Chapter 5: Fats, Oils, and Other Lipids
Objectives for Chapter 5

• Describe the three classifications of lipids and explain the differences in the structure of triglycerides, phospholipids, and cholesterol.
• Describe how fat is digested, absorbed, and transported in the body.
• Describe the functions of fat in the body.
• Define the dietary recommendations for total fat, the essential fatty acids, saturated fat, cholesterol, and trans fat.
• Identify the major food sources of the different types of fats, including the essential fatty acids, saturated fats, and trans fats.
• Compare the different fat substitutes currently used in food products.
• Describe the development of atherosclerosis, including its role in the risk of heart disease.
• Explain the dietary changes you can make to maintain healthy blood cholesterol levels and reduce your risk of heart disease.
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 a triglyceride
  - Fats serve multiple functions in foods:
    - Give flaky texture to baked goods
    - Make meats tender
    - Provide flavor and aromas
    - Contribute to satiety
What Are Fats and Why Do You Need Them?, Continued

- 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
Structure of a Fatty Acid

- Acid group
- Chain of carbon and hydrogen atoms

Figure 5.1
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
**Fatty Acids Vary in Length and Structure**

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

(a) Stearic acid, a saturated fatty acid

(b) Oleic acid, a monounsaturated fatty acid

Double bond in carbon chain creates a bend

(c) Linoleic acid, a polyunsaturated, omega-6 fatty acid

2 double bonds create 2 bends

(d) Alpha-linolenic acid, a polyunsaturated, omega-3 fatty acid

3 double bonds create 3 bends
Saturated and Unsaturated Fatty Acids Help Shape Foods

- **a** Saturated fatty acids
- **b** Unsaturated fatty acids

Figure 5.3
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
Structure of a Triglyceride

Glycerol backbone + Three fatty acids = A fat (triglyceride) + 3 H-O-H Water

- Palmitic acid
- Oleic acid
- Stearic acid
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
Structure of a Phospholipid

Glycerol (backbone) + Two fatty acids = Phospholipid

Phosphate group

Polar head (attracts water) Nonpolar tail (repels water)
Phospholipids' Role in Your Cell Membranes

1. Because the phosphorus-containing head is polar, it attracts charged particles, such as water located both outside and inside your cells.

2. Its fatty acid-containing tail is nonpolar, so it mingle and lines up with other nonpolar molecules such as the fatty acid-containing ends of other phospholipids.

3. This creates a two-layer membrane that surrounds the cell and acts as a barrier, allowing certain substances to enter the cell but keeping others from leaving.
Keeping a Salad Dressing Blended

Water

Fat droplet

Emulsifier (lecithin, a phospholipid)

Figure 5.7
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
    - Not required in diet since body makes all cholesterol needed
Structure of a Sterol

Figure 5.8
# Three Types of Lipids

<table>
<thead>
<tr>
<th>Lipid</th>
<th>Structure</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triglycerides</td>
<td><img src="image" alt="Glycerol and Fatty acids" /></td>
<td>Saturated fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unsaturated fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Trans</em> fat</td>
</tr>
<tr>
<td>Phospholipids</td>
<td><img src="image" alt="Phosphate head and Fatty acids" /></td>
<td>Lecithin</td>
</tr>
<tr>
<td>Sterols</td>
<td><img src="image" alt="Sterol structure" /></td>
<td>Cholesterol</td>
</tr>
</tbody>
</table>

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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
Fat Digestion
Lipid Digestion and Absorption
Most fat digestion occurs in the small intestine with the aid of bile and lipase enzymes. The absorbed digestive by-products are transported via chylomicrons into the lymphatic system.

**ORGANS OF THE GI TRACT**

**MOUTH**
Chewing begins the mechanical digestion of food. Solid fat melts with the warmth of the body. Lingual lipase in the saliva begins the chemical digestion of fats.

**STOMACH**
Peristalsis mixes and churns the fat-containing food with gastric juices. Gastric lipase breaks down some fats, creating diglycerides and free fatty acids.

**SMALL INTESTINE**
Bile secreted from the gallbladder through the common bile duct into the small intestine emulsifies fat into smaller globules. Pancreatic lipase breaks down fats into monoglycerides, glycerol, and free fatty acids.

The by-products of fat digestion are packaged into micelles for transport through the cells of the intestinal wall. As they are absorbed, the micelles separate into their component parts. Short-chain fatty acids enter the bloodstream directly. Long-chain fatty acids, cholesterol, phospholipids, and other remnants are repackaged into chylomicrons for transport into the lymphatic system.

**ACCESSORY ORGANS**

**LIVER**
Produces bile, which is stored in the gallbladder.

**GALLBLADDER**
Releases bile into the small intestine through the common bile duct.

**PANCREAS**
Produces pancreatic lipase, which is secreted into the small intestine via the pancreatic duct.

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What Happens to the Fat You Eat?, Continued

- 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, "good" cholesterol): deposit cholesterol on walls of arteries
  - **High-density lipoproteins** (HDL, "bad" cholesterol): remove cholesterol from body and deliver to liver for excretion
Chylomicron

- Phospholipid
- Cholesterol
- Protein
- Fat droplet (triglycerides)
Lipoproteins

Figure 5.12

Chylomicron

Protein 2%
Phospholipids 3%
Cholesterol

Triglycerides 90%

VLDL

Protein 10%
Phospholipids

Triglycerides 60%
Cholesterol 12%

LDL

Protein 25%
Phospholipids 15%
Cholesterol 50%

Triglycerides 10%

HDL

Protein 50%
Phospholipids 25%
Cholesterol 20%

Triglycerides 5%
Roles of Lipoproteins

Fat and cholesterol are transported in the body via several different lipoprotein compounds, such as chylomicrons, VLDLs, LDLs, and HDLs.

**CHYLMICRON**
Chylomicrons transport fat and cholesterol from a meal via the lymphatic system to your cells. Once in the blood, lipoprotein lipase helps break down fat. The remaining chylomicron remnant is dismantled in the liver.

**VLDLs**
VLDLs (very-low-density lipoproteins), produced mainly in the liver, transport fat to the cells. Lipoprotein lipase helps with the uptake of fatty acids into the cells, primarily those in muscle and fat tissue, transforming VLDLs to LDLs (low-density lipoproteins).

**LDLs**
Low-density lipoproteins release cholesterol into body cells. LDLs not taken up by cells degrade over time, releasing cholesterol that may then adhere to blood vessel walls.

**HDLs**
HDLs (high-density lipoproteins) produced by the liver circulate in the blood, picking up cholesterol from cells. The cholesterol is returned to the liver and excreted through the bile, removing it from the bloodstream.

Figure 5.13
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 for 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

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How Does Your Body Use Fat and Cholesterol?, Continued

• Two polyunsaturated fatty acids, linoleic acid (an omega-6 fatty acid) and alpha-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
Essential Fatty Acids

Polyunsaturated fatty acids

Omega-6 fatty acids
Linoleic acid (an essential fatty acid)

Arachidonic acid

Omega-3 fatty acids
Alpha-linolenic acid (an essential fatty acid)

Docosahexaenoic acid (DHA)

Eicosapentaenoic acid (EPA)

Figure 5.14
How Does Your Body Use Fat and Cholesterol?, Continued-1

- Cholesterol has many important roles:
  - Part of cell membranes
  - Precursor for vitamin D, bile acids, sex hormones
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) of your calories from saturated fats
### Table 5.1 Capping Your Fat Intake

<table>
<thead>
<tr>
<th>Calories to Maintain Weight</th>
<th>Fat (grams) (20% to 35% of total calories)</th>
<th>Saturated Fat (grams) (&lt;7% to 10% of total calories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,600</td>
<td>36-62</td>
<td>12-18</td>
</tr>
<tr>
<td>1,700</td>
<td>38-66</td>
<td>13-19</td>
</tr>
<tr>
<td>1,800</td>
<td>40-70</td>
<td>14-20</td>
</tr>
<tr>
<td>1,900</td>
<td>42-74</td>
<td>15-21</td>
</tr>
<tr>
<td>2,000</td>
<td>44-78</td>
<td>16-22</td>
</tr>
<tr>
<td>2,100</td>
<td>47-82</td>
<td>16-23</td>
</tr>
<tr>
<td>2,200</td>
<td>49-86</td>
<td>17-24</td>
</tr>
<tr>
<td>2,300</td>
<td>51-89</td>
<td>18-26</td>
</tr>
<tr>
<td>2,400</td>
<td>53-93</td>
<td>19-27</td>
</tr>
<tr>
<td>2,500</td>
<td>56-97</td>
<td>19-28</td>
</tr>
<tr>
<td>2,600</td>
<td>58-101</td>
<td>20-29</td>
</tr>
<tr>
<td>2,700</td>
<td>60-105</td>
<td>21-30</td>
</tr>
<tr>
<td>2,800</td>
<td>62-109</td>
<td>22-31</td>
</tr>
</tbody>
</table>
Sedentary women should consume approximately 1,600 calories daily. Teenage girls, active women, and many sedentary men need approximately 2,200 calories daily. Teenage boys, many active men, and some very active women need about 2,800 calories daily. To determine the number of calories you should be eating daily, turn to Table 2.1 in Chapter 2.

The percentage of calories from fat and the corresponding grams of fat can be calculated by multiplying your number of daily calories by 20 percent and 35 percent and then dividing those numbers by 9. (Fat provides 9 calories per gram.)

**For example, if you consume 2,000 calories daily:**

\[
\begin{align*}
2,000 \times 0.20 \text{ (20 percent)} &= 400 \text{ calories} \div 9 = 44 \text{ grams} \\
2,000 \times 0.35 \text{ (35 percent)} &= 700 \text{ calories} \div 9 = 78 \text{ grams}
\end{align*}
\]

**Your range of fat intake should be 44 to 78 grams daily.**

To find the maximum grams of saturated fat that you should be consuming daily, repeat the process:

\[
\begin{align*}
2,000 \times 0.07 \text{ (7 percent)} &= 140 \text{ calories} \div 9 = 16 \text{ grams} \\
2,000 \times 0.10 \text{ (10 percent)} &= 200 \text{ calories} \div 9 = 22 \text{ grams}
\end{align*}
\]

**The total amount of saturated fat intake should be no more than 22 grams daily.**
How Much Fat Do You Need Each Day?, Continued

• 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
How Much Fat Do You Need Each Day?, Continued-1

• 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*
  • *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.
Creating *Trans* Fatty Acids

\[ \text{cis} \]
Hydrogens are on the same side of the double bond

\[ \text{trans} \]
Hydrogens are on opposite sides of the double bond

Figure 5.15
Major Food Sources of Saturated and Trans Fat for Americans

Figure 5.16

- Fried white potatoes: 2.0%
- Nuts and seeds, and nut and seed mixed dishes: 2.1%
- Potato/corn/other chips: 2.4%
- Butter: 2.9%
- Candy: 3.1%
- Eggs and egg mixed dishes: 3.2%
- Whole milk: 3.4%
- Pasta and pasta dishes: 3.7%
- Reduced-fat milk: 3.9%
- All other food categories: 24.5%
- Regular cheese: 8.5%
- Pizza: 5.9%
- Grain-based desserts: 5.8%
- Dairy desserts: 5.6%
- Chicken and chicken mixed dishes: 5.5%
- Sausage, franks, bacon, ribs: 4.9%
- Tortillas, burritos, tacos: 4.1%
- Burgers: 4.4%
- Beef and beef mixed dishes: 4.1%
NutriTool: Build-A-Pizza
Practical Nutrition Tips Video: Pizza Parlor

Pizza Parlor Strategies

with
Joan Salge Blake
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, nuts, and flaxseeds are also good sources of essential fatty acids
Fats in Food
Food Sources of the Essential Fatty Acids

Figure 5.17

ChooseMyPlate.gov

<table>
<thead>
<tr>
<th>Food Source</th>
<th>Linoleic acid (g)</th>
<th>Alpha-linolenic acid (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaxseeds</td>
<td>2.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Soybeans</td>
<td>8.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Almonds</td>
<td>6.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Walnuts</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Canola oil</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Peanut oil</td>
<td>7.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Adults 19 to 50 years</td>
<td>12–17</td>
<td></td>
</tr>
<tr>
<td>Adults 19 to 50 years</td>
<td>1.1–1.6</td>
<td></td>
</tr>
</tbody>
</table>

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Where's the Saturated Fat in Your Foods?

Figure 5.18

<table>
<thead>
<tr>
<th></th>
<th>Grams (g) of saturated fat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breakfast</strong></td>
<td></td>
</tr>
<tr>
<td>Cream (2 oz) in coffee</td>
<td>7.0</td>
</tr>
<tr>
<td>Low-fat milk (2 oz) in coffee</td>
<td>0.5</td>
</tr>
<tr>
<td>Whole milk, 1 cup</td>
<td>5.0</td>
</tr>
<tr>
<td>Skim milk, 1 cup</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Bagel with 2 oz cream cheese</td>
<td>13.0</td>
</tr>
<tr>
<td>English muffin with 1 tbs light margarine</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Lunch</strong></td>
<td></td>
</tr>
<tr>
<td>Cheesburger on hamburger roll</td>
<td>13.5</td>
</tr>
<tr>
<td>Veggie burger on hamburger roll</td>
<td>1.5</td>
</tr>
<tr>
<td>Pepperoni pizza, 2 slices</td>
<td>4.5</td>
</tr>
<tr>
<td>Mushroom and pepper pizza, 2 slices</td>
<td>1.5</td>
</tr>
<tr>
<td>Steak and cheese sub</td>
<td>10.0</td>
</tr>
<tr>
<td>Roast beef sandwich on roll</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Dinner</strong></td>
<td></td>
</tr>
<tr>
<td>Beef hot dog on roll</td>
<td>6.5</td>
</tr>
<tr>
<td>Turkey hot dog on roll</td>
<td>3.0</td>
</tr>
<tr>
<td>Mashed potatoes with butter and milk, 1 cup</td>
<td>6.0</td>
</tr>
<tr>
<td>Baked potato (small) with 1 tbs light margarine</td>
<td>2.0</td>
</tr>
<tr>
<td>Prime rib, 3 oz</td>
<td>13.0</td>
</tr>
<tr>
<td>Grilled salmon, 3 oz</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Snacks</strong></td>
<td></td>
</tr>
<tr>
<td>Nachos with cheese, 2 oz chips and 3 oz cheese</td>
<td>21.0</td>
</tr>
<tr>
<td>Vegetables with salsa, 1 cup vegetables and 1/2 cup salsa</td>
<td>21.0</td>
</tr>
<tr>
<td>Gourmet vanilla ice cream, 1 cup</td>
<td>21.0</td>
</tr>
<tr>
<td>Gourmet lemon sorbet, 1 cup</td>
<td>21.0</td>
</tr>
</tbody>
</table>
Composition of Various Fats

Figure 5.19
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.
### Table 5.2 The Lighter Side of Fat: Fat Substitutes

<table>
<thead>
<tr>
<th>Name (trade names)</th>
<th>Calories per Gram</th>
<th>Properties</th>
<th>How It’s Used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carbohydrate Based</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibers from Grains (Beta-Trim)</td>
<td>1-4</td>
<td>Gelling, thickener</td>
<td>Baked goods, meats, spreads</td>
</tr>
<tr>
<td>Fibers, Cellulose (Avicel cellulose gel)</td>
<td>0</td>
<td>Water retention, texture, mouthfeel</td>
<td>Sauces, dairy products, frozen desserts, salad dressings</td>
</tr>
<tr>
<td>Gums (Slendid)</td>
<td>0</td>
<td>Thickener, texture, mouthfeel, water retention</td>
<td>Salad dressings, processed meats</td>
</tr>
<tr>
<td>Polydextrose (Litesse)</td>
<td>1</td>
<td>Water retention, adds bulk</td>
<td>Baked goods, dairy products, salad dressings, cookies, gum</td>
</tr>
<tr>
<td>Modified Food Starch (STA-SLIM)</td>
<td>1-4</td>
<td>Thickener, gelling, texture</td>
<td>Processed meats, salad dressings, frostings, fillings, frozen desserts</td>
</tr>
<tr>
<td><strong>Protein Based</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microparticulated Protein (Simplesse)</td>
<td>1-4</td>
<td>Mouthfeel</td>
<td>Dairy products, salad dressings, spreads</td>
</tr>
<tr>
<td><strong>Fat Based</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mono- or Diglycerides (Dur-Lo)</td>
<td>9*</td>
<td>Mouthfeel, moisture retention</td>
<td>Baked goods</td>
</tr>
<tr>
<td>Short-Chain Fatty Acids (Salatrim)</td>
<td>5</td>
<td>Mouthfeel</td>
<td>Confections, baked goods</td>
</tr>
<tr>
<td>Olestra (Olean)</td>
<td>0</td>
<td>Mouthfeel</td>
<td>Savory snacks</td>
</tr>
</tbody>
</table>

*Less of this fat substitute is needed to create the same effect as fat, so the calories are reduced in foods using this product.

Table 5.3 Fat Free Doesn’t Equal Calorie Free

<table>
<thead>
<tr>
<th>Serving Size</th>
<th>Calories</th>
<th>Fat (g)</th>
<th>Carbohydrates (g)</th>
<th>Calories Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig Newtons (Nabisco)</td>
<td>2 (31 g)</td>
<td>110</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Fat-Free Fig Newtons (Nabisco)</td>
<td>2 (29 g)</td>
<td>100</td>
<td>0</td>
<td>23</td>
</tr>
</tbody>
</table>

Practical Nutrition Tips Video: Low Fat Choices

Making Low Fat Choices
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)
    • Thought 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
Atherosclerosis

**HEALTHY ARTERY**
Blood flows unobstructed through normal, healthy artery.

**ARTERIAL INJURY**
The artery's lining is injured, attracting immune cells, and prompting inflammation.

**LIPIDS ACCUMULATE IN WALL**
Lipids, particularly cholesterol-containing LDLs, deposit beneath the arterial wall. The LDLs become oxidized. Immune cells, attracted to the site, engulf the oxidized LDLs and are transformed into foam cells.

**FATTY STREAK**
The foam cells accumulate to form a fatty streak, which releases more toxic and inflammatory chemicals.

**PLAQUE FORMATION**
The foam cells, along with platelets, calcium, protein fibers, and other substances, form thick deposits of plaque, stiffening and narrowing the artery. Blood flow through the artery is reduced or obstructed.

Plaque accumulation within coronary arteries narrows their interior and impedes the flow of oxygen-rich blood to the heart.
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
## Table 5.4 Risk Factors for Heart Disease

<table>
<thead>
<tr>
<th>Factors You Cannot Control</th>
<th>Factors You Can Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your age and gender</td>
<td>Type 2 diabetes mellitus</td>
</tr>
<tr>
<td>Your family history of heart disease</td>
<td>High blood pressure</td>
</tr>
<tr>
<td>Type 1 diabetes mellitus</td>
<td>Smoking</td>
</tr>
<tr>
<td></td>
<td>Physical inactivity</td>
</tr>
<tr>
<td></td>
<td>Excess weight</td>
</tr>
<tr>
<td></td>
<td>A low HDL “good” cholesterol level</td>
</tr>
<tr>
<td></td>
<td>A high LDL “bad” cholesterol level</td>
</tr>
</tbody>
</table>
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
Read Food Labels to Lower Saturated and Trans Fat Intake

Figure 5.21

- **Butter** is a rich source of saturated fatty acids and cholesterol. One tablespoon of butter contains 8 grams of saturated fat.

- **Margarine** doesn’t contain cholesterol but it may contain trans fat formed during hydrogenation of vegetable oils.

- Use liquid fats over solid fats on your food and in cooking. The more liquid a fat is at room temperature, the less saturated fat and trans fat it contains.
## Table 5.5 What Your Cholesterol Level* Can Tell You

<table>
<thead>
<tr>
<th>If Your Total Cholesterol Level Is</th>
<th>That Is Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;200</td>
<td>Fabulous! Keep up the good work!</td>
</tr>
<tr>
<td>200–239</td>
<td>Borderline high</td>
</tr>
<tr>
<td>≥240</td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Your LDL Cholesterol Level Is</th>
<th>That Is Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>Fabulous! Congratulations!</td>
</tr>
<tr>
<td>100–129</td>
<td>Near or above optimal</td>
</tr>
<tr>
<td>130–159</td>
<td>Borderline High</td>
</tr>
<tr>
<td>160–189</td>
<td>High</td>
</tr>
<tr>
<td>190</td>
<td>Much too high!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Your HDL Cholesterol Is</th>
<th>That Is Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥60</td>
<td>Fabulous!</td>
</tr>
<tr>
<td>40–60</td>
<td>Good</td>
</tr>
<tr>
<td>&lt;40</td>
<td>Too low</td>
</tr>
</tbody>
</table>

*All lipoprotein levels are measured in milligrams of cholesterol per deciliter of blood (mg/dl).

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
ABC News Video: Mediterranean Diet Could Help Reduce Heart Disease

>> We're going to turn now to the major health headline here tonight.
Mediterranean Diet Could Help Reduce Heart Disease

Discussion Questions

1. What are the characteristics of a Mediterranean diet that can reduce the risk for heart disease by 30%?

2. What dietary recommendations would you give to someone who wants to reduce his or her risk for heart disease?

3. What methods can be used to increase intake of protein rich foods and healthy fats?
The Traditional Healthy Mediterranean Diet Pyramid

- **Wine**: In moderation
- **Drink Water**: Often, at least two times per week
- **Fruits, Vegetables, Grains**: (mostly whole), Olive oil, Beans, Nuts, Legumes and Seeds, Herbs and Spices
  - Base every meal on these foods
- **Meats and Sweets**: Less often
  - Poultry and Eggs: Moderate portions, every two days or weekly
  - Cheese and Yogurt: Moderate portions, daily to weekly

Be Physically Active; Enjoy Meals with Others
Lipoproteins: VLDL, LDL, and HDL
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 and young children should avoid these four types of fish
  • Pregnant women/women of childbearing age: should consume 8 to 12 oz of other fish (variety) weekly
    • Canned albacore tuna has more mercury than light tuna: 6 oz/week limit
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.
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
Food Sources of Omega-3 Fatty Acids

Figure 5.22

[Bar chart showing grams of Omega-3s (EPA and DHA) from various food sources, with protein and daily needs indicated.]
# Changes to Decrease Excess LDL Cholesterol

Table 5.6 To Decrease Excess LDL Cholesterol

<table>
<thead>
<tr>
<th>Dietary Changes</th>
<th>Lifestyle Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consume less saturated fat</td>
<td>Lose excess weight</td>
</tr>
<tr>
<td>Consume less <em>trans</em> fats</td>
<td>Exercise more</td>
</tr>
<tr>
<td>Consume less dietary cholesterol</td>
<td></td>
</tr>
<tr>
<td>Consume more soluble fiber–rich foods</td>
<td></td>
</tr>
<tr>
<td>Consume a more plant-based diet</td>
<td></td>
</tr>
</tbody>
</table>

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