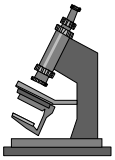
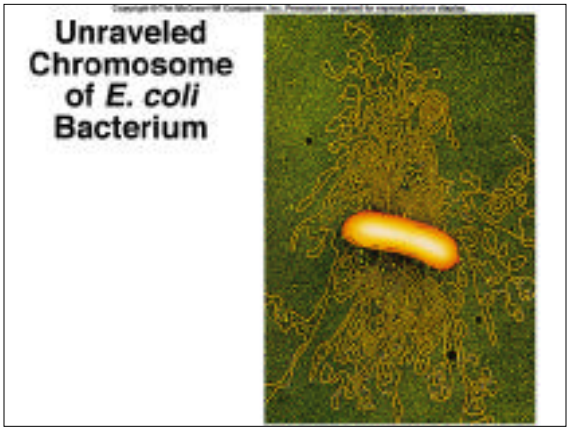
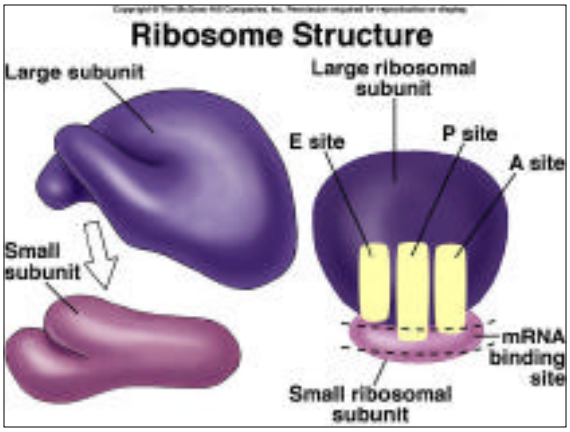
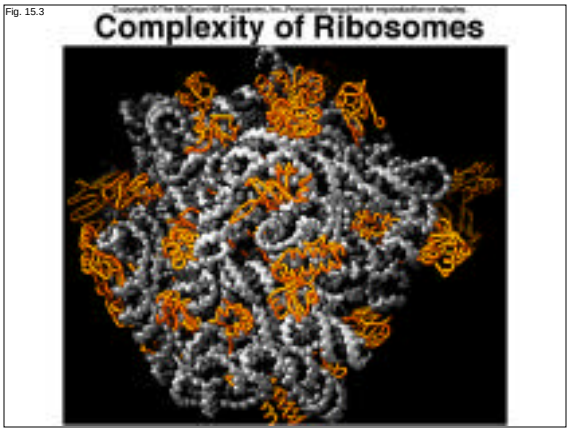
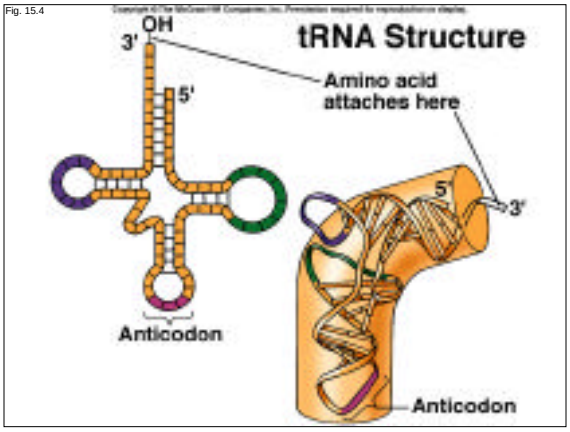
Transcription and Translation

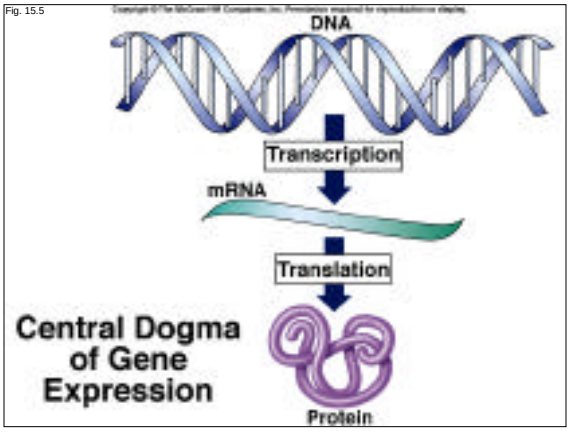


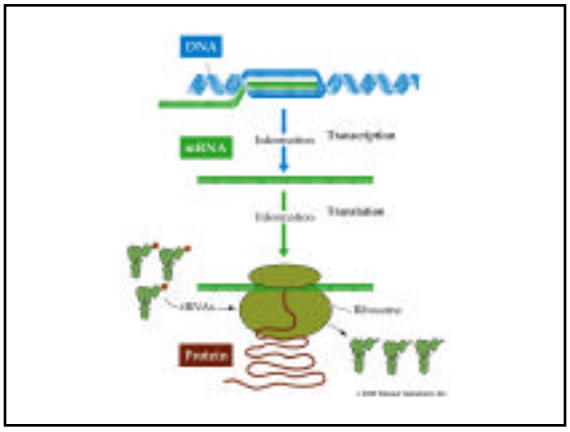


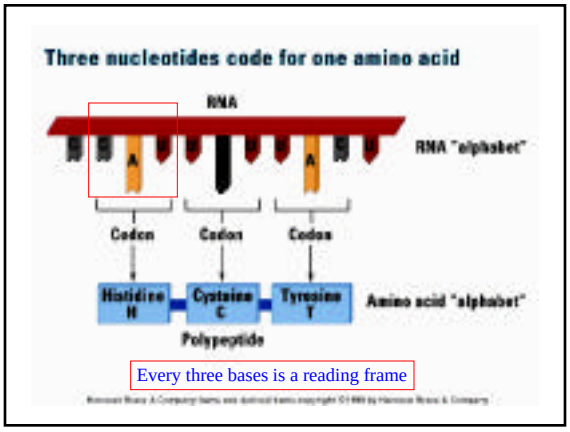


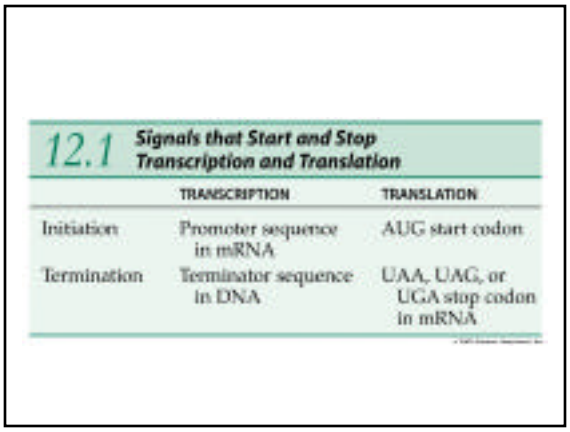


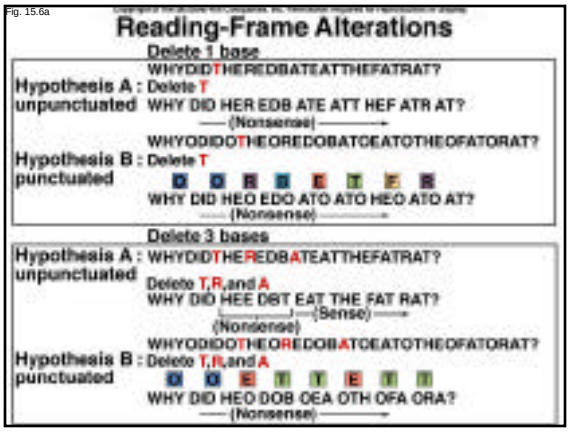


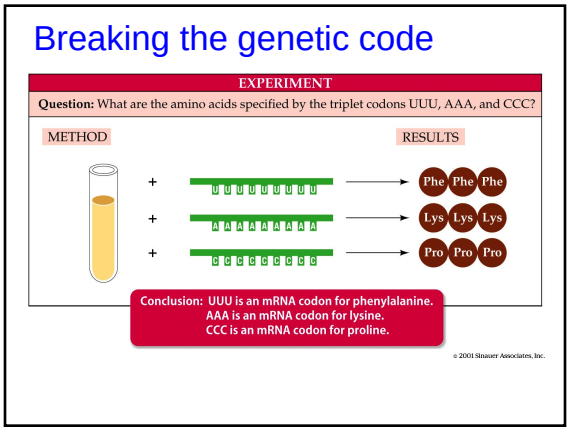


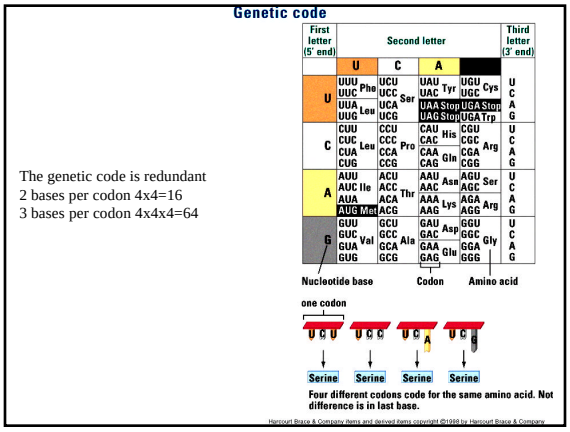












The genetic code is redundant
2 bases per codon 4x4=16
3 bases per codon 4x4x4=64

Fig. 15.6b

The Genetic Code

First Letter	Second Letter U		Second Letter C		Second Letter A		Second Letter G		Third Letter
U	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine	UCA		UAA	Stop	UGA	Stop	A
	UUG		UCG		UAG	Stop	UGG	Tryptophan	G
C	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Glutamine	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
	AUC		ACC		AAC		AGC		C
	AUA	Methionine; Start	ACA		AAA	Lysine	AGA	Arginine	A
	AUG		ACG		AAG		AGG		G
G	GUU	Valine	GCU	Alanine	GAU	Aspartate	GGU	Glycine	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glutamate	GGA		A
	GUG		GCG		GAG		GGG		G

Table 15.1 The Genetic Code

Fig. 15.7

RNA Polymerase

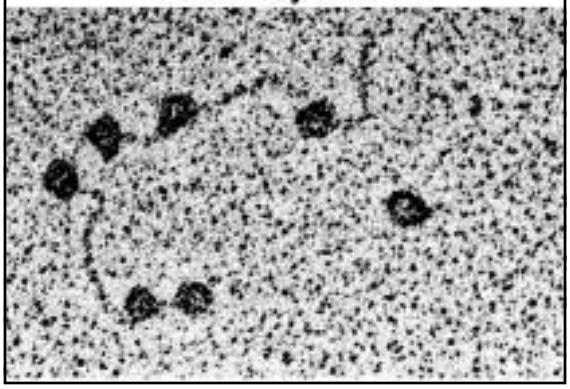


Fig. 15.8

Transcription Bubble

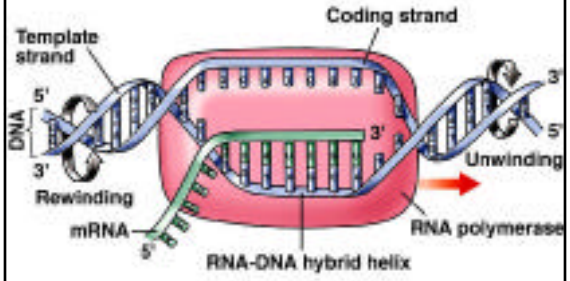


Fig. 15.9

GC Hairpin

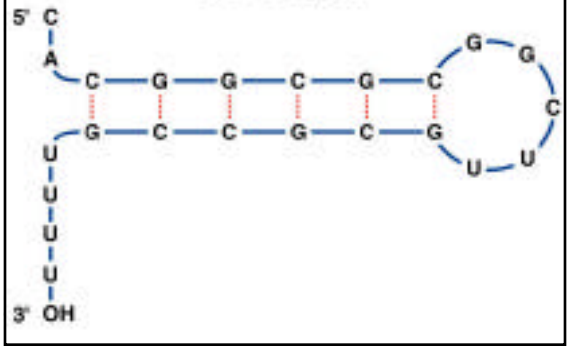
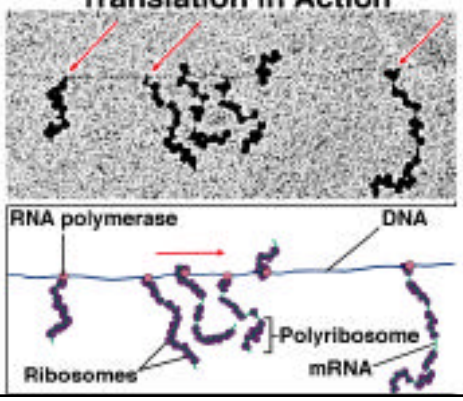
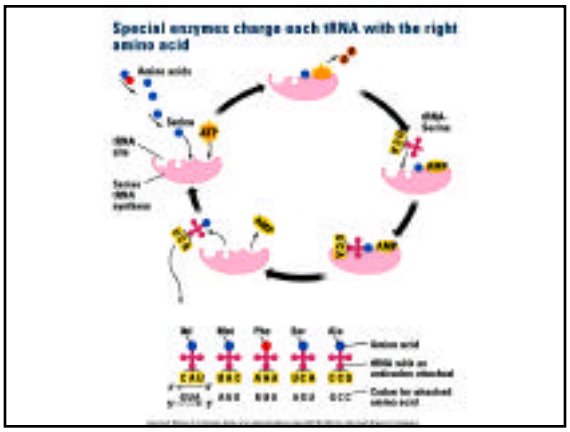
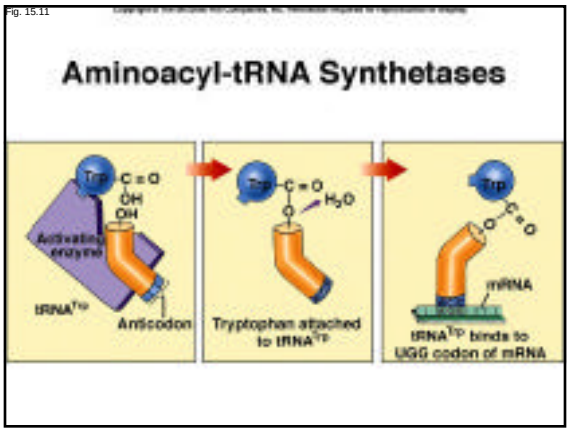


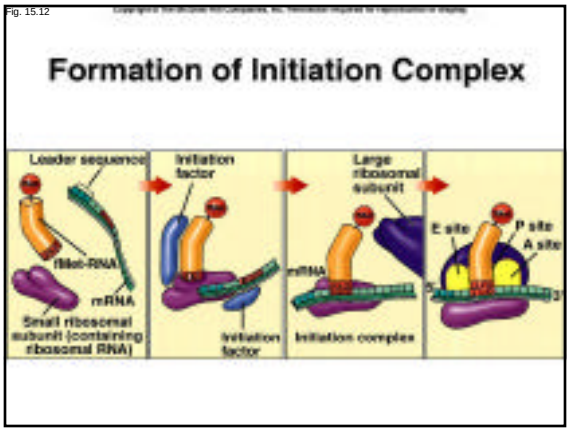
Fig. 15.10

Translation in Action

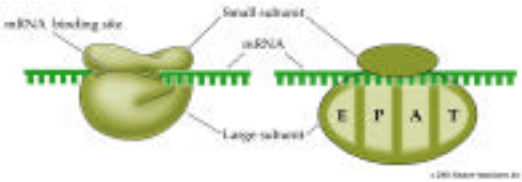




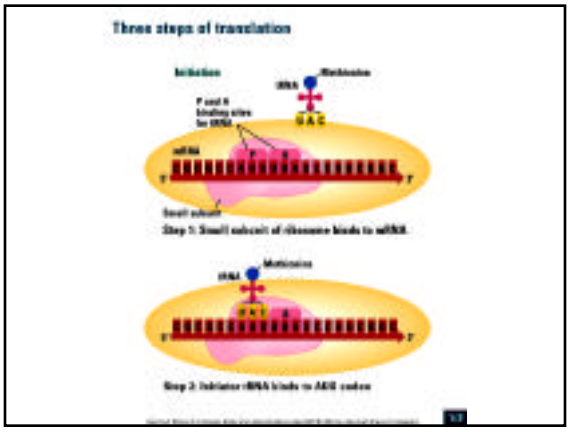




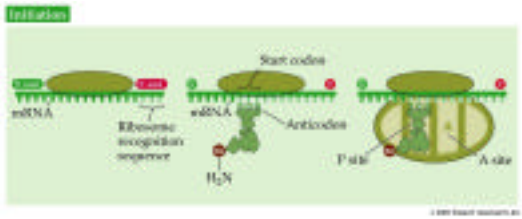
4 tRNA binding sites on the ribosome



T = transfer
A = amino acid
P = polypeptide
E = exit



Initiation



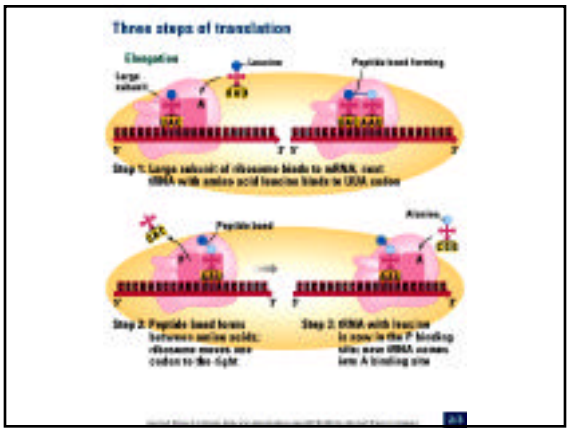
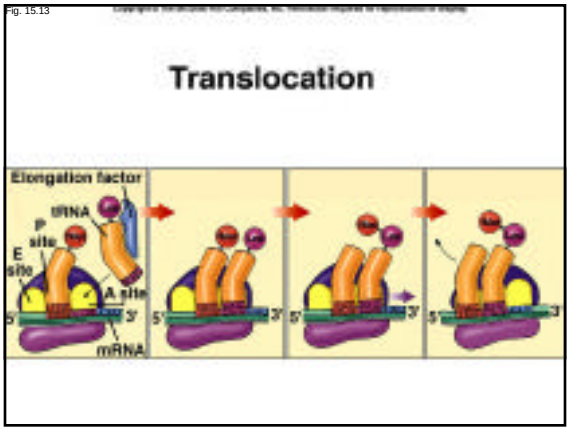
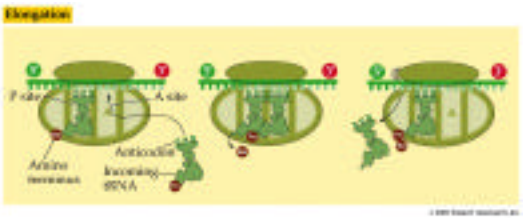


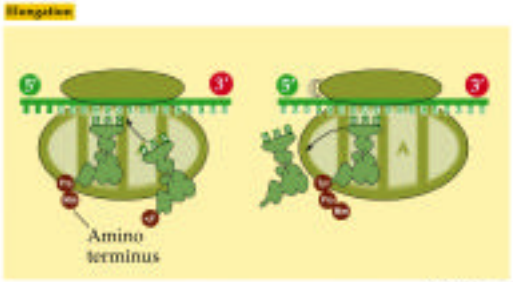
Fig. 15.13

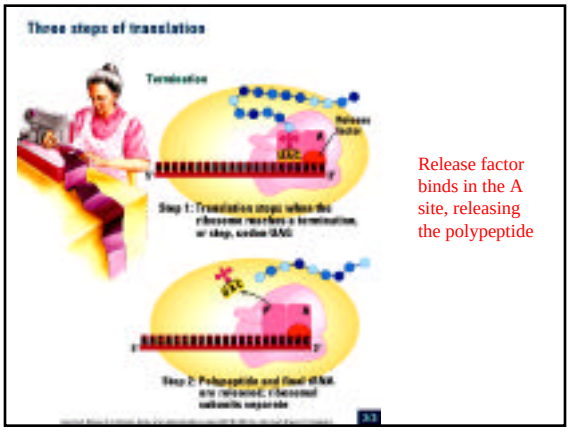


Elongation



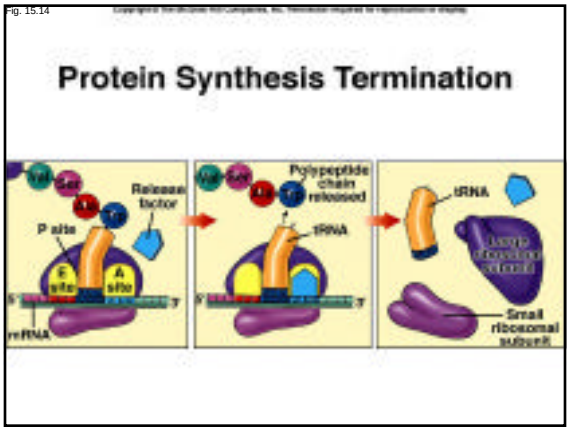
Elongation



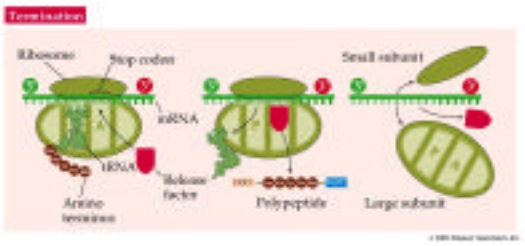


Release factor binds in the A site, releasing the polypeptide

Fig. 15.14



Termination



12.2 Antibiotics that Inhibit Bacterial Protein Synthesis

ANTIBIOTIC	STEP INHIBITED
Chloromycetin	Formation of peptide bonds
Erythromycin	Translocation of mRNA along ribosome
Neomycin	Interactions between tRNA and mRNA
Streptomycin	Initiation of translation
Tetracycline	Binding of tRNA to ribosome

Translation summary

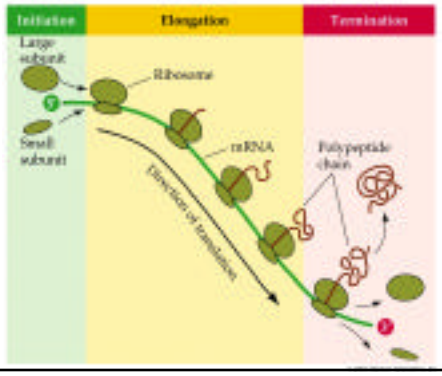


Fig. 15.15a

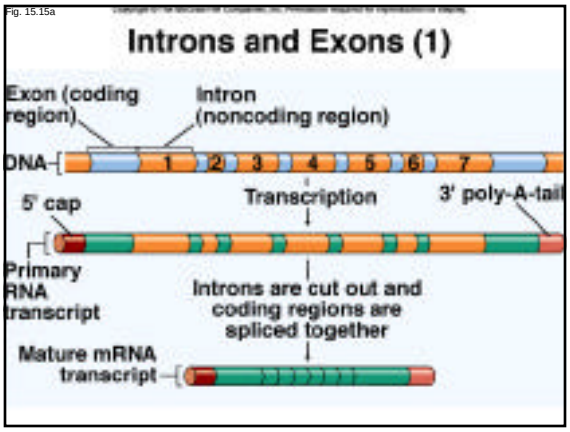


Fig. 15.15b

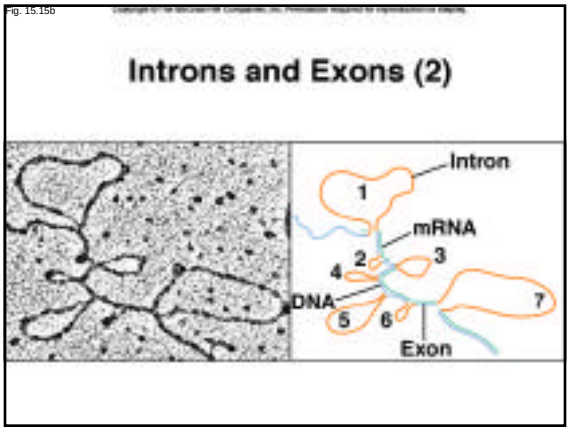
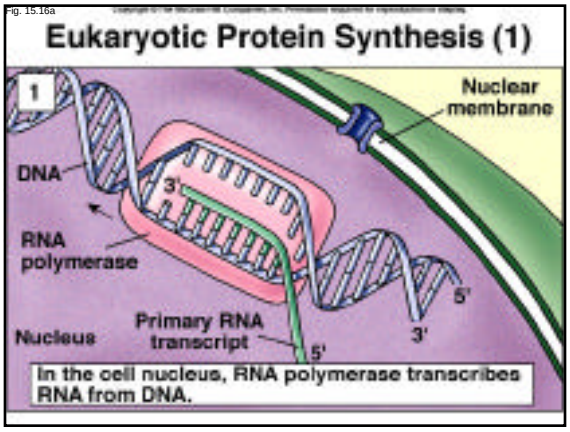


Fig. 15.16a



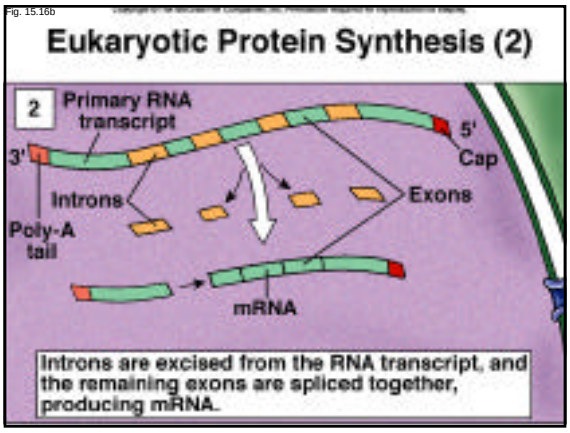


Fig. 15.16b
Eukaryotic Protein Synthesis (2)
2
Primary RNA transcript
5'
Cap
3'
Introns
Exons
Poly-A tail
mRNA
Introns are excised from the RNA transcript, and the remaining exons are spliced together, producing mRNA.

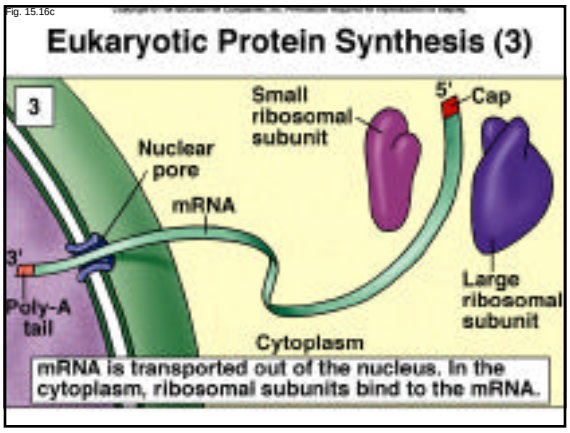


Fig. 15.16c
Eukaryotic Protein Synthesis (3)
3
Small ribosomal subunit
5'
Cap
Nuclear pore
mRNA
3'
Poly-A tail
Large ribosomal subunit
Cytoplasm
mRNA is transported out of the nucleus. In the cytoplasm, ribosomal subunits bind to the mRNA.

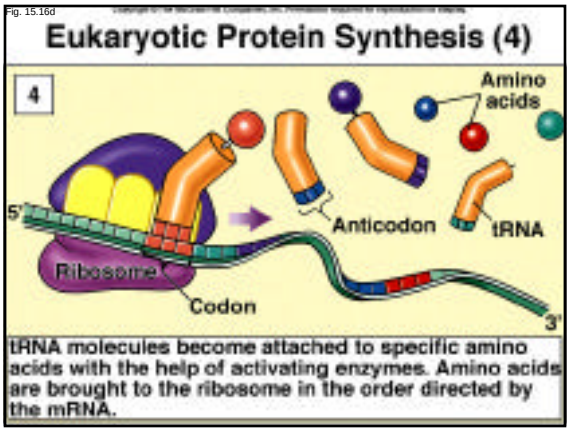


Fig. 15.16d
Eukaryotic Protein Synthesis (4)
4
Amino acids
5'
Anticodon
tRNA
Ribosome
Codon
3'
tRNA molecules become attached to specific amino acids with the help of activating enzymes. Amino acids are brought to the ribosome in the order directed by the mRNA.

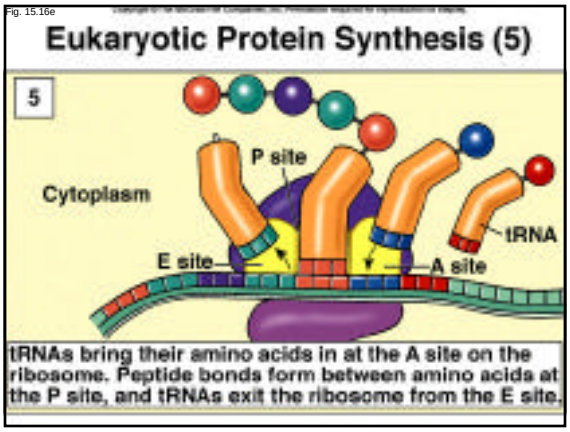


Fig. 15.16e
Eukaryotic Protein Synthesis (5)
5
P site
Cytoplasm
tRNA
E site
A site
tRNAs bring their amino acids in at the A site on the ribosome. Peptide bonds form between amino acids at the P site, and tRNAs exit the ribosome from the E site.

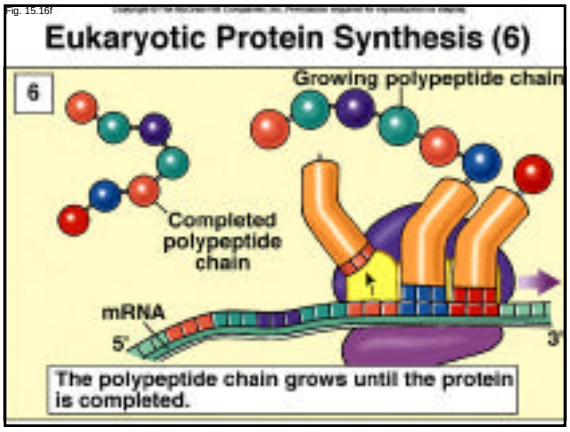
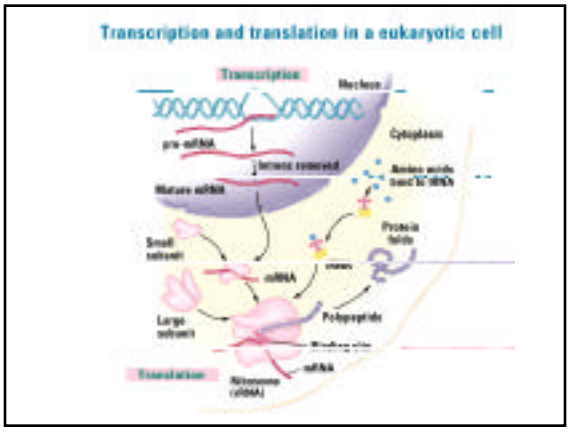
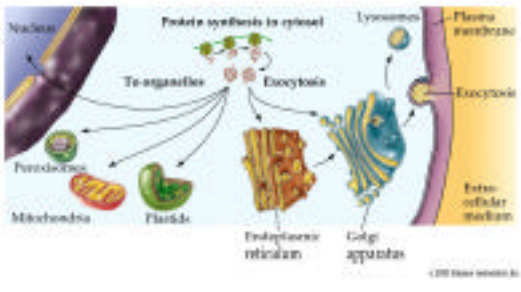


Fig. 15.16f
Eukaryotic Protein Synthesis (6)
6
Growing polypeptide chain
Completed polypeptide chain
mRNA
5'
3'
The polypeptide chain grows until the protein is completed.

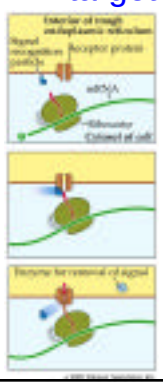

Transcription and translation in a eukaryotic cell
Transcription
Nucleus
Cytoplasm
pre-mRNA
introns removed
Mature mRNA
Protein
Small subunit
mRNA
Polypeptide
Large subunit
Translation
tRNA

Signal sequences direct proteins

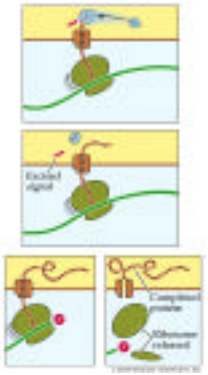
Signal sequences are short sequences at the N-terminus or in the middle that direct the proteins



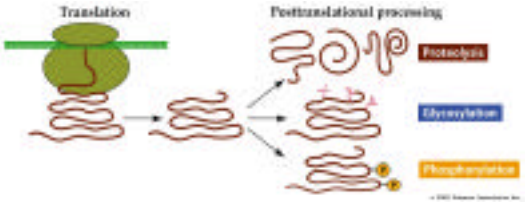
ER targeting of proteins

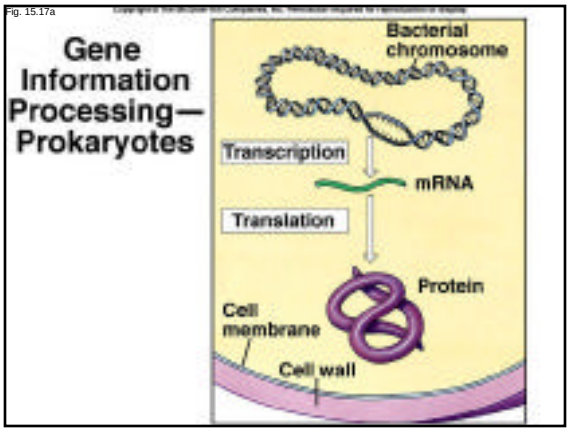


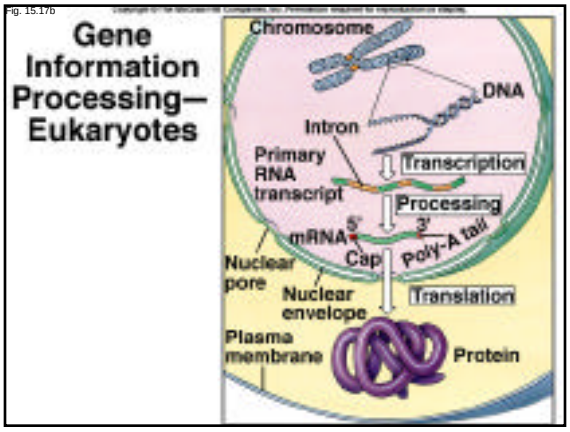
1. SRP bind signal recognition sequence
2. Docks it to the receptor protein on the ER
3. Signal recognition sequence is cleaved
4. Protein is synthesized into the ER



Post-translational modifications







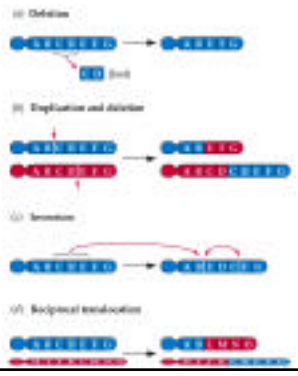
Mutations

Permanent changes in the DNA sequence

Somatic - non gamete cells
Germ-line mutations

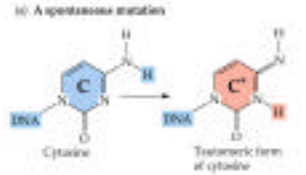
Point mutations - substitution or deletion/addition of a nucleotide
- Silent (no change)
- missense (sickle cell)
- Nonsense (Stop)
- Frame shift

Chromosome mutation - loss or change in a DNA segment



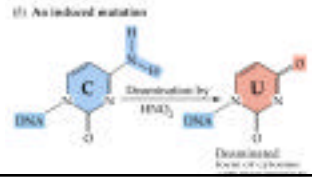
Spontaneous and induced mutations

Tautomeric C pairs with A

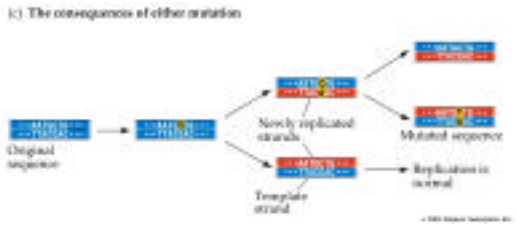


Base modifications by chemicals or radiation

- benzpyrene
- Nitrates
- X-rays
- UV light



Mutation propagation



The End.