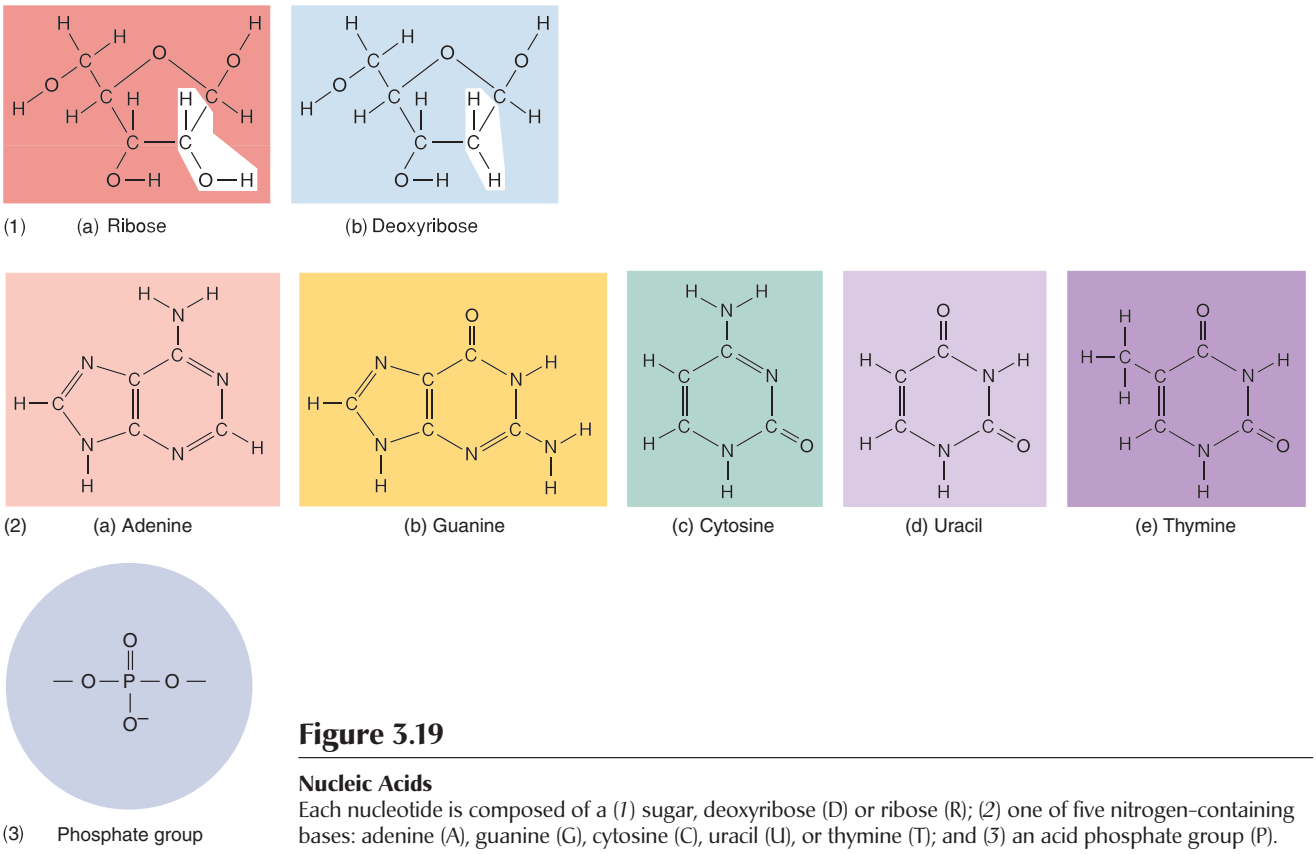

Figure 3.19

Nucleic Acids
Each nucleotide is composed of a (*1*) sugar, deoxyribose (D) or ribose (R); (*2*) one of five nitrogen-containing bases: adenine (A), guanine (G), cytosine (C), uracil (U), or thymine (T); and (*3*) an acid phosphate group (P).

from one strand always pairs with *T*hymine protruding from the other (in the case of RNA, *A*denine always pairs with *U*racil). *G*uanine always pairs with *C*ytosine.

A T (or A U) and G C

One strand of DNA is called the *coding strand* because it has a meaningful genetic message written using the nitrogenous bases as letters (e.g., the base sequence CATTAGACT) (figure 3.21). If these bases are read in groups of three, they make sense to us (i.e., "cat," "tag," and "act"). This is the basis of the genetic code for all organisms. The opposite strand is called *non-coding* since it makes no "sense" but protects the coding strand from chemical and physical damage. Both strands are twisted into a helix—that is, a molecule turned around a tubular space. Strands of helical DNA may contain tens or thousands of base pairs (AT and GC combinations) that an organism reads as a sequence of chapters in a book. Each chapter is a gene. Just as chapters in a book are identified by beginning and ending statements, different genes along a DNA strand have beginning and ending signals. They tell when to start and when to stop reading a particular gene. Human body cells contain 46 strands (books) of helical DNA, each containing thousands of genes (chapters). These strands are called **chromosomes** when they become super coiled in preparation for cellular reproduction. Before cell reproduction, the DNA makes copies of the coding and non-coding strands ensuring that the offspring or *daughter cells* will each receive a full complement of the genes required for their survival (figure 3.22).

RNA (*ribo*nucleic *a*cid) is found in three forms. **Messenger RNA (mRNA)** is a single strand copy of a portion of the coding strand of DNA for a specific gene. When mRNA is formed on the surface of the DNA, the base pair rule (A pairs with U and G pairs with C) applies. After mRNA is formed and peeled off, it moves to a cellular structure called the *ribosome* where the genetic message can be translated into a protein molecule. Ribosomes contain another type of RNA, **ribosomal RNA (rRNA).** rRNA is also an RNA copy of DNA, but after being formed it becomes twisted and covered in protein to form a ribosome. The third form of RNA, **transfer RNA (tRNA),** are also copies of different segments of DNA, but when peeled off the surface, each takes the form of a cloverleaf. tRNA molecules are responsible for transferring or carrying specific amino acids to the ribosome where all three forms of RNA come together and cooperate in the manufacture of protein molecules (figure 3.23).