelines for Americans at a Glance

- Five overarching guidelines
  1. Follow a healthy eating pattern across the lifespan
     - An eating pattern is the combination of foods and beverages that constitutes an individual's complete dietary intake over time

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

2.8 What Are MyPlate and myplate.gov

- **MyPlate** is the most recent food guidance system for Americans, released by the USDA in 2011
  - Part of Web-based initiative, https://www.myplate.gov
  - Shows variety of food groups
- Food **guidance systems:** visual diagrams providing variety of food recommendations to help create a well-balanced diet
  - Many countries create these based on their food supply, cultural food preferences, and the nutritional needs of their population

2.9 MyPlate Emphasizes Changes in Diet, Eating Behaviors, and Phyiscal Activity

- Promotes the concept of meal planning, healthful choices, proportionality, and moderation when planning a healthful diet
- **Proportionality:** the relationship of one entity to another
  - Shown by the five food groups and choices should be nutrient-dense
  - Half your plate should be vegetables and fruits
  - Smaller portion for grains (preferably whole grains)
  - Lean protein foods
  - Fat-free and low-fat dairy foods
- **Nutrient density** refers to the amount of nutrients a food contains in relationship to the number of calories it contains

  - Provide more nutrients per calorie
    * More nutrients per bite
  - Little solid fats and added sugars

- **Energy density** refers to foods that are high in energy (calories) but low in weight or volume; more calories per gram
  - Example: a potato chip is energy dense, while a baked potato is nutrient dense
    * Processing removes Potassium and adds Sodium

2.10 Table 2.3 How Much Should You Eat from Each Food Group TODO

- **Grains:** Includes all foods made with wheat, rice, oats, cornmeal, or barley, such as bread, pasta, oatmeal, breakfast cereals, tortillas, and grits. In general, 1 slice of bread, 1 cup of ready-to-eat-cereal, or 1/2 cup of cooked rice, pasta, or cooked cereal is considered 1 ounce equivalent(oz eq) from the grains group. **At least half of all grains consumed should be whole grains such as whole-wheat bread, oats, or brown rice.**

- **Protein:** In general, 1 ounce of lean meat, poultry, or fish, 1 egg, 1 tablespoon peanut butter, 1/4 cup cooked dry beans, or 1/2 ounce of nuts or seeds is considered 1 ounce equivalent (oz eq) from the protein foods group.

- **Dairy:** Includes all fat-free and low-fat milk, yogurt, and cheese. In general, 1 cup of milk or yogurt 1.5 ounces of natural cheese, or 2 ounces of processed cheese is considered 1 cup from the dairy group.

- **Oil:** Includes vegetable oils such as canola, corn, olive, soybean, and sunflower oil, fatty fish, nuts, avocados, mayonnaise, salad dressings made with oils, and soft margarine. (Oils are not considered a food group but should be added to your diet for good health)

2.11 Nutrition in the real World: When a Portion Isn't a Portion

- A **portion** is the amount of food eaten in one sitting
- The FDA defines **serving size** as a standard amount of food that is customarily consumed
  - Standardizing allows for consistency and helps consumer get a ballpark idea of what a typical serving should be
- The restaurant industry has appealed to your desire to get the most food for your money by expanding restaurant portion sizes, especially of inexpensive foods, such as fast foods

2.12 Examining the Evidence: Does the Time of Day You Eat Impact Your Health?

- Eating breakfast means more energy and fewer calories throughout the day
  - Skipping breakfast may reduce nutrient quality of your diet
- Snacking associated with consumption of excess calories and obesity
- Eating more during evenings and weekends can lead to overconsumption of calories
- Recommendations:
  - Start your day with nutrient-rich breakfast
  - Choose breakfast foods that are satisfying and improve appetite control throughout the day
  - Control calorie intake on nights and weekends

2.13 What Is a Food Label and Why Is It Important?

- The food label tells you what's in the package
  - To help consumers make informed food choices

- Food and Drug Administration (FDA) mandates that every packaged food be labeled with:
  - Name of the food
  - Net weight
  - Name and address of manufacturer or distributor
  - List of ingridients in descending order by weight
  - **Nutrition Facts Panel**
- The **Nutrition Facts Label** must also contain:
  - Serving sizes that are uniform among similar products
  - How a serving of food fits into an overall daily diet
  - Uniform definitions for descriptive label's terms such as "fat-free" and "light"
  - Health claims that are accurate and science-based
  - Presence of any of the eight common allergens
- Food exempt from nutrition labeling:
  - Plain coffee/tea, spices, flavorings, bakery foods, ready-to-eat foods prepared and sold in restaurants or produced by small businesses
- The food label can help you make healthy food choices
- **Nutrition Facts Panel:** area on food label that provides uniform listing of specific nutrients obtained in one serving
  - Calories
  - Total fat, saturated fat, and **trans** fat
  - Cholesterol
  - Sodium
  - Total carbohydrate, dietary fiber, and added sugars
  - Protein
  - Vitamin D, Calcium, Iron, and Potassium

- **Daily Values (DVs):** established reference levels of nutrients, based on 2,000-calorie diet, listed on the food label
  - Given as percentages
  - High: 20 percent or more of the DV
  - Low: 5 percent or less of the DV
- There are no DVs listed on the label for **trans** fat, total sugars, and protein
- Three types of label claims:
  1. **Nutrient Content Claims:** describe the level or amount of a nutrient in food product
  2. **Health Claims:** describe a relationship between a food or dietary compound and a disease or health-related condition
     - Example: Soluble fiber that naturally occurs in oats has been shown to lower blood cholesterol levels, which can help reduce the risk of heart disease.
  3. **Structure/function Claims:** describe how a nutrient or dietary compound affects the structure or function of the human body

2.14 Functional Foods: What Role Do They Play in Your Diet?

- **Functional Foods:** have a positive effect on health beyond providing basic nutrients
  - Example: broccoli contains beta-carotene, a plant chemical called a **phytochemical**, that protects cells from damaging substances that increase risk of chronic diseases (heart disease, cancer)
  - **Zoochemicals:** compounds in animal food products that benefit health
    - Example: omega-3 fatty acids in fatty fish
  - Manufacturers also fortify food products with phytochemicals or zoochemicals

- Global market of functional food will reach 255 billion dollars by 2024
  - Health Connection: Functional Foods and Cholesterol
- Benefits of functional foods:
  - Economical way for health professionals to treat chronic disease
    - Example: cholesterol-lowering oats and/or plant sterols may be preferable to drugs
- Concerns with functional foods:
  - Confusion over claims
  - Excess consumption may cause problems
- How to use functional foods:
  - Consume narturally occurring phytochemicals and zoochemicals
  - Don't overconsume packaged functional foods
  - Get advice from a registered dietitian nutritionist (RDN)

3 Chapter 3: The Basics of Digestion

3.1 What is Digestion and Why Is It Important?

- **Digestive process:** a multi-step process of breaking down foods into absorbable components using mechanical and chemical means in the **gastrointestinal (GI) tract**
- The GI tract is 30 feet long and the cells lining it function for 3-5 days, then shed into the **lumen** (interior of the intestinal tract).
- Gastrointestinal tract consists of:
  - Mouth
  - Esophagus
  - Stomach
  - Small and large intestines

  - Accessory organs: pancreas, liver, gallbladder

- Main roles of the GI tract are to:
  - Break down food into smallest components
  - Absorb nutrients
  - Prevent microorganisms or other harmful compounds in food from entering tissues of the body

3.2 Digest Is Mechanical and Chemical

- **Mechanical digestion:** chewing, grinding food to aid swallowing
- **Chemical digestion:** digestive juices and enzymes break down food into absorbable nutrients
  - **Peristalsis:** the forward, rhythmic motion that moves chyme through digestive system
  - **Segmentation:** ("sloshing motion") mixes chyme with chemical secretions; increases time food comes into contact with intestinal walls
  - **Pendular movement:** (constructive wave) enhances nutrient absorption in small intestine
- **Peristalsis** helps mix food with digestive secretions and propels the mixture, called a **bolus**, from the esophagus through the large intestine.
- The three types of mechanical digestion move partially-digested, semi-liquid food mass, called chyme, at a rate of 1cm per minute.
- Total contact time in small intestine: 3 to 6 hours, depending on amount and type of food

3.3 Nutrition in the Real World: Tinkering with your Body's Digestive Process

- Many people consider using weight loss aids
- Alli is a popular aid in drugstores

- First FDA-approved, over-the-counter drug containing orlistat
- Blocks the absorption of about 25 percent of the fat in a meal by preventing lipase enzyme from breaking down dietary fat
- Can experience unpleasant side effects - bathroom urgency, fatty/oily stools, frequent bowel movements
  - Symptoms are less present with lower fat meals
- Need for vitamin supplement with the fat-soluble vitamins A,D,E,K and the antioxidant beta-carotene

3.4 What Are the Organs of the GI Tract and Why Are They Important?

- Both mechanical and chemical digestion begin in the mouth
  - **Saliva** released: contains wayer, electrolytes, **mucus**, and a few enzymes
    - Softens, lubricates, dissolves food particles
  - **Bolus** (food mass) moves into pharynx, is swallowed, and enters the esophagus
  - **Epiglottis** closes off trachea during swallowing to prevent food from lodging in the windpipe
- Once swalloed, a bolus is pushed down the **esophagus** by **peristalsis** into the stomach
- **Gastoesophageal sphincter** (lower esophageal sphincter (LES)): bottom of esophagus narrows and relaxes to allow food into stomach
- The gastoesophageal sphincter then closes to prevent backflow of **hydroclhoric acid (HCL)** from **stomach**
  - Gastoesophageal reflux disease (GERD) is "reflux" of stomach acid that causes "heartburn" (irritation of esophagus lining)

3.5 The Stomach Stores, Mixes, and Prepares Food for Digestion

- The **stomach** is a muscular organ that continues mechanical digestions by churning and contracting to mix food with digestive juices for several hours
- **Stomach** produces powerful digestive secretions:
  - **HCl:** activates enzyme **pepsin**, enhances absorption of minerals, breaks down connective tissue of meat
    - Mucus protects stomach lining from damage
  - Digestive enzymes, intrinsic factor (for vitamin B12 absorption), stomach hormone **gastrin**
- **Bolus** becomes **chyme**, semiliquid substance of partially digested food and digestive juices
- **Gastrin:** hormone stimulates digestive activities and increases gastric motility and emptying
- Liquids, carbohydrates, low-fiber, and low-calorie foods exit stomach faster
- High-fiber, high-fat, and high-protein foods exit slower, keep you feeling full longer
- **Pyloric sphincter:** located between the stomach and small intestine; allows about 1tsp of chyme to enter the small intestine every 30 seconds
  - Prevents backflow of intestinal contents

3.6 Most Digestion and Absorption Occurs in the Small Intestine

- **Small intestine:** long, narrow, coiled
  - Three segments:
    1. Duodenum (shortest segment)
    2. Jejunum

3. Ileum (longest segment)

- In total the small intestine accounts for about 20 feet of the GI tract
- Interior surface area tremendously increased by **villi, microvilli**, circular folds

3.7 Large Intestine Eliminates Waste and Absorbs Water and Some Nutrients

- **Ileocecal sphincter:** prevents backflow of fecal matter into ileum as chyme enters the **large intestine**
- Most nutrients in chyme have been absorbed when it reaches large intestine
- **Large intestine** has three sections: cecum, colon, rectum
  - About 5 feet long, 2.5 inches in diameter (twice the diameter of the small intestine)
  - Absorbs water and electrolytes
  - No digestive enzymes; chemical digestion done by bacteria
- Intestinal matter passes through colon in 12 to 24 hours depending on age, health, diet, fiber intake
  - Bacteria in colon produce vitamin K and biotin and break down fiber and undigested carbohydrates, producing methane, carbon dioxide, hydrogen gas, and other compounds
- **Stool** or **feces**, is stored in the **rectum**
- **Anus** is connected to the rectum and controlled by two sphincters: internal and external
  - Final stage of defecation is under voluntary control
    - Influenced by age, diet, prescription medicines, health, and abdominal muscle tone

3.8 The Liver, Gallbladder, and Pancreas Are Accessory Organs

- **Liver:** largest internal organ of the body
  - Produces bile needed for fat digestion
  - Metabolism of carbohydrates, fats, and protein
  - Stores nutrients: vitamins A, D, B12, E; copper; iron; gylocogen (glucose storage form)
  - Detoxifies alcohol
- **Gallbladder:** concentrates and stores bile
  - Released into GI tract when fat is ingested
- **Pancreas**
  - Produces hormones: insulin and glucagon regulate blood glucose
  - Produces and secretes digestive enzymes and bicarbonate
    - Bicarbonate neutralizes acidic chyme, protects enzymes from inactivation by acid

3.9 How Do Hormones, Enzymes, and Bile Aid Digestion?

- **Hormones** are released from endocrine glands throughout the lining of the stomach and small intestine and regulate digestion
- They control digestive secretions and regulate **enzymes** and cellular activity
- **Enzymes** are substances that produce chemical changes or catalyze chemical reactions
- Gastrin stimulates stomach to release HCl and enzyme **gastric lipase**
- **Ghrelin** stimulates hunger
- Secretin causes pancreas to release **bicarbonate** to neutralize HCl

- **Cholecystokinin** stimulates pancreas to secrete digestive enzymes, controls pace of digestion
- **Enzymes** drive process of digestion
  - Speed up chemical reactions that break down food into absorbably nutrient components
  - Secreted by salivary glands, stomach, pancreas, and small intestine
  - Enzymes from pancreas are responsible for large portion of digested nutrients
    - **Amylase:** digests carbohydrates
    - **Lipase:** digests fats
    - **Trypsin, chymotrypsin, and carboxypeptidase:** digest protein
- **Bile** helps digest fat
  - Yellowish-green substance made in liver and stored in gallbladder
  - Breaks down large fat globules into smaller fat droplets
  - Can be reused by recycling through liver
    - Bile is recycled back to the liver from the large intestine through **enterohepatic** (**entero** = intestine, **hapatic** = liver) **circulation**

3.10 How Are Digested Nutrients Absorbed?

- After digestion, nutrients that have completely broken down are absorbed and move into the tissues
- **Absorption** of nutrients through the walls of the intestines go into the body's two transport systems:
  1. Circulatory system (blood)
  2. Lumphatic system
- Sent to the liver for processing before delivery to the body's cells

- GI tract is highly efficient: 92 to 97 percent of nutrients from food are digested and absorbed
- Nutrients absorbed by three methods:
    1. **Passive diffusion:** nutrients pass through the cell membrane due to concentration gradient
        - When concentration in GI tract exceeds that of intestinal cell, nutrient is forced across cell membrane
    2. **Facilitated diffusion:** similar to passive method, but requires specialized protein to carry nutrients
    3. **Active transport:** differs from other two methods
        - Nutrients absorbed from low to high concentration, requiring both carrier and energy

3.11 What Happens to Nutrients After They Are Absorbed?

- Circulatory system distributes nutrients through your blood
    - Water-soluble nutrients
- Lymphatic system distributes some nutrients through your lymph vessels
    - Fat-soluble nutrients
- Your body can store some surplus nutrients
- Excretory system passes waste out of the body

3.12 What Other Body Systems Affect Your Use of Nutrients?

- Nervous system stimulates your appetite
    - Hormone ghrelin signals your brain to eat

- Endocrine system releases hormones that help regulate the use of absorbed nutrients
  - Insulin and glucagon help regulate blood levels of glucose

3.13 What Are Some Common Digestive Disorders?

- Disorders of the mouth and esophagus:
  - Gingivitis and periodontal disease
- Swallowing problems
  - Dysphagia: difficulty swallowing
- Esophageal problems
  - Heartburn (acid reflux) may be caused by weak lower esophageal sphincter (LES)
    - Chronic heartburn can be a symptom of **gastroesophageal disease (GERD)**
    - Certain foods and behaviors (smoking, drinking alcohol, reclining after eating, large evening meals) may worsen condition
- Disorders of the stomach:
  - **Gastroenteritis:** stomach flu, caused by virus or bacteria
  - **Peptic ulcers:** sore or erosion caused by drugs, alcohol, or bacteria
- Gallbladder disease:
  - **Gallstones:** small, hard, crystalline, structures
    - May require surgery
- Disorders of the intestines:
  - **Flatulence:** release of intestinal gas from the rectum
  - **Constipation** and **diarrhea**

        * **Constipation** often due to insufficient fiber or water intake
        * **Diarrhea** causes loss of fluids and electrolytes; serious if lasting for extended period
    - **Hemorrhoids:** swelling and inflammation in veins of rectum and anus

- More serious intestinal disorders:
    - **Irritable Bowel Syndrome (IBS):** functional disorder involving changes in colon rhythm
    - **Celiac disease:** autoimmune, genetic disorder related to gluten consumption
    - **Colon cancer:** one of the leading forms of cancer, but curable if detected early

4 Chapter 4: Carbohydrates - Sugars, Starches, and Fiber

4.1 What Are Carbohydrates and Why Do You Need Them?

- Found primarily in plant-based foods
    - Grains, vegetables, fruits, nuts, legumes
    - Carbohydrate-based foods are staples in numerous cultures around the world
- Most desirable form of energy for body
    - **Glucose**
    - Brain and red blood cells especially rely on glucose for fuel source
- Plants convert the sun's energy into glucose by **photosynthesis**
- During **photosynthesis**, plants use the chlorophyll in their leaves to absorb the energy in sunlight.
- **Glucose** is the most abundant carbohydrate in nature

  - Used as energy by plants or combined with minerals from soil to make other compounds, such as protein and vitamins
  - Glucose units are linked together and stored in form of starch

- Two categories, simple and complex, based on number of units joined together

- **Simple carbohydrates** contain one or two sugar units: **monosaccharides** and **disaccharides**

  - There are three **monosaccharides: glucose, fructose, galactose**
  - There are three **disaccharides:** two monosaccharides joined together
    1. **Maltose** = glucose + glucose
    2. **Sucrose** (table sugar) = glucose + fructose
    3. **Lactose** (milk sugar) = glucose + galactose

- Complex carbohydrates: **polysaccharides**

  - Long chains and branches of sugars linked together
  - Starch, fiber, and glycogen

- **Starch** is the storage form in plants

  - Amylose: straight chains of glucose units
  - Amylopectin: branched chains of glucose units

- **Fiber** is a nondigestible polysaccharide

  - Examples: cellulose, hemicellulose, lignins, gums, pectin
  - Humans lack digestive enzyme needed to break down fiber
  - **Dietary fiber:** naturally found in foods
  - **Functional fiber:** added to food for beneficial effect
    * Example: psyllium added to cereals
  - Total fiber = dietary fiber + functional fiber

- Fiber is also sometimes classified by its affinity for water

  - **Soluble fiber:** dissolves in water and is fermented by intestinal bacteria
    * Many are viscous, have thickening properties
    * Move more slowly through GI tract
    * Examples: pectin in fruits and vegetables, beta-glucan in oats and barley, gums in legumes, psyllium
  - **Insoluble fiber:** cellulose, hemicellulose, lignins
    * Moves more rapidly through GI tract, laxative effect
    * Examples: bran of whole grains, seeds, fruits, vegetables

- **Glycogen** is the storage form of glucose in animals
  - Branched glucose similar to amylopectin
  - Stored in liver and muscle cells
    * Only limited amounts
  - Glycogen stored in animals breaks down when the animal dies, so these carbohydrates are not accessible for humans

4.2 What Happens to the Carbohydrates You Eat?

- You digest carbohydrates in your mouth and intestines
  - Saliva contains amylase enzyme, which starts breaking down amylose and amylopectin into smaller starch units and maltose
  - In small intestine, pancreatic amylase breaks down remaining starch into maltose
  - Maltose and other disaccharides are broken down to monosaccharides and absorbed into blood
  - Fiber continues to the large intestine, where some is metabolized by bacteria in the colon and the majority elminiated in your stool

4.3 What Is Lactose Maldigestion and Lactose Intolerance?

- **Lactose:** principal carbohydrate (disaccharide) found in dairy products

  - People with a deficiency of the enzyme **lactase** cannot digest lactose properly
  - **Lactose malabsorption** is natural part of aging
    * People with lactose malabsorption can still consume dairy and should not eliminate it from their diets.
  - **Lactose intolerance:** when lactose maldigestion results in nausea, cramps, bloating, diarrhea, and flatulence within two hours of eating or drinking foods containing lactose

- Tips for tolerating lactose:

  1. Gradually add dairy products to your diet
  2. Eat smaller amounts throughout day rather than large amount at one time
  3. Eat dairy foods with a meal or snack
  4. Try reduced-lactose milk and dairy products
  5. Consume lactase pills with lactose-laden meals or snacks

4.4 How Does Your Body Use Carbohydrates?

- Glucose supplies energy to the body
- **Hormones** regulate the amount of glucose in your blood
- The hormone **insulin** is released from the pancreas and regulates glucose in your blood
- Insulin is released by the pancreas in response to rising blood glucose levels after a meal that contains carbohydrates
  - Directs conversion of glucose in excess of immediate energy needs into glycogen (**glycogenesis**) in liver and muslce cells (limited capacity)
  - Rest of excess glucose converted to fat

4.5 Carbohydrates Fuel Your Body between Meals

- When blood glucose beings to drop, pancreas releases the hormone **glucagon** to raise blood glucose levels
  - Directs release of glucose from stored glycogen in liver = **glycogenolysis**
  - Signals liver to start **gluconeogenesis** = making glucose from noncarbohydrate sources, mostly protein
- Your body will also break down fat stores to provide energy for your tissues
- Epinephrine (adrenaline) also stimulates glycogenolysis and increases blood glucose levels
  - "Fight-or-flight" hormone: stress, bleeding, low blood glucose levels trigger its release

4.6 Carbohydrates Fuel Your Body during Fasting and Prevent Ketosis

- Liver glycogen stores depleted after about 18 hours
- Without glucose, fat can't be broken down completely and acidic **ketone bodies** are produced
  - **Ketosis:** elevated ketone levels after fasting about two days
  - Protein from muscle and organs broken down to make glucose
    - Brain switches to using ketone bodies for fuel to spare protein-rich tissues
    - If fasting continues, protein reserves are depleted and death occurs

4.7 How Much Carbohydrates Do You Need and What Are the Best Food Sources?

- Minimum amount of carbohydrates needed daily

  - DRI: 130 grams per day for brain function
  - Consume diet with low to moderate amounts of simple carbohydrates and higher amounts of fiber and other complex carbohydrates
  - Choose carbohydrates from a variety of nutrient dense, low saturated fat foods

- Whole grains can help meet starch and fiber needs
  - Select whole-grain breads and cereals that have at least 2-3 grams of total fiber per serving
- Fruits and vegetables provide surgars, starch, and fiber
- Legumes, nuts, and seeds are excellent sources of carbohydrates and fiber
- Low-fat and fat-free dairy products provide some simple sugars
- Be careful when selecting packaged foods
  - Can be good sources of carbohydrates, but may also have added sugar, salt, fat, and calories

4.8 How Much Fiber Do You Need and What Are Its Food Sources

- Filling up on fiber
  - DRI: 14 grams of fiber per 1,000 calories to promote heart health
    - Most Americans fall short: about 15 grams per day
  - Gradually increasing fiber in your diet will minimize side effects, such as flatulence
    - As you add fiber to your diet, you should also drink more fluids

4.9 Nutrition in the Real World: Grains, Glorious Whole Grains

- Grains: important staple and source of nutrition
  - Three edible parts: **bran, endosperm, germ**
  - **Refined grains:** milling removes bran and germ
    - Some B vitamins, iron, phytochemicals, and dietary fiber lost as a result
    - Examples: wheat or white bread, white rice
  - **Enriched grains:** folic acid, thiamin, niacin, riboflavin, and iron added to restore some of the lost nutrition
  - **Whole-grain** foods contain all three parts of kernel
    - Examples: brown rice, oatmeal, whole-wheat bread
      - Dark bread is not necessarily whole-grain bread

4.10 What's the Difference between Natural and Added Sugars?

- **Naturally occurring sugars** are found in fruits and dairy
  - Usually more nutrient dense; provide more nutrition per bite
- **Added sugars** are added by manufacturers and are often empty calories (calories that provide little nutrition)
  - Examples: soda, candy
- Taste buds can't distinguish between naturally occurring and added sugars
- Yearly consumption of added sugars has increased since 1970

4.11 Processed Foods and Sweets Often Contain Added Sugars

- Sugar does not cause hyperactivity in kids

- Too much sugar can contribute to dental caries, but so can any type of carbohydrate
- Too much sugar in the diet can raise "bad" LDL cholesterol and triglycerides
- Added sugars have more empty calories and few nutrients and may lead to weight gain
- Eating too much added sugar may increase the risk of diabetes
  - Moderation, balance, and staying within daily calorie needs are essential when it comes to added sugars
- Finding the added sugars in your foods:
  - Sugars on food labels appear under many different names
    - Honey and fructose are not nutritionally superior to sucrose
      - Honey should not be given to children younger than one year of age in order to prevent **Clostridium botulinum** spores that cause botulism
    - High-fructose corn syrup (HFCS) is less expensive than sucrose and has replaced sweets and soft drinks
  - Naturally occurring sugars are not distinguished from added sugars on the Nutrition Facts panel

4.12 Nutrition in the Real World: Avoiding a Trip to the Dentist

- Carbohydrates play a role in dental caries
  - Fermentable sugars and starch feed bacteria coating teeth, producing acid to erode tooth enamel and case
  - **Early childhood tooth decay** (baby bottle tooth decay)
- To minimize tooth decay:
  - Eat three balanced meals daily

  - Keep sncaking to a minimum, choosing whole fruits and raw vegetables
  - Include foods that fight dental caries: cheese, sugarless gum
    * Cheese is rich in protein, calcium, phosphorus, can assist in **remineralization** of your teeth.
  - Regular dental care and good dental hygiene
  - Drink water and avoid sugar-sweetened beverages

4.13 How Much Added Sugar Is Too Much?

- Latest conclusions from the report of the 2105 **Dietary Guidelines for Americans:**
  - 10 percent or less of your total daily calories should come from added sugars
- The American Heart Association has recommended:
  - Women should consume no more than 100 calories (6tsp) of added sugar daily
  - Men should consume no more than 150 calories (9tsp) of added sugar daily
- American adults currently consume 73 grams of added sugar daily (about 17tsp)

4.14 Examining the Evidence: Do Sugar-Sweetened Beverages Cause Obesity?

- Every day 50 percent of Americans consume some form of sugary drinks equivalent to about one 12-ounce soda.
- Major theories on relationship between sugar-sweetened drink consumption and weight gain
  - Additional calories leads to excess overall calorie intake
  - Sugar in liquid form increases our appetite

- Bottomline: There is not yet enough evidence to say that sugar sweetened beverages alone contribute more to obesity than other calorie sources

4.15 Why is Diabetes a Growing Epidemic?

- **Diabetes mellitus:** individual has high blood glucose levels due to insufficient insulin or insulin resistance
  - **Insulin resistance:** Glucose can't enter cells because the cells do not respond to insulin
    - Without glucose, acidic ketone bodies build up, causing life-threatening diabetic ketoacidosis: if untreated can result in coma, death
- **Type 1 diabetes:** an autoimmune disease that usually begins in childhood or early adult years
  - 5 to 10 percent of diabetes cases
  - Autoimmune disease: insulin-producing cells in pancreas destroyed; insulin injections required
- **Type 2 diabetes:** seen in people who have become insulin resistant
  - 90 to 95 percent of diabetes cases
  - Cells are resistant to insulin; eventually insulin-producing cells are exhausted and medication and/or insulin is required
  - People 45 and older or at risk for diabetes should be tested
- **Prediabetes:** may be precursor to type 2
  - Blood glucose higher than normal but not yet high enough to be classified as diabetes
  - Heart disease and stroke can occur
- What effects does diabetes have on your body?
  - High levels of glucose in your blood can result in long-term damage
    - High blood glucose levels damage vital organs

            - Nerve damage, numbness, poor circulation leading to infections and leg and foot amputations
            - Eye damage, blindness
            - Tooth and gum problems
            - Kidney damage
            - Increased risk of heart disease
            - Diabetic **ketoacidosis**

- Low blood sugar levels can also be dangerous
- **Hypoglycemia:** blood glucose level below 70 mg/dL
    - Symptoms: hunger, shakiness, dizziness
    - May occur in people with diabetes when they don't eat regularly to balance effects of insulin or blood glucose-lowering medication
        * Can cause fainting, coma
    - Uncommonly, may occur after eating (reactive hypoglycemia) or fasting (fasting hypoglycemia)
- How is diabetes treated and controlled?
    - Blood glucose control is key
    - Nutrition and lifestyle goals:
        * Physical exercise
        * Well-balanced diet containing:
            - High-fiber carbohydrates from whole grains, fruits, vegetables
            - Low-fat milk
            - Adequate lean protein sources
            - Unsaturated fats
- Glycemic index (GI) and glycemic load (GL) classify effects of carbohydrate-containing foods on blood glucose
    - GI: ranks foods' effects on blood glucose compared with equal amounts of pure glucose

  - GL: adjusts GI to take into account the amount of carbohydrate consumed

- Eating carbohydrate-heavy foods with protein, fat lowers GI
- Sugar is not prohibited; starch causes same rise in blood glucose levels
- Total calories important for weight management
- Diabetes incidence on the rise
  - Seventh leading cause of death in the United States
  - Adult cases more than tripled since 1980s
  - Rapid increase among children
    * Obesity, overweight, and physical inactivity increase risk
- Preventing type 2 diabetes:
  - Lose excess weight, exercise more, limit sugar-sweetened beverages, eat heart-healthy, plant-based diet

4.16 What Are Sugar Substitutes and What Forms Can They Take?

- **Sugar substitutes** are as sweet or sweeter than sugar, but contain fewer calories
  - Must be approved by FDA and deemed safe before allowed in food products in the United States
  - Many of these substitutes will not promote dental caries and do not affect blood glucose levels
- Reduced-Calorie Sweeteners
  - Polyols (sugar alcohols): sorbitol, mannitol, xylitol
    * Absorbed more slowly than sugar, don't cause spike in blood glucose but not calorie free
    * Not completely absorbed; can cause diarrhea
    * Found in sugar free chewing gum and candies

            - Can be labeled, "sugar-free" but
        - Hydrogenated starch hydrolysates (HSH)
        - Tagalose
            - Derived from lactose and found in some dairy products
            - 90 percent as sweet as sucrose

- Calorie-free sweeteners:
    - Saccharin (Sweet'N Low): 200-700 times sweeter than sucrose
        - The oldest sugar substitute, founded in 1879
    - Aspartame (Nutrasweet, Equal): 200 times sweeter
        - Derived from amino acids aspartic acid and phenylalanine
        - People with PKU need to monitor all dietary sources of phenylalanine, including aspartame
    - Neotame: 7,000-13,000 times sweeter
        - Also made from amino acids
- Acesulfame-K (sSunette): 200 times sweeter
    - The human body does not metabolize
- Sucralose (Splenda): 600 times sweeter
    - Modified sugar molecule that the body doesn't absorb
- Rebaudioside A (Truvia, PureVia, Sun Crystals): 200 times sweeter
    - Combination of a sugar alcohol and stevia extract
- Monk fruit (Nectresse): 150-300 times sweeter
    - Extract of the luo han guo fruit
- Advantame is the newest sugar substitute made from aspartame and vanillin: 20,000 times sweeter than sugar, 100 times sweeter than aspartame

4.17 Why is Fiber So Important?

- Fiber is nondigestible but has many powerful health effects
- Fiber helps lower risk of developing:
  - Constipation
  - Diverticulosis, diverticulitis
  - Obesity: high-fiber foods add to satiation
  - Heart disease: soluble fibers lower elevated blood cholesterol levels
  - Colorectal cancer
  - Diabetes mellitus: slows digestion and absorption of glucose
- Too much fiber can cause health problems, such as diarrhea, flatulence, and bloating
  - Gradually increase fiber intake to allow your body time to adjust
- Long-term constipation may play role in diverticulosis
- **Increased** pressure in the colon causes weak spots in the colon to bulge out, forming **diverticula**
- **Diverticulitis:** Infection of the diverticular
  - Stomach pain, fever, nausea, vomiting, cramping, and chills
  - Consume diet with adequate diet to prevent
- To increase daily fiber intake, here are som easy food substitutions:
  - Oatmeal or bran flakes instead of corn flakes
  - Whole grain crackers instead of cheese crackers
  - Whole grain bread instead of white bread
  - Popcorn instead of pretzels

5 Chapter 5: Fats, Oils, and Other Lipids

5.1 What Are Fats and Why Do You Need Them?

- **Lipids:** category of compounds containing carbon, hydrogen, and oxygen that are **hydrophobic** (insoluble in water)
- Fat is the common name for just one type of lipid, known as triglyceride
  - Fats serve multiple functions in foods:
    - Give flaky texture to baked goods
    - Make meats tender
    - Provide flavor and aromas
    - Contribute to satiety
- Fats and other lipids perform important functions in the body:
  - Energy storage
  - Insulation
  - Transport of proteins in blood
  - Cell membrane structure
- Three types of lipids found in foods and in your body:
  - Triglycerides (fats), phospholipids, and sterols
  - Basic unit of triglycerides and phospholipids is **fatty acid**

5.2 Fatty Acids Are Found in Triglycerides and Phospholipids

- **Fatty acids:** chain of carbon and hydrogen atoms with acid group (COOH at one end)
  - Over 20 different fatty acids
  - Can vary by:
    1. Length of chain
    2. Whether carbons have double or single bonds between them
    3. Total number of double bonds

5.3 Fatty Acids Vary in Length and Structure

- There are three main types of fatty acids:
    1. **Saturated fatty acids:** all carbons bonded to hydrogen
        - Example: stearic acid, 18 carbons, solid at room temperature
    2. **Monounsaturated fatty acids (MUFAs):** one double bond
        - Example: oleic acid, 18 carbons (olive oil), liquid at room temperature
    3. **Polyunsaturated fatty acids (PUFAs):** more than one double bond
        - Example: **essential fatty acids, linoleic acid**, and **alpha-linolenic acid** (soybean oil)

5.4 Triglycerides Contain Three Fatty Acid Chains

- **Triglyceride:** three fatty acids connected to glycerol "backbone"
    - Most common lipid found in foods and body
    - Referred to as fats
        * Saturated fats have mostly saturated fatty acids
        * Unsaturated fats have mostly unsaturated fatty acids
        * Oils are fats that are liquid at room temperature

5.5 Phospholipids Contain Phosphate

- **Phospholipids:** have **glycerol** backbone, but two fatty acids and a phosphorus group
    - Phosphorus-containing head is **hydrophilic**
    - Fatty acid tail is hydrophobic
    - Cell membranes made of phospholipid bilayer
        * Major phospholipid in cell membrane = lecithin
            · Lecithin used as **emulsifier** in foods such as salad dressings to keep oils and water mixed together

5.6 Sterols Have a Unique Ring Structure

- **Sterols** are composed mainly of four connecting rings of carbon and hydrogen
  - Example: cholesterol
    - Important role in cell membrane structure
    - **Precursor** of important compounds in body
      - Converted into vitamin D and other substances
    - Not required in diet since body makes all cholesterol needed

5.7 What Happens to the Fat You Eat?

- Mouth: chewing and lingual lipase start digestion
- Stomach: gastric lipase breaks down fat into **diglyceride** and one fatty acid
- Small intestine: most digestion occurs here
  - **Bile** acids: emulsify fat, break fat globules into smaller pieces
  - Pancreatic lipase: two fatty acids and **monoglyceride**
  - Lecithin in bile is packaged with monoglycerides and fatty acids to create **micelles** (small carriers) for absorption
  - Short-chain fatty acids enter bloodstream and travel to liver
  - Long-chain fatty acids enter **lymph** and need transport carriers
- **Lipoproteins** transport fat through the lymph and blood
  - **Chylomicrons:** carry digested fat through lymph into bloodstream
  - **Very low-density lipoproteins** (VLDL): deliver fat made in liver to cells
  - **Low-density lipoproteins** (LDL, "bad" cholesterol): deposite cholesterol on walls of arteries
  - **High-density lipoproteins** (HDL, "good" cholesterol): remove cholesterol from body and deliver to liver for excretion

5.8 How Does Your Body Use Fat and Cholesterol

- Fat
  - An energy-dense source of fuel: 9 calories per gram
    - Glucagon also stimulates release of fat from fat cells to provide energy forr heart, liver, and muscle when blood glucose level declines
  - Is needed for absorption of fat-soluble vitamins A, D, E, K, and carotenoids
  - Insulates body to maintain body temperature
  - Cushions bones, organs, nerves
- Two polunsaturated fatty acids, linoleic acid (an omega-6 fatty acid) and alpa-linolenic acid (an omega-3 fatty acid), are essential
  - The essential fatty acids help maintain healthy skin cells, nerves, and cell membranes and are precursors to eicosanoids, eicosapentaenoic acid, and docosahexaenoic acid
  - **Eicosanoids:** hormone-like substances made from essential fatty acids, which are involved in inflammation, blood clotting, blood pressure
  - **Eicosapentaenoic acid (EPA)** and **docosahexaenoic acid (DHA):** two omega-3 fatty acids that are heart-healthy
    - Fatty fish such as salmon, herring, and sardines are rich sources
- Cholesterol has many important roles:
  - Part of cell membranes
  - Precursor for vitamin D, bile acids, sex hormones
  - Cholesterol in your diet does not determine your blood cholesterol
  - Your body makes all the cholesterol it needs

5.9 How Much Fat Do You Need Each Day?

- You need to consume a specific percentage of your daily calories from fat

  - AMDR of DRI: 20 to 35 percent of total daily calories should come from fat
  - Remember that dietary fat has more than twice the calories per gram of carbohydrates or protein
  - For heart health, you should consume less than 10 percent (ideally less than 7 percent) lf your calories from saturated fats

- You need to consume a specific amount of essential fatty acids daily
  - Between 5 and 10 percent of the total calories in your diet should come from linoleic acid
  - Alpha-linolenic acid should make up 0.6 to 1.2 percent of your total calories

- You should minimize saturated fat and **trans** fat in your diet
  - Consuming too much saturated fat can lead to higher levels of the "bad" LDL cholesterol carrier
  - **Trans** fats are created by food manufacturers through the process of **hydrogenation**
    * Made by manufacturers to resist **randicidity** and increase shelf life
  - **Trans** fats are actually worse for heart health than saturated fat
    * Raise LDL cholesterol and lower HDL cholesterol

- Your body makes all the cholesterol it needs, so you do not need to consume it in your diet

- Healthy individuals over the age of 2 are advised to limit their dietary cholesterol to less than 300 mg daily

- The latest research suggests that dietary cholesterol has less impact on blood cholesterol levels than saturated fat

- However, very high intakes of dietary cholesterol can increase blood cholesterol levels

5.10 What Are the Best Food Sources of Fats?

- Foods that contain unsaturated fats (both monounsaturated and polyunsaturated fats) are better for your health than foods high in saturated fat, cholesterol, and/or **trans** fat
  - Unsaturated fats are abundant in vegetable oils as well as soybeans, walnuts, peanut butter, flaxseeds, and wheat germ
  - Vegetable oils, buts, and flaxseeds are also good sources of essential fatty acids

5.11 What Are Fat Substitutes and How Can They Be Part of a Healthy Diet?

- **Fat substitutes** are designed to provide all the creamy properties of fat for fewer calories and total fat grams
  - Because fat has more than double the calories per gram of carbohydrates or protein, fat substitutes have the potential to reduce calories from fat by more than 50 percent
- Fat substitutes can be carbohydrate-, protein-, or fat-based
  - The majority are carbohydrate-based and use plant polysaccharides

5.12 What Is Heart Disease and What Increases Your Risk?

- Heart disease begins with a buildup in the arteries
  - **Atherosclerosis:** narrowing of arteries due to buildup of **plaque** (hardened debris of cholesterol-laden foam cells, platelets, and other substances)
    - Though to begin with injury to lining of arteries, contributed by high blood pressure, high cholesterol levels, and smoking
    - Increases chance of blood clots blocking the vessel, causing **heart attack** or **stroke**

5.13 Risk Factors for Heart Disease

- Risk factors you **can't** control:
  - age, gender, family history, and Type 1 Diabetes
- Risk factors you **can** control:
  - Regular exercise can help lower LDL and raise HDL
  - Losing excess weight and quitting smoking can help increase HDL levels
- Other potential risk factors: high levels of homocysteine, Lp(a) protein, C-reactive protein (sign of inflammation), Apolipoprotein B (ApoB)
- **Metabolic Syndrome:** group of risk factors, including insulin resistance, that increase the risk of heart disease

5.14 What Can You Do to Maintain Healthy Blood Cholesterol Levels and Reduce Your Risk of Heart Disease?

1. Minimize saturated fats, **trans** fats, cholesterol in diet
2. Include fish in your weekly choices
3. Eat plenty of plant foods
4. Select foods rich in antioxidants and phytochemicals
5. Strive for plenty of exercise and manage your weight
6. Moderate use of alcohol may reduce risk of heart disease, but some should avoid alcohol
7. The whole is greater than the sum of its parts

5.15 Examining the Evidence: The Traditional Mediterranean Diet

- Traditional diet of Mediterranean region is associated with lower risk of heart disease and cancer
  - Very active lifestyle as well as long, relaxing family meals, afternoon naps, supportive community
  - Plant-based diet of whole grains, fruits, vegetables, legumes, and nuts
    - With olive oil, low-fat dairy, water
    - Occasional fish, poultry, eggs, meat, sweets, wine

5.16 Nutrition in the Real World: Mercury and Fish

- Methylmercury is a toxic chemical especially harmful to the nervous systems of unborn children
  - Accumulates in larger fish with a longer life span
    - Examples: swordfish, shark, king mackerel, tilefish
- Women of childbearing age age and young children should avoid these four types of fish
  - Pregnant women/women of childbearing age: should consume 8 to 12 ounces of other fish (variety) weekly
    - Ideally 2-3 4 ounce servings of fish per week from the "Best Choices" list or 1 serving from the "Good Choices" list
    - Canned albacore tuna has more mercury than light tuna: 6 ounce/week limit
  - Can server 1 to 2 two ounce servings/week to children starting at 2 years old

5.17 Eat Plenty of Plant Foods

- Eating more plant foods high in soluble fiber may be one of the easiest ways to decrease LDL

- Although all plant foods are cholesterol free, they do contain **phytosterols**, which are plant sterols similar to cholesterol found in the plant's cell membranes
  - Plant sterols can help lower LDL cholesterol levels by competing with cholesterol for absorption in the intestinal tract
  - Sources of sterols include soybean oil, many fruits, vegetables, legumes, sesame seeds, nuts, cereals, and other plant foods

5.18 Routinely Select Foods Rich in Antioxidants and phytochemicals

- Antioxidants may help reduce LDL cholesterol levels
- **Flavonoids** are phytochemicals found in fruits, vegetables, tea, nuts, and seeds that may offer some antioxidant protection as well as potentially inhibiting platelet aggregation, which can perpetuate a blood clot

5.19 Made Over Made Better

- Make these replacements to keep saturated fat intake no more than 7-10 percent of your total calories every day
  - Replace 2 percent milk and whipped cream in your coffee with a black coffee
  - Replace butter with jelly on toast
  - Choose reduced-fat cheese instead of full-fat cheddar cheese
  - Choose low-fat frozen yogurt instead of chocolate ice cream

6 Chapter 6: Proteins and Amino Acids

6.1 What Are Proteins and Why Are They Important?

- **Proteins** are the predominant structural and functional materials in every cell

  - Contain carbon, hydrogen, oxygen (like carbohydrates and fats)
  - Also contain nitrogen
  - Each amino acid has:
    * **Acid group (COOH)**
    * **Amine group (NH2)**
    * **Side chain (unique)**

- All proteins consist of a chain of some combination of 20 unique **amino acids**
- An acid group and amine group are connected by **peptide bonds** to create **dipeptides**

6.2 Essential, Nonessential, and Conditional Amino Acids

- Nine **essential amino acids**
  - Cannot be made by the body
  - It is "essential" to obtain them from the diet
- Eleven **nonessential amino acids**
  - Can be synthesized in the body from other amino acids or by adding nitrogen to carbon-containing **structures**
- **Conditionally essential amino acids**
  - Under certain conditions, some nonessential amino acids cannot be synthesized and must be consumed in the diet

6.3 Denaturation of Proteins Changes Their Shape

- **Denaturation:** the alteration (unfolding) of a protein's shape, which changes the structure and function of the protein
  - Examples: cooking meat, eggs changing texture
  - Stomach acid untangles protiens to aid in digestion

6.4 What Happens to the Protein You Eat?

- Dietary proteins are digested and absorbed in stomach and small intestine
  - Stomach acids denature protein and activate pepsin, which breaks down protein into shorter polypeptides
  - In the small intestine, polypeptides are broken down into tripeptides, dipeptides, and amino acids
  - Amino acids enter blood and travel to liver

6.5 Your Body Degrades and Synthesizes Proteins

- Amino acids come from:
  - Diet
  - Breakdown of proteins in the body
  - A limited supply is stored in **amino acid pools** in blood and cells for needed protein synthesis
- **Protein turnover:** process of continuous breakdown and synthesis of protein from its amino acids
- Amino acids can be used to make:
  - Body proteins
  - Non-protein substances
    - Examples: thyroid hormones, melanin
- After amine groups are removed (converted to urea, excreted in urine), amino acids can also be:
  - Burned for energy
  - Stored as fat
  - Made into glucose

6.6 DNA Directs Synthesis of New Proteins

- DNA in the cell nucleus contains instructions for protein synthesis
- **Gene:** DNA segment that codes for specific protein
- Specialized RNA molecules carry out instructions for protein synthesis
  - **Messenger RNA (mRNA)** and transfer **RNA (tRNA)** perform very specific roles during protein synthesis
- When abnormalities occur during protein synthesis, serious medical conditions may result
  - Example: **sickle-cell anemia**

6.7 How Does Your Body Use Proteins

- Proteins provide structural and mechanical support and help maintain body tissues
  - **Collagen:** a ropelike, fibrous protein that is the most abundant protein in your body
  - **Connective tissue:** the most abundant tissue type in the body; made up primarily of collagen, it supports and connects body parts as well as providing protectionand insulation
- Most enzymes and many hormones are composed of proteins
- Proteins help maintain fluid balance
- Proteins help maintain acid-base balance
  - **Buffers:** substances that help maintain the proper pH in a solution by attracting or donating hydrogen ions
- Proteins transport substances throughout the body
  - **Transport proteins** shuttle oxygen, waste products, lipids, some vitamins, and sodium and potassium through your blood and into and out of cells through cell membranes

- Proteins contribute to a healthy immune system
  - Specialized protein "soldiers" called **antibodies** eliminate potentially harmful substances
- Proteins can provide energy
- Protein improves satiety and appetite control

6.8 How Much Protein Do You Need?

- Healthy adults should be in **nitrogen balance**
  - Amount of nitrogen consumed (in dietary protein) amount excreted (in urine)
- Nitrogen imbalances
  - **Positive nitrogen balance:** more nitrogen is retained (for protein synthesis) than is excreted
    - Examples: infantts, children, pregnant women
  - **Negative nitrogen balance:** more nitrogen is excreted than consumed (body proteins broken down)
    - Examples: starvation, serious injury, or illness

6.9 Not All Protein Is Created Equal

- **Protein quality** is determined by two factors:
  - The protein's **digestibility**
  - The protein's **amino acid profile:** the types and amounts of amino acids (essential, nonessential, or both) that the protein contains.
    - **Complete proteins:** all essential amino acids, plus some nonessential amino acids
      - Sources: soy, quinoa, and animal protein
    - **Incomplete proteins:** low in one or more essential amino acids

· Sources: plant foods

- Plant proteins "upgraded" to complete proteins by:
  - Consuming modest amounts of soy or animal protein OR
  - Being complemented with other plant proteins that provide enough of the limiting amino acid
    - Complementary proteins do not need to be eaten in the same meal, only the same day
- **Protein Digestibility Corrected Amino Acid Score (PDCAAS)**
  - Measure of protein quality taking into acount digestibility and amino acid profile
  - Basis of protein as percent Dailty Value on food labels

6.10 You Can Determine Your Personal Protein Needs

- Protein recommendations (DRI)
  - 10 to 35 percent of total daily calories from protein
    - Average intake in the United States = 15 percent
  - 0.8g of protein/kg of body weight needed daily
- Calculating your daily protein needs
  - Convert weight to pounds by dividing by 2.2 pounds/kg
    - For example: 130 pounds / 2.2 = 59kg, 59kg x 0.8g = 47g of protein/day

6.11 What Are the Best Food Sources of Protein?

- Some amount of protein is found in many foods, but it is particularly abundant in meat, fish, poultry, and meat alternatives such as dried beans, peanut butter, buts, and soy

6.12 Examining the Evidence: Protein Supplements: Are They Necessary?

- Varied products promise many benefits, but not needed with adequate diet
- Protein shakes and powder
  - Made of whey, soy, or rice protein
  - May contain unwanted additives
- Amino acid supplements
  - Sold as remedies for various health issues
  - May have negative effects
- Protein and energy bars
  - Convenient, but expensive and high in calories

6.13 What Happens if You Eat Too Much or Too Little Protein?

- Eating too much protein:
  - May increase risk of heart disease, kidney stones, calcium loss from bones
  - Can displace other nutrient- and fiber- rich foods associated with a reduced risk of chronic diseases
    - Whole grains, fruits, vegetables
- Eating too little protein
  - May lead to reduction of lean body mass, especially in older adults
  - Risk of increased frailty, impaired healing, decreased immune function
- **Protein-energy malnutrition (PEM)**
  - Inadequate calories and/or protein

  - More common in children, because they are growing
  - Factors: poverty, poor food quality, insufficient food, unsanitary living conditions, ignorance, stopping lactation (nursing) too early

6.14 Eating Too Little Protein Can Lead to Poor Health and Malnutrition

- **Kwashiorkor:** severe dificiency of dietary protein
  - Signs: edema, muscle loss, skin rashes, hair changes, water and electrolyte
  - Seen in children weaned to low-protein cereals
- **Marasmus:** severe deficiency of calories
  - Signs: emaciation, lack of growth, loss of fat stores
- **Marasmic kwashiorkor:** worst of both conditions
- Treatment includes a multi-step approach
  1. Address life-threatening factors
     - Severe dehydration
     - Fluid/nutrition imbalances
  2. Restore deplated tissue
     - Gradually provide nutritionally dense kilocalories and high-quality protein
  3. Transition to foods and introduce physical activity

6.15 How Do Vegetarians Meet Protein Needs?

- **Vegetarians** can meet protein needs by consuming:
  - Variety of plant foods
  - Protein-rich meat alternatives:
    * Soy
    * Dried beans and other legumes

        * Nuts
        * Eggs, dairy (lacto-ovo-vegetarians)

6.16 Potential Benefits and Risks of Vegetarian Diets

- Benefits
    - May reduce risk of heart disease, high blood pressure, diabetes, cancer, stroke, and obesity
    - Vegetarian diet food staples are rich in fiber and low in saturated fat and cholesterol
- Risks
    - Potential deficiencies of nutrients found in animal foods
        * Protein, iron, zinc, calcium, vitamin D, riboflavin, vitamins B12 and A, omega-3 fatty acids

6.17 Nutrition in the Real World: The Joy of Soy

- Benefits of soy
    - High-quality protein source
    - Low in saturated fat
    - Contains **isoflavones** (phytoestrogens)
        * Have chemical structure similar to human **estrogen**
    - Lowers blood cholesterol levels
    - May reduce risk of heart disease, certain cancers

7 Chapter 7: Vitamins

7.1 What Are Vitamins?

- Vitamins are essential nutrients
    - Tasteless, organic compounds needed in small amounts

  - A deficiency will cause physiological symptoms
  - Consuming too much of some vitamins will cause adverse effects

- Vitamins are either fat-soluble or water-soluble
  - Fat-soluble vitamins (A, D, E, and K) are absorbed with dietary fat and can be stored in body
  - Water-soluble vitamins (B vitamins and C) are absorbed with water and enter the bloodstream directly
    * Not stored in body, but excesses can still be harmful

- Some vitamins function as **antioxidants**, which counteract **oxidation** by neutralizing substances called free radicals.
  - Vitamins A, C, and E, and beta-carotene are antioxidants
  - **Free radicals** are unstable oxygen-containing molecules that can damage the cells of the body and possibly contribute to increased risk of chronic diseases

- Vitamins differ in **bioavailability:** the degree to which a nutrient is absorbed from foods and used in the body
  - Vitamins can be destroyed by air, water, or heat
  - Don't expose your produce to air
  - A little water is enough for cooking
  - Reduce your cooking time
  - Keep your food cool

- Overconsumption of some vitamins can be toxic

- **Provitamins** can be converted to vitamins by the body

7.2 Vitamins Can Be Destroyed by Air, Water, or Heat

- Air exposure can destroy water-soluble vitamins and fat-soluble vitamins A, E, and K.

  - Store in airtight, covered containers and use soon after purchase

- To reduce vitamin loss, cook vegetables in a minimal amount of liquid
  - Steaming or microwaving with minimal water may help preserve some vitamins in vegetables
- Heat will also destroy water soluble vitamins, especially vitamin C
  - Microwaving, steaming, or stir-frying can preserve more vitamins than boiling
- Cooler temperatures help preserve vitamins, so store produce in the refrigerator rather than pantry

7.3 Overconsumption of Some Vitamins Can Be Toxic

- Vitamin **toxicity**, or hypervitaminosis, is very rare
- Vitamin toxicity does not occur be eating a normal balanced diet
- Can result when individuals consume **megadose** levels of vitamin supplements, usually in the mistaken belief that more is better
- To prevent excessive intake, the Dietary Reference Intakes include a tolerable upper intake level for most vitamins

7.4 Provitamins Can Be Converted to Vitamins by the Body

- **Provitamins** are substances found in foods that are not in a form directly usably by the body, but that can be converted into an active form once they are absorbed
  - Example: beta-carotene, which is split into two molecules of vitamin A in the small intestinal cell wall or in the liver cells
- Vitamins found in foods that are already in the active form, called **preformed** vitamins, do not undergo conversion in the body.

7.5 Vitamin A

- **Vitamin A: retinoids** (retinol, retinal, retinoic acid)
  - Preformed vitamin A only found in animal foods: liver, eggs, fortified milk and cheese
  - Some plants contain **provitamin A carotenoids**, which are converted to retinol in your body
    - Carotenoids, including **beta-carotene**, are pigments that give color to carrots, cantaloupe, sweet potatoes, spinach, broccoli
      - Like fat-soluble vitamins, are absorbed more efficiently if fat is present in intestinal tract
- Functions:
  - Essential for healthy eyes
    - Component of **rhodopsin** and **iodopsin**, light-sensitive proteins needed for vision
  - Involved in cell differentation, reproduction, and immunity by promoting gene expression for:
    - Healthy skin, mucous membranes
    - Bone growth
    - Fetal development
    - White blood cells to fight harmful bacteria
- Daily needs:
  - Adult males: 900 micrograms (μg) **retinol activity equivalents (RAE)**
  - One RAE = 3.3 **international units (IU)**
  - Adult females: 700 micrograms RAE
- Food sources: organ meats (liver), milk, eggs, carrots, spinach, sweet potatoes, pumpkin
- Too much or too little:

  - Excessive amounts of preformed vitamin A can accumulate to toxic levels
    * Upper limit for adults: 3,000 micrograms
  - Carotenoids in food are not toxic
    * Excess carotenoids in diet cause nonthreatening condition: **carotenodermia**
  - Chronic vitamin A deficiency causes **night blindless**
  - Prolonged vitamin A deficiency leads to **xerophthalmia** (permanent damage to the cornea)
    * Main cause of preventable blindness in children
  - Vitamin A deficiency also associated with stunting of bones

7.6 Vitamin E

- Alpha-tocopherol is most active form in body
- Functions:
  - Acts as apowerful antioxidant
    * Protects cell membranes, prevents oxidation of LDL cholesterol
  - Acts as an anticoagulant, inhibiting formation of harmful clots inside bloodstream
- Daily needs: Adults need 15mg of alpha-tocopherol equivalents
- Food sources: vegetable oils, nuts, seeds, fortified cereals, some green leafy vegetables
- Too much or too little:
  - No known risk of consuming too much vitamin E from natural food sources
    * Overconsumption of synthetic form in dietary supplements and fortified foods can increase risk of a **hemorrhage:** upper limit is 1,000 mg/day

  - Although rare, chronic deficiency of vitamin E can cause nerve problems, muscle weakness, and free radical damage to cell membranes

7.7 Vitamin K

- Two forms of vitamin K
  - **Menaquinone** synthesized by intestinal bacteria
  - Phylloquinone found in green plants
- Functions:
  - Essential for blood clotting **(coagulation)**
    - Involved in synthesizing four blood **clotting factors**
  - Important to bone health
    - Enables bone protein **osteocalcin** to bind with calcium
- Daily needs: based on current consumption, since amount contributed by intestinal synthesis is unknown
  - Men need 120 μg/day
  - Women need 90 μg/day
- Food sources: green vegetables such as broccoli, asparagus, spinach, salad greens, brussels sprouts, cabbage; also vegetable oils and margarine
- Too much or too little:
  - No known problems of consuming too much vitamin K from foods or supplements
  - People taking anticoagulant medications such as **warfarin** (Coumadin) need to keep vitamin K intake consistent
    - Changes in intake can increase or decrease drug effectiveness
  - Vitamin K deficiency that is severe enough to affect blood clotting is extremely rare
    - At risk: people with problems absorbing fat

7.8 Vitamin D

- Called "sunshin vitamin" because it is made in the body with help of sunlight **(UV)**
  - Cholesterol-containing compound in skin is converted to inactive form of vitamin D
  - People with insufficient sunlight exposure must meet needs through diet; vitamin D in foods is also an inactive form
  - Inactive form converted to circulating form in liver, then to active form in kidneys
- Functions: active form acts as a hormone
  - Regulates two important bone minerals: calcium (Ca) and phosphorus (P)
    - Stimulates intestinal absorption of Ca and P to maintain healthy blood levels and build and maintain bones
    - When dietary calcium is inadequate, vitamin D and **parathyroid hormone** cause calcium to leave bones to maintain necessary blood levels
  - May aid prevention of some cancers, diabetes, heart disease, and other conditions
- Daily needs:
  - Sun exposure cannot meet everyone's vitamin D needs
    - Skin pigment melanin and use of sunscreen reduce vitamin D production
    - Sunlight intensity during winter in northern and southern latitudes not sufficient to make vitamin D
  - Therefore, vitamin D needs are based on dietary sources
  - Adults: 15 to 20 micrograms (600 to 800 IU) per day, depending on age (19 to 70 yo and ¿ 70 yo, respectively)
- Food sources: fortified milk and yogurt, fortified cereals, fatty fish (examples: sardines, salmon)

- Too much or too little:
  - Overuse of supplements may lead to **hypervitaminosis D**, which causes **hypercalcemia**
    - Damaging calcium deposited in kidneys, lungs, blood vessels, heart
    - UL: 4,000 IU (100μg)
  - **Rickets:** vitamin D deficiency disease in children
    - On the rise in United States due to decreased milk consumption, other factors
    - Bones inadequately mineralized with calcium and phosphorus, causing them to weaken and leading to bowed legs
  - **Osteomalacia:** adult equivalent of rickets

7.9 The B Vitamins and Vitamin C Are Water-Soluble

- Water-soluble vitamins are not stored in body
  - Excess is excreted in urine
  - However, routine intakes of excssive amounts can be harmful
- B vitamins share common role as **coenzymes**
  - Help many enzymes produce chemical reactions in cells

7.10 Thiamin (B1)

- First B vitamin discovered
- Functions:
  - Transmission of nerve impulses
  - Metabolism of carbohydrates and certain amino acids
  - Plays role in breakdown of alcohol in body
- Daily needs: men: 1.2 mg/day; women: 1.1 mg/day
- Food sources: enriched and whole grain products, pork

- Too much or too little:
  - No known toxicity, no UL set
  - **Beriberi:** thiamin deficiency disease
    - Symptoms can include rapid heartbeat, edema, confusion, loss of coordination
    - Rare in United States due to enrichment of grains
    - Chronic alcohol abuse can lead to advanced form, **Wernicke-Korsakoff syndrome:** progressively damaging brain disorder
      - Due to thiamin-deficient diet, and alcohol interfering with thiamin absorption

7.11 Riboflavin (B2)

- Light-sensitive vitamin, abundant in milk
  - Opaque containers preserve riboflavin content
- Functions:
  - Important for energy metabolism
  - Keeps cells healthy
  - Enhances functions of other B vitamins, such as niacin and B12
- Daily needs:
  - Men: 1.3 mg/day
  - Women: 1.1 mg/day
- Food sources: milk, yogurt, enriched cereals, grains
- Too much or too little:
  - Excess riboflavin excreted in urine: bright yellow color
  - No UL set
  - Deficiency symptomps rarely seen in healthy individuals eating a balanced diet:
    - Sore throat, swelling inside mouth, inflamed and purplish-red tongue (glossitis), dry and scaly lips

7.12 Niacin (B3)

- Active forms: **nicotinic acid and nicotinamide**
- **Functions:**
  - Energy metabolism
  - Synthesize fat and cholesterol
  - Keep skin cells and digestive system healthy
- Sometimes prescribed in high doses (50 times UL) by physicians to decrease blood LDL cholesterol and triglycerides, increase HDL
- Daily needs: men: 16 mg/day; women: 14 mg/day
  - Can also be made in the body from the amino acid **tryptophan:** daily needs expressed in niacin equivalents (NE)
- Food sources: meat, fish, poultry, enriched whole-grain breads, fortified cereals
  - Protein-rich foods are good sources of tryptophan
- Too much or too little:
  - Overconsumption of niacin supplements can cause flushing, nausea, vomiting; be toxic to liver; raise blood glucose levels: UL is 35 mg/day to prevent **flushing**
  - **Pellagra:** niacin deficiency disease
    - Four Ds: dermatitis, diarrhea, dementia, death
    - Once common in South, due to corn-based diet

7.13 Vitamin B6

- Active forms: **pyridoxine**, pyridoxal, and pyridoxamine
- Functions: as coenzyme with over 100 enzymes in protein metabolism, needed to:
  - Make nonessential amino acids, convert tryptophan to niacin and hemoglobin in red blood cells

  - Keep immune and nervous systems healthy
  - Metabolize fats and carbohydrates and break down glycogen
- Daily needs: men: 1.3 to 1.7 mg/day; women: 1.3 to 1.5 mg/day, depending on age
- Food sources
  - Meat, fish, poultry, fortified cereals, nuts, legumes, peanut butter, many fruits and vegetables
- Too much or too little:
  - UL is 100 mg/day to prevent nerve damage
  - Has been used to alleviate symptoms of **premenstrual syndrome (PMD)**
  - Deficiency symptoms:
    * Sore tongue, skin inflammation, depression, confusion, anemia
  - Those with alcoholism are at risk for deficiency due to poor diet, and because alcohol causes body to lose B6

7.14 Folate

- Naturally occurring form in foods
- **Folic acid:** synthetic form of folate added to foods and supplements
- Functions: vital for DNA synthesis
  - To create and maintain new cells, including red blood cells
  - To help body use amino acids
  - Folate deficiency during pregnancy can result in **neural tube birth defects** (examples: **spina bifida**, anencephaly)
  - Reduces risks of some cancers
- Daily needs:
  - Adults need 400 micrograms of **dietary folate equivalents (DFE)**

  - Folic acid is absorbed 1.7 times more efficiently than folate found naturally in foods
  - Women who might become pregnant need 400 micrograms extra from fortified foods/supplements
- Food sources:
  - Enriched grains (rice, pasta, breads, cereals), legumes, broccoli, asparagus, leafy greens such as spinach
- Too much or too little:
  - UL = 1,000 micrograms/day of folic acid from enriched/fortified foods and supplements
    - Too much folic acid (not naturally occurring folate in foods) masks vitamin B12 deficiency anemia
  - Folate deficiency can lead to macrocytic anemia

7.15 Vitamin B12

- Also called cobalamine because it contains the element cobalt
- Requires **intrinsic factor**, protein made in stomach, in order to be absorbed in small intestine
  - **Pernicious anemia** results in people who cannot make intrinsic factor; treatment requires B12 injection to bypass intestine
  - Symptoms may take years to appear since B12 is stored in the liver
- Functions:
  - To make DNA
  - To use certain fatty acids and amino acids
  - For healthy nerves and cells, especially red blood cells
- Daily needs:
  - Adults: 2.4 μg/day

  - Ability to absorb naturally occurring B12 from foods declines with age

- Food sources:
  - Naturally occurring B12 only found in animal foods (meat, fish, poultry, dairy)
  - Synthetic B12 found in fortified foods such as soy milk and some cereals

- Too much or too little:
  - No upper level set since no known risk from consuming too much B12 natural or synthetic
  - Deficiency can cause macrocytic anemia (because folate can't be utilized properly)
    * Lack of intrinsic factor causes pernicious anemia, involves nerve damage

7.16 Vitamin C

- Also known as **ascorbic acid**
- Function: coenzyme to synthesize and use certain amino acids
  - Needed to make collagen, most abundant protein in body, present in connective tissue
    * Important for healthy bones, skin, blood vessels, teeth
  - Also acts as an antioxidant
  - Helps absorb iron from plant foods
  - Breaks down histamine cause of inflammation
  - Helps to maintain a strong immune system
- Daily needs:
  - Men: 90 mg/day
  - Women: 75/day

  - Smokers: 35+ mg/day

- Food sources: fruits and vegetables (tomatoes, peppers, broccoli, oranges, cantaloupe)

- Too much or too little:

  - UL = 2,000 mg/day to avoid nausea, stomach cramps, diarrhea
    * People with a history of kidney stones or **hemochromatosis** (body stores too much iron) should avoid excess
  - Deficiency disease: **scurvy**

7.17 Pantothenic Acid and Biotin

- Functions: assist in energy metabolism of carbohydrates, fats, proteins

- Daily needs for adults:

  - Daily needs for adults:
    * Pantothenic acid: 5 mg/day
    * Biotin: 30 μg/day
  - Food sources:
    * Widespread in foods such as whole grains and cereals, nuts, legumes, peanut butter, meat, milk, eggs
    * Biotin also synthesized by intestinal bacteria

- Too much or too little:

  - No UL, no known adverse effects from consuming too much of either vitamin
  - Deficiencies of these vitamins are rare
    * "Burning feet" syndrome seen in WWII prisoners of war in Asia due to pantothenic acid-deficient diet of polished rice
    * Biotin deficiency: hair loss, skin rash, fatigue, nausea, depression
      · **Avidin** protein in raw egg whites binds biotin, preventing absorption

7.18 Are There Other Important Nutrients?

- **Choline:** essential nutrient needed for healthy cells and nerves
  - Not classified as a vitamin; body can synthesize it, but dietary sources may be needed
  - Daily needs: men: 550 mg; women: 425 mg
  - Widely available in foods: milk, eggs, peanuts, liver
  - UL of 3,500 mg/day to prevent **hypotension**, sweating, vomiting, fishy odor
- **Carnitine, lipoic acid, inositol** are not essential because body can synthesize adequate amounts

7.19 Examining the Evidence: Myths and Facts about the Common Cold

- The truth about catching a cold:
  - Direct or indirect contact with cold virus
- Vitamin C and the common cold
  - Research shows vitamin C to be ineffective in preventing colds, but may reduce severity in some people
  - Other cold remedies (echinacea, zinc): jury is still out
    - Zinc may have some benefits
- What you can do: wash hands frequently in soap and water to reduce risk of cold

7.20 How Should You Get Your Vitamins?

- Food is still the best way to meet your vitamin needs
  - Dietary Guidelines recommend a variety of foods and increased amounts of fruits, vegetables, whole grains, lean dairy to meet needs

- Fortified foods can provide additional nutrients but should not displace vitamin-/mineral-rich foods
  - Excessive use of fortified foods can increase risk of overconsumption of some nutrients
- Vitamin supplements are not a substitute for healthy eating
  - Cannot provide all missing substances of a healthy diet
- Who might benefit from a supplement?
  - People who cannot meet their needs through a regular, varied diet, such as pregnant or lactating women; older people; strict vegetarians; people with food allergies, with medical conditions, or on low-calorie diets
- FDA approval not required for ingredients in use prior to 1994; FDA cannot remove supplement from marketplace until shown to be harmful
- Consult health professional before taking vitamin/mineral supplements
  - Read supplement label carefully
    - **U.S. Pharmacopoeia (USP)** seal of approval ensures quality and safety, but does not endorse or validate health claims

8 Chapter 8: Minerals and Water

8.1 Why Is Water so Important?

- Water is the most abundant substance in body
  - Average healthy adult is about 60 percent water
    - Muscle tissue is 75 percent water, fat up to 20 percent
  - Can survive only a few days without water
  - Water is balanced among fluid compartments
    - **Intracellular fluids:** inside cells
    - **Extracellular fluids:** interstitial fluid between cells and fluid in the blood

  - **Electrolytes:** minerals that help maintain fluid balance

- Acts as universal solvent and transport medium
  - Medium for chemical reactions in body
  - As part of blood, helps transport oxygen, nutrients, hormones to cells
  - As part of interstitial fluid, helps transport waste products away from cells for excretion
- Helps maintain body temperature
- Lubricant for joints, eyes; part of mucus and saliva
- Protective cushion for brain, organs, fetus

8.2 What Is Water Balance and How Do You Maintain It?

- **Water balance:** water consumed = water lost
- You take in water through beverages and food
- You lose water through your kidneys (as urine), large intestine, lungs, skin
  - **Insensible water loss:** through evaporation from skin and when you exhale
  - **Sensible water loss:** through urine, feces, and sweat

8.3 Losing Too Much Water Can Cause Dehydration

- Dehydration can result from inadequate water intake or too much water loss from diarrhea, vomiting, high fever, or use of diuretics
- Your thirst mechanism signals dehydration
  - Dry mouth due to increased electrolyte concentration in blood: less water available to make saliva
  - Blood volume decreases, sodium concentration increases in blood

        * Brain triggers thirst mechanism and secretion of antidiuretic hormone (ADH) to reduce urine output
        * Fluid inside cells moves into blood by osmosis

- Other ways to tell if you're dehydrated:
    - Cornerstone method: measure body weight before and after exercise
        * Weight loss = water loss
    - Monitor urine color
        * Color darkens with concentration, indicating water loss

8.4 Consuming Too Much Water Can Cause Hyponatremia

- **Hyponatremia** is a condition of too little sodium in the blood
- For healthy individuals who consume a balanced diet, it is difficult to consume too much water
- However, some individuals have experienced water toxicity
    - Examples: soldiers in training, endurance athletes

8.5 How Much Water Do You Need and What Are the Best Sources?

- Daily water needs depend on physical activity, environmental factors, diet
- Recommendations based on reported total water intake of healthy Americans
- Men: 16 cups/day (about 13 cups of beverages)
- Women: 12 cups/day (about 9 cups of beverages)
    - About 80 percent from beverages, 20 percent from foods
    - Physical activity increases needs

8.6 Nutrition in the Real World: Tap Water or Bottled Water: Is Bottled Better?

- False assumption: bottled water is purer than tap water
- Tap water is perfectly safe
  - Monitored by Environmental Protection Agency (EPA)
  - Provides fluoride, helps prevent dental caries
- Bottled water is very popular
  - Most products conform to FDA requirements
  - May actually be tap water
  - High cost
  - Various "designer" waters on the market

8.7 What Are Minerals and Why Do You Need Them?

- **Inorganic** elements needed in relatively small amounts
- Mineral absorption depends on **bioavailability**
  - Some minerals compete for absorption: too much of one can decrease absorption of another
    - Example: excess zinc can reduce copper absorption
  - Some substances bind minerals, making them unavailable for absorption
    - Example: oxalates in spinach bind calcium
- **Major minerals** (macrominerals): needed in amounts greater than 100 mg/day
- **Trace minerals** (microminerals): needed in amounts less than 20 mg/day
- You need major minerals in larger amounts

  - Sodium, chloride, potassium, magnesium, sulfur play key roles in fluid balance
  - Calcium, phosphorus, magnesium work together to strengthen bones and teeth
- Trace minerals are needed in small amounts
  - Play essential roles as important as major minerals
  - Chromium and iodine help certain hormones
  - Iron maintains healthy red blood cells
  - Fluoride protects teeth
  - Iron, zinc, copper, manganese, and molybdenum are cofactors that work with enzymes in critical chemical reactions
- Overconsumption of minerals can be toxic
  - Difference between recommended and excessive amount may be minimal
    * Example: magnesium, which can cause gastrointestinal problems
- Foods alone rarely provide excessive amounts
  - Problems usually arise with supplements
  - Another good reason to eat a varied diet

8.8 Exploring Sodium

- What are sodium and salt?
  - Sodium is an electrolyte (charged ion) in blood and in the fluid surrounding cells
  - About 90 percent of sodium consumed is in form of sodium chloride, table salt
- Functions: chief role is regulation of fluid balance
  - Also transports substances such as amino acids across cell membranes

- Sodium balance in your body
  - Sodium levels is maintained by the kidneys reducing or increasing sodium excretion as needed
  - Smaller amounts lost in stool and sweat
- Daily needs: 1,500 mg/day for adults under 51
- Food sources: 75 percent of sodium consumed by Americans comes from processed foods
  - About 10 percent occurs naturally in foods; another 5-10 percent added during cooking and at table
- Too much or too little:
  - UL for adults is set at 2,300 mg/day to reduce the risk of **hypertension** (high blood pressure)
    - Cut back on processed foods and salt added to foods to lower sodium intake
  - Sodium deficiency is rare in healthy individuals consuming a balanced diet

8.9 You and Your Blood Pressure

- Blood pressure: a measure of force that blood exerts on the walls of arteries
- Expressed as **systolic pressure** (when heart beats) over **diastolic pressure** (when heart is at rest between beats)
  - ¡ 120/80 mmHg is normal
  - Systolic ¿ 120 or diastolic ¿ 80 = prehypertension
  - ¿= 140/90 = hypertension
- **Hypertension** is a silent killer
  - No symptoms - have blood pressure checked regularly
  - Contributes to atherosclerosis, heart enlarges and weakens

  - Damages arteries leading to brain and kidneys, increasing risk of stroke and kidney disease

- To control hypertension:
  - Reduce weight, increase physical activity, eat a balanced diet

8.10 Exploring Potassium

- Important mineral with many functions:
  - Fluid balance: electrolyte inside cells
  - A blood buffer: helps keep blood pH and acid-base balance correct
  - Muscle contraction and nerve impulse conduction
  - Can help lower high blood pressure
  - Aids in bone health: helps increase bone density
  - Reduces kidney stones by helping to excrete citrate (binds with calcium to form **kidney stones**)
- Daily needs:
  - Adults: 4,700 mg/day
  - Adult females consume only about 2,400 mg/day and adult males only 3,170 mg/day on average
- Food sources:
  - Fruits and vegetables
    - Minimum of 4.5 cups/day will help meet potassium needs
  - Dairy foods, nuts, legumes also good sources
- Too much or too little:
  - Too much from supplements or salt substitutes can cause **hyperkalemia** in some individuals
    - Can cause irregular heartbeats, damage heart, and be life-threatening

  - Too little can cause **hypokalemia**
    * Can cause muscle weakness, cramps, irregular heartbeats, and paralysis
    * Can occur as result of excessive vomiting and/or diarrhea, anorexia and/or bulimia eating disorders

8.11 Exploring Calcium

- Most abundant mineral in body
  - More than 99 percent located in bones and teeth
- Functions:
  - Helps build strong bones and teeth
  - Plays a role in muscles, nerves, and blood
  - May help lower high blood pressure
  - May fight colon cancer
  - May reduce risk of kidney stones (though supplements have opposite effect)
- Daily needs:
  - 1,000 to 1,200 mg/day, depending on age
- Food sources:
  - Milk, yogurt, cheese, broccoli, kale, canned salmon (with bones), tofu processed with calcium, calcium-fortified juices and cereals
- Too much or too little:
  - UL: 2,500 mg/day (ages 19-50); 2,000 mg (51+)
  - Too much calcium leads to hypercalcemia: impaired kidneys, calcium deposits in body
  - Too little can lead to less dense, weakened, brittle bones, and increased risk for osteoporosis
- Calcium supplements:

  - Consume in doses of 500mg or less
  - Some sources (oyster shell, bone meal, dolomite) may contain lead, other toxic metals
  - May be inadvisable if consuming enough in foods

8.12 Osteoporosis: Not Just Your Grandmother's Problem

- Bones are living tissue, constantly changing
- Peak bone mass occurs in early adulthood (20s)
  - Then slowly more bone is lost than added
  - As bones lose mass, they become more porous and prone to fractures, leading to osteoporosis
- **Bone mineral density (BMD)** test measaures bone density
  - Low score = **osteopenia** (low bone mass)
  - Very low score = **osteoporosis**
- Risk factors:
  - Gender (females at higher risk due to loss of estrogen after menopause)
  - Ethnicity (Caucasian and Asian-American at higher risk)
  - Age (over 30)
  - Body type (small-boned/petite women at higher risk)
  - Family history of fractures increases risk
  - Level of sex hormones (amenorrhea, menopause, or mena with low levels of sex hormones)
  - Medications: glucocorticoids, antiseizure medications, aluminum-containing antacids, high amounts of thyroid replacement hormones
  - Smoking
  - Low physical activity: 30 minutes per day recommended

  - Alcohol (more than one drink for women, two for men)
  - Inadequate calcium and vitamin D (less than three cups/day of vitamin D-fortified milk or yogurt)

8.13 Exploring Phosphorus

- Second most abundant mineral in body
  - 85 percent in bones; rest in cells and fluids outside cells, including blood
- Functions:
  - Needed for bones and teeth
  - Important component of cell membranes
  - Needed for energy metabolism and stores
  - Acts as a blood buffer
  - Part of DNA and RNA
- Daily needs:
  - Adults: 700 mg/day
- Food sources:
  - Meat, fish, poultry, dairy
  - Abundant in diet
- Too much or too little:
  - UL set at 4,000 mg/day for adults 19 to 50 to prevent **hyperphosphatemia**, which can lead to calcification of tissues; 3,000 mg for those aged 51 or older
  - Too little can result in muscle weakness, bone pain, rickets, confusion, death; would need to be in state of near starvation to experience deficiency

8.14 Exploring Magnesium

- Another abundant mineral in body
  - About half in bones; most of rest inside cells
- Functions:
  - Helps more than 300 enzymes, including energy metabolism
  - Used in synthesis of protein
  - Helps muscles and nerves function properly
  - Maintains healthy bones and regular heartbeat
  - May help lower high blood pressure and reduce risk of type 2 diabetes
- Daily needs:
  - 19 to 30 years: males, 400 mg/day; females, 310 mg/day
  - ¿ 30 years: males, 420 mg/day; females, 320 mg/day
  - Many Americans fall short (80 to 85 percent of needs)
- Food sources:
  - Whole grains, vegetables, nuts, fruits; also milk, yogurt, meat, eggs
- Too much or too little:
  - UL from supplements (not foods) = 350 mg/day to avoid diarrhea
  - Deficiencies are rare, but diuretics and some antibiotics can inhibit absorption

8.15 Exploring Chloride

- Chloride is part of hydrochloric acid in the stomach, which enhances protein digestion
- Functions:

  - Sodium and chloride are major electrolytes outside cells and in blood to help maintain fluid balance
  - Acts as buffer to keep blood at normal pH
- Daily needs: adults: 2,300 mg/day
- Food sources: salt (NaCl) is main source
- Too much or too little: deficiencies are rare
  - UL 3,600 mg/day to match sodium UL

8.16 Exploring Sulfur

- Component of other compounds in body, including the vitamins thiamin, biotin, pantothenic acid
- Functions:
  - Helps give proteins 3-D shape as part of amino acids methionine, cystine, and cysteine
  - Sulfites used as food preservative
- Food sources: meat, poultry, fish, eggs, legumes, dairy, fruits, vegetables
- Too much or too little: no known toxicity or deficiency symptoms

8.17 Exploring Iron

- Most abundant mineral on Earth and main trace mineral in body
- Two forms: heme and nonheme iron
  - Heme iron from animal sources is part of hemoglobin and myoglobin and easily absorbed
  - Nonheme iron in plant foods is not as easily absorbed, due to phytates and other substances
  - Body absorbs only 10 to 15 percent of iron consumed

  - Absorption increases if body stores are low
  - Not excreted in urine or stool; once absorbed, very little leaves body (95 percent recycled, reused)

- Functions:
  - **Hemoglobin** in red blood cells transports oxygen from lungs to tissues and picks up carbon dioxide waste from cells
  - Myoglobin transports and stores oxygen in muscle cells
  - Aids brain function by helping enzymes that make neurotransmitters

- Daily needs:
  - Men and women ¿ 50: 8 mg/day
  - Women 19 to 50: 18 mg/day: higher due to iron lost during menstruation

- Food sources:
  - Iron-enriched bread and grain products; heme iron in meats, fish, and poultry

- Too much or too little:
  - Too much iron from supplements can cause constipation, nausea, vomiting, diarrhea
  - In United States, a leading cause of accidental poisoning deaths in children under 6 years
  - iron overload can damage heart, kidneys, liver, nervous system
  - **Hemochromatosis**, a genetic disorder, can cause iron overload
  - Iron deficiency: most common nutritional disorder in world
  - **Iron-deficiency anemia** occurs when iron stores are depleted and hemoglobin levels decrease

8.18 Exploring Copper

- Functions:
  - Part of many enzymes and proteins
  - Important for iron absorption and transfer, synthesis of hemoglobin and red blood cells
  - Helps generate energy in cells, synthesize melanin, link the proteins collagen and elastin together in connective tissues
  - Helps enzymes protect cells from free radicals
  - Role in blood clotting and maintaining healthy immune system
- Daily needs:
  - Adults: 900 micrograms/day
- Food sources:
  - Organ meats, seafood, nuts, seeds, bran cereals, whole-grain products, cocoa
- Too much or too little:
  - UL: 10,000 micrograms/day
  - Excess can cause stomach cramps, nausea, diarrhea, vomiting, liver damage
  - Copper deficiency rare in United States

8.19 Exploring Zinc

- Involved in function of more than 100 enzymes
- Functions:
  - DNA synthesis, growth, and development
  - Healthy immune system and wound healing
  - Taste acuity
  - Treatment for common cold

  - May reduce risk of age-related macular degeneration

- Daily needs:
  - Men: 11 mg/day; women: 8mg/day
  - Vegetarians may need as much as 50 percent more

- Food sources:
  - Red meat, some seafood, whole grains

- Too much or too little:
  - UL = 40 mg/day
  - As little as 50mg can cause stomach pains, nausea, vomiting, diarrhea
  - 60 mg/day can inhibit copper absorption
  - Excessive amounts can suppress immune system, lower HDL cholesterol
  - Deficiency: hair loss, impaired taste, loss of appetite, diarrhea, delayed sexual maturation, impotence, skin rashes, impaired growth

8.20 Exploring Selenium

- Part of class of proteins called selenoproteins, many of which are enzymes

- Functions of selenoproteins:
  - Help regulate thyroid hormones
  - Act as antioxidants
  - May help fight cancer

- Daily needs: adults: 55 micrograms/day

- Food sources: meat, seafood, cereal, grains, dairy foods, fruits, vegetables
  - Amount varies depending on soil content

- Too much or too little:
  - UL = 400 micrograms/day
  - Too much can cause toxic condition **selenosis**
    - Symptoms: brittleness and loss of nails and hair, stomach and intestinal discomfort, skin rash, garlicky breath, fatigue, nervous system damage
  - Selenium deficiency is rare in United States
    - Deficiency can cause **Keshan disease** (heart damage): seen in children in rural areas that have selenium-poor soils

8.21 Exploring Fluoride

- Functions:
  - Protects against dental caries
    - Helps repair enamel eroded by acids from bacteria
    - Reduces amount of acid bacteria produce
    - Provides protective barrier
  - Fluoridated drinking water has reduced dental caries in United States
- Daily needs:
  - Men: 3.8 mg/day
  - Women: 3.1 mg/day
- Sources: food are not a good source
  - Best source is fluoridated drinking water and beverages made with this water
- Too much or too little:
  - Too little increases risk of dental caries
  - Too much can cause **fluorosis** (mottling/staining) when teeth are forming during infancy/childhood

        * Fluorosis of bones can occur when ¿ 10 mg/day is consumed for 10 or more years
    - UL: adults: 10 mg/day, much lower for infants and children

8.22 Exploring Chromium

- Functions:
    - Helps insulin in your body
        * Increases effectiveness in cells
- May improve blood glucose control, but no large study confirms this theory
    - Small study suggests chromium supplement may reduce risk of insulin resistance
    - FDA allows a **Qualified Health Claim** on chromium supplements, but label must state that evidence is not certain
    - Does not help build muscle mass
- Daily needs:
    - Men: 30 to 35 micrograms
    - Women: 20 to 25 micrograms
- Food sources: grains, meat, fish, poultry, some fruits and vegetables
- Too much or too little:
    - No known risk from consuming too much
    - Deficiency is rare in United States

8.23 Exploring Iodine

- Functions: needed by thyroid to make essential hormones
    - Thyroid hormones regulate metabolic rate; help heart, nerves, muscle and intestine function properly

- Daily needs: adults: 150 micrograms/day
- Food sources: iodized salt (400 micrograms/tsp)
  - Amount in foods in low; depends on iodine content of soil, water, fertilizer
  - Salt-water fish have higher amounts
- Too much or too little: UL = 1,100 micrograms/day
  - Excess iodine can impair thyroid function, decrease synthesis and release of thyroid hormones
  - Early sign of deficiency = **goiter** (enlarged thyroid gland)
    * Mandatory iodization salt has decreased iodine deficiency in Untied States but not in other parts of world
    * Iodine deficiency during early stages of fetal development can cause **cretinism** (congenital hypothyroidism)

8.24 Exploring Manganese

- Part of, or activities, many enzymes, in body
- Functions:
  - Helps metabolize carbohydrates, fats, amino acids
  - Aids bone formation
- Daily needs:
  - Men: 2.3 mg/day
  - Women: 1.8 mg/day
- Food sources: Whole grains, nuts, legumes, tea, vegetables, pineapples, strawberries, bananas
- Too much or too little:
  - UL = 11 mg/day to avoid toxicity with Parkinson's disease-like symptoms

8.25 Exploring Molybdenum

- Functions: part of several enzymes involved in breakdown of certain amino acids and other compounds
- Daily needs: adults: 45 micrograms/day
- Food sources: legumes, grains, nuts
- Too much or too little:
  - UL = 2 mg/day, based on animal studies in which too much molybdenum caused reproductive problems
  - No cases seen in healthy individuals

8.26 Other Minerals

- Arsenic, boron, nickel, silicon, and vanadium
  - Exist in body but essential role in humans not established by research
  - May have function for some animals
  - Tolerable upper levels set for:
    - Boron: 20 mg/day (10 times more than average American consumes)
    - Nickel: 1mg/day
    - Vanadium: 1.8 mg/day

9 Chapter 9: Alcohol

9.1 What Is Alcohol and How Is It Made?

- **Alcohol** is **not** an essential nutrient
- **Ethanol** is the type of alcohol consumed in alcoholic beverages
  - Methanol (in antifreeze) and isopropanol (rubbing alcohol) are both poisonous to humans

  - Ethanol is safe for consumption, but excessive amounts are toxic and can be fatal
  - Made by **fermentation** of yeast and natural sugars in grains (beer) and fruits (wine)
    * Liquor is concentrated alcohol collected through **distillation**

9.2 Why Do People Drink Alcohol?

- People drink to relax, celebrate, and socialize
- **Social drinking:** drinking patterns that are considered acceptable by society
- Moderate alcohol consumption may have health benefits: may reduce risk of heart disease
  - **Moderate alcohol consumption:** no more than one drink daily for adult women, two for men
  - Alcohol can increase HDL cholesterol and may make blood platelets less "sticky": less likely to form unwanted blood clots
  - Health benefits only shown in women ¿= 55 years of age and men ¿= 45 years old, not in younger people
- Moderate consumption is based on standard drink sizes, which contain about half an ounce of alcohol
- A standard drink is one of the following:
  - 12-ounce serving of beer
  - 1.5-ounce shot of liquor
  - 5-ounce glass of wine
- Moderate drinkers should pay attention to:
  - Size of drinks
  - Frequency of drinking
    * Abstaining from alcohol for several days, then overdrinking one day is **not** moderate drinking

9.3 What Happens to Alcohol in the Body?

- Alcohol is a toxin, and the body works quickly to metabolize and eliminate it
- You absorb alcohol in your stomach and small intestine
  - Some alcohol is metabolized by **alcohol dehydrogenase** enzyme in the stomach before it's absorbed
  - Women are more susceptible to effects of alcohol than men
    - Have 20 to 30 percent less alcohol dehydrogenase than men, so absorb more alcohol in stomach
  - Food in stomach slows alcohol absorption
  - About 80 percent of alcohol is absorbed in the small intestine
- You metabolize alcohol primarily in your liver: one standard drink is metabolized in 1.5 to 2 hours
  - Alcohol dehydrogenase converts alcohol to **acetaldehyde** (eventually metabolized to CO2 and water)
  - The **microsomal ethanol-oxidizing system** (MEOS) also metabolizes alcohol and is revved up when chronically high levels of alcohol are present in liver
- Alcohol circulates in your blood until metabolized
  - **Blood alcohol concentration (BAC)** correlates with amount of alcohol in your breath
- Effects of alcohol on your brain
  - Depressant of central nervous system
  - Slows down transmission of nerve impulses and reaction time to stimuli
  - Impairs thoughts, actions, behavior
  - The more consumed, the more areas of brain affected
  - If enough consumed, activities of brain stem are suppressed (breathing, heart rate), resulting in death

9.4 How Can Alcohol Be Harmful?

- Alcohol can disrupt sleep and cause hangovers
  - Even moderate amount in late afternoon/evening can disrupt sleep cycle
- Alcoholic beverages may contain **congeners**, which contribute to hangover symptoms
  - Symptoms: headache, fatigue, nausea, increased thirst, rapid heart beat, tremors, sweating, dizziness, depression, anxiety, irritability
- Alcohol is a diuretic; can cause dehydration and electrolyte imbalances
- Alcohol can interact with hormones
  - Interferes with insulin and glucagon that regulate blood glucose level
  - Negatively affects parathyroid hormone and other bone-strengthening hormones; can increase risk of osteoporosis
  - Can increase estrogen levels in women; may increase risk of breast cancer
  - Affects reproductive hormones and associated with both male and female sexual dysfunction
  - Alcohol may lead to overnutrition and malnutrition
    - Provides 7 calories per gram, contributing to weight gain
      - Increases fat and weight around stomach
    - Alcohol calories can displace nutritious foods
    - Excessive alcohol can interfere with absorption and/or use of protein, zinc, magnesium, thiamin, folate, and vitamins B12, A, D, E, K
      - Thiamin deficiency affects brain function and increases risk of Wernicke-Korsakoff syndrome
- Alcohol can harm your digestive organs, heart, and liver
- Excessive amounts of alcohol can cause:

  - Inflammation of esophagus
  - Cancers of the esophagus, mouth, and throat
  - **Gastritis** and stomach ulcers
  - Hyptertension and damage to heart tissue
  - Increased **endotoxin**
  - **Alcoholic liver disease**
    * Three stages: **fatty liver, alcoholic hepatitis**, cirrhosis

- Alcohol can put a healthy pregnancy at risk
  - Exposure to alcohol prenatally can cause **fetal alcohol spectrum disorders (FASDs)**
    * Most severe form is fetal alcohol syndrome (FAS)
      · Causes physical, mental, and behavioral abnormalities
    * Effects of FASDs are permanent
    * The only proven, safe amount of alcohol a pregnant woman can consume is **none**

9.5 What is Alcohol Use Disorder?

- **Alcohol use disorder (AUD)** is the continuation of alcohol consumption even though this behavior has created social, psychological, and/or physical health problems.

- **Binge drinking**, drinking and driving, and underage drinking are situations in which alcohol is being abused.

- Binge drinking: consumption of 5 or more drinks by men, 4 by women, in about two hours
  - Increased likelihood of injuries, car accidents, drowning, unplanned sexual activity, death
  - Associated with sexual aggression, assaults, suicide, homicide, child abuse, and health problems (hypertension, heart attack, sexually transmitted disease)

- Binge drinking

  - Can cause **blackouts** and lead to alcohol poisoning
  - Chronic drinking can lead to alcohol tolerance
    * Brain becomes less sensitive to alcohol, needing more to get same intoxicating effect

- Drinking and driving: illegal to drive with BAC of 0.08
  - One drink impairs alertness, judgment, coordination

- Underage drinking
  - Inreases risk of violence, injuries, health risks
  - Can also interfere with brain development and lead to cognitive and memory damage in teenagers
  - Underage drinking and driving is extremely risky
  - The earlier in life a person starts drinking, the higher the risk for alcoholism

9.6 How to Get Help for AUD

- Research has shown that support from a provider can reduce alcohol consumption for those with mild AUD
- Those with more severe AUD may need to seek specialized counseling as well as medical support
- Some individuals have found success with ongoing support programs such as Alcoholics Anonymous (AA)

9.7 Some People Should Avoid Consuming Alcohol

- According to the **Dietary Guidelines for Americans**, the following people should also abstain from drinking alcohol:
  - Women of childbearing age who may become pregnant
  - Pregnant women
  - Children and adolescents

  - Those taking medications that can interact with alcohol, which include prescription and over-the-counter medications
  - Those with specific medical conditions, such as liver disease
  - Those engaging in activities that require attention, skill, or coordination, such as driving or operating machinery
  - Those who cannot restrict their alcohol intake

10 Chapter 10: Weight Management and Energy Balance

10.1 What Is a Healthy Weight and Why Is Maintaing It Important?

- **Healthy weight:** body weight relative to height that does not increase the risk of developing weight-related health problems or diseases
  - **Weight management:** maintaining weight within a healthy range
  - **Overweight:** 10 to 15 pounds more than healthy weight
    - More than 70 percent of Americans are overweight
  - **Obesity:** 25 to 40 pounds more than healthy weight
    - Over 37 percent of those Americans are obese
    - Classified as a disease by the AMA in 2013
- Being overweight increases risk of:
  - Hypertension and stroke
  - Heart disease
  - Gallbladder disease
  - Type 2 diabetes
  - Osteoarthritis
  - Some cancers
  - Sleep apnea
- Losing 5 to 10 percent of body weight can produce health benefits

  - Lower blood pressure, cholesterol, and glucose

- **Underweight:** weighing too little for your height
  - May be caused by excessive calorie restriction and/or physical activity, underlying medical condition, emotional stress
  - Increases risk for osteoporosis
  - Risks for:
    * Young adults: nutrient deficiencies, electrolyte imbalance, low energy levels, decreased concentration
    * Older adults: low body protein and fat stores, depressed immune system, medical complications

10.2 How Do You Know If You're at a Healthy Weight?

- BMI measurements can provide a general guideline:
  - Body mass index
    * BMI ¿= 25 is overweight: modest increase in risk of dying from diseases
    * ¿= 30 is obese: 50 to 100 percent higher risk of dying prematurely compared to healthy weight
    * ¡ 18.5 is underweight; can also be unhealthy
  - May not be accurate for everyone
  - Does not directly measure body fat percentage
- Measure your body fat and its location
  - Average healthy adult male between 20 and 49 years of age: 16 to 21 percent of weight is body fat
  - Average healthy female: 22 to 26 percent body fat
- Techniques to measure body fat include skinfold thickness measurements and bioelectrical impedance
- **Central obesity** (excess **visceral fat**) vs **subcutaneous fat**, increases risk of heart disease, diabetes, hypertension

  - Measure waist circumference

- There are many ways to measure percentage of body fat

10.3 What Is Energy Balance and What Determines Energy Needs?

- Energy balance is calories in versus calories out
  - **Positive energy balance:** more calories consumed than expended (leads to fat storage, weight gain)
    - **Energy excess**
  - **Negative energy balance:** more calories expended than consumed (leads to weight loss)
    - **Energy deficit**
- Energy needs are different for everyone
  - Energy needs comprise:
    - Basal metabolism
    - Thermic effect of food
    - Physical activities
- Your basal metabolic rate **(BMR)** is the minimum amount of energy you need to function
  - Amount needed to meet basic physiological needs, keep you alive
  - Makes up about 60 percent of total energy needs
  - Many factors affect BMR, chiefly **lean body mass**
- The **thermic effect of food** affects your energy needs
  - Amount of calories expended to digest, absorb, and process fodd (about 10 percent of calories in food eaten)
- Physical activity will increase your energy needs
  - Energy expended by sedentary people = less than half of BMR

  - Very active athletes can expend twice BMR
    * Exercise causes small increase in energy expenditure after activity has stopped

- Calculating your energy needs:
  - **Estimated energy requirement (EER):** daily energy need based on age, gender, height, weight, activity level

10.4 Energy Imbalances over Time Can Lead to Changes in Body Weight

- Reducing calories can lead to weight loss
  - Stored glycogen and fat are used as fuel sources
    * Amino acids from body protein breakdown can be used to make glucose
    * Prolonged fast depletes all liver glycogen
    * Ketone bodies generated from incomplete breakdown of fat
    * Fat stores and about one-third of lean tissue mass depleted in about 60 days

10.5 What Are the Effects of an Energy Imbalance?

- Excess calories can lead to weight gain
  - Excess calories are stored as fat, regardless of source
    * Limited capacity to store glucose as glycogen
    * Can't store extra protein
    * Unlimited capacity to store fat
      · Body contains about 35 billion fat cells, which can expand

10.6 What Factors Are Likely to AffBody Weight?

- Factors in weight management: what and how often you eat, physiology, genetics, environment
- Hunger and appetite affect what you eat

  - Appetite is psychological desire for food
  - Hunger is physiological need for food; subsides as feeling of **satiation** sets in
    * **Satiety** determines length of time between eating episodes

- Physiological mechanisms help regulate hunger
  - Many hormones play a role:
    * **Ghrelin:** produced in stomach when empty; increases hunger
    * When fat stores increase, **leptin** in fat tissue signals brain to decrease hunger and food intake
    * **Cholecystokinin:** released when stomach is distended, increasing feelings of satiation, decreasing hunger
  - Protein, fatty acids, and monosaccharides in small intestine stimulate feedback to brain to decrease hunger
  - Insulin also causes brain to decrease hunger

- Many people override feedback mechanisms, resulting in energy imbalance

- Genetics partially determines body weight
  - Risk of becoming obese doubles if parents are overweight, triples if obese, five times greater if severely obese
  - Confirmed by studies of identical twins separated at birth

- Genetic differences in level or function of hormones, such as high ghrelin or low leptin levels, increase obesity
  - Many obese have adequate leptin, but brain has developed resistance to it

- Genetic differences **in non-exercise-associated thermogenesis (NEAT):** energy expenditure in nonexercise movements, such as fidgeting, standing, chewing gum

- "Set point" theory holds that body opposes weight loss and works to maintain a set weight

- Environmental factors can increase appetite and decrease physical activity
- Environmental of cheap and easily obtainable energy-dense foos stimulates appetite
  - **Gene-environment interaction:** increases risk of obesity in some people
- We work more and cook less
  - 32 percent of calories come from ready-to-eat foods prepared outside of home
  - Frequent dining out associated with higher BMI
- We eat more (and more)
  - Increased availability of food-service establishmentsand access to large variety of foods, larger portions encourage people to eat more
- We sit more and move less
  - Americans are eating about 600 calories/day more than in 1970
  - Labor-saving devices at work and home, sedentary leisure activites ("screen time") result in decreased energy expenditure

10.7 How Can You Lose Weight Healthfully?

- National Institutes of Health: overweight individuals should aim to lose about 10 percent of body weight over 6-month period
  - Example: 180-pound person should lose 18 pounds/6 months = 3 pounds/month, 0.75 pounds/week
  - To lose 1 pound of body fat, need 3,500-calorie deficit
    - For a weight loss of 0.5 to 1 pounds/week, need to decrease daily calories by 250 to 500 calories
- Fad diets promise dramatic results but may carry risks

- Successful long-term weight loss requires changes in diet, physical activity, behavior
- Eat smart, because calories count: add satiation to low-calorie meals by including higher-volume foods
  - Eat more vegetables, fruit, and fiber
  - Include some protein and fat in your meals
    - Protein increases satiety most
    - Fat slows movement of food from stomach into intestines
    - Choose lean meat, skinless chicken, fish, nuts, unsaturated oils
- Use MyPlate as a weight-loss guide
  - High volume of fruits, vegetables, whole grains, some lean protein, modest amounts of fat
  - Diet should contain variety of foods from all food groups
    - Replace higher-calorie foods with lower-calorie options from each food group
      - Example: replace full-fat dairy with nonfat products
      - Replaces sodas with water
- Move to lose
  - 45 minutes/day of moderate-intensity activities can prevent becoming overweight and aid in weight loss
    - 10,000 steps/dat can reduce risk of becoming overweight
- Break bad habits
  - **Behavior modification:** change behaviors that contribute to weight gain or impede weight loss
    - Techniques include keeping food log, controlling environments cues that trigger eating, managing stress

10.8 Examining the Evidence: Evaluating Popular Diets

- Reduction of calories, not composition of diet, is key to weight loss
- People who diligently adhere to diets lose the most weight
  - High dropout rates for most extreme diets (Atkins and Ornish diets)
- Beware of fad diet claims and hype:
  - "It's carbs, not calories, that make you fat!"
  - "Lose seven pounds in one week!"
  - Celebrity-endorsed miracle weight-loss products
  - "Natural" substances help lose weight without risk

10.9 Dealing with Extreme Obesity

- BMI ¿ 40 = extreme obesity
  - High risk of heart disease, stroke, dying
  - Requires aggressive weight-loss treatment, including very-low-calorie diets, medications, and/or surgery
  - **Very-low-calorie diets** (¡ 800 calories) are short-term and must be medically supervised
  - Medications such as Orlistat, Belviq, and Qsymia can't replace a lower-calorie diet, physical activity, and behavior modification
    - However, they impact appetite and help individuals lose from 3-9 percent of their body weight wehn combined with diet and exercise
- Gastric bypass and gastric banding result in higher levels of satiety and lower levels of hunger
  - Results in dramatic weight loss and reduction of hypertension, diabetes, high blood cholesterol, and sleep apnea
  - Small risk of gallstones, death from surgery

- Liposuction is performed for cosmetic reasons
  - Fat may reappear; results are not permanent
  - Complications such as infections, scars, swelling

10.10 How Can You Maintain Weight Loss?

- **Weight cycling** (repeated gain and loss of body weight) is common result of fad diets
- Weight loss can be maintained if healthy habits used during weight loss are maintained
  - National Weight Control Registry
- New, lower weight requires fewer calories to maintain weight
  - Physical activity can close the **"energy gap,"** which is easier than further reducing caloric intake
    - estimated that the energy gap is about 8 calories per pound of lost weight
- Gaining weight for the underweight is as challenging as losing weight is for the overweight
- Need to add at least 500 calories to daily energy intake for gain 1 pound/week
  - Choose more energy-dense, but nutritious foods from each food group
    - Examples: waffle instead of toast, coleslaw instead of cabbage
  - Eat more snacks during day to add more calories

10.11 What Is Disordered Eating and What Are the Warning Signs?

- **Disordered eating:** abnormal and potentially harmful eating behaviors that do not meet specific criteria for eating disorders

- **Eating disorders:** psychological illnesses that involve specific abnormal eating behaviors and other factors
  - In United States, about 20 million women and 10 million men struggle with eating disorders at some point in life
    - Most are adolescent or young adult white, middle- or upper-middle-class females, but increasing among males, minorities, other age-groups
- No single factor causes eating disorders
- Sociocultural factors
  - Dseire/social pressure to be thin or "cut"
- Genetic factors
  - Eating disorders "run in families"
- Psychological factors
  - Depression, anxiety, perfectionism, sense of control contribute
- **Anorexia nervosa** results from severe calorie restriction
  - Self-starvation and excessive weight loss
  - Intense fear of being "fat"
  - Distorted body image: see oneself as fat when underweight
  - Health consequences: electrolyte imbalance (low blood potassium) can be fatal
  - Other risks: decrease in heart rate and blood pressure, **lanugo** (downy hair), osteoporosis
- **Bulimia nervosa** involves cycle of binge eating and purging
  - **Purging** can include self-induced vomiting; excessive exercising; strict dieting or fasting; abuse of diet pills, laxatives, diuretics
    - Vomiting can cause tears in esophagus, swollen parotid glands, tooth decay, gum disease, broken blood vessels in eyes

  - Potentially fatal electrolyte imabalance can result

- **Binge eating disorder** involves compulsive overeating (without purging)
  - Eat in secret, feelings of shame
  - Health effects are those associated with obesity
    * High blood pressure, cholesterol levles
    * Risk of heart disease, type 2 diabtes, gallbladder disease

- Other disordered eating behaviors can be harmful

- **Avoidant/Restrictive Food Intake Distorder (ARFID)**

- **Pica:** desire to consume nonnutritive substances (clay, dirt, chalk)
  - Can cause medical complications

- **Other Specified Feeding or Eating Disorder (OSFED)**
  - Purging disorder
  - Atypical Anorexia Nervosa
  - **Orthorexia:** "healthy or righteous eating"
    * Fixation on eating the "right" foods
  - **Night eating syndrome:** combination eating, sleep, mood disorder
    * Person consumes most calories after evening meal, wake up at night to eat

- There are some common signs of disordered eating
  - Hair loss
  - Significant/sudden weight changes
  - **Russell's sign:** scar tissue on knuckles of fingers used to induce vomiting (bulimia nervosa)
  - Avoiding social situations where food is present
  - Weighing often, obsessibely counting calories

  - Denial of problem

- Eating disorders can be treated
- Multidisciplinary team approach is most effective
  - Psychological, medical, and nutrition professionals
  - Nutritional approaches include:
    * Identifying binge triggers, safe and unsafe foods, hunger and fullness cues using food journals
    * Meal plans to ensure adequate calorie/nutrient intake (anorexia nervosa) or to avoid overeating (bulimia nervosa, binge eating disorder)
  - Best treated in early stages; no "quick fix"

10.12 A Closer Look at Body Image

- Body image is the way you perceive and what you believe about your physical appearance
- **Body dysmorphic disorder:** is a mental illness in which a person's preoccupation with minor or imaginary physical flaws cause signifcant distress
- Strategies to help maintain a positive body image:
  - Know and accept what determines your physical appearance (genetics, age, etc.)
  - Avoid dieting
  - Avoid comparing yourself to others
  - Recognize that you are a whole person and not just individual aprts
  - Respect yourself and others based on the qualities of character and accomplishments, rather than appearance

11 Chapter 11: Nutrition and Fitness

11.1 What Is Physical Fitness and Why Is It Important?

- **Physical fitness:** good health or physical condition, primarily the result of **exercise** and proper nutrition
- Physical fitness has five basic components:
  - **Cardiorespiratory endurance:** ability to sustain cardiorespiratory exercise for extended time
    - Examples: running, biking
    - Cardiovascular and respiratory systems must provide enough oxygen and energy to muscles
  - **Muscle strength:** ability to produce force for brief time
- **Muscle endurance:** ability to exert force for a long period of time without fatigue
  - Muscle strength and endurance best achieved with strength training
- **Flexibility:** range of motion around a joint
  - Improved with stretching
- **Body composition:** proportion of muscle, fat, water, and other body tissues that make up body weight
- Physical fitness provides numerous benefits
  - Helps achieve and maintain healthy body weight
  - Reduces risk of cardiovascular disease, type 2 diabetes, and some types of cancer
  - Improves body composition, bone health, and immune system
  - Improves overall health, such as more restful sleep and stress reduction
- Over half of adults in United States do not meet regular physical activity recommendations

11.2 What Does a Physical Fitness Program Look Like?

- Cardiorespiratory exercise can improve cardiorespiratory endurance and body composition
  - Continuous activities that use large muscle groups
    - Examples: high-impact aerobics, stair climbing, brisk walking
    - Primarily aerobic because it uses oxygen
      - Heart rate and stroke volume increased to maximize blood flow delivery to muscles
- Strength training can improve muscle strength, muscle endurance, and body composition
  - To increase muscle strength: low number of repititions using heavy weights
  - To increase muscle endurance: high number of repititions using lighter weights
  - Important to rest between sets of an exercise and between workouts to prevent muscle strains and injury
- Stretching can improve flexibility
- The **FITT Principle** can help you design a fitness program: Frequency, Intensity, Time, Type
  - **Rate of perceived exertion** (RPE) is a self assessment that measures intensity of cardiorespiratory exercise
  - **Target heart rate** shows exercise intensity through heart rate (percentage of maximum)
  - **Repetition maximum** (RM) refers to intensity of strength training
- **Physical Activity Guidelines:** 60 miniutes/week of moderate-intensity activity for some health benefits; 150 minutes/week for substantial benefits and reduced risk of chronic disease
  - 60 to 90 minutes daily to lose weight effectively

- The **progressive overload principle** can help improve fitness over time
  - The body adapts to physical activities, producing fitness plateau
  - Modify one or more FITT principles to increase exercise and improve fitness

11.3 How Are Carbohydrate, Fat, and Protein Used during Exercise?

- Energy during first few minutes of physical activity is provided by **anaerobic energy production** (without oxygen) from breakdown of:
  - **Adenosine triphosphate (ATP)**
  - **Creatine phosphate**
    - Limited amount stored in cells
- As exercise continues, oxygen intake and aerobic energy production increase
  - Carbohydrate (glucose) and fatty acids broken down to yield ATP energy via aerobic metabolism
- Carbohydrate is the primary energy source during high-intensity exercise
  - Carbohydrate from blood glucose and stored glycogen in muscle and liver: about 2 hours of exercise
  - Well-trained muscles store 20 to 50 percent more glycogen than untrained muscles
  - Liver glycogen maintains normal blood glucose
  - Lactic acid is produced at high exercise intensities and shuttled to other tissues
    - Used for energy during low-intensity exercise
- Intensity affecfts how much glucose and glycogen you use
  - Glucose and glycogen use increases as intensity increases

- How much carbohydrate do you need for exercise?
  - Depends on duration of activity
    - During and/or after activity: bananas, bagels, corn flakes that are absorbed quickly
    - 2 hours before exercise: rice, oatmeal, pasta, corn enter blood more slowly for sustained energy
- Fat is the primary energy source during low-intensity exercise
  - Two forms: fatty acids (from triglycerides) in adipose tissue and in muscle tissue
  - Converting fatty acids into energy is slow and requires more oxygen compared with carbohydrate
- Intensity and training affect how much fat you use
  - Low-intensity exercise uses mostly fat from adipose tissue
  - Moderate-intensity exercise also uses fatty acids from muscle triglycerides
  - Well-trained muscles burn more fat than less trained muscles
    - Body uses less glycogen and more fat, increases endurance
- How much fat do you need for exercise?
  - 25 to 30 percent of calories should come from fat
    - Consume unsaturated fats and limit saturated fat to ¡= 10 percent of total calories
    - Too little fat (¡20 percent) has nutritional risks
- **Fat-burning zone:** 65 to 73 percent of maximum heart rate
- **"Cardio" zone:** ¿73 percent of maximum heart rate
- Not necessary to stay in fat-burning zone to lose weight
  - Need to burn calories to produce overall calorie deficit
  - High-intensity exercise burns calories more quickly but lower-intensity workout can last longer and achieve more

- Protein is primarily needed to build and repair muscle
  - Muscle damage results from exercise, especially in weight or strength training
  - Amino acids needed to promote muscle growth and recovery
- Body can use protein for energy but prefers carbohydrate and fat as main energy sources
  - Amino acids are converted to glucose in liver
- Endurance athletes need 1.2 to 1.4 g of protein per kg of body weight
- Resistance/strength activities: 1.2 to 1.7 g/kg body weight
- Total calorie needs depend on the type and schedule of exercise
- Timing of meals affects fitness performance
  - Optimal food choices vary before, during, and after exercise

11.4 How Does the Timing of Meals Affect Fitness and Athletic Performance?

- Optimal foods before exercise
  - Allow adequate time for digestion
    - Large meal: 3 to 4 hours
    - Smaller meals: 2 to 3 hours
    - Snack or liquid supplement: 0.5 to 1 hour
- Pre-exercise meal: 1 to 4.5 g carbohydrate/kg body weight, 1 to 4 hours before exercise
  - Carbohydrate 15 to 30 minutes before gives muscles immediate energy, spares glycogen stores, helps reduce muscle damage
  - Consuming protein before exercise as well as during exercise increases muscle glycogen synthesis and protein synthesis after exercise is over

  - High-fat foods should be avoided before exercise: take longer to digest, may cause stomach discomfort and sluggishness

- Optimal foods during exercise
  - For exercise ¿ 1 hours, begin carbohydrate intake shortly after start and every 15 to 20 minutes
    - 30 to 60 g carbohydrate/hour to avoid fatigue
  - Glucose, sucrose, maltodextrin are best choices for quick absorption
    - Avoid fructose, which can cause GI problems
  - Consuming both carbohydrate and protein is best for muscle maintenance and growth

- Optimal foods after exercise
  - The best post-exercise meal is consumed quickly and contains both carbohydrate and protein:
    - Carbohydrate/protein ratio of 3:1 is ideal to promote muscle glycogen and protein synthesis and faster recovery time
  - Preferred protein choice: whey protein (in milk) is absorbed rapidly and contains all essential amino acids needed

- When consuming small snack or liquid supplement after exercise, should have high-carbohydrate, moderate-protein, low-fat meal within 2 hours

11.5 What Vitamins and Minerals Are Important for Fitness

- Vitamins and minerals play major role in metabolism of carbohydrate, fat, and protein for energy during exercise

- Some also act as antioxidants and help protect cells from the oxidative stress that can occur with exercise

- Antioxidants and cellular damage caused by exercise
  - Using more oxygen during exercise increases free radicals that damage cells

        * Supplements of antioxidant vitamins E and C not shown to improve athletic performance or decrease oxidative stress in highly trained athletes
        * Consume adequate amounts (RDA) from nuts, vegetable oils, broccoli, citrus fruits

- Some minerals can be of concern in highly active people
- **Iron:** Low iron levels can reduce hemoglobin and blood's ability to transport oxygen to cells, causing early fatigue during exercise
    - Female athletes more at risk for iron-deficiency anemia
        * Also long-distance runners, those in "make weight" sports and other sports
        * Iron-rich foods and iron supplements may be needed
    - "Sports anemia": Decreased hemoglobin can result from strenuous training due to increased blood volume
        * Not same as iron-deficiency anemia and is self-correcting
- **Calcium:** important to reduce risk of bone fractures
    - Calcium is lost in sweat
    - Exercise can increase bon mineral content and may be able to compensate for calcium lost in sweat
    - **Magnesium:** Higher needs with physical activity
    - Supplements not recommended unless food intake is inadequate
- Vitamin and mineral supplements are generally not necessary
    - Everyone, not just athletes, should obtain vitamins and minerals through nutrient-dense foods before considering the use of supplemennts

11.6 How Does Fluid Intake Affect Fitness?

- Fluid and electrolyte balance and body temperature are affected by exercise

  - Water is lost through sweat and exhalation
  - Sodium and chloride, and to a lesser extent potassium, are electrolytes lost in sweat
    * Electrolyte imbalance can cause heat cramps, nausea, lowered blood pressure, edema
  - Evaporation of sweat helps cool the body
    * Hot, humid weather reduces evaporation and body heat increases: increases risk of heat exhaustion and heat stroke

- You need fluids before, during, and after exercise
  - The American College of Sports Medicine has specific recommendations for how much fluid to drink before and during exercise

11.7 Some Beverages Are Better Than Others

- Sports drinks contain 6 to 8 percent carbohydrate and sodium and potassium: beneficial in long endurance events
  - For events less than 60 minutes, water is sufficient to replace fluids, and post-exercise food will replace electrolytes
  - Sports drinks should be avoided as a daily beverage: damage tooth enamel, provide unwanted calories
- Not recommended during physical activity: fruit juice (too high carbohydrate concentration); carbonated drinks (bloating); alcohol and caffeine (diuretics, unwanted side effects)

11.8 Consuming Too Little or Too Much Fluid Can Be Harmful

- Thirst is not a good indicator of fluid needs for athletes
  - **Acute dehydration:** when not adequately hydrated over a short period of time
  - **Chronic dehydration:** when not adequately hydrated over extended period of time

    - Fatigue, muscle soreness, poor recovery from workout, headaches, nausea, dark urine

- **Hyponatremia:** low sodium blood levels due to consuming too much water without electrolytes

11.9 Can Dietary Supplements Contribute to Fitness?

- Dietary supplements are not strictly regulated by FDA
  - Manufacturers not required to prove safety or efficacy of supplement claims
- Dietary supplements and ergogenic aids may improve performance, but can have side effects
  - **Creatine:** research data mixed on enhancement of performance
    - Improves high-intensity, short-duration activities (like weight training) that rely on anaerobic metabolism
- **Caffeine** enhances athletic performance, mostly during endurance events.
  - Stimulates central nervous system, breakdown of muscle glycogen, may increase fatty acid availability
  - Considered a banned substance by some athletic associations
- **Anabolic steroids:** testosterone-based substances that promote muscle growth and strength (anabolic effect)
  - Androgenic effect (testosterone-promoting): hormone imbalance causes undesirable side effects in both men and women; also health risks
- **Growth hormone:** little research on effects on athletic performance, results mixed
  - Increases muscle mass and reduces body fat but does not increase muscle strength
  - Excess can cause acromegaly and serious health issues

- **Erythropoietin and blood doping:** to increase oxygen-carrying capacity of the blood
  - Can increase blood viscosity, increase risk of stroke and heart attack
- Sports bars, shakes, and meal replacers may provide benefits
  - The main energy source in most sports bars and shakes is carbohydrate, with protein and fat contributing smaller amounts of energy
  - Convenient alternative, but more expensive than whole foods
    * Often include vitamins and minerals, which may be unneeded

12 Chapter 12: Consumerism and Sustainability: From Farm to Table

12.1 How Do Advertising and Marketing Influence Your Food Choices?

- As **food consumers**, we have influence over **food industry**, but advertising and marketing control many of our choices
- Food companies spend close to 10 billion dollars annually to promote their products
  - Much promotion for nutritionally dubious products
  - Advertising for fruits, vegetables almost nonexistent
    * Yale Rudd Center for Food Policy and Obesity Fast Food Facts in 2012
      · McDonald's spent 3x as much advertising on products as did others advertising fruit, vegetables, bottled water, or milk
- College-aged and young adults are increasingly targets of advertisers

12.2 Where Does Your Food Come From?

- Much of your food comes from small, family-run American farms
  - To be a farm in the United States, must produce and sell at least 1,000 dollars of agricultural products/year
  - Just over 2 million farms, most in Midwest, Great Plains, California
    - 80,000 fewer farms in 2012 than in 2007, continues to decline
  - Fewer than 960,000 Americans farmers (1 percent of population) produce food for population of 300+ million
- Challenges of farming
  - High costs
  - Demand for low food prices
  - Competition
  - Dependence on nature's cooperation
- Technology, government support aid farmer
  - Computers, Internet allow for **precision agriculture**
  - Government subsidies for commodity crops (e.g. corn, soybean, and wheat)
- The role of agribusiness
  - **Agribusiness:** blending of agricultural and business entities that affect how food, clothes, home goods are developed, processed, distributed, and purchased
    - Food portion includes food production, agricultural chemicals, finance and trade, management, environmental considerations, land development
  - Agriculture sector employs about 11 percent of U.S. population 21 million Americans
    - Food processing companies comprise large share
- Crops grown for food

  - Top three food crops in United States: corn, soybeans, wheat
    * World's largest corn producer: 10 billion bushels from ¿ 400,000 farms in **Corn Belt**
      · Most of the corn in the U.S. ends up as feed for livestock, poultry, and fish
    * 50 percent of world's soybeans from ¿ 290,000 U.S. farms
      · 70 percent of soybeans used to feed livestock
    * 13 percent of world's wheat from ¿ 160,000 farms in Great Plains
      · 70 percent used for food, 22 percent used for animal feed, rest used to replenish crops
  - Most staple crops used for animal feed, not humans
- Animals raised for food on **feedlots**
  - Dominant food animals in United States: cows, pigs, chickens
- Exporting foods: the good and bad news
  - U.S. farmers help feed world
    * Estimated 30 percent of farm income from foreign trade
  - Also exporting unhealthy eating habits
    * Shift to high-calorie, high-fat, processed food diet
    * **Globesity** (growing incidence of obesity worldwide) becoming a global threat
- Food production outside the United States
  - U.S. exports more agricultural products than it imports
    * Most coffee, cocoa, and spices in the U.S. is imported from other countries
    * Most coffee comes from Colombia and Brazil
- Importing foods: the good and bad news
  - Two primary reasons for U.S. food imports
    * Demand for variety of products year round

        * Demand for cheap food
    - Problems:
        * Environmental costs of long-distance shipping
        * Potential for food contamination overseas
            · Because of the tremendous volume of imports, the FDA only inspects less than 2 percent of all food products brought into the United States

12.3 What Is a Sustainable Food System?

- A **sustainable food system** is one that addresses concerns regarding the health of individuals, the community, and the environment in a way that intends to provide healthy food for the world's population for generations to come
- A sustainable food system must:
    - Be environmentally friendly
    - Economically viable
    - Socially equitable
- Many food systems degrade environment, reduce biodiversity, pollute air and water
- Concerns about:
    - Soil use: improper use degrades topsoil, endangers food soil web
    - Energy use: fossil fuels harm environment
        * Using alternatives aids sustainability
    - Water use: growing consumption
        * Convservation is necessary
    - Reducing food waste is part of sustainability
        * 30-40 percent of all food produced is wasted
- Being a more sustainable food consumer
    - Adopting "greener" habits can help

        * Examples: eating less meat

- The most sustainable foods are locally grown and plant-based
    - Plant based diets are also more health promoting
- Small farms often provide foods to people living in their communities through:
    - Community-supported agriculture (CSA)
    - Farmers' markets
    - Contracts through local grocery stores
- Buying food from local farms doesn't guarantee that foods were grown in a sustainable way, nor does being from a distant farm mean that those farmers didn't practice sustainable agriculture.

12.4 Nutrition in the Real World: You as a Sustainable Farmer: Growing Vegetables in a Container

- Almsot anyone can be a home gardener
    - Requirements:
        * Container: ceramic pot, planter box, or other
        * Potting mixture: soil mix
        * Plant: various vegetables
        * Fertilizing: enrich soil with powdered fertilizer
        * Watering: avoid under- or overwatering
        * Harvesting: timing depends on plant type

12.5 How Do We Balance the World Population's Demand for Food with Sustainability?

- Costs and Benefits of Using Hormones
    - Chemical compounds improve farm yields but also cause concern
    - Hormones

    * In cows, bovine **growth hormone** and its synthetic version, **recombinant bovine somatotropin (rbST)**, stimulate milk production
    * FDA has found no negative effects, but some consumer groups question safety

- Costs and Benefits of Using Antibiotics
  - Whether injected or given via feed, **antibiotics** are used for three purposes:
    * To treat animals that are sick
    * To preventatively treat animals that may be at risk of being sick
    * To promote growth
  - Risks include growth of antibiotic-resistant bacteria, posing threat to humans when consumed
    * Government agencies try to prevent overuse

- Costs and Benefits of Using Pesticides
  - Control pests that threaten food supply

- Types of **pesticides**
  - **Herbicides:** kill weeds
  - **Antimicrobials:** kill microorganisms (bacteria, viruses)
  - **Fungicides:** kill fungi (mold)
  - **Biopesticides:** derived from natural materials; include sex pheromones
  - **Organophosphates:** affect nervous system of pests

- Risks and regulation of pesticides
  - When not used responsibly, can cause harm to animals, environment, humans
  - Use is heavily regulated in United States
  - **Risk assessment** (by EPA) is process to determine potential human health risks posed by exposure

- Alternatives to pesticides
  - **Integrated pest management** uses methods to control pests but limit harmful impact on humans, environment
    - Examples: crop rotation, pest-resistant crops, biopesticides, natural predators

12.6 What Are the Risks and Benefits of Using Biotechnology in Agriculture

- Humans have been manipulating genes of food products for generations
  - **Biotechnology:** the application of biological techniques to living cells, which alters their genetic makeup
    - **Gene editing**
  - **Plant breeding:** a type of biotechnology in which two plants are crossbred to produce offspring with desired traits from both
- Genetic engineering
  - **Genetic engineering (GE):** the biological technique that isolates and manipulates the genes of organisms to produce a targeted, modified product
  - **Genetically modified organisms (GMOs):** organisms genetically engineered to contain both original and foreign genes
  - First GMO crops grown in early 1990s, designed to reduce pesticide, herbicide use
    - Later versions added nutrients, improved shelf life
  - Proponents believe GMOs are good for environment and food supply
- Concerns and regulations associated with GE foods
  - Opponents fear creation of "frankenfoods," but industry is tightly regulated by FDA, USDA, EPA
  - Many unanswered questions, including:
    - Effects on natural environment, ecological balance

    * Production of plant toxins
    * Introduction of new allergens into food
    * Changes in nutrient content
    * Unsafe animal feed

12.7 How Does Food Policy Affect the Foods Available to You to Buy and Consume?

- Various government agencies regulate the food industry and set food and nutrition policy
- Food policy can help encourage food producers to create healthier products
    - Example: **Dietary Guidelines for Americans** caused shift toward whole grains, improved diet
- Food policy can lead to relabeling and reformulating without providing a healthier food product
    - Example: Food producers replaced **trans** fat with saturated fat, with no net positive effect
- What are the politics of the food industry?
    - Government programs are food consumers
        * Federal government is nation's biggest food consumer
        * Examples: National School Lunch Program, Summer Food Service Program, Emergency Food Assistance Program, Child and Adult Care Food Program
    - Food lobbyists exert influence
        * Example: 2009 push to tax sugared beverages was blocked in Congress

12.8 How Do You Know How Foods Were Produced?

- Label terms provide information about how foods were produced

  - USDA defines labeling for animal food products
    * Prepackaged meat products:
      · Certified
      · Fresh poultry
      · Free range
      · Kosher
      · Natural
      · No hormones
      · No antibiotics

- Understand the meaning of the term **organic**
  - Market for organic foods has grown rapidly
  - USDA developed National Organic Standards (NOS)
  - Organic farming means grown without some synthetic pesticides and fertilizers, bioengineering, irradiation
    * Some pesticides may be used
  - No evidence that organic foods are nutritionally superior
    * Advantages: Fewer synthetic pesticides and antibiotics; may have environmental benefits
    * Disadvantages: Often more expensive than conventionally grown foods

13 Chapter 13: Food Safety and Technology

13.1 What Causes Foodborne Illness?

- United States enjoys one of safest food supplies in world
  - Millions still suffer annually from foodborne illness
    * Cost 36 billion dollars per year
  - Food safety practices and guidelines established to ensure safety of foods
  - Several government agencies work together to ensure safety of foods from farm to table

- Foodborne illnesses are often caused by **pathogens** (viruses, bacteria, parasites, fungal agents or prions)
  - Can be spread by **fecal-to-oral transmission**
  - **Viruses** require living **host** to survive
    - Examples: **Norovirus (gastroenteritis)**, hepatitis A
- **Bacteria** flourish on living and nonliving surfaces
  - Some are beneficial: make vitamin K and biotin in inestines, used to make yogurt and cheese
  - Others can cause food spoilage and illness
    - Most common: **Campylobacter, E. coli, Salmonella**
      - Can lead to major complications such as Guillain-Barre syndrome, hemolytic uremic syndrome, and traveler's diarrhea
- **Parasites:** microscopic organisms that takes nourishment from hosts
  - Found in food and water, often transmitted by fecal-oral route
- **Prions** are an extremely rare but deadly infectious agent
  - **Bovine spongiform ecephalopathy (BSE):** mad cow disease is caused by prions
- Chemical agents and **toxins** can also cause illness
  - Naturally occurring toxins include poisonous mushrooms and some fish
- Some people are at higher risk for foodborne illness
  - Older adults, young children, and those with compromised immune systems are more susceptible to ill effects

13.2 Health Connection: Getting the Lowdown on Listeria

- Listeriosis is an infection caused by the bacterium Listeria.
- Listeria is found in undercooked meats and unpasteurized milk and cheeses.
- The young, elderly, and pregnant women are at higher risk for foodborne illness
- Pregnant women should avoid eating the following to prevent contamination with Listeria
  - Deli meats, hot dogs, salami, unpasteurized milk and cheese, undercooked or raw meat, chicken, or fish, raw alfalfa and broccoli sprouts, celery, and cantaloupes

13.3 What Can You Do to Prevent Foodborne Illness?

- Bacteria thrive when these conditions exist:
  - Adequate nutrients
  - Moisture
  - Correct pH
  - Correct temperature
  - Time
- Fight BAC! for food safety:
  - Clean
  - Separate
  - Cook
  - Chill
- **Clean** your hands and produce
  - Hands: hot soapy water with agitation for 20 seconds

  - Sanitize cutting boards, sponges
  - Wash fruits and vegetables under cold running water, scrub firm skins with vegetable brush

- **Separate** meat and non-meat foods to combat **cross-contamination**
  - Keep raw meat, poultry, fish separate from other foods during preparation, storage, transport
  - Don't use meat marinades as serving sauce
  - Use separate knives and cutting boards, clean dish towels

- **Cook** foods thoroughly
  - Raw meats, poultry, fish can cause illness
  - Color not reliable indicator
    * Meat may look brown but be undercooked
    * Cooked chicken may still look pink
  - For safety, measure internal temperature

- **Chill** foods at a low enough temperature
  - Bacteria multiply rapidly in the "danger zone" between 40*F and 140*F
    * Keep hot foods hot: above 140*F
    * Keep cold foods below 40*F: perishables shouldn't be left out more than two hours
    * Keep leftovers no more than four days in refrigerator, raw meats two days
  - Freezer temperature: at or below 0*F

13.4 Who Protects Your Food and How Do They Do It?

- Several government agencies police the food supply
  - **Food Safety Initiative (FSI):** joint effort of agencies has caused decline in foodborne illness

  - **DNA fingerprinting:** used in food safety to distinguish between different strains of a bacterium
  - Hazard Analysis and Critical Control Points (HACCP)
    * Food safety program of FDA and USDA
  - **Farm-to-table continuum:** visual tool showing food safeguards from farmer to consumer

- **Food preservation:** Food manufacturers use preservation techniques to destroy contaminants
  - **Pasteurization:** heating liquids, food at high enough temperatures to destroy foodborne pathogens
    * Examples: milk, dairy foods, most juices
  - **Canning:** heating food at high temperature to kill bacteria, packing food in airtight container
    * **Clostridium botulinum spores** can survive in environments without air
      · Very rare cases of botulism usually occur from home canning
      · Honey should not be fed to children under 1 year old
      · **Retort canning:** high temperature after canning
  - **Modified atmosphere packaging (MAP):** reducing oxygen inside packages of fruits/vegetables
  - **High-pressure processing (HPP):** high pressure pulses destroy microorganisms

- **Irradiation**
  - Food subjected to radiant energy source without causing harmful chemical changes
    * Kills bacteria but not viruses
    * Irradiated food must be labeled and have "radura" logo

- Product dating can help you determine peak quality

- **Closed (coded) dating:** packing numbers used by manufacturers on nonperishable foods to track inventory, rotate stock, identify products that may need to be recalled
- **Open dating:** calendar date on perishable foods to indicate food quality (not food safety)
  - Labeled with "Sell By" or "Use By" date
  - If product not stored at proper temperature, may be unsafe even if used by the date

13.5 What Are Food Additives and How Are They Used?

- Commonly used **food additives** include preservatives, nutrients, and flavor enhancers
- Preservatives prevent spoilage and increase shelf life
  - Most additives are preservatives
  - **Nitrites** and **nitrates:** salts added to prevent microbial growth
    - In cured meats, prevent **Clostridium botulinum**
    - Use of these salts form carcinogenic nitrosamines
  - **Sulfites:** antioxidants that prevent browning, inhibit microbial growth
- Some additives enhance texture and consistency
  - Gums and pectins used for consistency, texture
  - Emulsifiers improve stability, consistency, homogeneity
  - Leavening agents added to breads to cause them to rise
  - Anti-caking agnets prevent moisture absorption and lumping
  - Humectants increase moisture
- Some additives improve nutrient content
  - Grains enriched with B vitamins, iron

  - Folic acid added to breads, cereal, grain products

- Color and flavor enhancers improve the appeal of foods
  - FDA certifies color additives
    - Both man-made and natural
  - **MSG** is a common flavor enhancer
    - May cause headache, nausea, other side effects

- Food additives are closely regulated by the FDA
  - Some exceptions based on **prior-sanctioned status** (pre-1958) and long history of use
    - Nitrates for meat preservation
    - Salt, sugar, spices, other foods "generally recognized as safe" (GRAS status)

- Some food additives are unintentional
  - Chemicals from processing
  - Dioxings used in paper bleaching (coffee filters)

13.6 What Are Toxins and Chemical Agents?

- Toxins occur naturally
  - **Marine toxins:** cooking won't kill them
    - Spoiled finfish can cause **scombrotoxic (histamine) fish poisoning**
    - Large reef fish can **bioaccumulate** ciguatoxins produced by dinoflagellates, causing **ciguatera poisoning**
    - Shellfish can be contaminated by **neurotoxins** produced by dinoflagellates, causing **paralytic shellfish poisoning**

- Toxins in other foods
  - Potatoes exposed to light and turned green contain **solanine**

  - Wild lima beans, cassava contain **cyanogenic glycosides** that can cause cyanide poisoning

- Contamination is sometimes due to pollution
  - **Polychlorinated biphenyls (PCBs)** may cause cancer in humans
    - Now banned, but still in environment
  - PCBs and **methylmercury** can bioaccumulate in fish

13.7 What Is Bioterrorism and How Can You Protect Yourself?

- Food and water are potential targets
  - As primary agents of **bioterrorism:** foodborne pathogens such as botulism, **Salmonella, E. coli** O157:H7, **Shigella**
  - As secondary agents: disrupting availability of adequate safe amounts or by limiting fuel needed to cook and refrigerate perishable foods
- Under Department of Homeland Security, various local, state, and federal agencies work together for **food biosecurity**

14 Chapter 14: Life Cycle Nutrition: Pregnancy through Infancy

14.1 What Nutrients and Behaviors Are Most Important before Attempting a Healthy Pregnancy?

- A man's diet and lifestyle affect the health of his sperm
  - Smoking, alcohol and drug abuse, obesity may decrease sperm production and function
  - Zinc and folate are associated with healthy sperm production
  - Antioxidants (vitamins C and E, carotenoids) may help protect sperm from free-radical damage.

  - Should consume well-balanced diet of fruits and vegetables, whole grains, and healthy protein foods

- Women need to adopt a healthy lifestyle before conception
  - Attain a healthy weight
  - Get adequate folic acid
    - For new cells and baby's growth and development
  - Moderate fish and caffeine consumption
    - Methylmercury is a problem in some fish
      - See Nutrition in the Real World Mercury in Fish, Chapter 5
    - Consume ¡ 200 mg of caffeine/day
      - ¿ 500 mg/day may delay conception
  - Avoid cigarettes and other toxic substances

14.2 What Nutrients and Behaviors Are Important in the First Trimester?

- During the first trimester, the fertilized egg develops into a fetus
  - Full-term pregnancy is approximately 40 weeks long, divided into three **trimesters**
  - Moment of conception marks first trimester
  - During first few days, fertilized egg travels down fallopian tube to embed in lining of uterus
  - After eighth week of pregnancy, developing **embryo** is called a **fetus**
  - **Placenta:** attached to the fetus via the **umbilical cord**

14.3 What Nutrients and Behaviors Are Most Important in the First Trimester?

- "Morning Sickness" and cravings are common

  - Big myth of pregnancy is that morning sickness happens only in morning
  - Causes of morning sickness are unknown, but fluctuating hormone levels may play role
  - Some women develop aversion to certain foods; others have cravings
    * Pica: craving for nonfood substances, such as cornstarch, clay, dirt, baking soda

- Adequate weight gain supports the baby's growth
  - Healthy women generally advised to gain 25 to 35 pounds during entire pregnancy
    * Women having twins: 37-54 pounds
  - Typical weight gain in first trimester: 1 to 4.5 pounds
  - Gaining excess weight may:
    * Make it difficult to lose weight after delivery
    * Cause overweight in mother for years
    * Increase risk that baby will be obese later in life

- The need for certain nutrients increases
  - From moment of conception, pregnant woman needs certain vitamins and minerals in higher quantities
  - Most needs can be met with diet, but some nutrients require special attention
    * Folate/folic acid: need 400 micrograms/day before conception, continued after
    * Iron: supplement needed for red blood cells, anemia prevention, fatal development
    * Zinc and copper: key to baby's cell growth
    * Calcium and vitamin D: to preserve bone mass
  - Other nutrients also a concern, especially for those who eat no animal products (vegans, vegetarians)
    * Omega-3 fat DHA (in seafood) for brain, retina

        * Choline for healthy cell division, especially in brain
        * Vitamin B12 (in animal foods) for nerve cells, red blood cells, production of nucleic acids
    - Too much preformed vitamin A can be toxic, increase risk for birth defects
        * Limit supplements to no more than 3,000 IU/day
- Pregnancy increases risk for foodborne illness
    - **Listeria monocytogenes** may cause miscarriage, premature labor, **low birth weight**, developmental problems, infant death
    - Avoid raw and undercooked meat, fish, or poultry; unpasteurized milk, cheese, juices; raw sprouts
- Pregnant women should avoid many other substances
    - Nicotine, alcohol, illicit drugs
        * Risks: SIDS, FASDS, birth defects
    - Restrict caffeine intake to 200 mg or less
- The importance of critical periods
    - **Critical periods:** developmental stages in first trimester when cells and tissue rapidly grow and differentiate to form body structures
    - Embryo and fetus are highly vulnerable to nutritional deficiencies, toxins, other harmful factors
    - Risk of miscarriage is greatest
        * First trimester

14.4 What Nutrients and Behaviors Are Important in the Second Trimester?

- Pregnant women need to consume adequate calories, carbohydrate, and protein to support growth
    - Should consume 340 calories more in second trimester than before pregnancy, and gain about 1 pound/week

  - Need 175g of carbohydrates/day (vs 130g for nonpregnant women)
  - Protein needs increase 35 percent, to about 71 g/day, during second and third trimesters

- Exercise is important for pregnant women
  - Should get at least 150 minutes of moderate-intensity aerobic activity per week, spread over 7 days
  - Benefits:
    * Improves weight gain within targeted ranges
    * Decreases aches and pains
    * Lessens constipation
    * Improves energy level
    * Reduces stress
    * Improves sleep
    * Lowers risk of gestational diabetes

- Potential complications: gestational diabetes and hypertension

- **Gestational diabetes:** diabetes that occurs in women during pregnancy
  - Certain factors increase risk of gestational diabetes
  - Can result in **macrosomia:** large baby, weighing more than 8 pounds, 13 ounces
  - Increases risk of baby having **jaundice**, breathing problems, birth defects

- **Pregnancy-induced hypertension** includes:
  - **Gestational hypertension:** high blood pressure develops about halfway through pregnancy
  - **Preeclampsia:** includes hypertension and protein in urine, a sign of kidney damage
    * Treatment includes bed rest, medication, even hospitalization until baby can be safely delivered
    * If untreated, can lead to eclampsia

  - **Eclampsia:** can cause seizures in mother and is major cause of death in women during pregnancy

14.5 What Nutrients and Behaviors Are Important in the Third Trimester?

- Women should be taking in 450 extra calories/day and gaining about 1 pound/week
  - Growing baby puts pressure on stomach and intestines; hormones slow food through GI tract
  - Heartburn and constipation may result
    - Small, frequent meals avoiding spicy foods can help heartburn
    - More fiber-rich foods can help prevent constipation
  - Hemorrhoids may also develop

14.6 What Special Concerns Might Younger or Older Mothers-to-Be Face?

- Pregnant teenagers face special challenges: still growing and likely to have unbalanced diets
  - May be short on iron, folic acid, calcium, and calories
  - Higher risk of pregnancy-induced hypertension, premature and low birth weight babies
- Women older than 35 more likely to develop diabetes and hypertension
  - Achieve healthy weight prior to conception, avoid smoking, eat balanced diet, consume adequate folic acid

14.7 What Is Breast-Feeding and Why Is It Beneficial

- **Lactation:** production of breast milk in woman's body after childbirth
  - Prolactin causes milk to be produced
  - Oxytocin causes milk to be released (**let down response**)

- **Breast-feeding** provides physical, emotional, and financial benefits for mothers
  - Breast-feeding helps with pregnancy recovery; reduces risk of some chronic diseases
  - Breast milk is less expensive, more convenient than formula
    * Infant formula costs 2000 dollars per year; breastfeeding costs 300 dollars per year
  - Breast-feeding promotes bonding with baby
- Breast-feeding provides nutritional and health benefits
  - Breast milk is best for an infant's unique nutritional needs
    * Composition of breast milk changes as infant grows
    * **Colostrum:** fluid produced after birth that contains antibodies, protein, minerals, vitamin A
    * Breast milk is high in lactose, fat, B vitamins
      · Low in protein and in more digestible form: alpha-lactalbumin
  - Breast-feeding protects against infections, allergies, and chronic diseases and may enhance brain development
    * Decreases risk and severity of diarrhea; meningitis; respiratory, ear, and urinary tract infections
      · Lactoferrin proteins protects against bacteria, viruses
    * May reduce risk of childhood obesity
    * May help infant's intellectual development
      · Two fatty acids, DHA and AA, aid nervous system, brain development

14.8 What Are the Best Dietary and Lifestyle Habits for a Breast-Feeding Mother?

- In first 6 months, mother produces 24 ounce of breast milk/day; in second 6 months 16 ounce/day
  - Mother needs about 13 cups of fluids/day

- Extra calories needed:
  - First 6 months: 500/day (170 from fat stores, 330 from food)
  - Second 6 months: 400/day
- Well-balanced diet should be similar to diet during pregnancy
- Avoid alcohol and illicit drugs, limit caffeine, and follow FDA's guidelines on fish consumption

14.9 When Is Infant Formula a Healthy Alternative to Breast Milk?

- Some women may not be able to breast-feed
  - Women with HIV, AIDS, human T-cell leukemia, or active tuberculosis; receiving chemotherapy and/or radiation; or using illegal drugs should not breast-feed
  - Infants with galactosemia cannot metabolize lactose and should not breast-feed
  - Women taking prescription medications should check with health care provider regarding safety
- Formula is the best alternative to breast-feeding
  - Cow's milk doesn't meet nutritional needs
    - Too high in potassium and sodium
    - Too low in fat and linoleic acid
    - Iron is poorly absorbed
  - Infant formula is as similar as possible to breast milk
    - Regulated by FDA: sets nutrient requirements
    - Made from cow's milk (altered to improve nutrient content and availability) or soy protein
    - Powdered, concentrated liquid, or read-to-use
      - Avoid infants sleeping with bottles to avoid **early childhood caries**

14.10 What Are the Nutrient Needs of an Infant and Why Are They So High?

- Infants grow at an accelerated rate
  - Double birth weight by about 6 months of age; triple by 12 months
- Monitoring infant growth
  - Infants not receiving adequate nutrition may have difficulty reaching milestones
  - Failure to thrive (FTT): delayed in physical growth or size or does not gain enough weight
  - **Growth charts** track physical development
    - Head circumference, length, weight, and weight for length measures used to assess growth
- Infants have higher nutrient needs
  - 82 calories/kg of body weight for first 6 months
  - Need for increased carbohydrate and protein with age
  - Fat and overall calories should not be limited
  - Vitamin K injection needed due to sterile gut
  - Vitamin D drops needed (not enough in breast milk to prevent rickets)
  - Iron-rich foods (fortified cereals, puréed meats) should be introduced at 6 months
  - Vitamin B12 may be needed if mother's diet is deficient
  - May need fluoride if not in water used for formula

14.11 When Are Solid Foods Safe?

- **Solid foods** may be introduced once certain milestones are met
  - Infant needs to be nutritionally ready: at 6 months old, infant iron stores depleted

  - Infant needs to be physiologically ready
    * GI tract and kidneys cannot process solid foods in early infancy
    * Doubled birth weight to at least 13 pounds
    * **Tongue-thrust reflex** has faded (4 to 6 months)
    * Swallowing skills have matured adequately
    * Has head and neck control, able to sit with support
- Solid foods should be introduced gradually
  - First puréed, then mashed
  - Puréed meat, fortified rice cereal are good first foods
  - Parents should be patient; infants often reject food at first
  - Commercial baby foods are of high quality, but homemade food may be cheaper
- Some foods are dangerous for infants and should be avoided
  - Certain foods, such as hot dog rounds or raw carrots, may present choking hazard
  - **Food allergens** (dangerous for those with allergies)
  - Peanuts can be introduced at 6 months to 12 years
  - Honey may contain bacteria that causes **botulism**, which can be fatal
  - Fruit juices may contribute unneeded calories, displace other nutritious foods
  - Overabundance of breast milk and infant formula may decrease interest in other foods important for growth

14.12 Nutrition in the Real World: Feeding the Baby

- Natural mechanisms help newborns eat
  - Rooting reflex
  - Sucks/swallow reflex

  - **Tongue-thrust reflex**
  - Gag reflex
- Infants should eat when hungry, not on set schedule
  - Cues include waking/tossing, sucking on fist, crying/fussing

14.13 A Taste Could Be Dangerous: Food Allergies

- **Food allergy:** abnormal reaction by immune system to a particular food
  - Two stages: sensitization and allergic reaction
    - Mast cells: antibodies attach to these cells, setting the state for future allergic reaction
  - Reactions can occur with minimal exposure
  - Symptoms: vomiting, diarrhea, hives, asthma
    - **Anaphylactic reactions** are life-threatening
  - Common sources in children: eggs, milk, peanuts
- **Food intolerance:** adverse reaction to a food that does not involve immune response
  - Example: lactose intolerance

15 Chapter 15: Life Cycle Nutrition: Toddlers through the Later Years

15.1 What Are the Issues Associated with Feeding Young Children?

- Two age-groups of very young children
  - **Toddlers:** 1 to 3 years old
  - **Preschoolers:** 3 to 5 years old
- Growth slows compared with infancy

  - Average weight/height gain in second year: 3 to 5 pounds, 3 to 5 inches
  - After that, per year: 4.5 to 6.5 pounds, 2.5 to 3.5 inches
  - Smaller appetites, lower calorie needs relative to infants
- Young children need to eat frequent, small meals with nutrient-rich foods
  - Toddlers are very active, but have small stomach, eat less at mealtimes
  - Ages 2 to 3 need 1,000 to 1,400 calories daily
    * Protein-rich foods such as lean meats, eggs, poultry, dairy, beans, fruits, vegetables, whole grains
- Be mindful of portion size
  - Use child-size cups and plates
  - Tailor portions to child's needs
- By 15 months, self-feeding: using cup, spoon
- Avoid choking hazards: hot dogs, nuts, whole graps, round candy, popcorn, raisins, raw carrots should not be given to children younger than four
  - Always eat when sitting up, never while riding in car
- Food choices at day care should be monitored
- Young children have special nutrient needs
  - Calcium
    * 1 to 3 years: 700 mg/day
    * 4 to 8 years: 1000 mg/day
    * 8 oz milk, fortified soy drink/orange juice = 300 mg
  - Iron deficiency can lead to developmental delays
    * Cause: too much milk, other iron-poor foods
    * 1 to 3 years: 7 mg/day

        * 4 to 8 years: 10 mg/day
        * Provide lean meats, iron-fortified grains (cereal)
- Vitamin D: for healthy bones
    - 1 to 8 years: 600 IU/day
- Fiber: for bowel regularity
    - 1 to 3 years: 19g/day
    - 4 to 8 years: 25g/day
    - Whole grains, fruits, vegetables
- Fluids
    - 1 to 3 years: 4 cups/day
    - 3 to 5 years: 5 cups/day
    - Water, milk, juice; also in fruits, vegetables
        * No more than 4-6 ounces 100 percent fruit juice per day
- **Picky eating** and **food jags** are common in small children
    - Division of responsibility in feeding:
        * Parents control type of food offered, when, and where
        * Children control whether to eat and how much
    - Parents should serve as good role models, eat varied diet
    - **Food jags** (favoring some foods to exclusion of others) are usually temporary
    - Young children following vegetarian diet need adequate Vitamin D, calcium, iron, zinc, and Vitamin B12

15.2 What Are the Nutritional Needs and Issues of School-Aged Children?

- Quality of diet impacts growth of **school-aged children** (ages 6 to 11)

  - Parents/caregivers should encourage and model healthy habits
  - Eating patterns may be affected by developmental disabilities
    * Example: autistic children may fixate on certain foods

- **Childhood overweight and obesity**

- High obesity rates in school-aged children
  - More than doubled in children, tripled in adolescents over past 30 years
  - Due to many factors: too many calories, too little physical activity
    * Excess calories from sugary drinks, sports drinks, high-fat foods, larger portions
    * Less physical activity due to increased "screen" time, less physical education at school
  - Contributes to type 2 diabetes

- Daily food plans for kids help guide food choices
  - Plans available at https://www.myplate.gov
  - Key messages:
    * Eat foods from every food group every day
    * Choose healthier foods from each group
    * Make the right choices for you
    * Take healthy eating one step at a time
    * Use healthy fats
    * Be physically active on a regular basis

- The importance of breakfast
  - A nutritious morning meal is very important
  - Aids mental function, academic performance, school attendance rates, psychosocial function, mood
  - May be associated with healthier body weight
  - Optimally, children should eat breakfast at home before school

- School lunch contributes to a child's nutritional status
  - National School Lunch Program (NSLP) provides nutritionally balanced, low cost or free lunches
    - Standards set in **Dietary Guidelines for Americans**
  - For some children, school lunch is healthiest meal of the day
  - U.S. Department of Agriculture (USDA) donates food to program
    - Reimburses for breakfast and lunch meals if schools meet meal guidelines

15.3 Examining the Evidence: Nutrition, Behavior, and Developmental Disabilities

- Attention deficit **hyperactivity disorder (ADHD)**
  - Also called **Attention deficit disorder (ADD)**
  - Avoidance of certain foods may help
    - Sugar often blamed, but evidence lacking
  - Nutritional advice from registered dietitian maty help counter effects of medication, disruptive mealtimes
- **Autism spectrum disorder (ASD)**
  - May involve GI tract, immune system, but link unclear
  - Possible diet strategies: restrict glutens, casein (milk protein), food allergens; increase vitamins/minerals

15.4 Tips for Helping Children Eat Healthfully from myplate.gov

- **Cut back on kids' sweet treats**
  1. Serve small portions
  2. Offer healthy drinks
  3. Use the check-out lane that does not display candy
  4. Choose not to offer sweets as rewards

5. Make fruit the everyday dessert
6. Encourage kids to invent new snacks
7. Play detective in the cereal aisle
8. Make treats "treats", not everyday foods
9. If kids don't eat their meal, they don't need sweet "extras"

- **Be a healthy role model for children**

1. Show by example
2. Go food shopping together
3. Get creative in the kitchen
4. Offer the same foods for everyone
5. Reward with attention, not food
6. Focus on each other at the table
7. Listen to your child
8. Limit screen time
9. Encourage physical activity
10. Be a good food role model

15.5 What Are the Nutritional Needs and Issues of Adolescents?

- **Adolescence:** stage of life between start of puberty and adulthood
  - Many hormonal, physical, and emotional changes
- Peer pressure and other factors influence teen eating behaviors
  - Peer influence, defiance of authority may prompt different diets, negative habits
  - Busy schedule may influence food choices, increase snacking
- Adolescents need calcium and vitamin D for bone growth
  - Bone growth occurs in **epiphyseal plate**

  - Low calcium, vitamin D intake can cause low **peak bone mass**, increased fracture risk
    * Soft drinks and diet sodas displace milk in diet
- Teenage girls need more iron
  - Needed for muscle growth, blood volume
  - Girls have special need due to blood loss in menstruation
    * Inadequate iron intake is common
- Adolescents: at risk for disordered eating
  - Anorexia nervosa, bulimia, binging, and other behaviors typically emerge during adolescence
  - Disordered eating has emotional and physical consequences
    * Nutrient deficiencies can affect energy level and health
  - Adolescents struggling with body image should seek help from mental health specialist

15.6 What Are the Nutritional Needs of Older Adults?

- **Life expectancy** has increased
  - In 1900, 47 years
  - Today, ages 65 and older are fastest growing segment of population
  - Advances in medical research, health care, public health policy have increased life span
  - Number of older adults in United States will increase dramatically over next several decades
- Older adults need fewer calories, not less nutrition
  - Metabolic rate declines with age, reducing calorie needs
  - Continued intake of nutrients required to build cells, repair tissues, reduce risk of chronic disease
- Older adults need to get adequate fiber and fluids

  - Fiber reduces risk of diverticulosis, heart disease, other chronic illnesses
  - Fiber and fluids help prevent constipation
  - Declining thirst mechanism insreases risk of dehydration
- Older adults should monitor their micronutrients
  - Preformed **vitamin A:** overconsumption may increase risk of osteoporosis and fractures
  - **Vitamin D:** ability to convert from sunlight (and to absorb and convert to active form in intestines and kidneys) declines with age
    * Daily need increases from 600 IU/day to 800 IU/day for those aged 70 and older
  - **Vitamin B12:** Many over age 50 can't absorb natural form because stomach produces less HCl
    * Synthetic form in fortified foods and supplements should be added to diet

15.7 Older Adults' Nutritional Needs and Issues

- **Iron:** deficiency uncommon but may result from lack of iron-rich diet, chronic malabsorption, intestinal blood loss, kidney disease, cancer, arthritis
- **Zinc:** needed for healthy immune system, ability to taste
- **Calcium:** absorption declines with age
  - Women over 50 need 1,200 mg/day
  - Men need 1,000 mg/day until age 70, then 1,200 mg/day after
- **Sodium:** reduce intake to ¡= 1,500 mg/day at age 50

15.8 What Additional Challenges Do Older Adults Face?

- Eating right for health and to prevent and manage chronic disease
  - Heart disease and stroke

  - Type 2 Diabetes
  - **Arthritis**
  - **Alzheimer's disease (AD)/dementia**
  - **Cancer**

- Compounds, such as fiber, vitamins, and minerals, in whole and lightly processed foods help prevent age-related diseases (cancer, heart disease, and more)
  - Antioxidants help protect body from free radicals, may reduce risk of cognitive problems (Alzheimer's)
- Most older Americans not eating healthies diet
  - Too much sodium, saturated fat, calories
  - Inadequate servings from various food groups (dairy, fruits, vegetables, whole grains)

15.9 What Additional Challenges May Older Adults Face?

- Heart disease and stroke
  - Many older adults have diabetes and hypertension, which add to risk for heart attack, stroke
  - Cardiovascular disease more common with age
    - Most common: coronary heart disease, number one cause of death in United States
- Type 2 diabetes
  - Ability to maintain glucose blood level diminishes with age, can result in diabetes
  - Most people with this illness are overweight
- Hypertension
  - Controlled with medication, weight loss/physical activity, limiting alcohol/sodium

- Arthritis: painful inflammation in joints
  - Osteoarthritis most common, may be eased by supplements glucosamine and chondroitin
  - Rheumatoid arthritis: omega-3 fats in seafood may help
- Alzheimer's disease: form of dementia
  - Healthy diet, physical activity, social engagement may help reduce risk
- Economic and emotional conditions can affect nutritional health.
  - **Food insecurity:** limited access to adequate, nutritious food
    - Older Americans Act (1965) provides support and services for ages 60 and older, including nutrition education and **congregate meals**
  - Depression and grief affect nutrition and health
  - Alcohol abuse can add to depression, impair judgment and coordination, lead to accidents
    - Alcohol may interact negatively with medication
- Staying physically active
  - A necessity, not an option
  - Many benefits:
    - Lowers risk of chronic disease
    - Helps maintain healthy bones, muscles, joints
    - Reduces anxiety, stress, depression
    - Improves sleep, flexibility, range of motion
    - Can help postpone cognitive decline
    - Promotes independent living
  - Suggested exercise per week for adults over age 65 (2008 Physical **Activity Guidelines for Americans**):
    - 150 minutes moderate intensity or 75 minutes vigorous intensity, or combination of the two

    - Muscle strengthening activities two or more days
    - If unable to meet these goals, be as physically active as possible
    - Avoid sitting for long periods

15.10 Fighting Cancer with a Healthy Lifestyle

- **Cancer** includes 100+ diseases characterized by uncontrolled growth and spread of abnormal cells
  - Half of all men and one-third of women in United States will develop cancer during lifetime
  - Most common
    - Men: prostate cancer
    - Women: breast cancer
- Carcinogens are thought to cause most cancers
  - About 5 percent hereditary, rest caused by damage to DNA by carcinogens:
    - **Tobacco:** primary cause of lung cancer, mainly among smokers but also from secondhand smoke
    - **Alcohol:** moderate to heavy consumption associated with head and neck, breast, colorectal, esophageal, and liver cancers
    - **Radiation:** overexposure to UV radiation (sunlight) and other forms (X-rays)
    - **Industrial chemicals:** certain metals (nickel), pesticides, and compounds (benzene)
    - **Cancer-causing agents in foods and beverages**
- You can reduce your risk for cancer with a healthy diet
  - **Phytonutrients** (lycopene)
  - **Antioxidants** (carotenoids, selenium)
  - **Retinoids** (vitamin A), vitamin D, folate

  - **Omega-3 fatty acids** (in fish, some oils)
  - **Fiber**
    * Helps dilute, shed waste products in intestinal tract
    * Feeds healthy bacteria in colon, creating by-product that may help fight cancer

- Avoid foods and beverages that may increase your risk for cancer
  - Diet high in red and/or processed meats
    * Nitrites in processed meats can react with amino acids to form cancer-promoting compounds (nitrosamines, nitroamides)
  - Alcohol, consumed in excess
  - High salt consumption
  - Excess body weight
    * Contributes to as many as 1 in 5 cancer-related deaths

15.11 Nutrition in the Real World: Drug, Food, and Drug-Herb Interactions

- Drugs, food, and herbs can interact in negative, unhealthy ways
  - Foods can delay or increase absorption of drugs
    * Example: Calcium binds with tetracycline (antibiotic), decreasing absorption
  - Drugs can interfere with metabolism of substances in foods, leading to dangerously high levels in blood
    * Example: tyramine in cheese, smoked fish, yogurt
  - Herbal remedies may be unsafe with medication
    * Example: **Ginkgo biloga** interferes with blood clotting, should not be taken with blood thinners Coumadin or aspirin