The major function of DNA is to carry genetic information in its base sequence. The genetic information in DNA is transcribed by RNA molecules and translated in protein synthesis. The templates for RNA synthesis are DNA molecules, and RNA molecules are the templates for protein synthesis. The formation of RNA molecules from DNA is known as DNA *transcription*, and the formation of peptides and proteins from RNA is called *translation*.

Certain RNA molecules function as the genetic information-carrying intermediates in protein synthesis (*messenger,* m-*RNA*), whereas other RNA molecules [*transfer* (t-*RNA*) and *ribosomal* (r-*RNA*)] are part of the machinery of protein synthesis. The ribosomal r-RNA is located in ribosomes which are small particles made of protein and RNA. *Ribosomes* are cytoplasmic organelles (usually attached on the inner surfaces of endoplasmic reticulum in eucaryotes) and are the sites of protein synthesis.

RNA is a long, unbranched macromolecule consisting of nucleotides joined by 3′–5′ phosphodiester bonds. An RNA molecule may contain from 70 to several thousand nucleotides. RNA molecules are usually single stranded, except some viral RNA. However, certain RNA molecules contain regions of double-helical structure, like hairpin loops. Figure 2.19 describes the cloverleaf structure of t-RNA (transfer RNA). In double-helical regions of t-RNA, A pairs with U and G pairs with C. The RNA content of cells is usually two to six times higher than the DNA content.

Let us summarize the roles of each class of RNA species:

Messenger RNA (m-RNA) is synthesized on the chromosome and carries genetic information from the chromosome for synthesis of a particular protein to the ribosomes. The m-RNA molecule is a large one with a short half-life.

Transfer RNA (t-RNA) is a relatively small and stable molecule that carries a specific amino acid from the cytoplasm to the site of protein synthesis on ribosomes. t-RNAs contain 70 to 90 nucleotides and have a MW range of 23 to 28 kD. Each one of 20 amino acids has at least one corresponding t-RNA.

Ribosomal RNA (r-RNA) is the major component of ribosomes, constituting nearly 65%. The remainder is various ribosomal proteins. Three distinct types of r-RNAs present in the *E. coli* ribosome are specified as 23S, 16S, and 5S, respectively, on the basis of their sedimentation coefficients (determined in a centrifuge). The symbol S denotes a Svedberg unit. The molecular weights are 35 kD for 5S, 550 kD for 16S, and 1,100 kD for 23S. These three r-RNAs differ in their base sequences and ratios. Eucaryotic cells have larger ribosomes and four different types of r-RNAs: 5S, 7S, 18S, and 28S. Ribosomal RNAs make up a large fraction of total RNA. In *E. coli*, about 85% of the total RNA is r-RNA, while t-RNA is about 12% and m-RNA is 2% to 3%.

2.3. CELL NUTRIENTS

2.3.1. Introduction

A cell's composition differs greatly from its environment. A cell must selectively remove desirable compounds from its extracellular environment and retain other compounds within itself. A semipermeable membrane is the key to this selectivity. Since the cell dif-