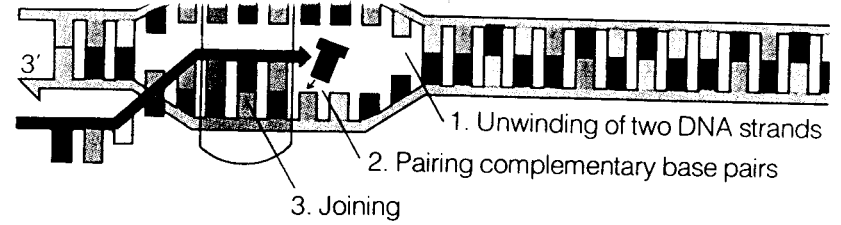
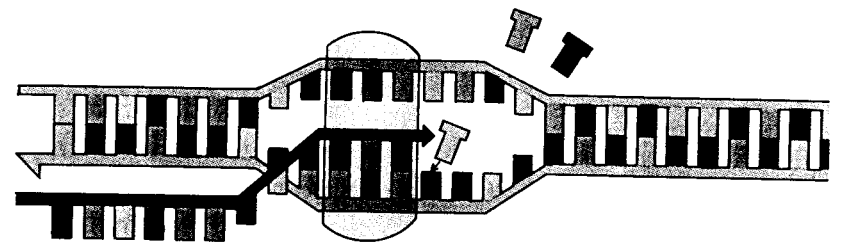
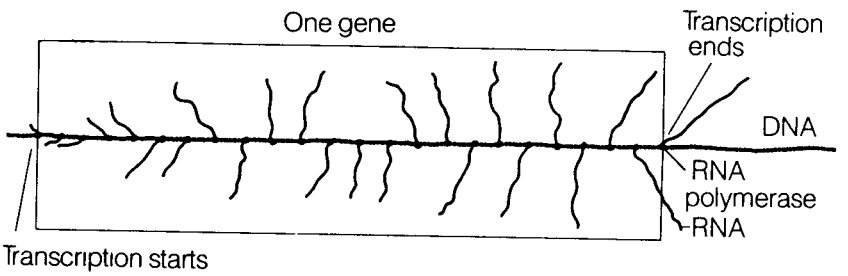




(b) Transcription process



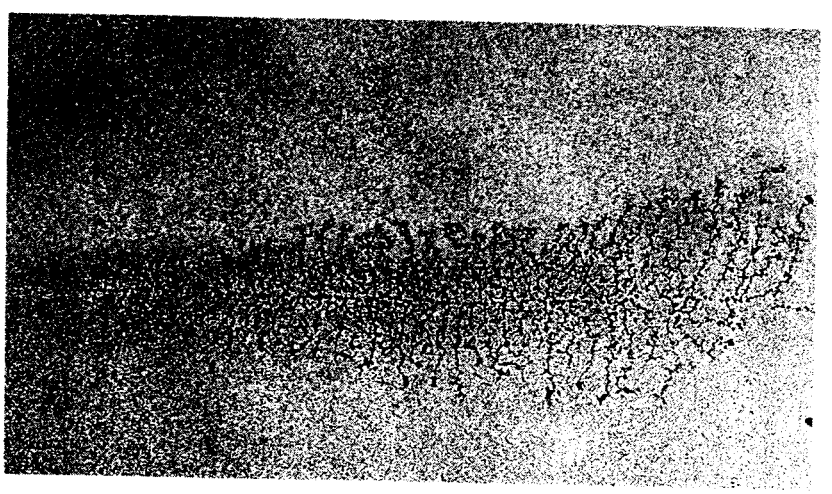


Figure 10.5 How DNA Is Transcribed into RNA. (a) The stages of transcription in progress. (1) Unwinding. Just as in DNA replication, the two strands of the helix separate. This requires energy because the hydrogen bonds must be broken. (2) Complementary base pairing. The four types of ribonucleotides float in and pair with their complementary bases on only one strand of the DNA duplex. (3) Joining the ribonucleotide to the growing RNA. Once the first two nucleotide units are in place, the large enzyme RNA polymerase begins joining the sugar-phosphate backbone together. New nucleotides are added to the growing chain in only the 5′ to 3′ direction. (b) The transcription process in one instant of time can be captured in an electron micrograph and matching diagrams. You can see a "Christmas tree" pattern as transcription takes place on genes of the African clawed toad. With the photo interpreted, the DNA strand (blue), the RNA polymerase enzyme (purple), and the growing mRNA chains (red) are all visible. The chains are shorter where transcription starts and, of course, longer where it ends, giving the effect of widening Christmas tree limbs.

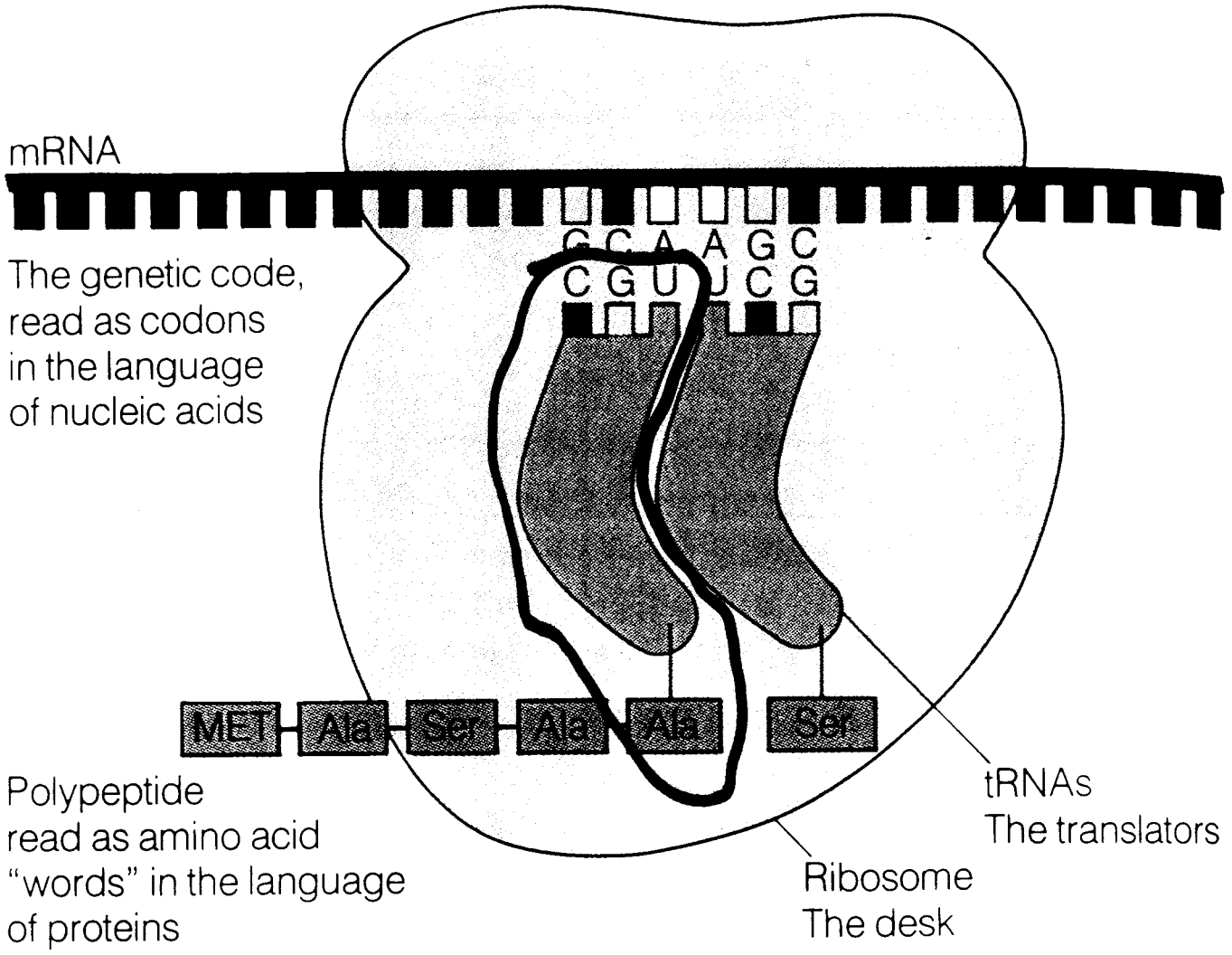


Figure 10.8 An Overview of Translation: mRNA to tRNA to Protein. In this diagram, the message (mRNA; red) is being translated into a polypeptide chain (purple) by the tRNAs on the ribosome (composed of rRNA and protein).

the same. The tRNAs work rather like human translators. To translate a message from French to English, a person must find the English word that matches each French one. Similarly, to translate a message from RNA into protein, tRNA molecules must match a nucleic acid word, or codon,

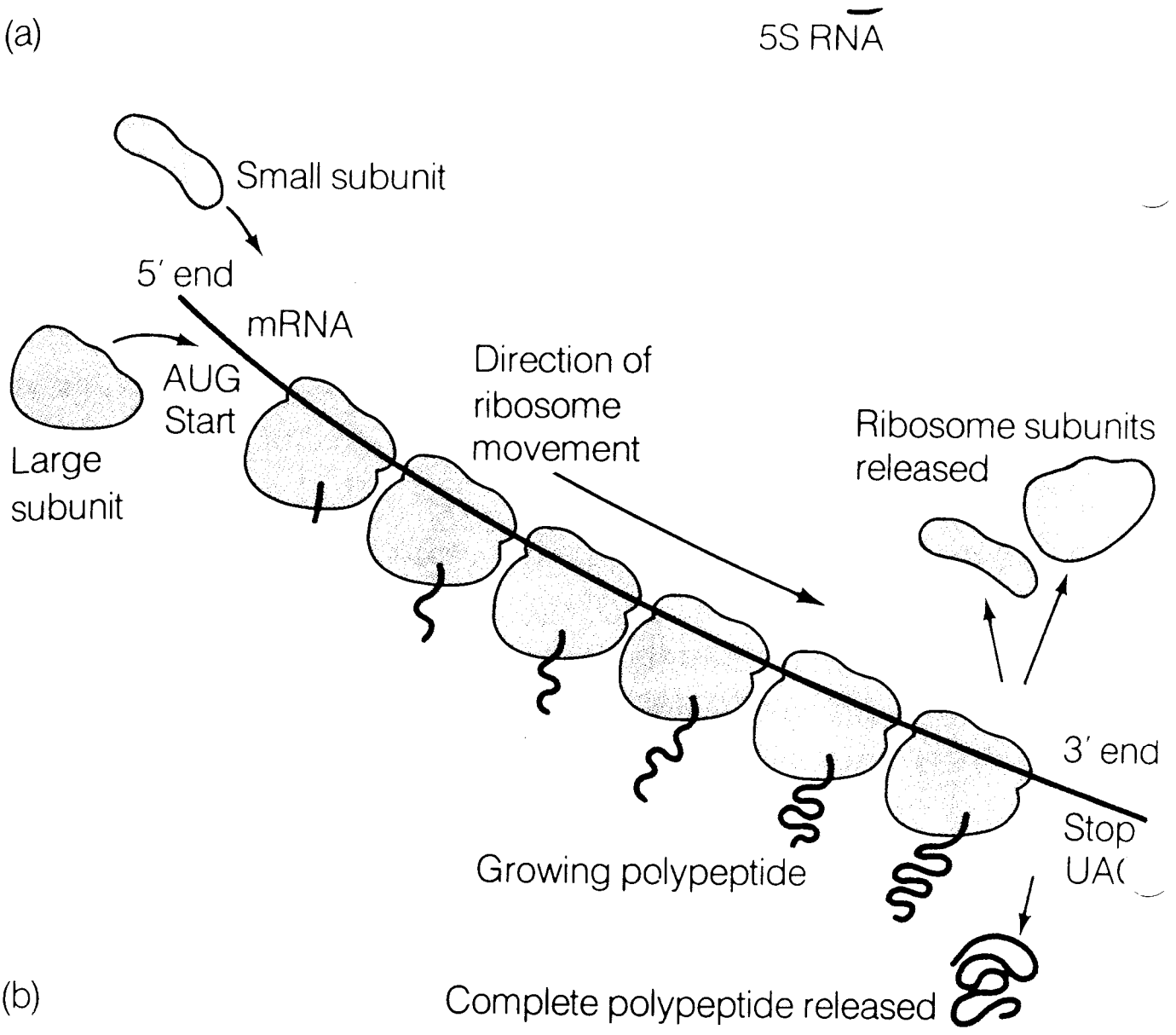


Figure 10.10 Ribosomes: The Desks on Which Translation Occurs. (a) Ribosomal subunits are made up of RNAs of specific lengths as well as many kinds of associated proteins. (The numbers followed by "S" with each type of RNA are indications of size; 18S is longer and heavier than 5.8S, and so on.) (b) The ribosome subunits join to the mRNA, then slide along the mRNA like a train on a track or a pulley on a rope, and the order of bases in the mRNA can then be translated into an equivalent ordering of amino acids in a polypeptide.

one of the six tRNAs with the amino acid serine attached to one end has the anticodon UCG at the other end (see Figure 10.9). The UCG anticodon on the tRNA pairs up with the AGC codon on an mRNA, and this connection makes AGC