Gene Expression

Chapter 4: Basic Molecular Genetic mechanisms

The four basic molecular genetic processes

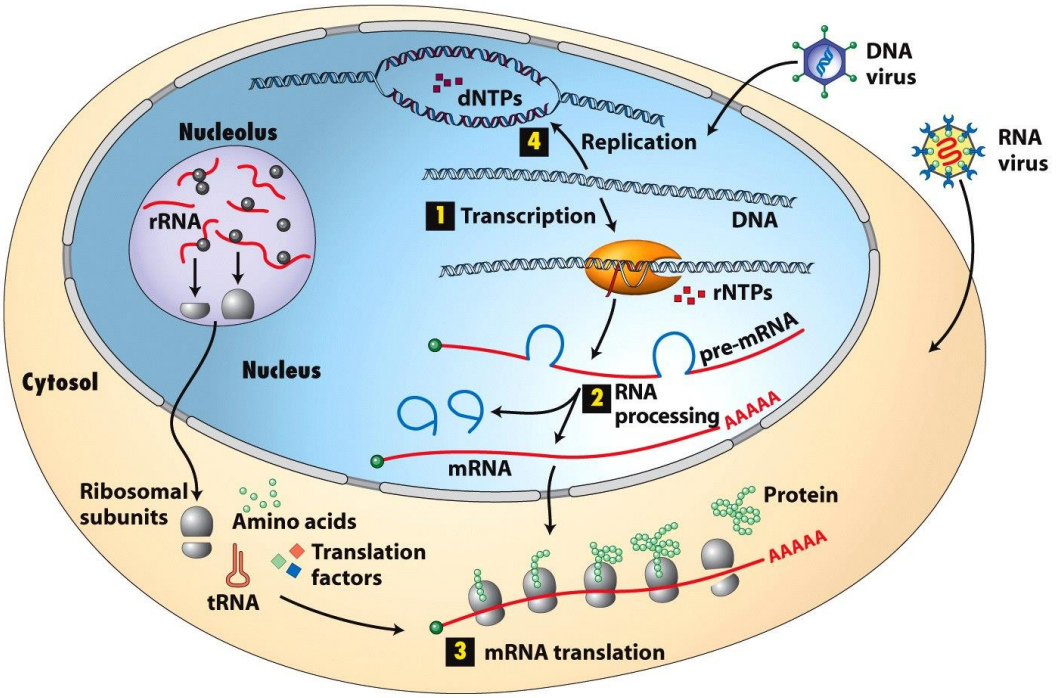

Figure 4-1
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Structure of nucleic acid

•A nucleic acid strand is a linear polymer with end-to-end directionality

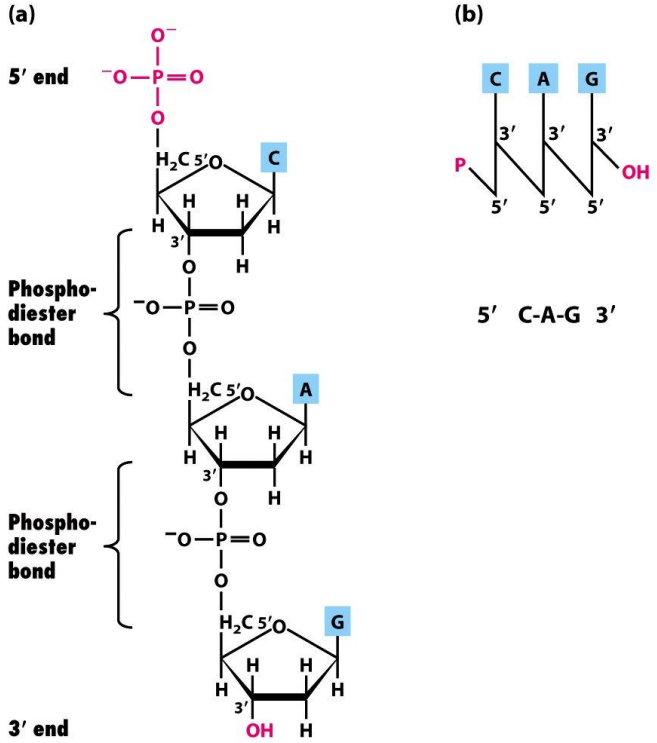

Figure 4-2
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•Native DNA is a double helix of complementary antiparallel strand

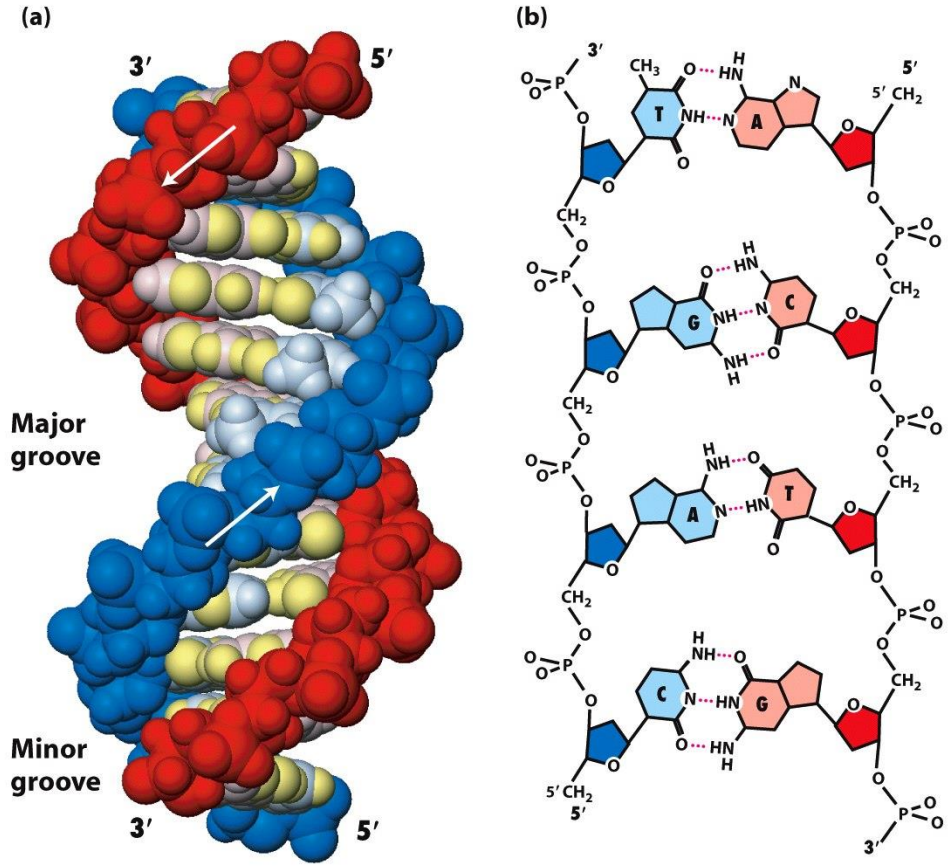

Figure 4-3
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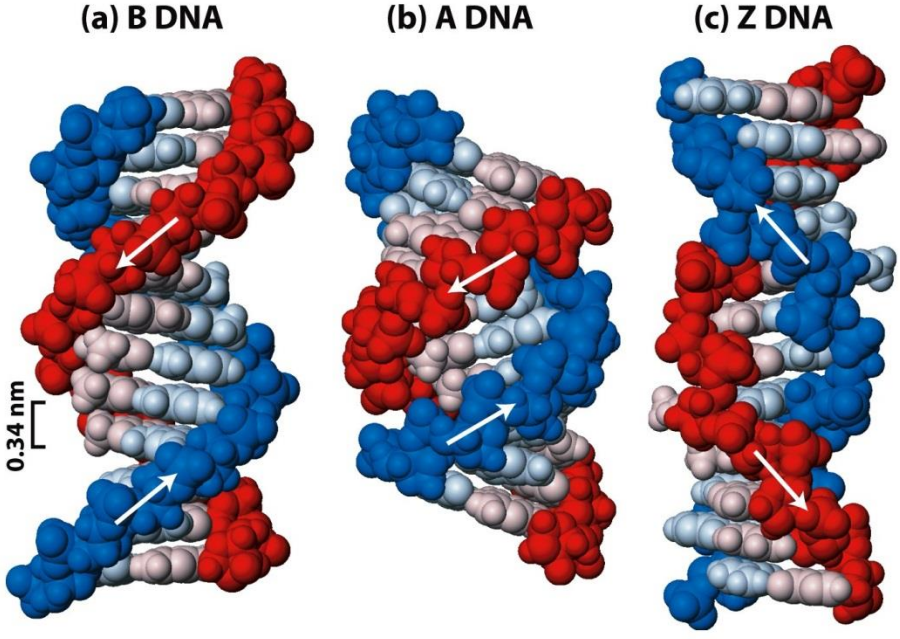

Figure 4-4
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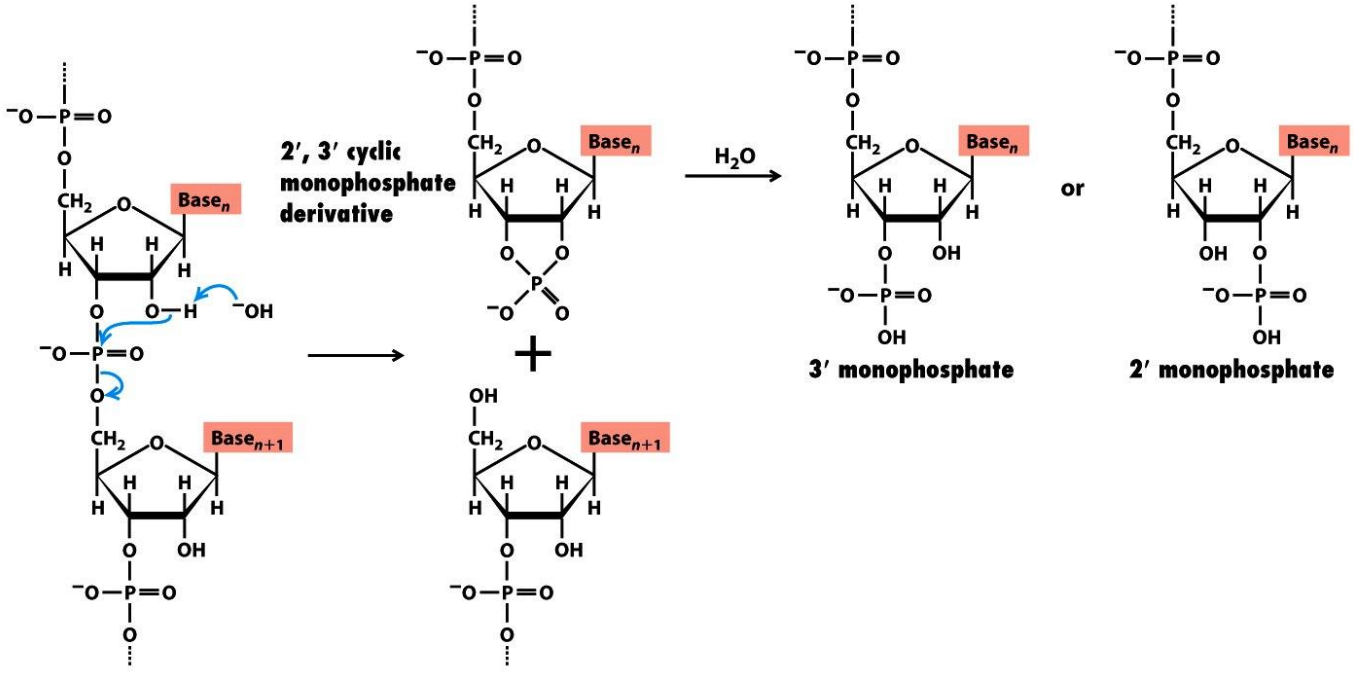

Figure 4-6
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•Different types of RNA exhibit various conformations related to their functions

Ribozyme: (folded RNA and proteins) folded RNA has a catalytic function such as splicing of the non coding regions of the pre-mature mRNA

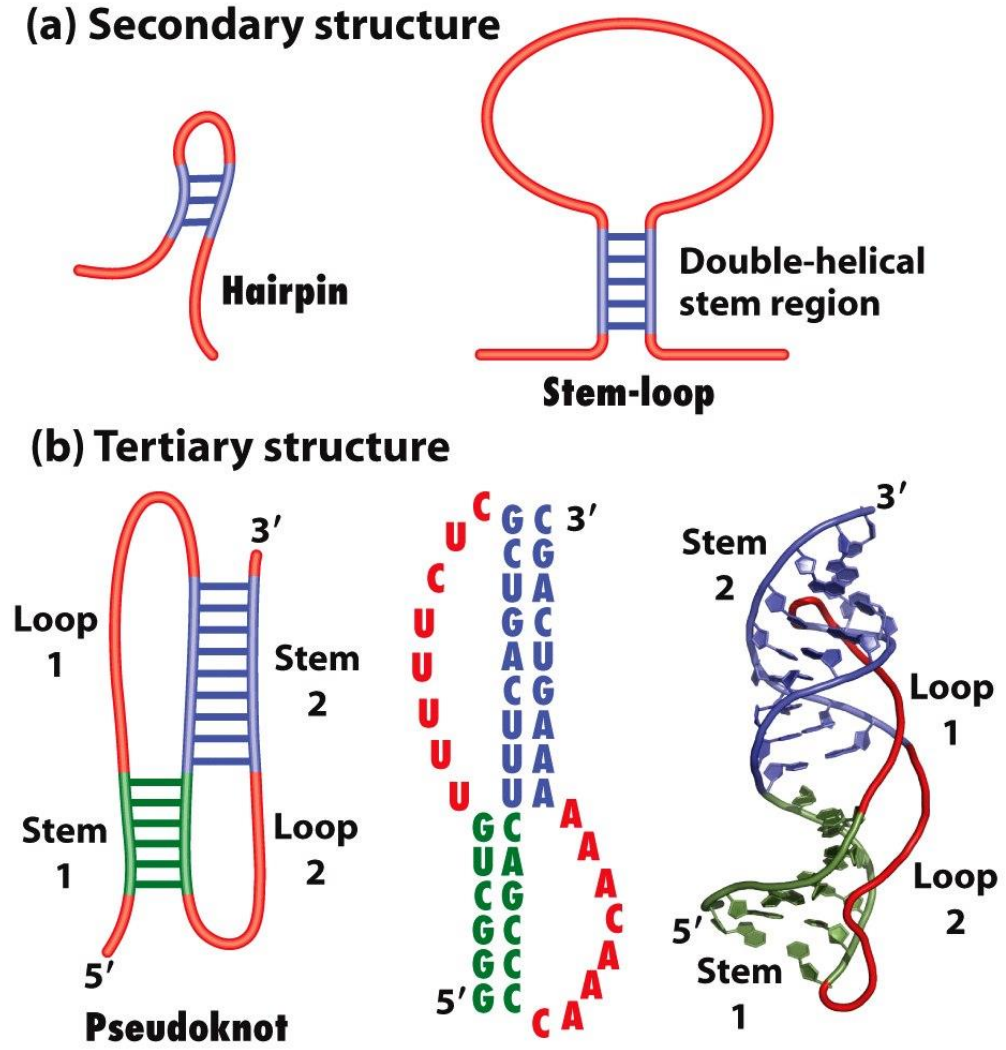

Figure 4-9
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Transcription of protein-coding genes and formation of functional mRNA

Gene: is a unit of DNA that contains the information to specify the synthesis of a single polypeptide chain or functional RNA (tRNA)

• A template DNA strand is transcribed into a complementary RNA chain by RNA polymerase

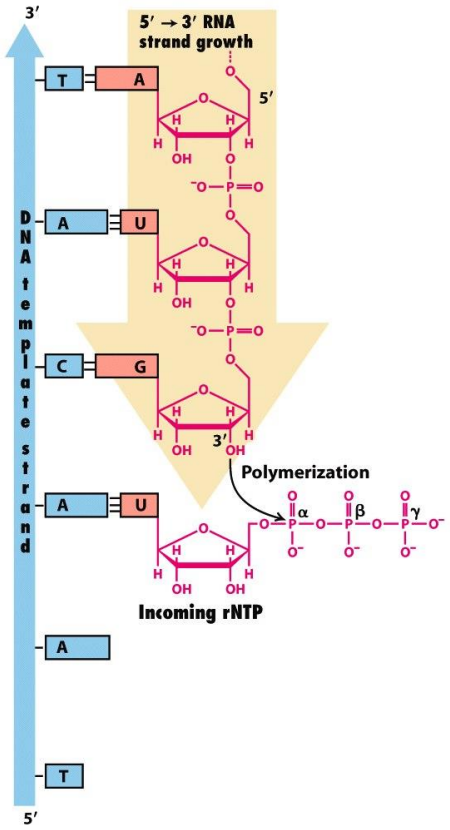

Figure 4-10a
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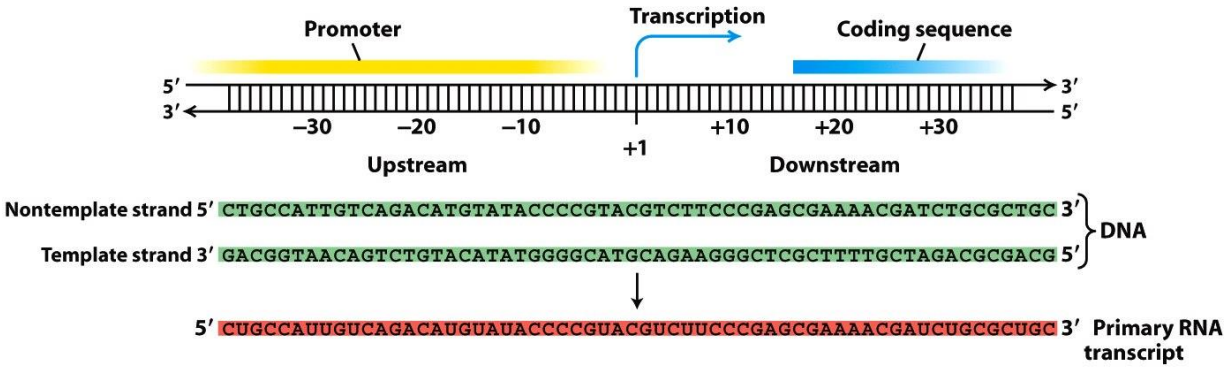

Figure 4-10b
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Stages of transcription

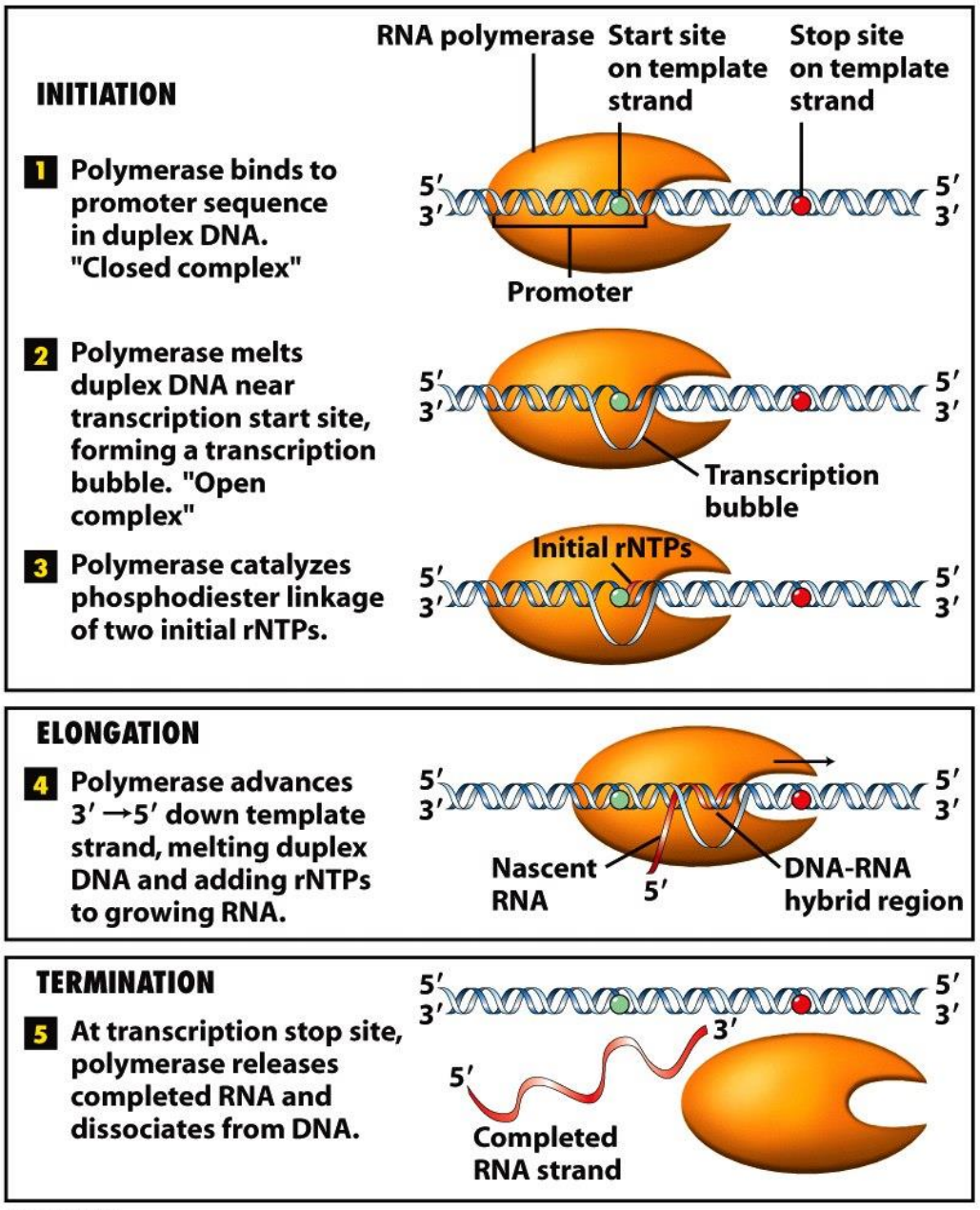

Figure 4-11
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Structure of RNA polymerase….

•**Organization of genes differs in prokaryotic and eukaryotic DNA**

Operon: continuous segment of the genome that contains genes which encode for proteins with similar functions

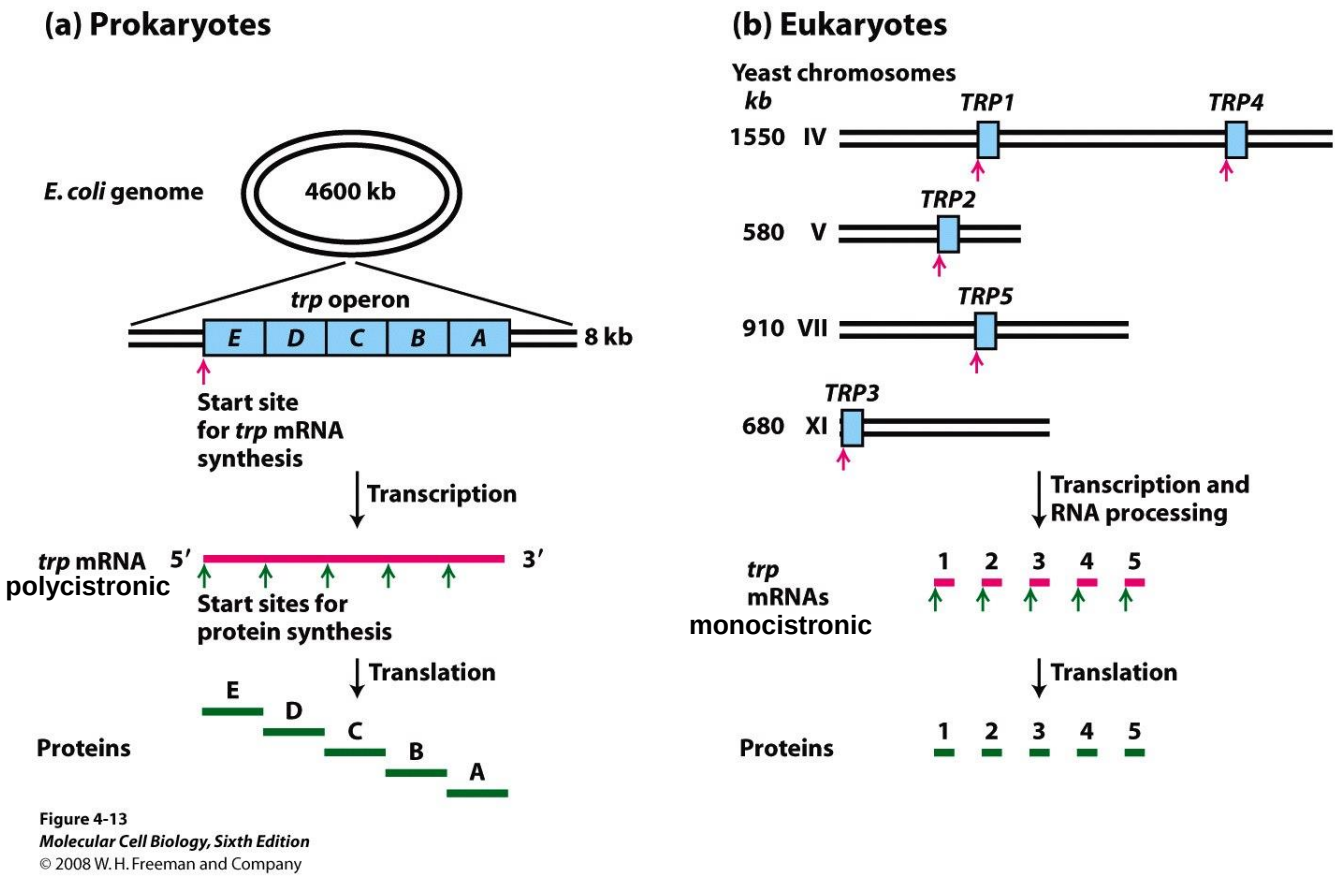

Figure 4-13
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•Eukaryotic precursor mRNAs are processed to form functional mRNAs

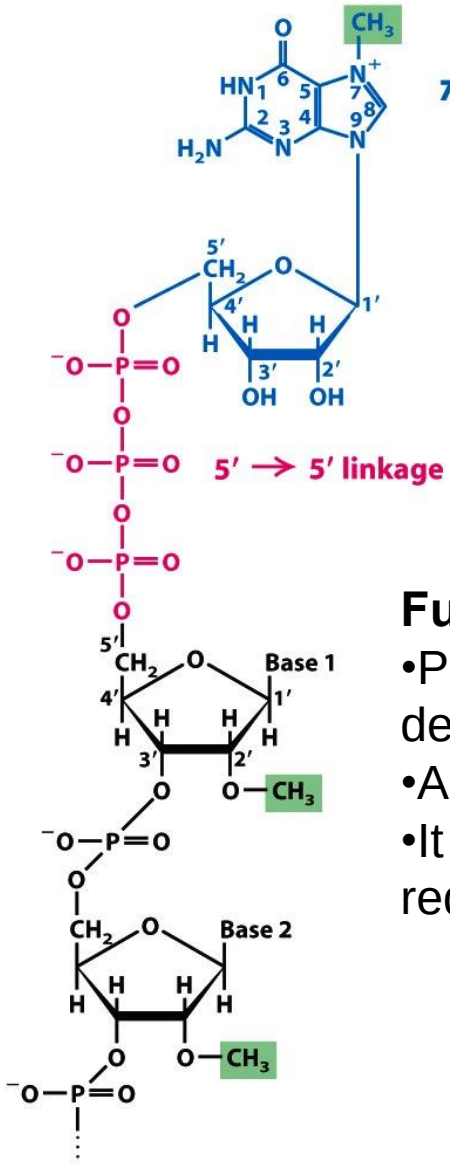

Figure 4-14
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Function of 5’ cap:

•Protect the mRNA from enzymatic degradation

•Assist in its transport to the cytoplasm

•It is bound into a protein factor which is required to initiate translation in the cytoplasm

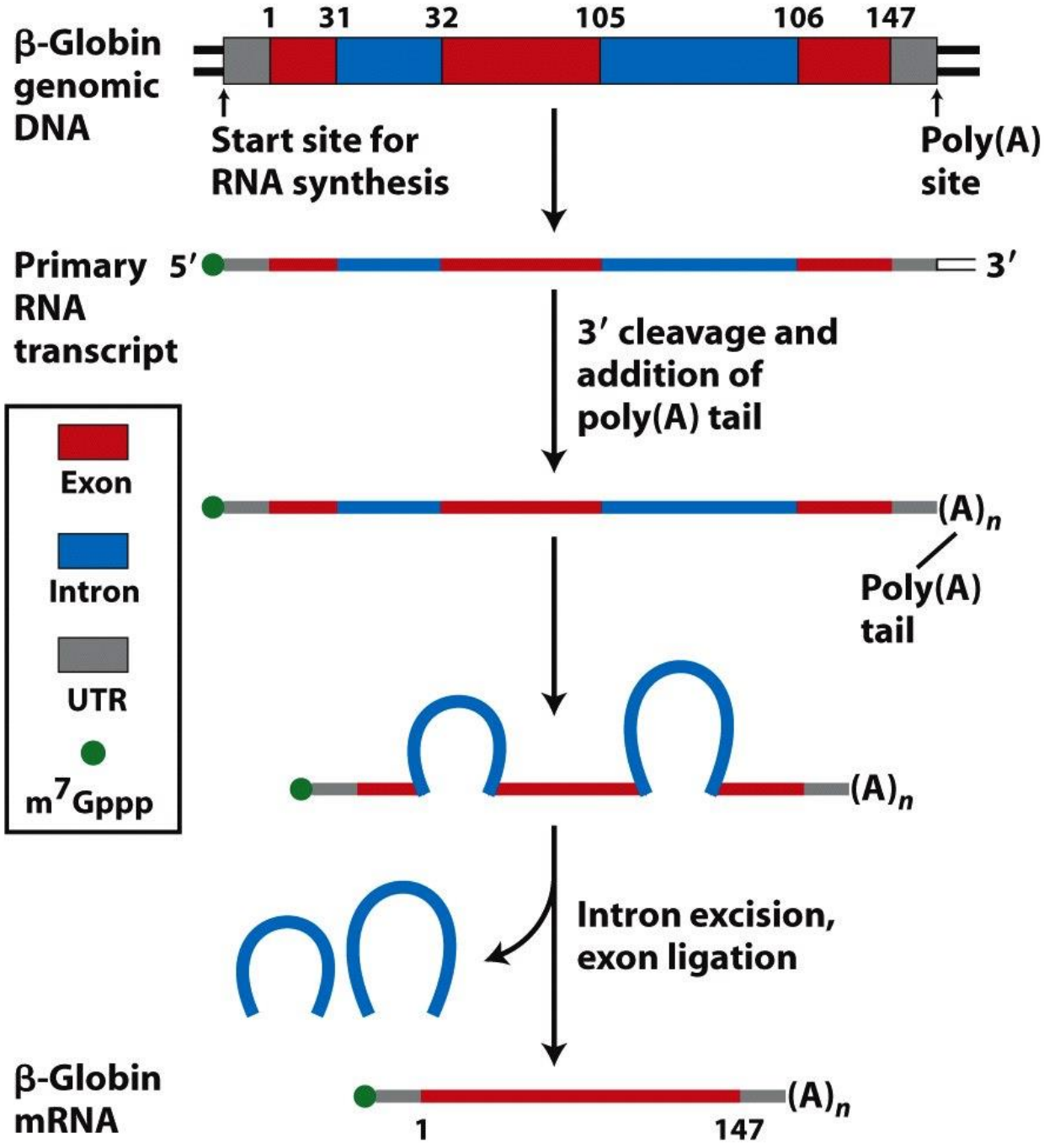

Figure 4-15
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The decoding of mRNA by tRNAs

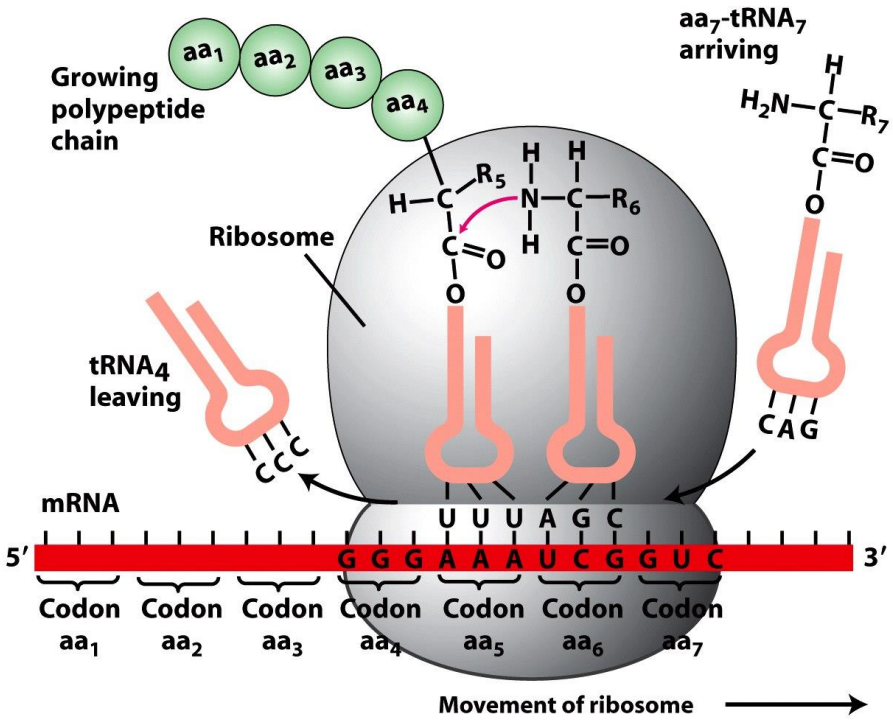

Figure 4-17
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- **mRNA carries information from DNA in a 3 letter genetic code**

Genetic code: rules where Codons (nucleotide triplets) in the mRNA specify amino acids in the protein

Reading frame: sequence of codons that runs from a specified start codon to a stop codon

TABLE 4-1 The Genetic Code (Codons to Amino Acids)*

FIRST POSITION (5′ END)	SECOND POSITION U	SECOND POSITION C	SECOND POSITION A	SECOND POSITION G	THIRD POSITION (3′ END)
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu (Met)*	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met (Start)	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val (Met)*	Ala	Glu	Gly	G

*AUG is the most common initiator codon; GUG usually codes for valine and CUG for leucine, but, rarely, these codons can also code for methionine to initiate a protein chain.

Table 4-1
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- **The folded structure of tRNA promotes its decoding functions**
- **Non standard base pairing often occurs between codons and anticodons**

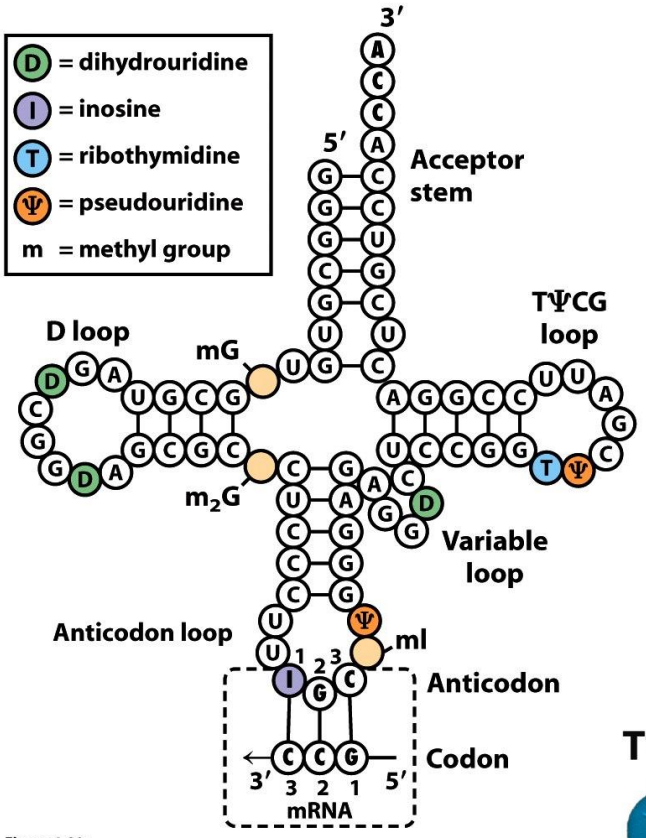

Figure 4-20a
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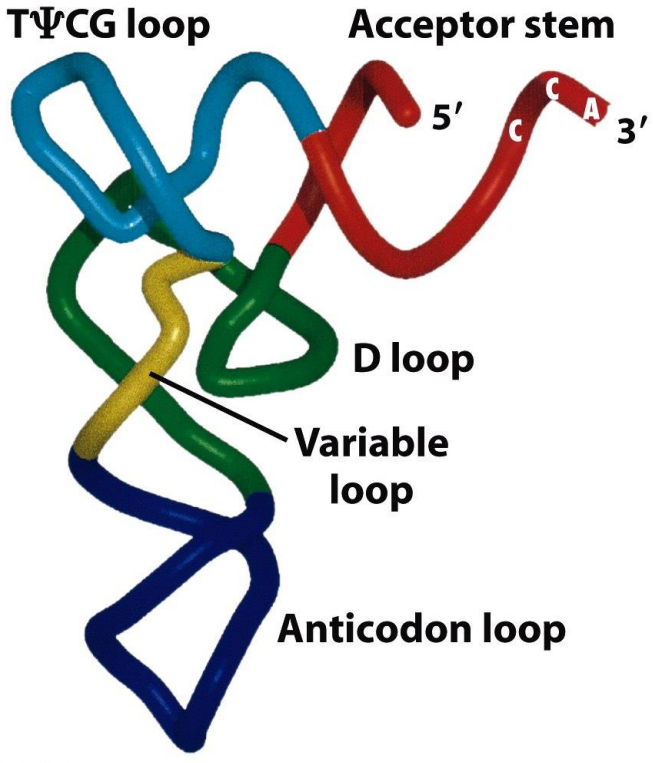

Figure 4-20b
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- **The folded structure of tRNA promotes its decoding functions**
- **Non standard base pairing often occurs between codons and anticodons**

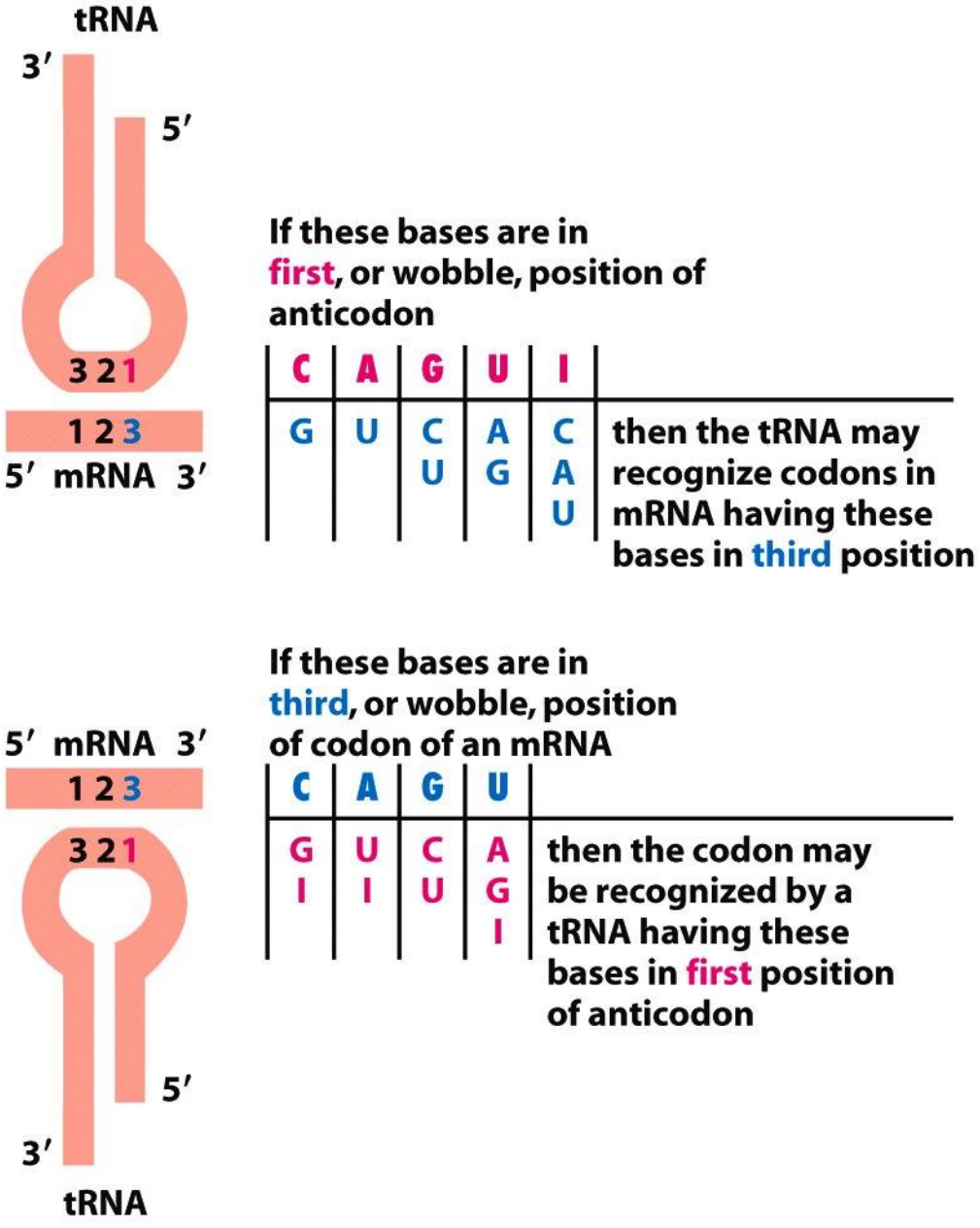

Figure 4-21
Molecular Cell Biology, Sixth Edition

- **The folded structure of tRNA promotes its decoding functions**
- **Non standard base pairing often occurs between codons and anticodons**

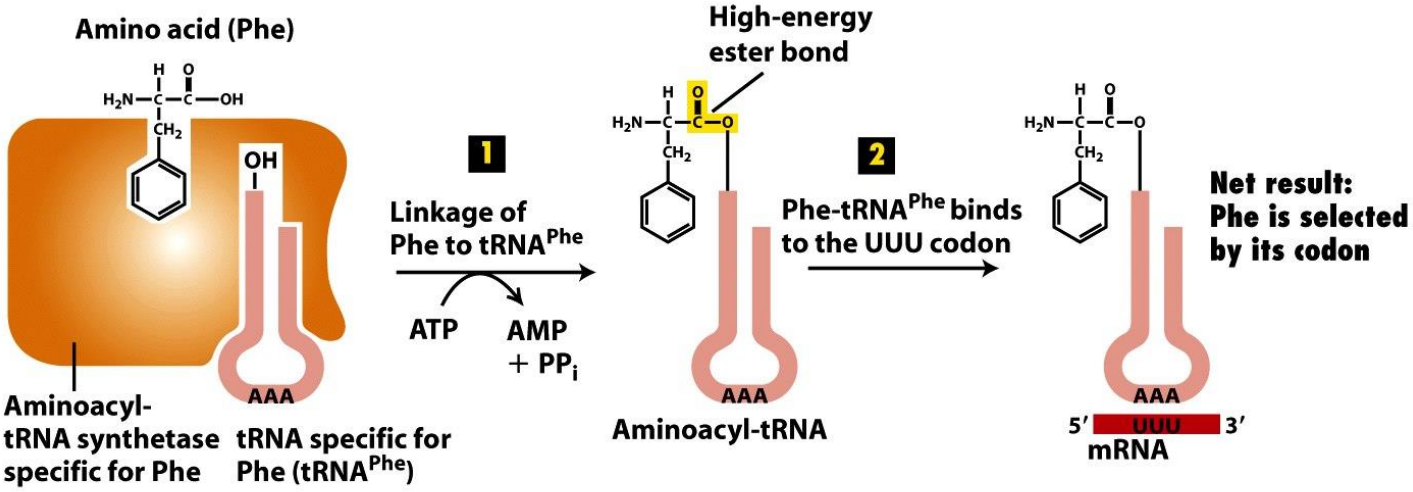

Figure 4-19
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Stepwise synthesis of proteins on ribosomes

•Ribosomes are protein-synthesizing machines

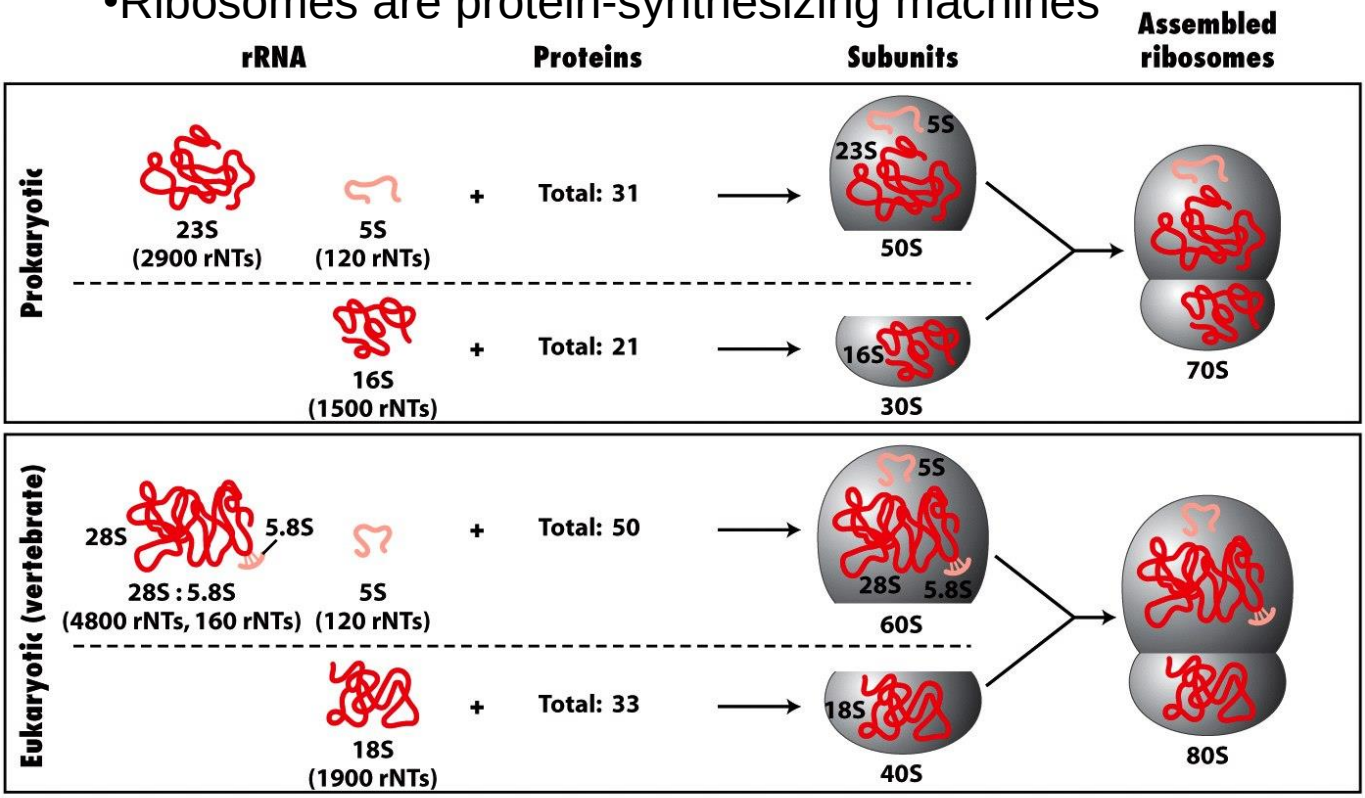

Figure 4-22
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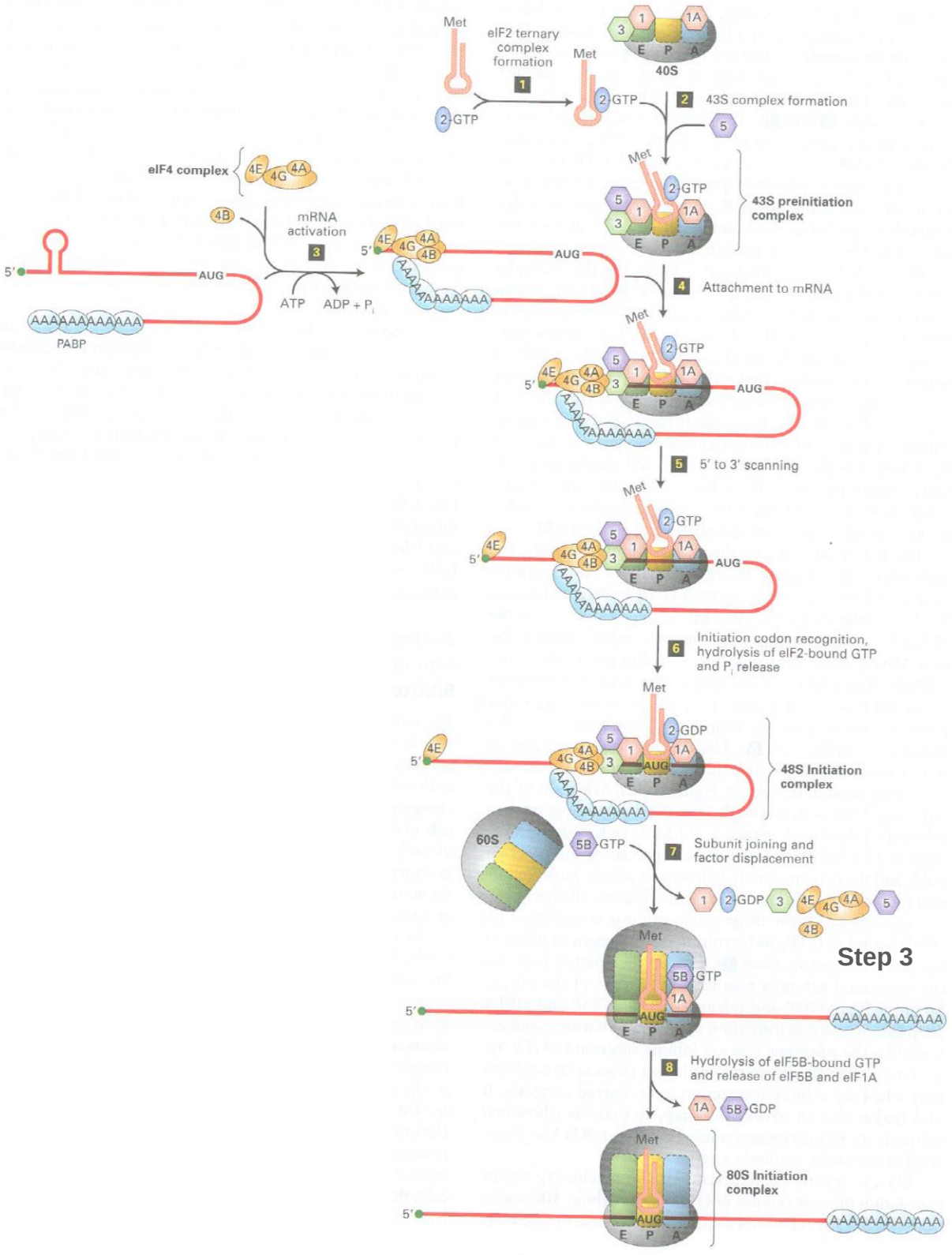
Svedberg unit: a measure of sedimentation rate of macromolecules centrifuged under standard conditions

•Methionyl-tRNAi ^{Met} recognizes the AUG start codon…..

•Translation initiation usually occurs at the first AUG from the 5’ end of an mRNA



•During chain elongation each incoming aminoacyl-tRNA moves through three ribosomal sites

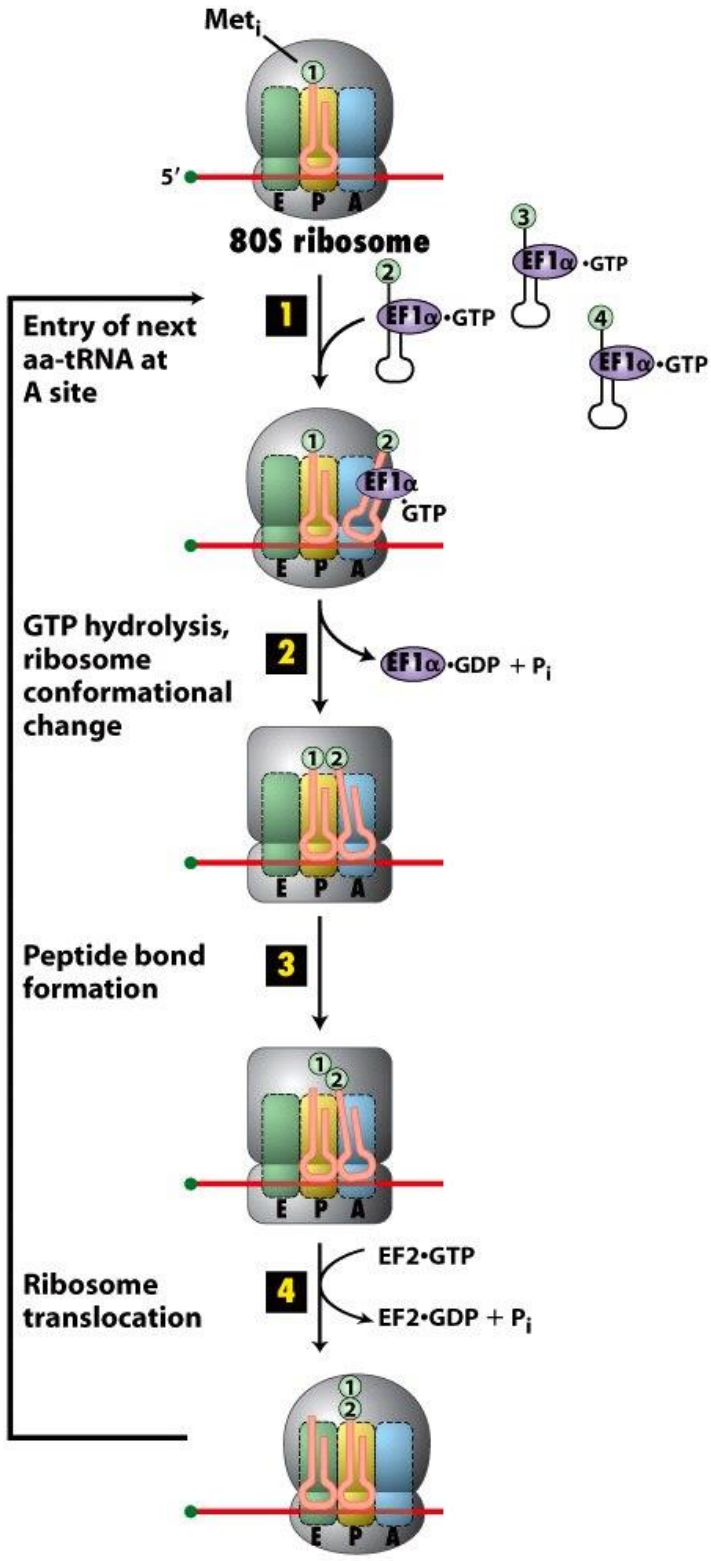


Figure 4-25
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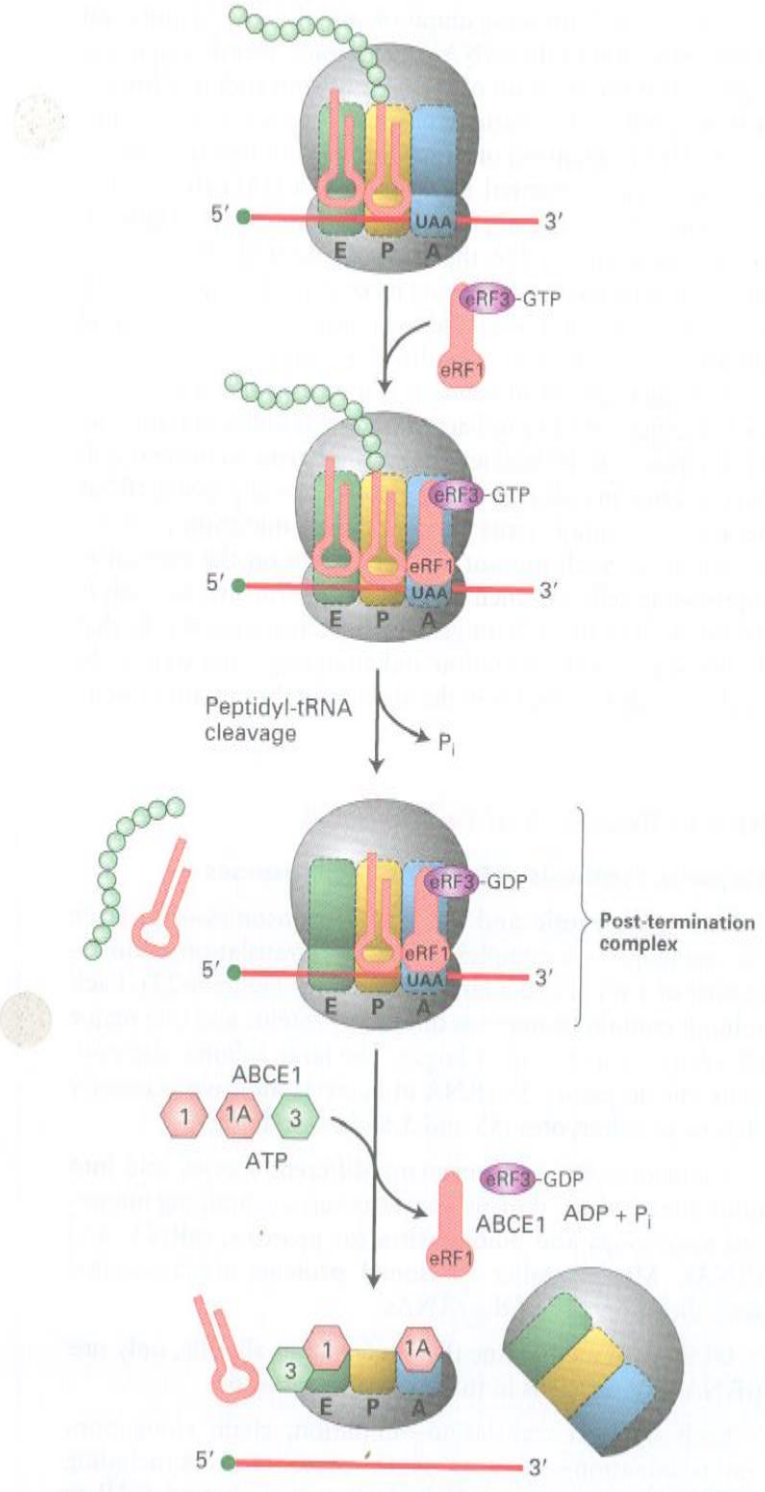
•Translation is terminated by release factors when a stop codon is reached



•Polysomes and rapid ribosome recycling increase the efficiency of translation

Polyribosomes: simultaneous translation of an mRNA by multiple ribosomes

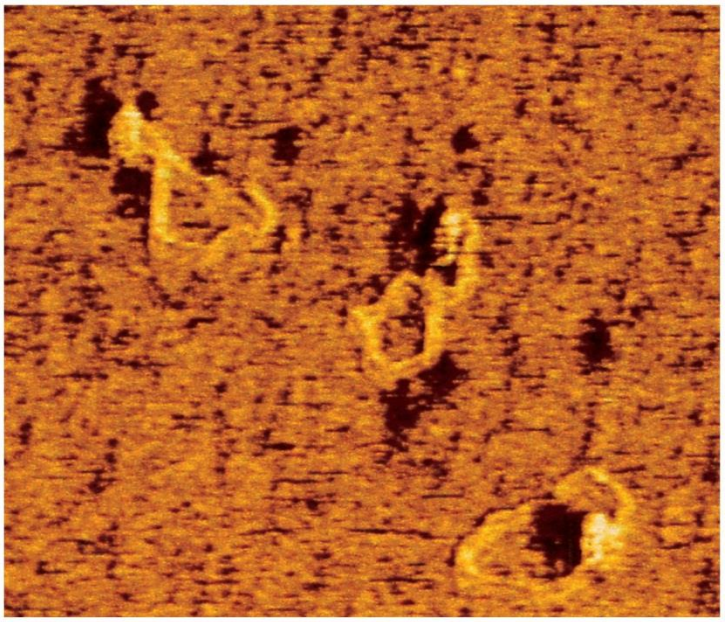


Figure 4-28a
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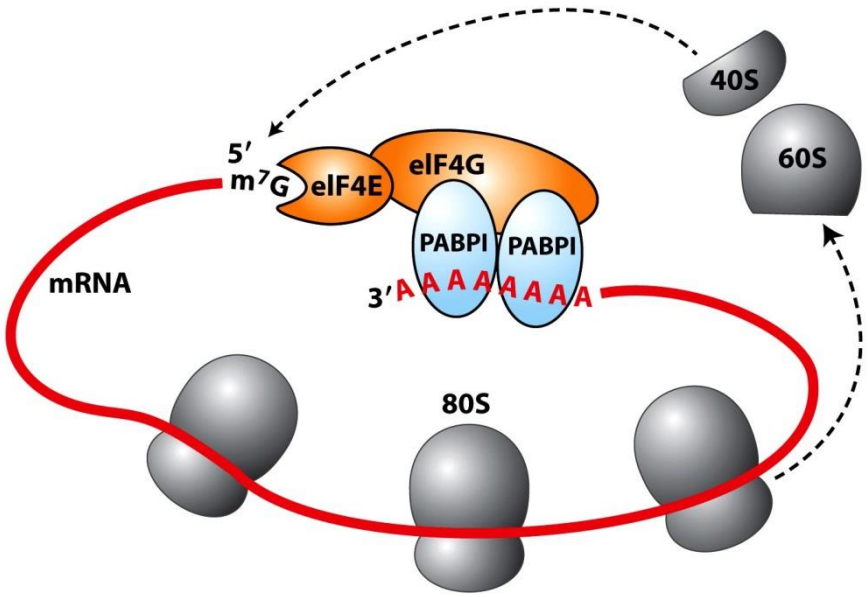

Figure 4-28b
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