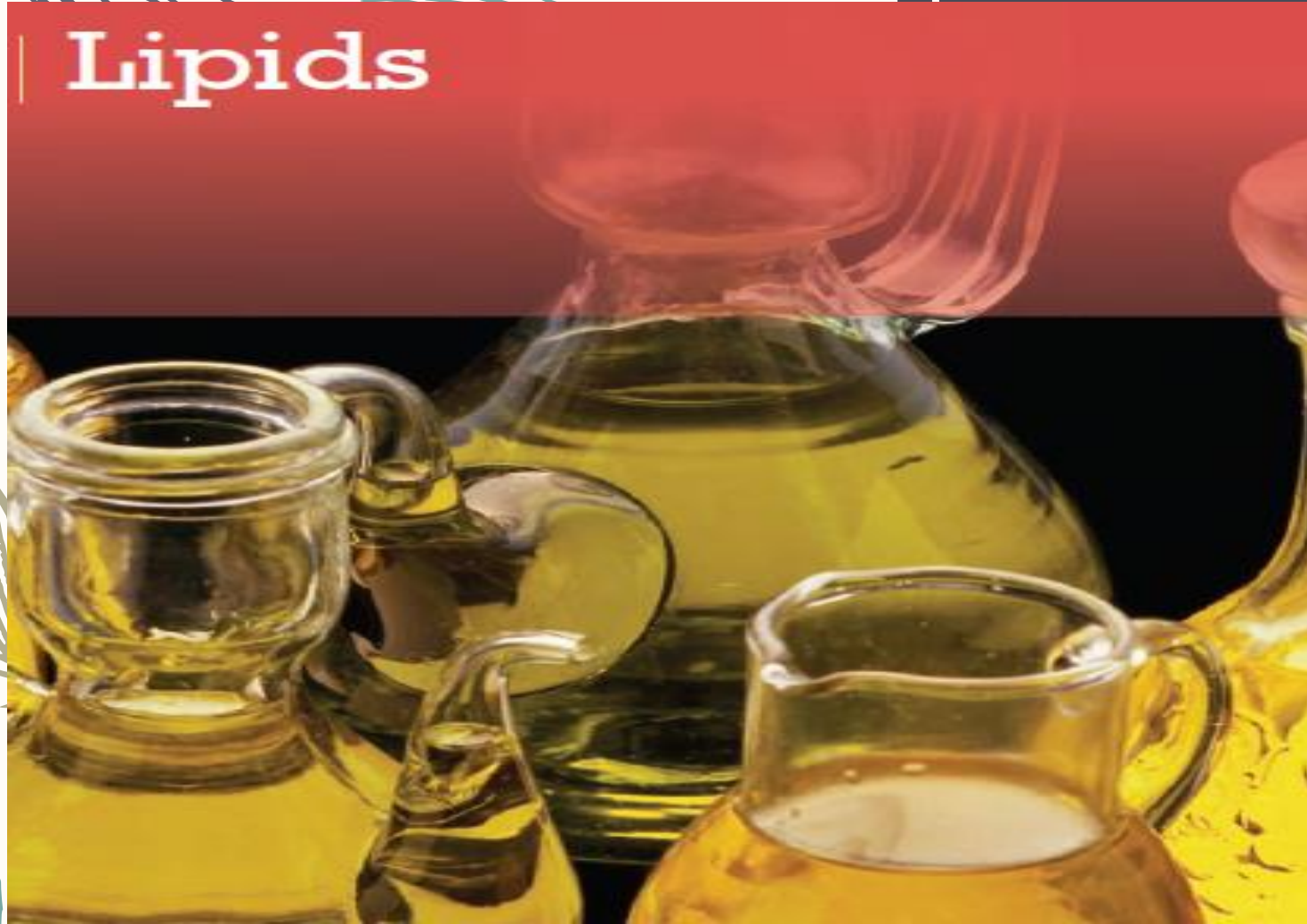


# Lipids





☐ Fat is a member of the class of compounds called lipids.

The lipids in foods and in the human body include **triglycerides (fats and oils), phospholipids, and sterols.**

☐ Fats are greasy substances that are **not soluble** in water. They are soluble in some solvents such as ether, benzene, and chloroform.

☐ They provide a more concentrated source of energy than carbohydrates; **each gram of fat contains 9 calories.** This is slightly more than twice the calorie content of carbohydrates.

☐ Like carbohydrates, fats are composed of carbon, hydrogen, and oxygen but with a substantially lower proportion of oxygen.



## **FUNCTIONS**

- ☐ In addition to **providing energy**, fats are essential for the functioning and **structure of body tissues** (Table 5-1).  
Fats are a necessary part of cell membranes .

- ☐ They contain **essential fatty acids** and act as **carriers for fat-soluble vitamins A, D, E, and K**.

The fat stored in body tissues provides energy when one cannot eat, as may occur during some illness and after abdominal surgery.

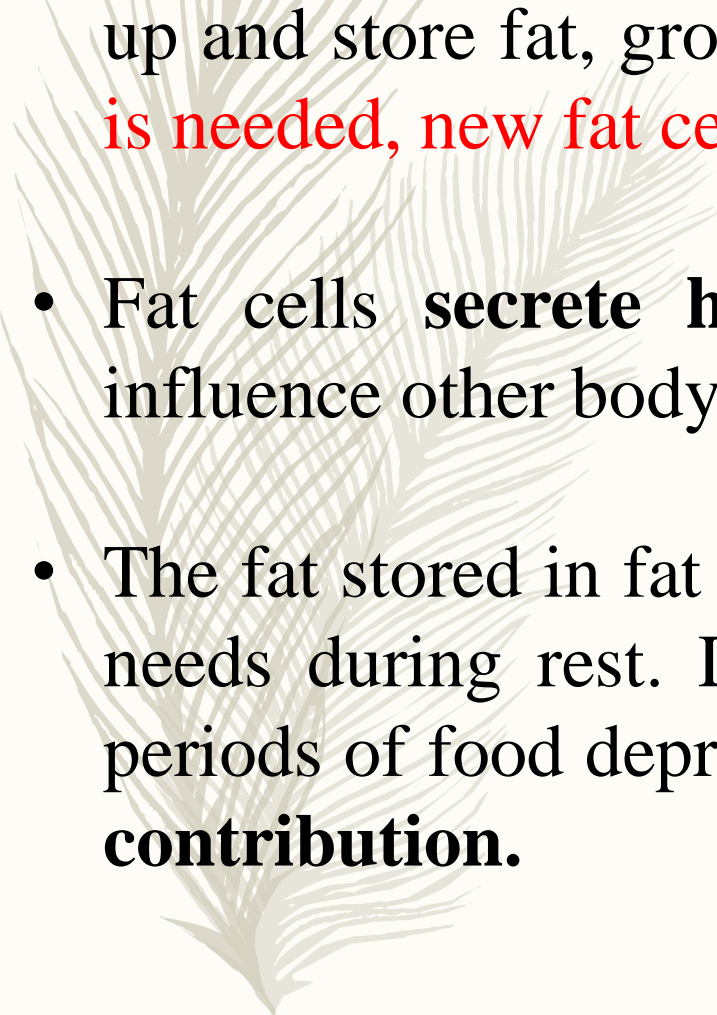
- ☐ Adipose (fatty) tissue protects organs and bones from injury by serving as **protective padding and support**.
- ☐ Body fat also serves as insulation from cold.

- ☐ In addition, fats provide a feeling of **satiety (satisfaction)** after meals. This is due partly to the flavor fats give other foods and partly to their slow rate of digestion, which delays hunger.



**Table 5-1** *Fats*

<b>FUNCTIONS</b>	<b>DEFICIENCY SIGNS</b>	<b>SOURCES</b>
Provide energy	Eczema	Animal
Carry fat-soluble vitamins	Weight loss	Fatty meats
Supply essential fatty acids	Retarded growth	Lard
Protect and support organs and bones		Butter
Insulate from cold		Cheese
Provide satiety to meals		Cream
		Whole milk
		Egg yolk
		Plant
		Vegetable oils
		Nuts
		Chocolate
		Avocados
		Olives
		Margarine

- 
- The body's stores of glycogen are limited, however. In contrast, the body's capacity to store fat for energy is virtually unlimited due to the **fat-storing cells of the adipose tissue**. The fat cells of the adipose tissue readily take up and store fat, growing in size as they do so. **When extra energy storage is needed, new fat cells are readily produced.**
  - Fat cells **secrete hormones that help to regulate the appetite** and influence other body functions.
  - The fat stored in fat cells supplies 60 percent of the body's ongoing energy needs during rest. During some types of physical activity or prolonged periods of food deprivation, **fat stores may make an even greater energy contribution.**

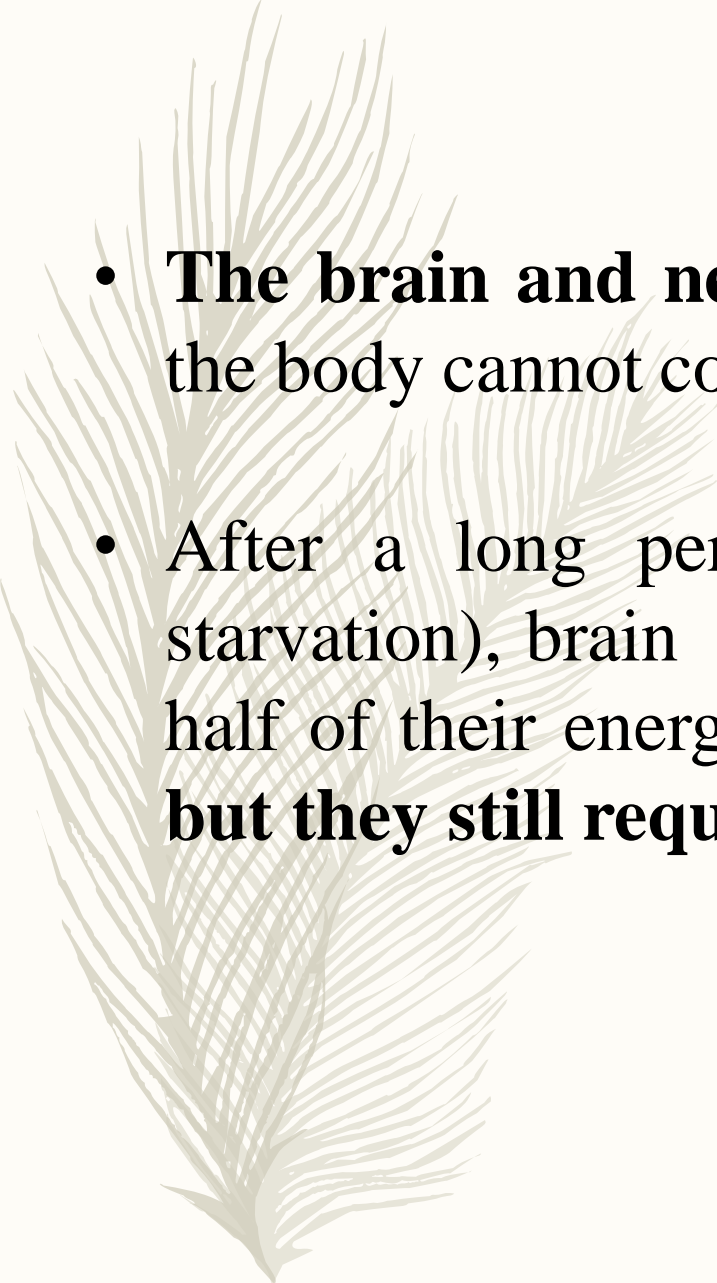
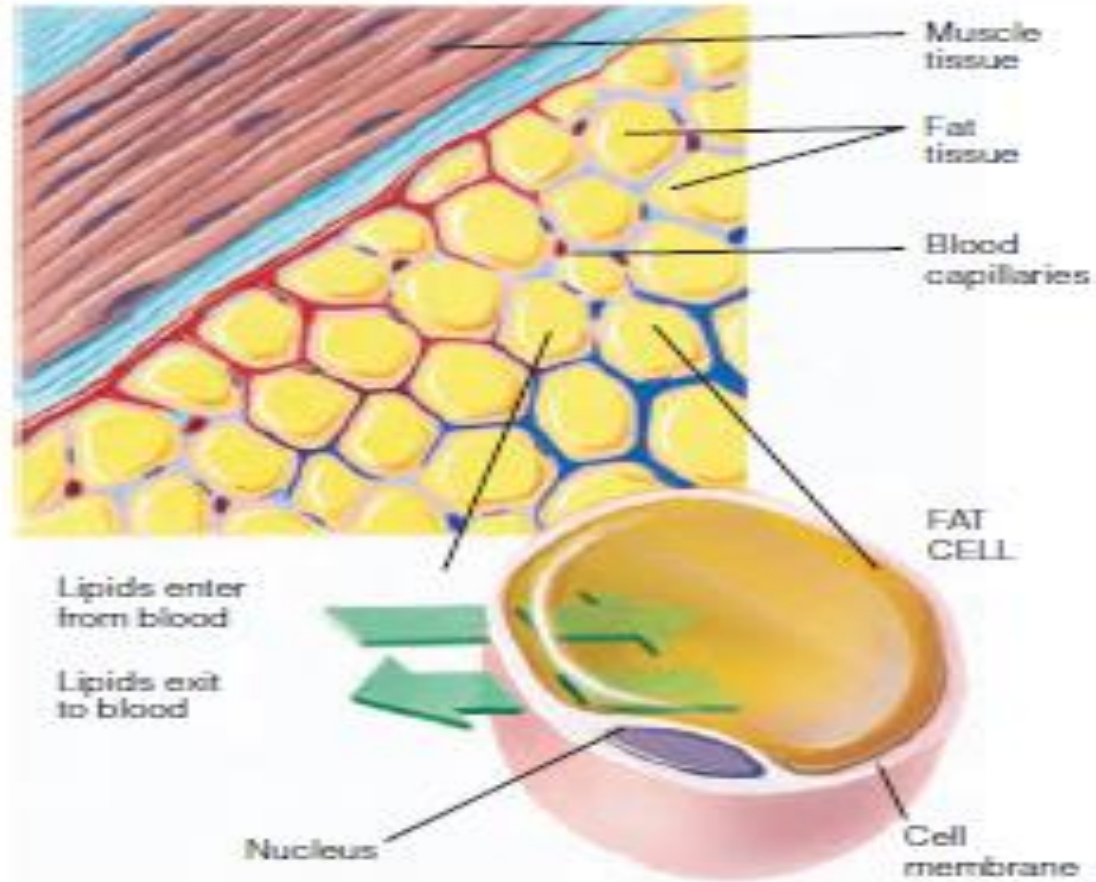
- 
- **The brain and nerves**, however, need their energy as glucose, and the body cannot convert fat to glucose.
  - After a long period of glucose deprivation (during fasting or starvation), brain and nerve cells develop the ability to derive about half of their energy from a special form of fat known as **ketones**, **but they still require glucose as well.**

FIGURE  
4-1

## A Fat Cell



Within the fat, or adipose, cell, lipid is stored in a droplet. This droplet can greatly enlarge, and the fat cell membrane will expand to accommodate its swollen contents.

## Other functions of lipids:

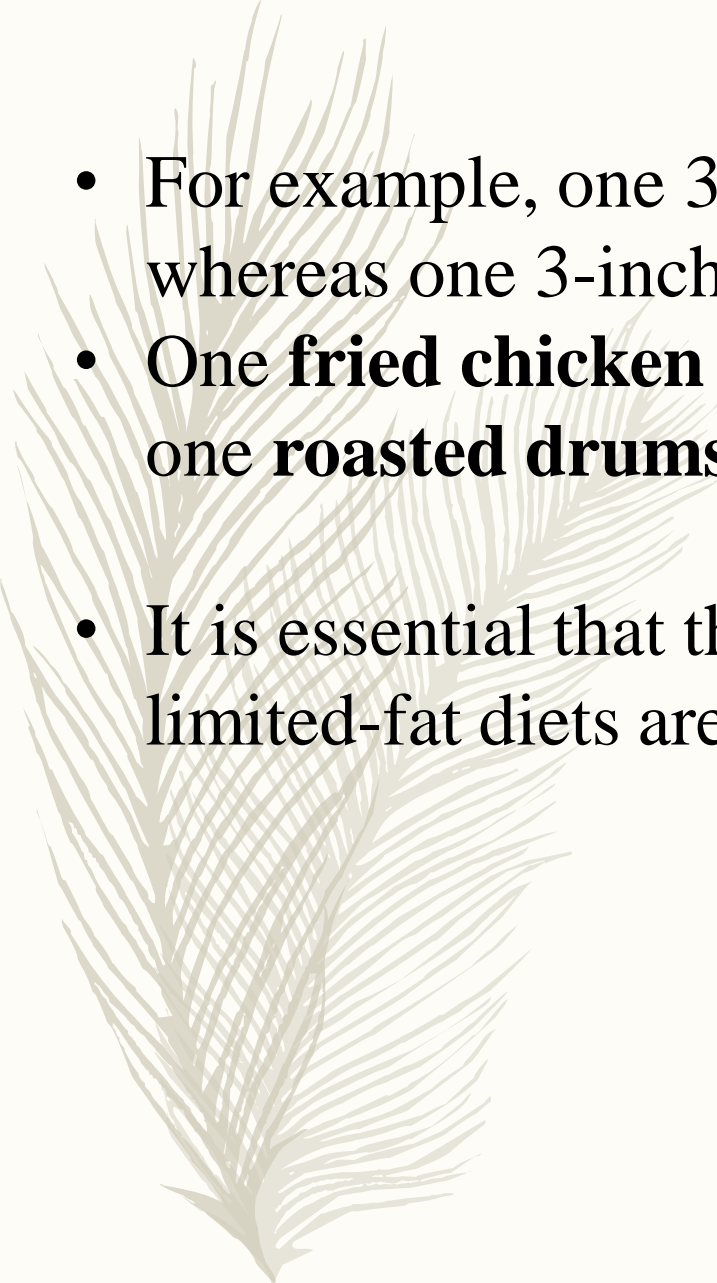
- ✓ Natural oils in the skin provide a **radiant complexion**; in the scalp, they help **nourish the hair and make it glossy**.
- ✓ The layer of fat beneath the skin **insulates** the body from extremes of temperature.
- ✓ A pad of hard **fat beneath each kidney** protects it from being jarred and damaged, even during a motorcycle ride on a bumpy road.
- ✓ The soft fat in a woman's breasts **protects her mammary glands** from heat and cold and cushions them against shock.
- ✓ The phospholipids and the sterol cholesterol are cell membrane constituents that help maintain the structure and health of all cells.

## FOOD SOURCES

- ❑ Fats are present in both animal and plant foods.
- ❑ The animal foods that provide the richest sources of fats are meats, especially fatty meats such as bacon, sausage, and luncheon meats; whole, low-fat, and reduced-fat milk; cream; butter; cheeses made with cream; egg yolks (egg white contains no fat; it is almost entirely protein and water); and fatty fish such as tuna and salmon.
- ❑ The plant foods containing the richest sources of fats are cooking oils made from olives ,sunflower, or sesame seeds or from corn, peanuts, or soybeans, margarine (which is made from vegetable oils), nuts, avocados, coconut, and cocoa butter.

## Visible and Invisible Fats in Food

- Sometimes fats are referred to as visible or invisible, depending on their food sources.
- Fats that are purchased and used as fats such as butter, margarine, lard, and cooking oils are called **visible fats**.
- **Hidden or invisible fats are those** found in other foods such as meats, cream, whole milk, cheese, egg yolk, fried foods, pastries, avocados, and nuts.
- It is often the invisible fats that can make it difficult for clients on limited fat diets to regulate their fat intake.

- 
- For example, one 3-inch **doughnut** may contain **12 grams of fat**, whereas one 3-inch **bagel** contains only **2 grams of fat**.
  - One **fried chicken** drumstick may contain **11 grams of fat**, whereas one **roasted drumstick** may contain only **2 grams of fat**.
  - It is essential that the health care professional confirm that clients on limited-fat diets are carefully educated about sources of hidden fats.

## **G**visible fats

fats in foods that are purchased and used as fats, such as butter or margarine



## **G**invisible fats

fats that are not immediately noticeable such as those in egg yolk, cheese, cream, and salad dressings

## **G**triglycerides

three fatty acids attached to a framework of glycerol

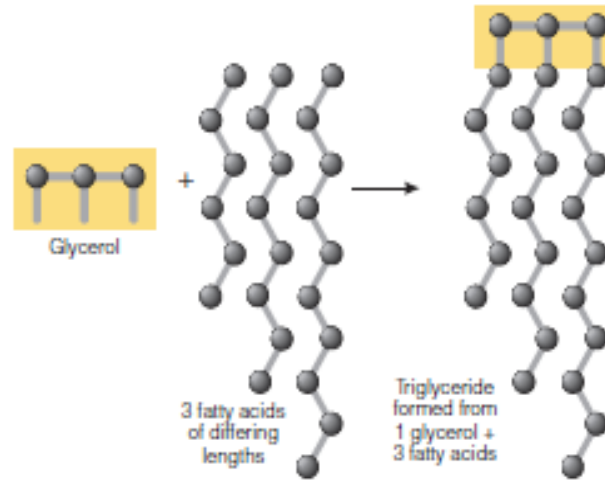


## **G**lycerol

a component of fat; derived from a water-soluble carbohydrate

FIGURE  
4-2

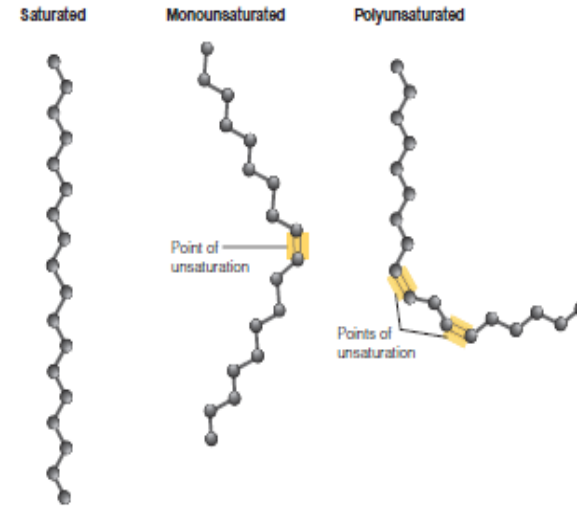
### Triglyceride Formation



Glycerol, a small, water-soluble compound, plus three fatty acids, equals a triglyceride.

FIGURE  
4-3

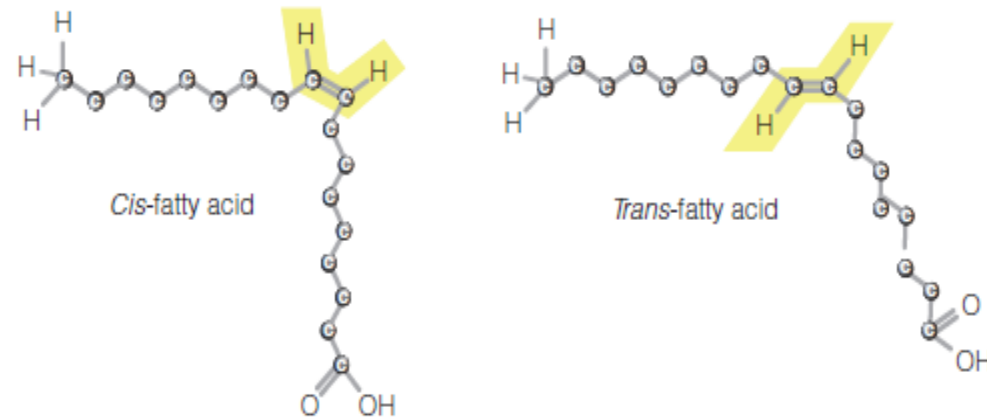
### Three Types of Fatty Acids



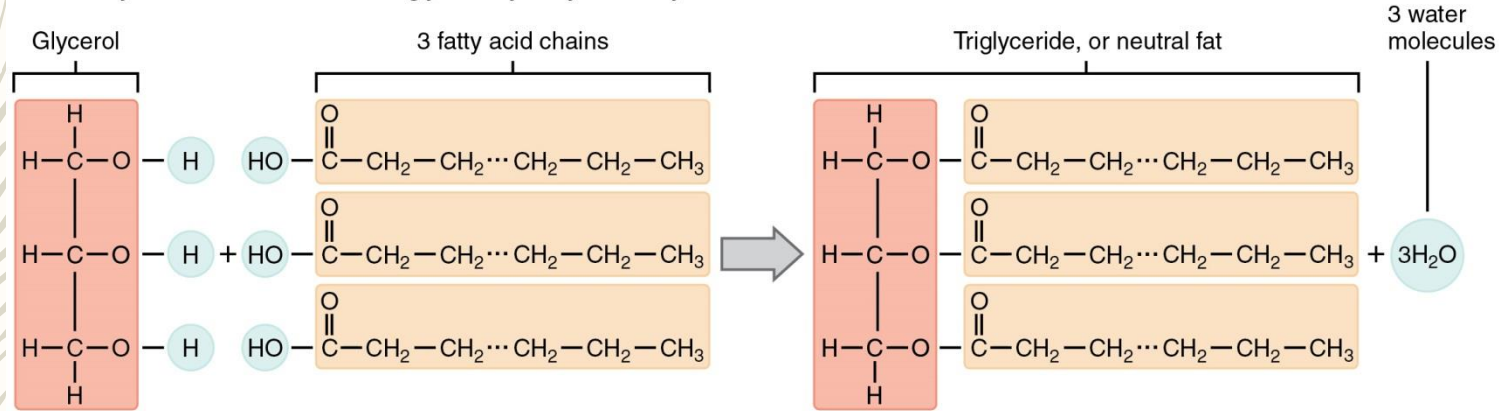
The more carbon atoms in a fatty acid, the longer it is. The more hydrogen atoms attached to those carbons, the more saturated the fatty acid is.

FIGURE  
4-4

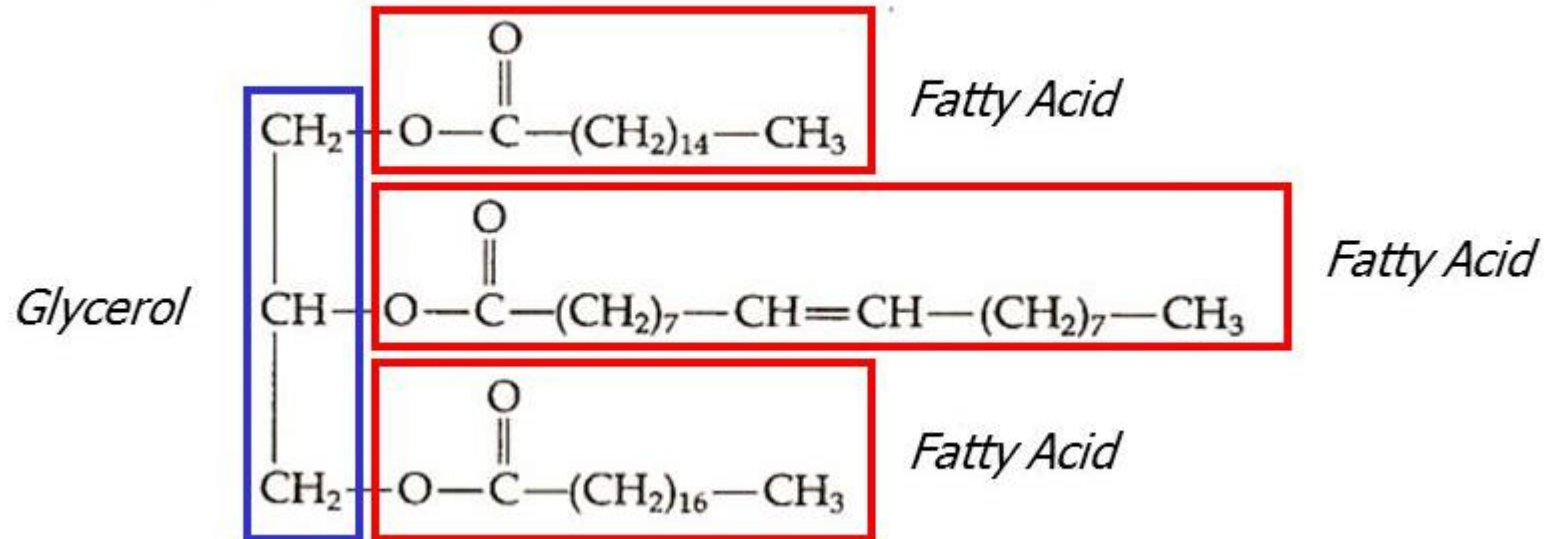
### Cis- and Trans-Fatty Acids Compared



Three fatty acid chains are bound to glycerol by dehydration synthesis.



## ■ Fatty acids may be same or mixed

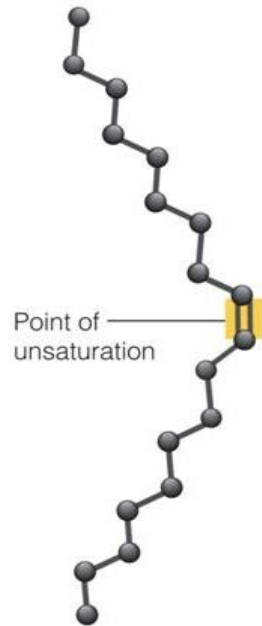


# Three Types of Fatty Acids

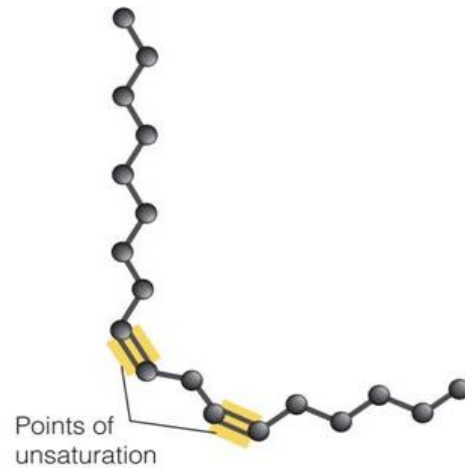
Saturated



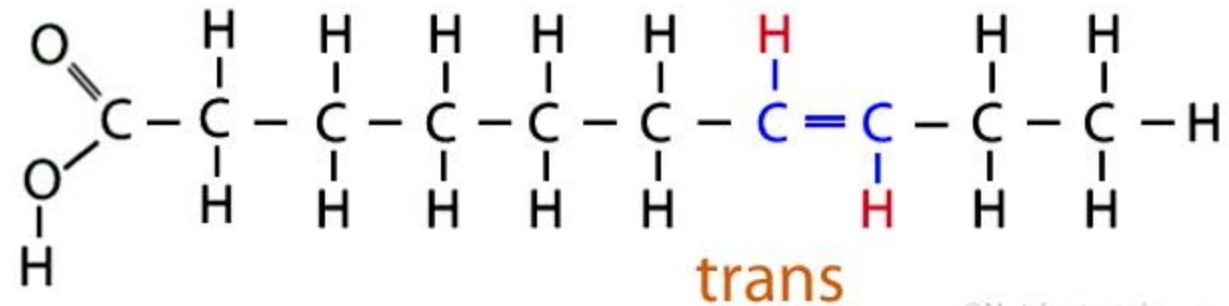
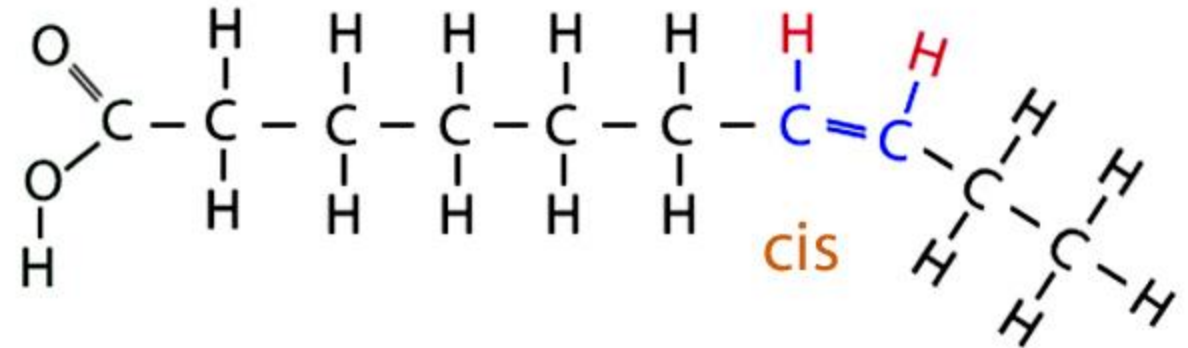
Monounsaturated



Polyunsaturated



## Cis- and Trans-Fatty Acids



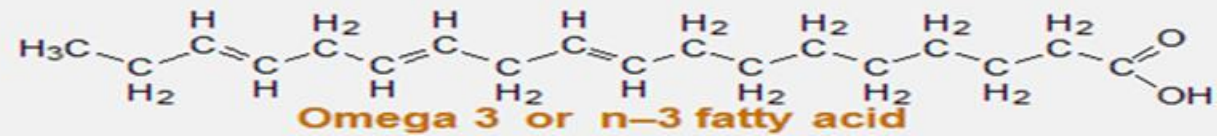
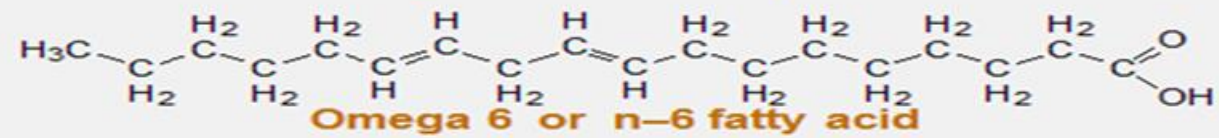
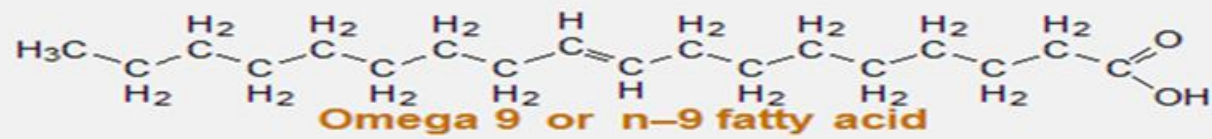


TABLE  
4-2

## The Lipid Family

### Triglycerides (fats and oils)

- Glycerol (1 per triglyceride)
- Fatty acids (3 per triglyceride)

Saturated

Monounsaturated

Polyunsaturated

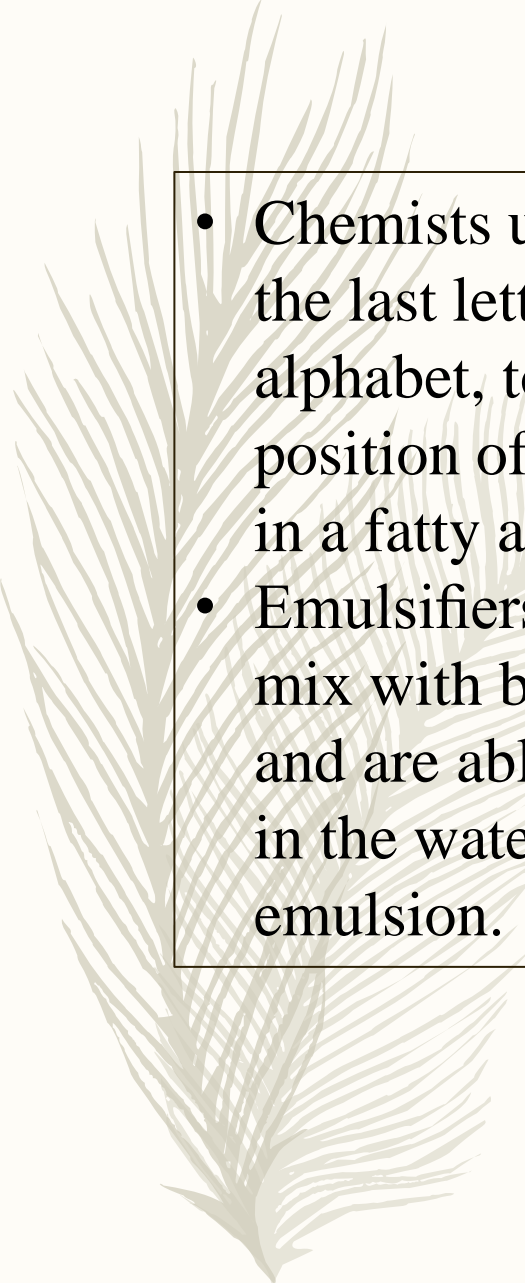
Omega-6

Omega-3

### Phospholipids (such as the lecithins)

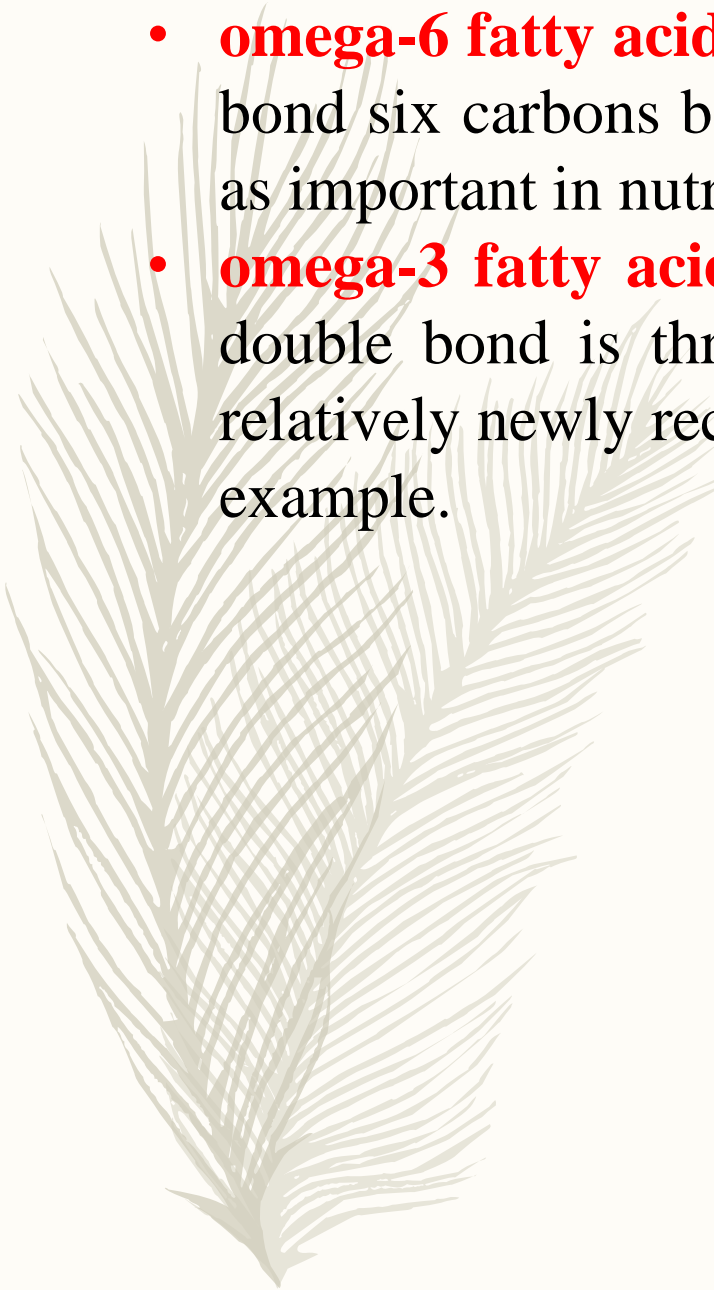
### Sterols (such as cholesterol)



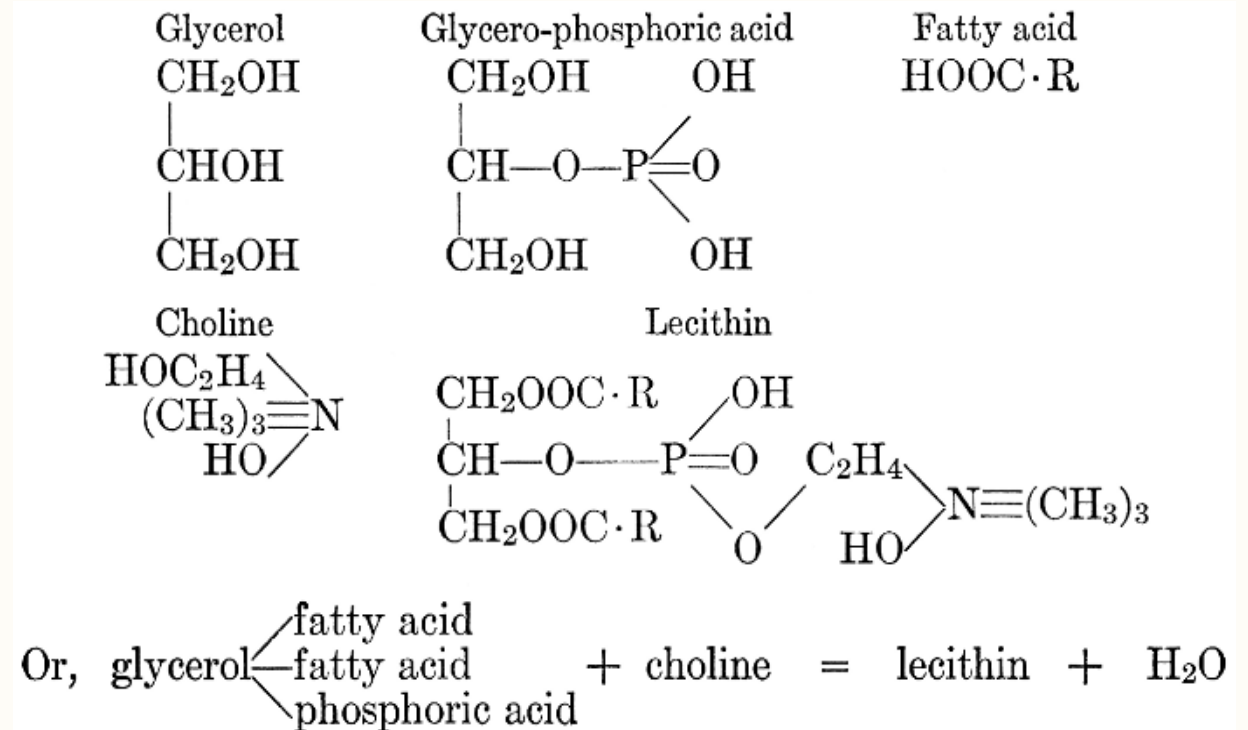
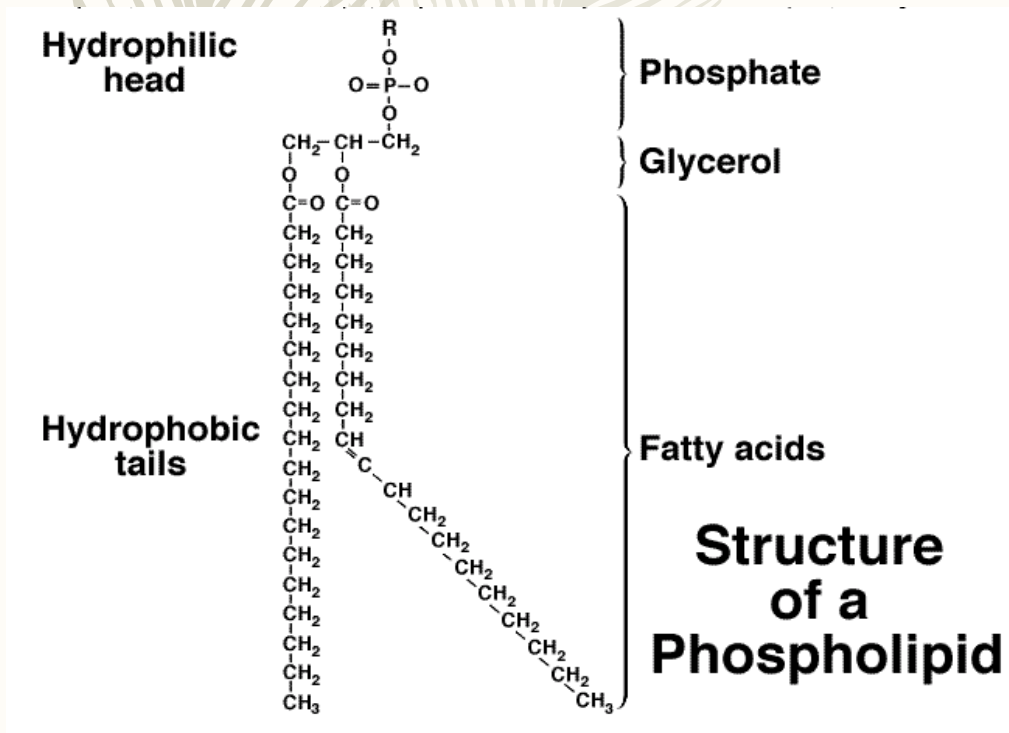
- 
- Chemists use the term omega, the last letter of the Greek alphabet, to refer to the position of the last double bond in a fatty acid.
  - Emulsifiers are substances that mix with both fat and water and are able to disperse the fat in the water, forming an emulsion.

- **saturated fatty acid:** a fatty acid carrying the maximum possible number of hydrogen atoms (having no points of unsaturation).
- **unsaturated fatty acid:** a fatty acid with one or more points of unsaturation where hydrogen atoms are missing (includes monounsaturated and polyunsaturated fatty acids).
- **monounsaturated fatty acid (MUFA):** a fatty acid that has one point of unsaturation; for example, the oleic acid found in olive oil.

- **omega-6 fatty acid:** a polyunsaturated fatty acid with its endmost double bond six carbons back from the end of its carbon chain; long recognized as important in nutrition. Linoleic acid is an example.
- **omega-3 fatty acids:** polyunsaturated fatty acids in which the endmost double bond is three carbons back from the end of the carbon chain; relatively newly recognized as important in nutrition. Linolenic acid is an example.



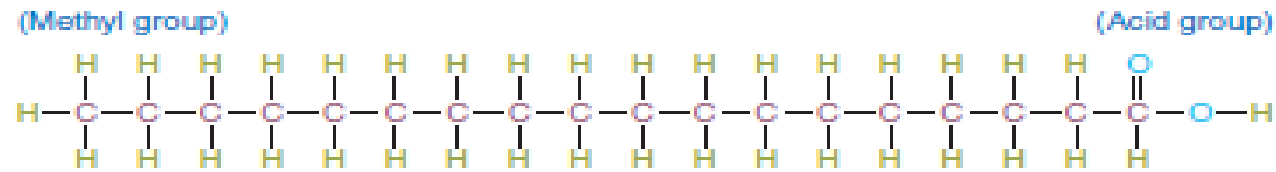
- **phospholipids:** one of the three main classes of lipids; compounds that are similar to triglycerides but have choline (or another compound) and a phosphorus-containing acid in place of one of the fatty acids.
- **lecithins:** one type of phospholipid.
- **choline:** a nonessential nutrient that can be made in the body from an amino acid.



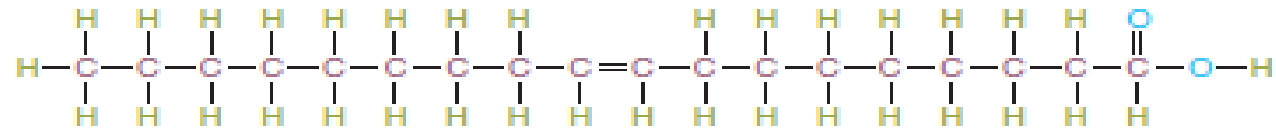
# Saturated Fats

- When a fatty acid is **saturated**, each of its carbon atoms carries all the **hydrogen atoms** possible.
- In general, animal foods contain more saturated fatty acids than unsaturated. Examples include meat, poultry, egg yolks, whole milk, whole milk cheeses, cream, ice cream, and butter.
- Although plant foods generally contain more polyunsaturated fatty acids than saturated fatty acids, chocolate, coconut, palm oil, and palm kernel oils are exceptions. They contain substantial amounts of saturated fatty acids.
- Foods containing a high proportion of saturated fats are usually solid at room temperature.
- It is recommended that one consume no more than 7% of total daily calories as saturated fats

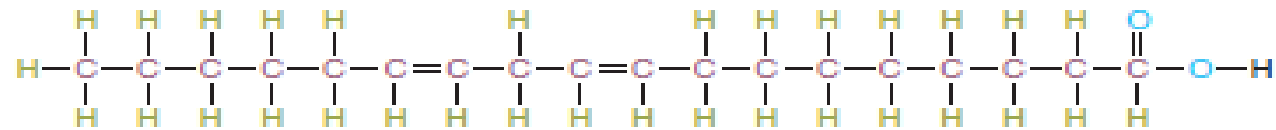
A. Saturated fatty acid (stearic acid)



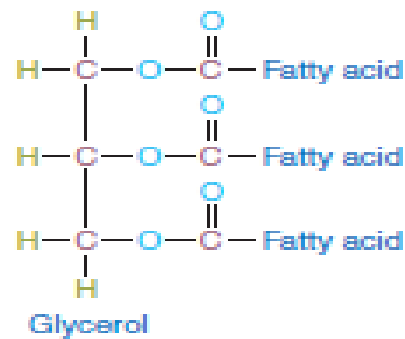
B. Monounsaturated fatty acid (oleic acid:  $\omega$ -9)



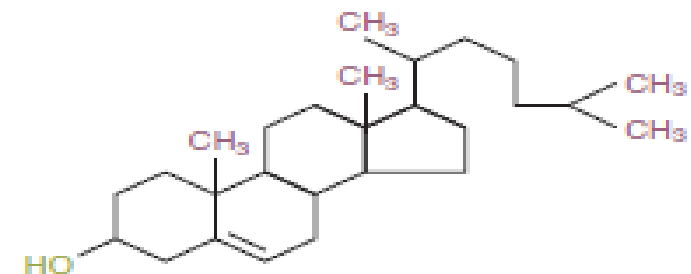
C. Polyunsaturated fatty acid (linoleic acid:  $\omega$ -6)



D. Triglyceride



E. Cholesterol



**Figure 5-2** Chemical formula for (A) saturated fatty acid, (B) monounsaturated fatty acid, (C) polyunsaturated fatty acid, (D) triglyceride, and (E) cholesterol.

# Monounsaturated Fats

- If a fat is **monounsaturated**, there is one place among the **carbon atoms** of its fatty acids where there are **fewer hydrogen atoms attached** than in saturated fats.
- Examples of foods containing monounsaturated fats are olive oil, peanut oil, canola oil, avocados, and cashew nuts.
- Research indicates that monounsaturated fats **lower** the amount of low-density lipoprotein (**LDL**) (“bad cholesterol”) in the blood, but only when they replace saturated fats in one’s diet.
- They have **no effect** on high-density lipoproteins (**HDLs**) (“good cholesterol”).
- It is recommended that one consume 15% of total daily calories as monounsaturated fats (Table 5-2).

**Table 5-2 Sources of Saturated, Monounsaturated, and Polyunsaturated Fatty Acids**

SATURATED	MONOUNSATURATED	POLYUNSATURATED
Meats	Canola oil	Safflower oil
Coconut	Olive oil	Soybean oil
Palm oil, palm kernel oil	Peanut oil	Sunflower oil
Butter	Nuts	Soybeans
Egg yolks	Avocados	Tofu
Milk and milk products (except fat-free)	Sardines	

TABLE 4-3 | Food Sources of Omega-6 and Omega-3 Fatty Acids

**Omega-6**

Linoleic acid	Leafy vegetables, seeds, nuts, grains, vegetable oils (corn, cottonseed, safflower, sesame, soybean, sunflower), poultry fat
---------------	--

**Omega-3**

Linolenic acid <sup>a</sup>	Oils (canola, flaxseed, soybean, walnut, wheat germ; liquid or soft margarine made from canola or soybean oil) Nuts and seeds (flaxseeds, walnuts, soybeans) Vegetables (soybeans)
-----------------------------	--

EPA and DHA	Human milk Fatty coldwater fish and other seafood (see Table NP4-1)
-------------	--

<sup>a</sup> Alpha-linolenic acid. Also found in the seed oil of the herb *evening primrose*.

## Polyunsaturated Fats

- The two major fatty acids denoted by the placement of their double bonds are the omega-3 and omega-6 fatty acids.
- **Omega-3 fatty acids have been reported to help lower the risk of heart disease.** Because omega-3 fatty acids are found in fish oils, an increased intake of fatty fish is recommended.
- Omega-6 (linoleic acid) has a cholesterol-lowering effect.
- The use of **supplements** of either of these fatty acids is **not recommended**. Examples of foods containing polyunsaturated fats include cooking oils made from sunflower, safflower, or sesame seeds or from corn or soybeans and fish.
- Foods containing high proportions of polyunsaturated fats are usually soft or oily.
- Polyunsaturated fats should not exceed 8% of total daily calories.

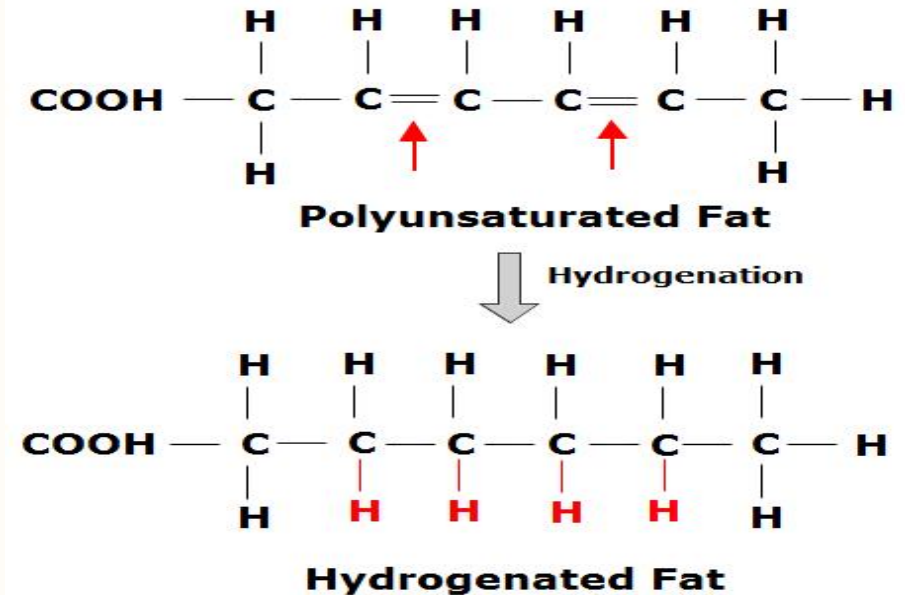
## Hydrogenated fats

- **Trans-fatty acids (TFAs) are produced when hydrogen atoms are added to monounsaturated or polyunsaturated fats to produce a semisolid product like margarine.**
- A product is likely to contain a significant amount of TFAs if partially hydrogenated vegetable oil is listed in the first three ingredients on the label.
- The major source of TFAs in the diet is from baked goods and foods eaten in restaurants.
- TFAs raise LDLs and total cholesterol.

# Hydrogenated Fats

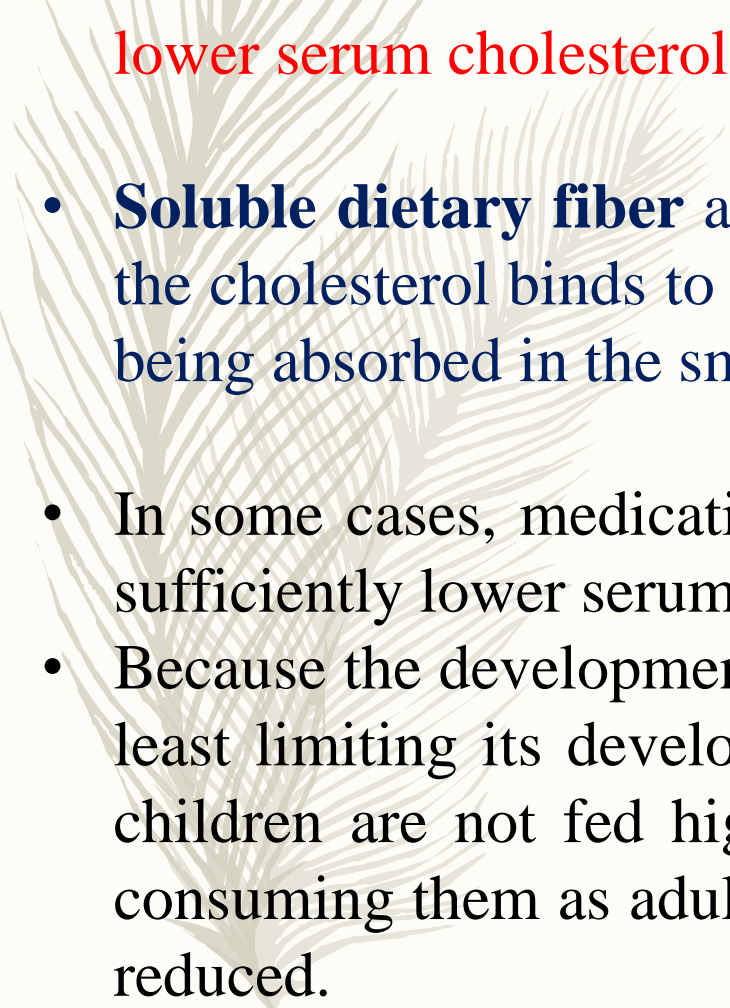


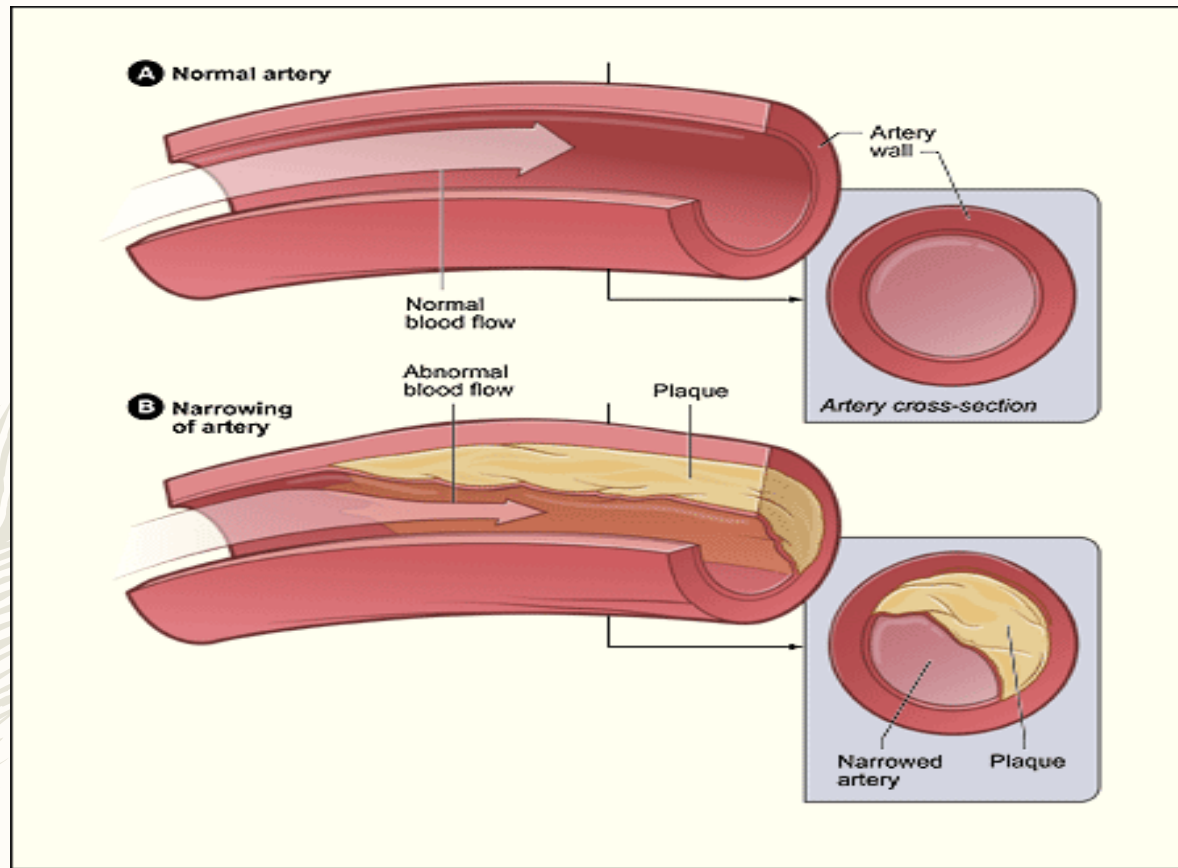
- Polyunsaturated vegetable oils to which hydrogen has been added commercially to make them solid at room temperature
- This process, called hydrogenation, turns polyunsaturated vegetable oils into saturated fats.
- Margarine and shortening are made in this way.



# CHOLESTEROL

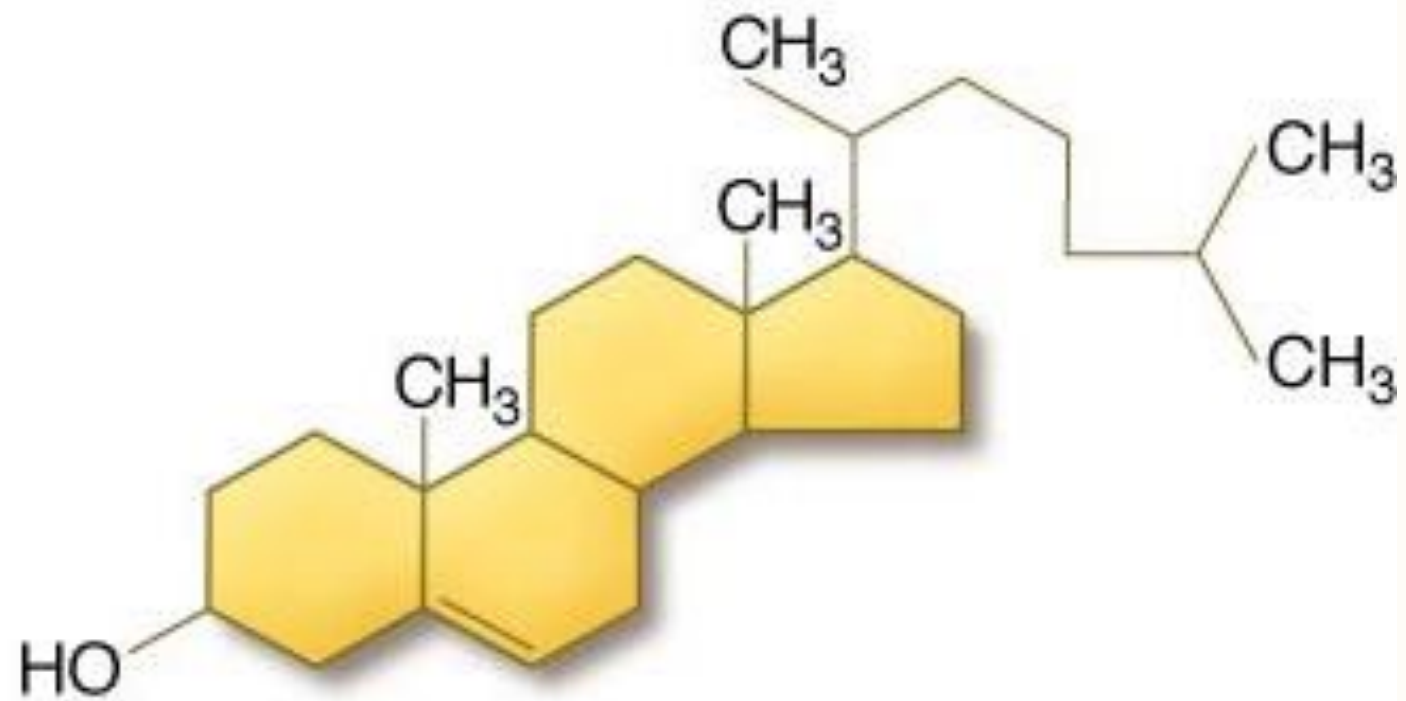
- **Cholesterol is a sterol . It is not a true fat but a fatlike substance** that exists in animal foods and body cells. It does not exist in plant foods.
- Cholesterol is essential for the synthesis of **bile, sex hormones, cortisone, and vitamin D** and is needed by every cell in the body.
- The body manufactures 800 to 1,000 mg of cholesterol a day in the liver.
- Cholesterol is a common constituent (part) of one's daily diet because it is found so abundantly in **egg yolk, fatty meats, shellfish, butter, cream, cheese, whole milk, and organ meats (liver, kidneys, brains, sweetbreads)**.
- Cholesterol is thought to be a contributing factor in heart disease because high serum cholesterol, also called **hypercholesterolemia, is common** in clients with atherosclerosis.
- Atherosclerosis is a cardiovascular disease in which **plaque (fatty deposits containing cholesterol and other substances)** forms on the inside of artery walls, reducing the space for blood flow. When the blood cannot flow through an artery near the heart, a heart attack occurs. When this is the case near the brain, a stroke occurs.

- 
- It is considered advisable that blood cholesterol levels not exceed 200 mg/dl (200 milligrams of cholesterol per 1 deciliter of blood).
  - **A reduction** in the amount of total fat, saturated fats, and cholesterol and an increase in the amounts of monounsaturated fats in the diet, weight loss, and exercise all help to lower serum cholesterol levels.
  - **Soluble dietary fiber** also is considered helpful in lowering blood cholesterol because the cholesterol binds to the fiber and is eliminated via the feces, thus preventing it from being absorbed in the small intestine.
  - In some cases, medication may be prescribed if diet, weight loss, and exercise do not sufficiently lower serum cholesterol.
  - Because the development of plaque is cumulative, the preferred means of avoiding or at least limiting its development is to limit cholesterol and fat intake throughout life. If children are not fed high-cholesterol foods on a regular basis, their chances of over consuming them as adults are reduced. Thus, their risk of heart attack and stroke is also reduced.



## Atherosclerosis

Plaque builds up inside arteries limiting the flow of oxygen-rich blood to organs and other parts of the body





## SUPERSIZE USA

Taco Bell® is a favorite place to eat for the younger generation. My son would come home with 3 beef burritos, 3 tacos, nachos bellgrande, and a large cola. Let us look at the calories, fat, and sodium content of his meal.

FOOD ITEM	CALORIES	FAT/SAT FAT (g)		SODIUM (mg)
Soft Beef Taco	210	9	4	620
Crunchy Beef Taco	170	10	3.5	330
Nachos BellGrande	760	42	6	1,250
Large Cola	210			13
Totals for meal above:				
3 Soft Beef Tacos	630	27	12	1,860
3 Crunchy Beef Tacos	510	30	10.5	990
Nachos Bellgrande	760	42	6	1,250
Large Cola	210			13
<b>GRAND TOTAL</b>	<b>2,110</b>	<b>99</b>	<b>20.5</b>	<b>4,100</b>

What a tasty meal! Because it is his favorite place to eat and it fits within his budget, should he continue to eat there? As a mother and dietitian I tried to tell him the cons for his body, but like all kids he knows everything. He doesn't exercise much and worries about his weight. He should—he is on the way to supersizing himself.

Source: Retrieved June 2009 from [www.tacobell.com/nutrition/information](http://www.tacobell.com/nutrition/information).



**Table 5-3 Fat and Cholesterol Content of Some Common Foods**

FOOD	AMOUNT	SATURATED FAT (g)	CHOLESTEROL (mg)	TOTAL FAT (g)	TOTAL KCAL
<b>Dairy</b>					
Creamed cottage cheese (4% fat)	1 cup	6.4	34	10	235
Uncreamed cottage cheese (0.5% fat)	1 cup	0.4	10	1	125
Cream cheese	1 oz	6.2	31	10	100
Swiss cheese	1 oz	5.0	26	8	105
American processed cheese	1 oz	5.6	27	9	105
Half and half	1 Tbsp	1.1	6	2	20
Heavy cream	1 Tbsp	3.5	21	6	54
Nondairy creamer	1 Tbsp	1.4	0	1	20
Whole milk	1 cup	5.1	33	8	150
Reduced-fat milk	1 cup	2.9	18	5	120
Low-fat milk	1 cup	1.6	10	3	100
Fat-free milk	1 cup	0.3	4	Trace	85
Chocolate milk shake	10 oz	4.8	30	8	335
Ice cream (11% fat)	1/2 cup	8.9	59	14	270
Egg	1	1.7	274	6	80
<b>Oils</b>					
Butter	1 Tbsp	7.1	31	11	100
Margarine	1 Tbsp	2.2	0	11	100
Corn oil	1 Tbsp	1.8	0	14	125
<b>Seafood</b>					
Crabmeat (canned)	1 cup	0.5	135	3	135
Salmon (canned)	3 oz	0.9	34	5	120
Shrimp (canned)	3 oz	0.2	128	1	100
Tuna					
Water-packed	3 oz	0.3	48	1	135
Oil-packed	3 oz	1.4	55	7	165
<b>Vegetable</b>					
Avocado	1/2	2.2	0	15	150
<b>Bread</b>					
Bagel	1	0.3	0	2	200
Doughnut	1	2.8	20	12	210
English muffin	1	0.3	0	1	140
<b>Nuts</b>					
Peanuts (dry roasted)	1 oz	2.0	0	15	170
<b>Meat</b>					
Ground beef (lean)	3 oz	6.2	74	16	230
Roast beef (lean)	4.4 oz	7.2	100	18	300
Leg lamb (lean)	5.2 oz	4.8	130	12	280
Leg lamb (lean and fat)	6 oz	11.2	156	26	410
Bacon	3 slices	3.3	16	9	110
Pork chop (lean)	5 oz	5.2	142	16	330
Frankfurter	1.5 oz	4.8	23	13	145
Chicken leg, fried (meat and skin)	5 oz	6.0	124	22	390
Chicken leg, roasted (meat only)	3.2 oz	1.4	82	4	150

Source: U.S. Department of Agriculture. *Nutritive Values of Foods*. Home and Garden Bulletin, No. 72. 2002 (rev. ed.).



# **Digestion and absorption**

# Digestion and absorption

- Although 95% of ingested fats are digested, it is a complex process. The chemical digestion of fats occurs mainly in the **small intestine**.
- Fats are not digested in the mouth.
- They are digested only slightly in the stomach, where gastric lipase acts on emulsified fats such as those found in cream and egg yolk.
- Fats must be mixed well with the gastric juices before entering the small intestine
- In the small intestine, bile emulsifies the fats, and the enzyme **pancreatic lipase** reduces them to fatty acids and glycerol, which the body subsequently absorbs through villi.

## Figure: Steps of lipid digestion and absorption

### Lipids:

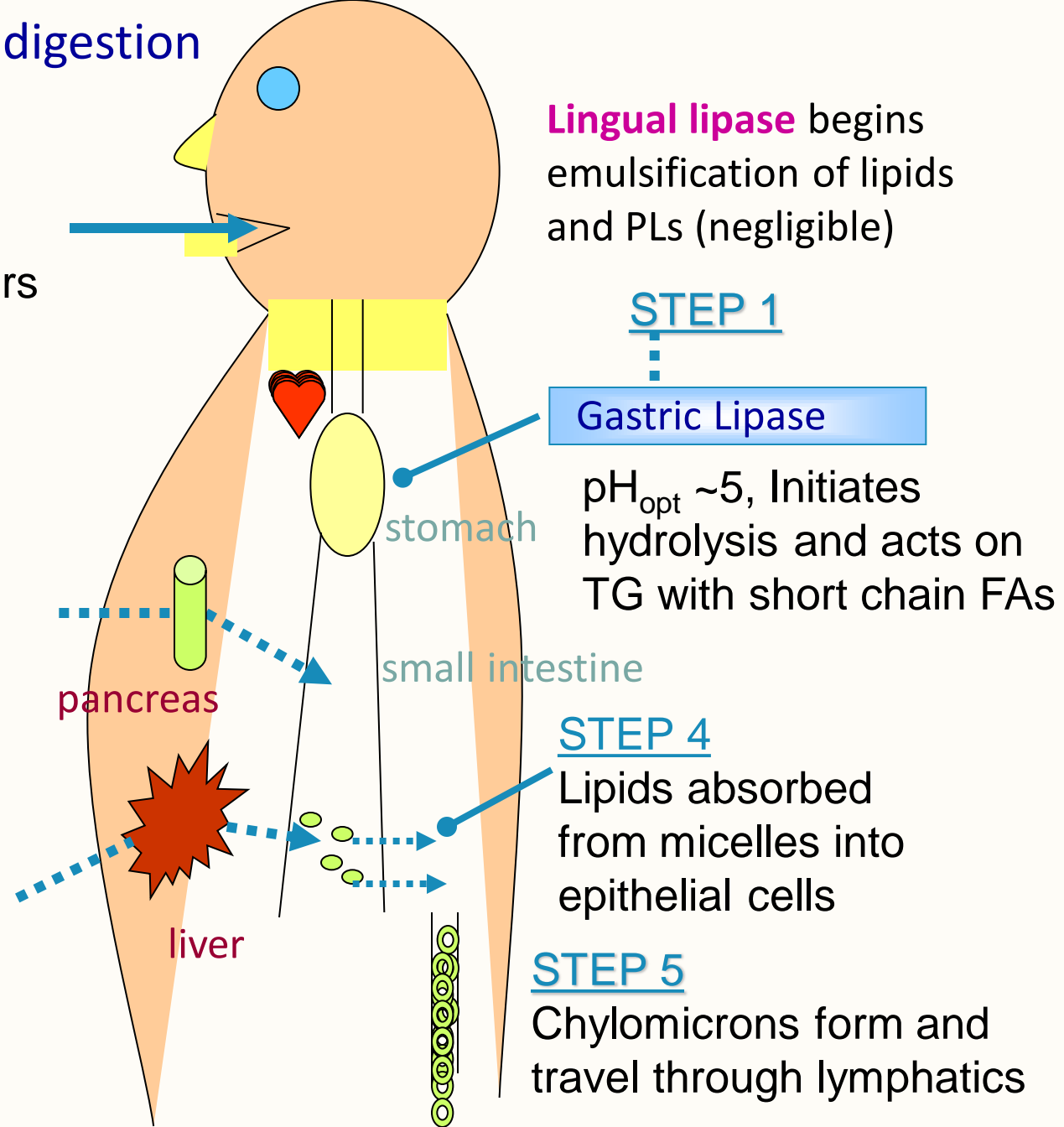
Triacylglycerols  
Cholesterol esters  
Phospholipids

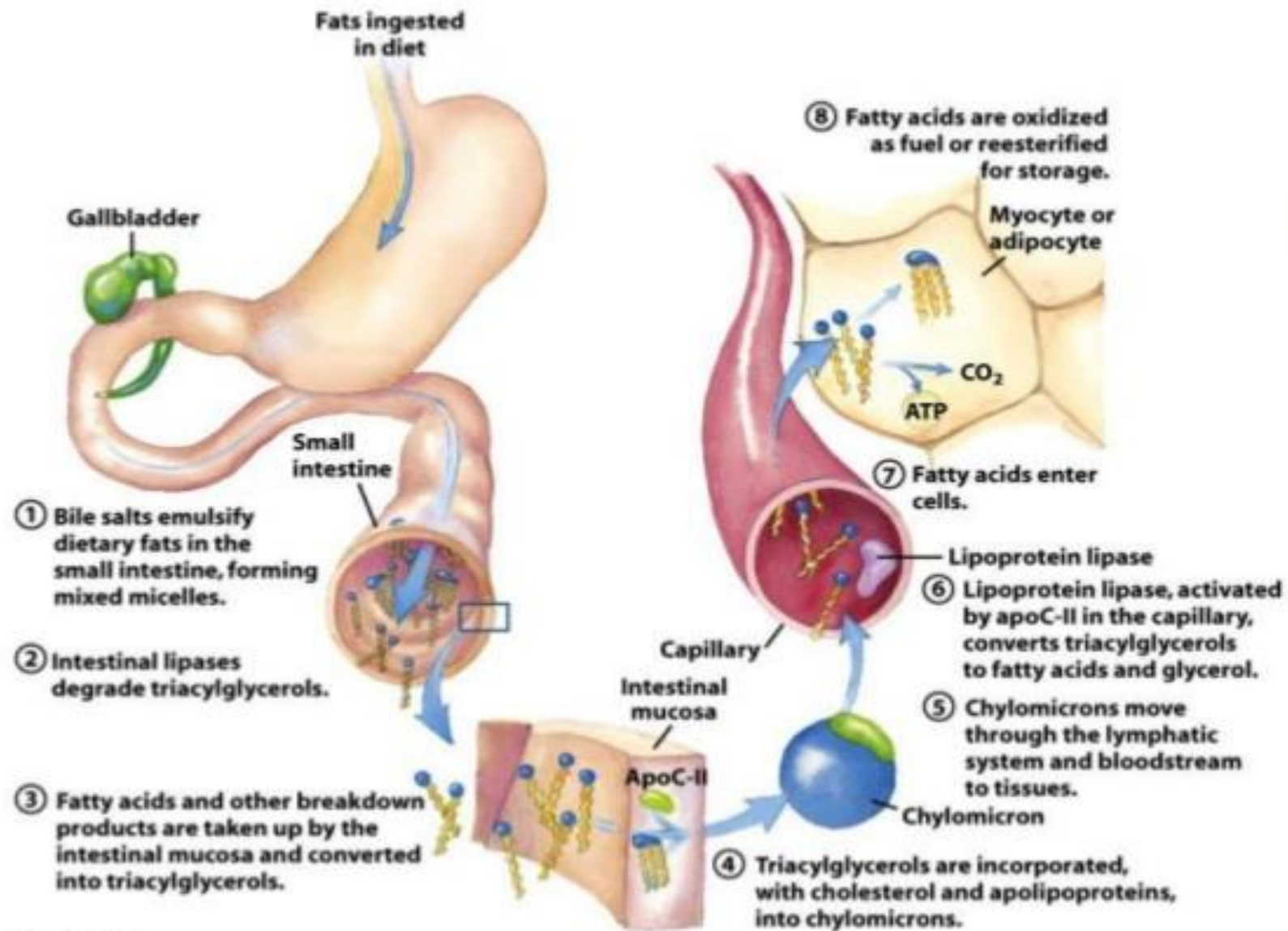
### STEP 2

Pancreas releases:  
Lipase (+colipase)  
cholesterol esterase  
phospholipase A<sub>2</sub>

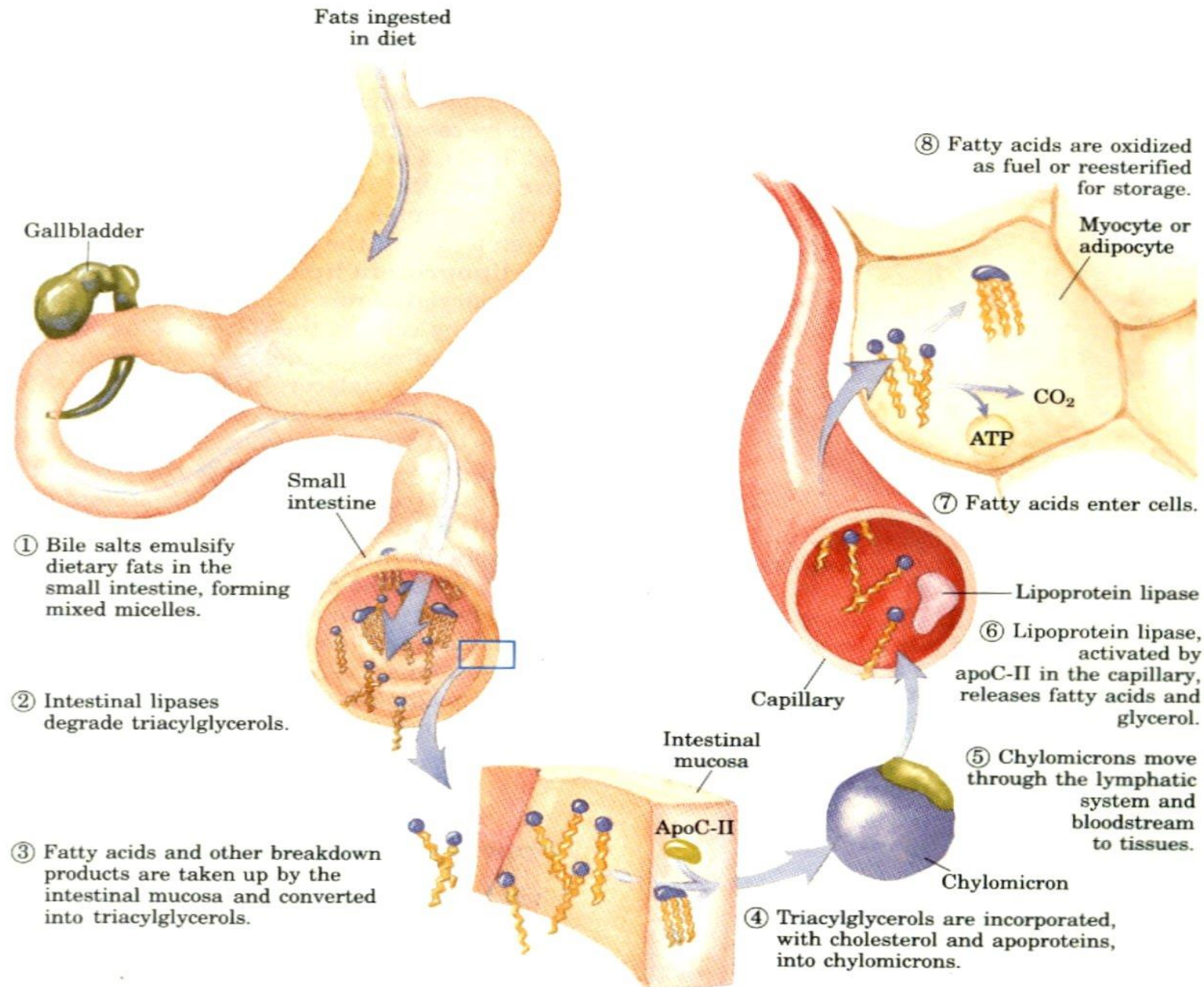
### STEP 3

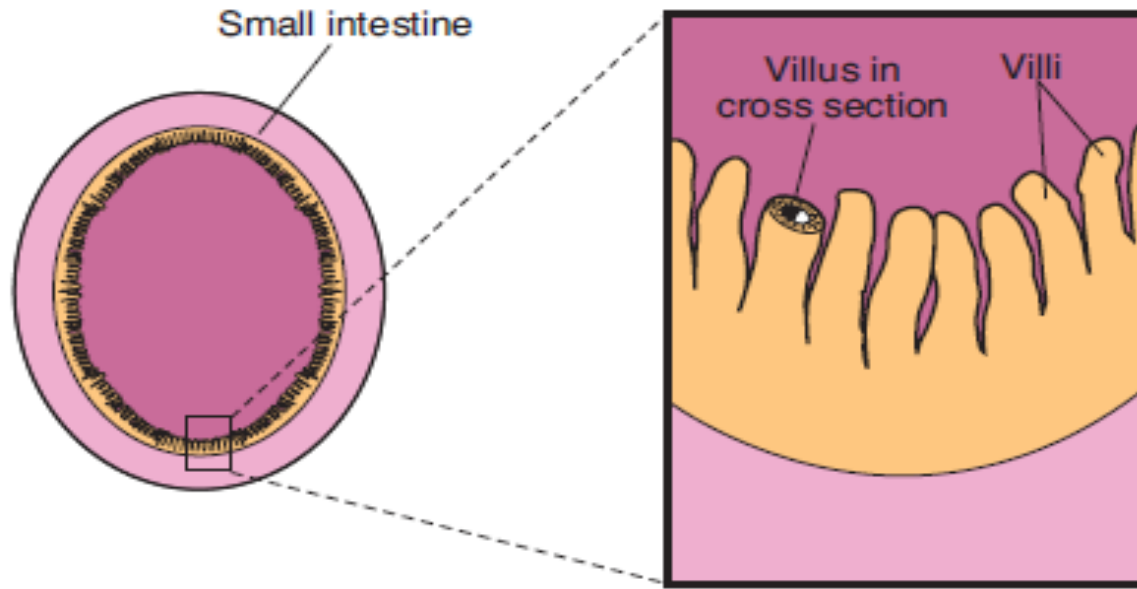
Liver releases bile  
acids to solubilize  
lipid products in  
mixed micelles





**Figure 17-1**  
 Lehninger Principles of Biochemistry, Fifth Edition  
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**Figure 5-3** The body absorbs fatty acids and glycerol through the villi of the small intestine.

### 6 lipoproteins

carriers of fat in the blood

### 6 chylomicrons

the largest lipoprotein; transport the lipids after digestion into the body

### 6 very-low-density lipoproteins (VLDLs)

lipoproteins made by the liver to transport lipids throughout the body

### 6 low-density lipoproteins (LDLs)

carry blood cholesterol to the cells

### 6 high-density lipoproteins (HDLs)

lipoproteins that carry cholesterol from cells to the liver for eventual excretion

# Lipoproteins

- Fats are insoluble in water, which is the main component of blood. Therefore, special carriers must be provided for the fats to be absorbed and transported by the blood to body cells.
- In the initial stages of absorption, bile joins with the products of fat digestion to carry fat. Later, protein combines with the final products of fat digestion to form special carriers called **lipoproteins**. **The lipoproteins subsequently carry the fats to the body cells by way of the blood.**
- Lipoproteins are classified as **chylomicrons, very-low-density lipoproteins (VLDLs), low-density lipoproteins (LDLs), and high-density lipoproteins (HDLs), according to their mobility and density.**
- **Chylomicrons** are the first lipoprotein identified after eating. They are the largest lipoproteins and the lightest in weight.
- They are composed of 80% to 90% triglycerides.
- Lipoprotein lipase acts to break down the triglycerides into free fatty acids and glycerol. Without this enzyme, fat could not get into the cells.

- **Very-low-density lipoproteins** are made primarily by the liver cells and are composed of 55% to 65% triglycerides. They carry triglycerides and other lipids to all cells. As the VLDLs lose triglycerides, they pick up cholesterol from other lipoproteins in the blood, and they then become **LDLs**.
- **Low-density lipoproteins** are approximately 45% cholesterol with few triglycerides. They carry most of the blood cholesterol from the liver to the cells. Elevated blood levels greater than 130 mg/dl of LDL are thought to be contributing factors in atherosclerosis. Low-density lipoprotein is sometimes termed *bad cholesterol*.
- **High-density lipoproteins** carry cholesterol from the cells to the liver for eventual excretion. The level at which low HDL becomes a major risk factor for heart disease has been set at 40 mg/dl.
- Research indicates that an HDL level of 60 mg/dl or more is considered protective against heart disease.
- High-density lipoproteins are sometimes called *good cholesterol*.
- *Exercising*, maintaining a desirable weight, and giving up smoking are all ways to increase one's HDL.



## **METABOLISM AND ELIMINATION**

The liver controls fat metabolism. It hydrolyzes triglycerides and forms new ones from this hydrolysis as needed. Ultimately, the metabolism of fats occurs in the cells, where fatty acids are broken down to carbon dioxide and water, releasing energy.

The portion of fat that is not needed for immediate use is stored as adipose tissue. Carbon dioxide and water are by-products that are used or removed from the body by the circulatory, respiratory, and excretory systems.

## FATS AND THE CONSUMER

- Fats continue to be of particular interest to the consumer. Most people know that fats are high-calorie foods and that they are related to heart disease. But people who are not in the health field may not know ***how fats affect health.***
- Consequently, they may be easily duped by clever ads for or salespersons of nutritional supplements or new “health food” products.
- It is important that the health care professional carefully evaluate any new dietary “supplement” for which a nutrition claim is made. If the item is not included in the RDA, DRI, or AI, it is safe to assume that medical research has not determined that it is essential. Ingestion of dietary supplements of unknown value could, ironically, be damaging to one’s health.

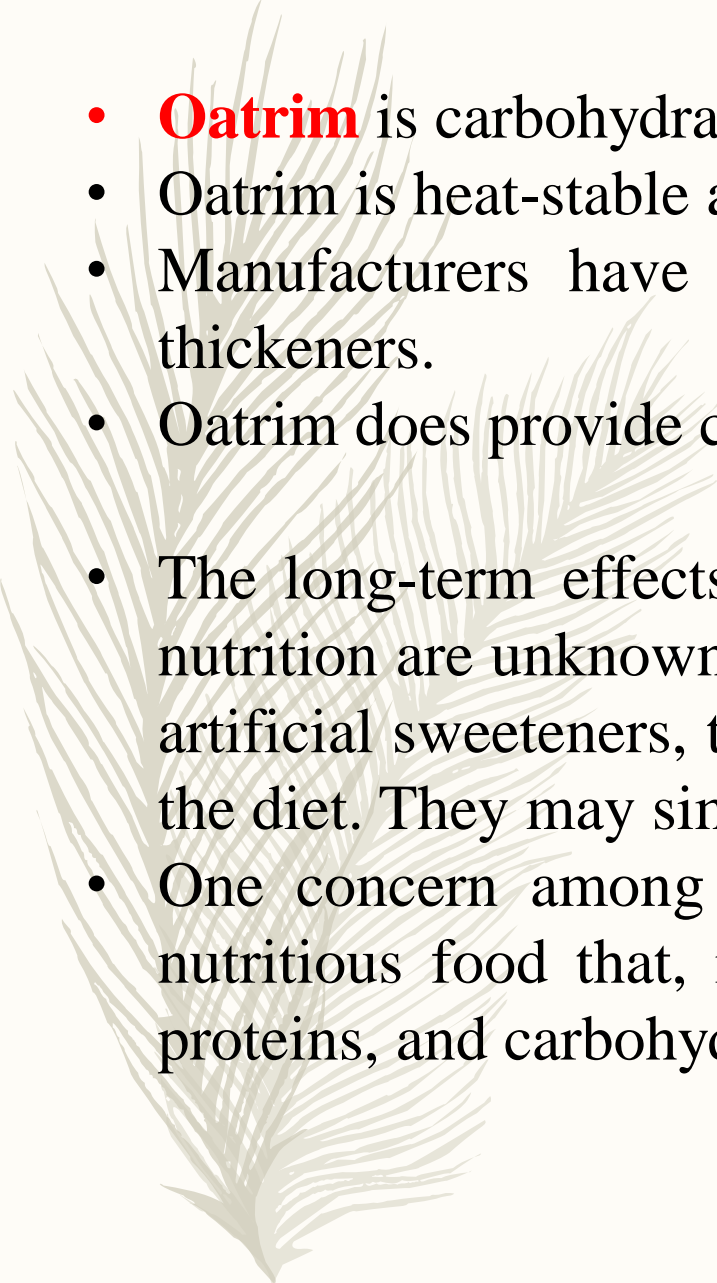


## Lecithin

- **Lecithin is a fatty substance classified as a phospholipid.**
- **It is found in both** plant and animal foods and is synthesized in the liver. It is a natural emulsifier that helps transport fat in the bloodstream. It is used commercially to make food products smooth.
- Lecithin supplements have been promoted by some health food salespersons as being able to prevent cardiovascular disease. To date, this has not been scientifically proven.

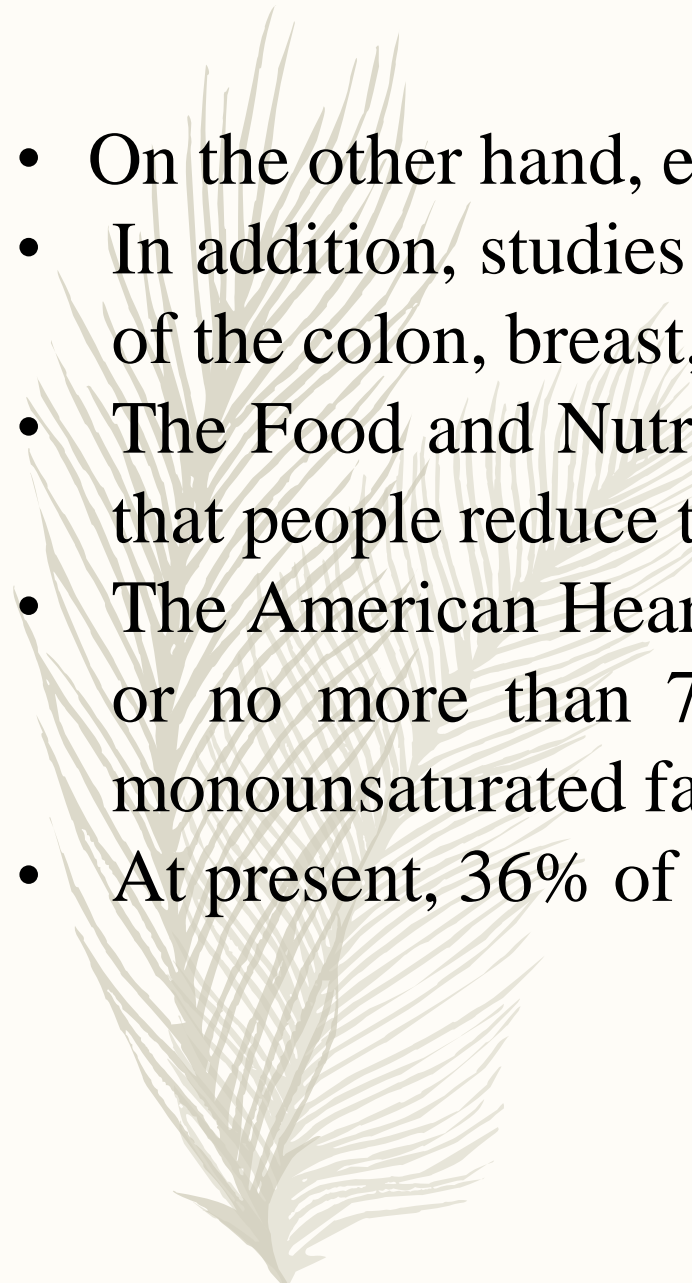
## Fat Alternatives

- Research into fat alternatives has been in progress for decades.
- **Olestra**, the newest product on the market, is made from carbohydrates and fat.
- The FDA has approved olestra for use only in snack foods such as potato chips, tortilla chips, and crackers. The government requires that food labels indicate that olestra “**inhibits the absorption of some vitamins and other nutrients.**” Therefore, the fat-soluble vitamins A, D, E, and K have been added to foods containing olestra.
- Olestra contains no calories, but it can cause cramps and diarrhea.
- The products manufactured with olestra should be used in moderation.
- **Simplesse** is made from either egg white or milk protein and contains 1.3 kcal/g. Simplesse can be used only in cold foods such as ice cream because it becomes thick or gels when heated.
- Simplesse is not available for home use.

- 
- **Oatrim** is carbohydrate-based and is derived from oat fiber.
  - Oatrim is heat-stable and can be used in baking but not in frying.
  - Manufacturers have used carbohydrate-based compounds for years as thickeners.
  - Oatrim does provide calories, but significantly less than fat.
  - The long-term effects of these products may have on human health and nutrition are unknown. If they are used in the way the U.S. population uses artificial sweeteners, they probably will not reduce the actual fat content in the diet. They may simply be additions to it.
  - One concern among nutritionists is that they will be used in place of nutritious food that, in addition to fat, also provides vitamins, minerals, proteins, and carbohydrates.

# DIETARY REQUIREMENTS

- Although no specific dietary requirement for fats is included in the RDA and DRIs, deficiency symptoms do occur when fats provide less than 10% of the total daily calorie requirement.
- When deficiency occurs, ***eczema*** (inflamed and scaly skin condition) can develop.
- This has been observed in infants who were fed formulas lacking the essential fatty acid linoleic acid and in clients maintained for long periods on intravenous feedings that lack linoleic acid.
- Also, growth may be retarded, and weight loss can occur when diets are seriously deficient in fats.

- 
- On the other hand, excessive fat in the diet can lead to obesity or heart disease.
  - In addition, studies point to an association between high-fat diets and cancers of the colon, breast, uterus, and prostate.
  - The Food and Nutrition Board's Committee on Diet and Health recommends that people reduce their fat intake to 30% of total calories.
  - The American Heart Association's newest recommendation is to consume less or no more than 7% of saturated fats, 8% polyunsaturated fats, and 15% monounsaturated fats.
  - At present, 36% of calories in U.S. diets is derived from fats.

## Considerations for the health care professional

To accomplish dietary change, the health care professional should review clients' usual diets *with them*. *Changes then can be introduced clearly and* sensitively and with the clients' active participation. Unless clients understand *why dietary changes are needed and want to make them, they are unlikely to* change their diets.

FIGURE  
4-5

## Cutting Fat Cuts kCalories—and Saturated Fat



Pork chop with fat (340 kcal, 19 g fat, 7 g saturated fat)



Pork chop with fat trimmed off (230 kcal, 9 g fat, 3 g saturated fat)



Potato with 1 tbs butter and 1 tbs sour cream (350 kcal, 14 g fat, 10 g saturated fat)



Plain potato (220 kcal, <1 g fat, 0 g saturated fat)



Whole milk, 1 c (150 kcal, 8 g fat, 5 g saturated fat)



Fat-free milk, 1 c (90 kcal, <1 g fat, <1 g saturated fat)

FIGURE  
4-6

## Comparison of Dietary Fats

**Key:**

■ Saturated

■ Monounsaturated

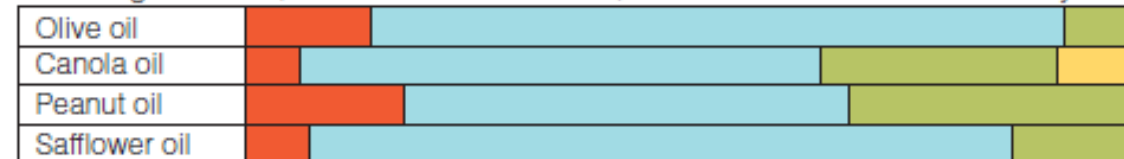
■ Polyunsaturated,  
omega-6

■ Polyunsaturated,  
omega-3

Animal fats and the tropical oils of coconut and palm are mostly **saturated** fatty acids.



Some vegetable oils, such as olive and canola, are rich in **monounsaturated** fatty acids.



Many vegetable oils are rich in **polyunsaturated** fatty acids.



Most fats are a mixture of saturated, monounsaturated, and polyunsaturated fatty acids.



## HOW TO | Make Heart-Healthy Choices—by Food Group

### Breads and Cereals

- Select breads, cereals, and crackers that are low in saturated and *trans* fat (for example, bagels instead of croissants).
- Prepare pasta with a tomato sauce instead of a cheese or cream sauce.

### Vegetables and Fruits

- Enjoy the natural flavor of steamed vegetables (without butter) for dinner and fruits for dessert.
- Eat at least two vegetables (in addition to a salad) with dinner.
- Snack on raw vegetables or fruits instead of high-fat items like potato chips.
- Buy frozen vegetables without sauce.

### Milk and Milk Products

- Switch from whole milk to reduced-fat, from reduced-fat to low-fat, and from low-fat to fat-free (nonfat).
- Use fat-free and low-fat cheeses (such as part-skim ricotta and low-fat mozzarella) instead of regular cheeses.
- Use fat-free or low-fat yogurt or sour cream instead of regular sour cream.
- Use evaporated fat-free milk instead of cream.
- Enjoy fat-free frozen yogurt, sherbet, or ice milk instead of ice cream.

### Meat and Legumes

- Fat adds up quickly, even with lean meat; limit intake to about 6 ounces (cooked weight) daily.
- Eat at least two servings of fish per week (particularly fish such as mackerel, lake trout, herring, sardines, and salmon).
- Choose fish, poultry, or lean cuts of pork or beef; look for unmarbled cuts named *round* or *loin* (eye of round, top round, bottom round, round tip, tenderloin, sirloin, center loin, and top loin).
- Choose processed meats such as lunch meats and hot dogs that are low in saturated fat and cholesterol.
- Trim the fat from pork and beef; remove the skin from poultry.
- Grill, roast, broil, bake, stir-fry, stew, or braise meats; don't fry. When possible, place food on a rack so that fat can drain.
- Use lean ground turkey or lean ground beef in recipes; brown ground meats without added fat, then drain off fat.
- Select tuna, sardines, and other canned meats packed in water; rinse oil-packed items with hot water to remove much of the fat.

- Fill kabob skewers with lots of vegetables and slivers of meat; create main dishes and casseroles by combining a little meat, fish, or poultry with a lot of pasta, rice, or vegetables.
- Use legumes often.
- Eat a meatless meal or two daily.
- Use egg substitutes in recipes instead of whole eggs or use two egg whites in place of each whole egg.

### Fats and Oils

- Use butter or stick margarine sparingly; select soft margarines instead of hard margarines.
- Use fruit butters, reduced-kcalorie margarines, or butter replacers instead of butter.
- Use low-fat or fat-free mayonnaise and salad dressing instead of regular.
- Limit use of lard and meat fat.
- Limit use of products made with coconut oil, palm kernel oil, and palm oil (read labels on bakery goods, processed foods, popcorn oils, and nondairy creamers).
- Reduce use of hydrogenated shortenings and stick margarines and products that contain them (read labels on crackers, cookies, and other commercially prepared baked goods); use vegetable oils instead.

### Miscellaneous

- Use a nonstick pan, or coat the pan lightly with vegetable oil.
- Refrigerate soups and stews; when the fat solidifies, remove it before reheating.
- Use wine; lemon, orange, or tomato juice; herbs; spices; fruits; or broth instead of butter or margarine when cooking.
- Stir-fry in a small amount of oil; add moisture and flavor with broth, tomato juice, or wine.
- Use variety to enhance enjoyment of the meal: vary colors, textures, and temperatures—hot cooked versus cool raw foods—and use garnishes to complement food.
- Omit high-fat meat gravies and cheese sauces.
- Order pizzas with lots of vegetables, a little lean meat, and half the cheese.

SOURCE: Adapted from Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), Third Report of the National Cholesterol Education Program (NCEP), NIH publication no. 02-5215 (Bethesda, MD: National Heart, Lung, and Blood Institute, 2002), pp. V-25–V-27.

## **To reduce your intake of saturated fat and cholesterol:**

- ☐ Choose vegetable oils rather than solid fats (meat and dairy fats, shortening).
- ☐ If you need fewer calories, decrease the amount of fat you use in cooking and at the table.
- ☐ Get most of your calories from plant foods (grains, fruits, vegetables).
- ☐ Use the Nutrition Facts Labels to help choose foods lower in fat, saturated fat, and cholesterol.
- ☐ Choose fat-free or low-fat milk, fat-free or low-fat yogurt, and low-fat cheese most often.
- ☐ Choose fish or lean meats.
- ☐ Limit ground meat and fatty processed meats, marbled steaks, and cheese.
- ☐ Limit your intake of foods with creamy sauces, and add little or no butter to your food.
- ☐ Choose fruits as desserts

# USDA MEAT GRADES



Prime

Choice

Select



Prime



Choice



Select



Moderately  
Abundant



Slightly  
Abundant



Moderate



Modest



Small



Slight



***THANK YOU***