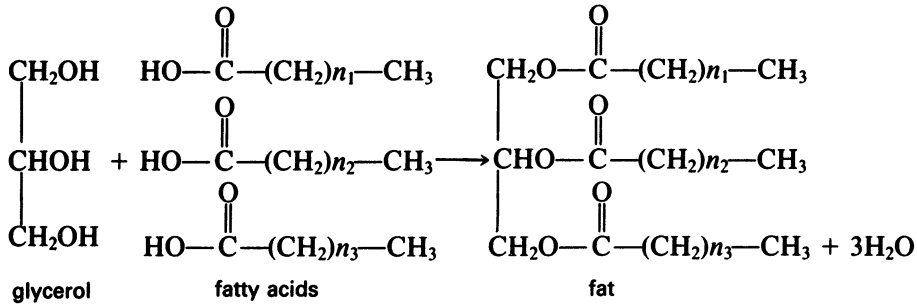

Phosphoglycerides have similar structures to fats, the only difference being that phosphoric acid replaces a fatty acid and is esterified at one end to glycerol.

Membranes with selective permeability are key to life. Cells must control the entry and exit of molecules. *Phospholipids* are key components, but membranes contain large amounts of proteins. Biological membranes are based on a lipid bilayer. The hydrophobic tails of the phospholipids associate with each other in the core of the membrane. The hydrophilic heads form the outsides of the membrane and associate with the aqueous cytosol or the aqueous extracellular fluid. Some proteins span across the membrane, while others are attached to one of the surfaces. Membranes are dynamic structures, and lipids and proteins can diffuse rapidly. Typical membrane phospholipids include phosphatidylcholine, phosphatidlyserine, phosphatidyl glycerol, and phosphatidyl inositol.

Another class of lipids of increasing technological importance is the polyhydroxyalkanoates (PHA). In particular, *polyhydroxybutyrate* (PHB) is a good example. It can be used to form a clear, biodegradable polymeric sheet. Polymers with a variety of PHAs are being commercially developed. In some cells PHB is formed as a storage product.

Steroids can also be classified as lipids. Naturally occurring steroids are hormones that are important regulators of animal development and metabolism at very low concentrations (for example, 10^{-8} *M*). A well-known steroid, cholesterol, is present in membranes of animal tissues. Figure 2.14 depicts the structures of some important steroids. Cortisone is an anti-inflammatory used to treat rheumatoid arthritis and some skin diseases. Derivatives of estrogens and progesterone are used as contraceptives. The commercial production of steroids is very important and depends on microbial conversions. Because of the large number of asymmetric centers, the total synthesis of steroids is difficult. Plants provide a source of abundant lipid precursors for these steroids, but the highly specific hydroxylation of these substrates at positions 11 (and 16) or dehydrogenations at position 1 are necessary to convert the precursors into compounds similar to those made in the adrenal gland. This cannot be done easily with chemical means and is done commercially using microbes that contain enzymes mediating specific hydroxylations or dehydrogenations.

2.2.5. Nucleic Acids, RNA, and DNA

Nucleic acids play the central role in reproduction of living cells. *Deoxyribonucleic acid* (DNA) stores and preserves genetic information. *Ribonucleic acid* (RNA) plays a central role in protein synthesis. Both DNA and RNA are large polymers made of their corresponding nucleotides.