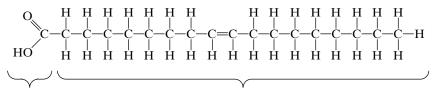


## Lipids

Lipids are another important class of nutrients in our diet. They are found in dairy products, grains, meats, and oils. A **lipid** is a type of biochemical that does not dissolve in water, has a high percentage of C and H atoms, and is soluble in nonpolar solvents. As a class, lipids are not nearly as similar to each other as carbohydrates are. Long-chain fatty acids, phospholipids, steroids, and cholesterol are lipids.

## **Fatty Acids and Triglycerides**

**Fatty acids** consist of a long, nonpolar hydrocarbon "tail" and a polar carboxylic acid functional group at the "head." Fatty acids are the simplest lipid molecules. They have hydrophilic polar heads, but their hydrocarbon chains make them insoluble in water. Fatty acids can also be saturated or unsaturated. Saturated fatty acids have no carbon-carbon double bonds, while unsaturated fatty acids have one or more double bonds in the hydrocarbon chain. The lipid shown below is oleic acid.



hydrophilic region

hydrophobic region

Triglycerides are the major component of the fats and oils in your diet. They are formed by condensation reactions in which three fatty acid molecules bond to one glycerol (a type of alcohol) molecule. Fats, such as butter and lard, come from animals, while oils come from plant sources, such as coconuts, peanuts, corn, and olives, as shown in **Figure 5.** Because they have a large amount of saturated fatty acids, fats are solids at room temperature. Oils have more unsaturated fatty acids than fats, and are liquids. Like other animals, humans make fat, which is stored in *adipose* tissue until it is needed as an energy source. Fat has about twice as much energy per gram as carbohydrates or proteins do. Thus, fat is an efficient form of energy storage.

Fats have another important commercial value based on their ability to react with sodium hydroxide, NaOH, commonly known as *lye. When a fat combines with NaOH, an acid-base reaction called* **saponification** *occurs, and a salt and water form.* This salt is made up of molecules that have long carboxylic acid chains and is called *soap*. A molecule of soap has a charged ionic head and a nonpolar hydrocarbon tail. This structure allows the ionic head of a soap molecule to dissolve in water and the nonpolar tail to dissolve in nonpolar greases. This property gives the soap its cleaning ability. The chemistry of this reaction is also used as a way of classifying lipids. Lipids that react with a base to form soap are called *saponifiable lipids*, which include fats, oils, and fatty acids.

**FIGURE 5** Fats, such as lard and butter, are obtained from animals. Oils are found in many different plants.

