ME 498 / ME 599

Biological Frameworks for Engineers

Biological Frameworks for Engineers

ME 498 / ME 599

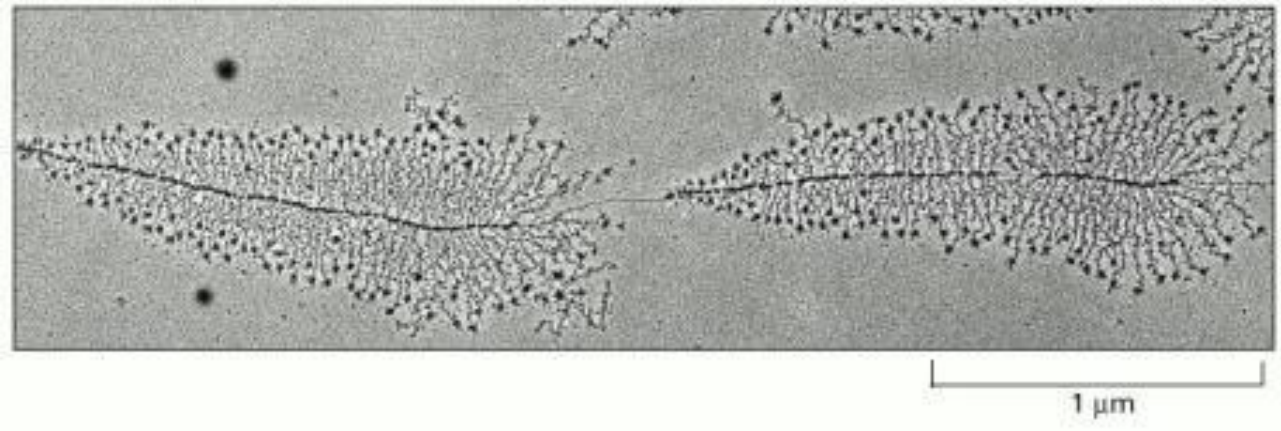
DNA

UNIVERSITY OF WASHINGTON

DNA = Ticker Tape?

DNA to RNA

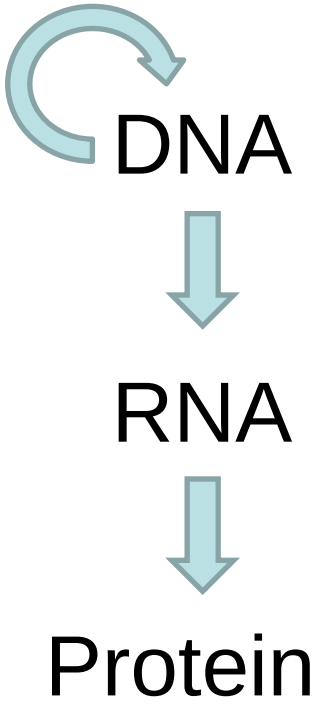
Electron micrograph below shows many molecules of RNA polymerase simultaneously transcribing two genes.



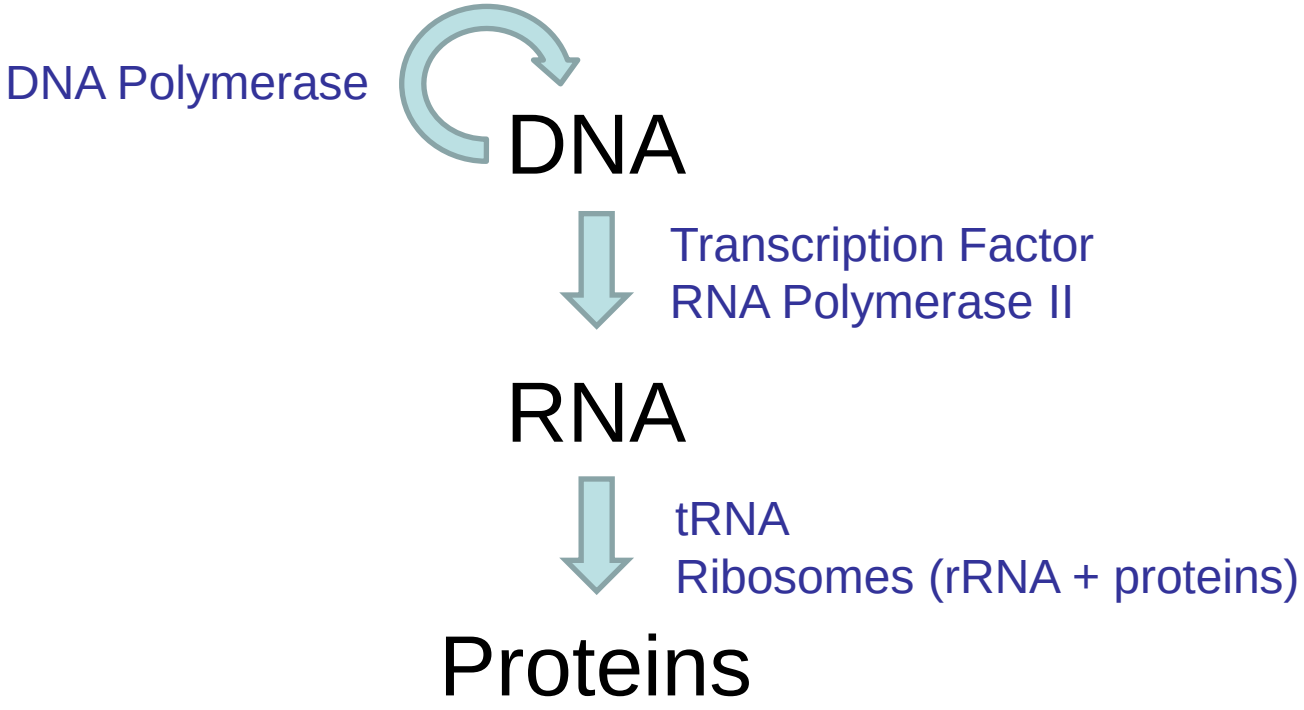
Individual RNA polymerases are visible as dots along the DNA. New RNA (fine threads) are attached to them.

Lengths of new RNA indicates that DNA is read from left to right (3' to 5' of DNA)

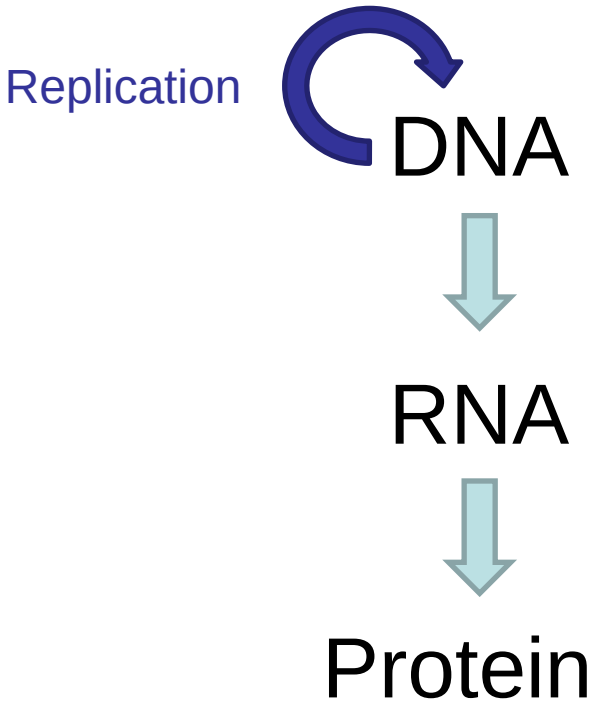
Central Dogma



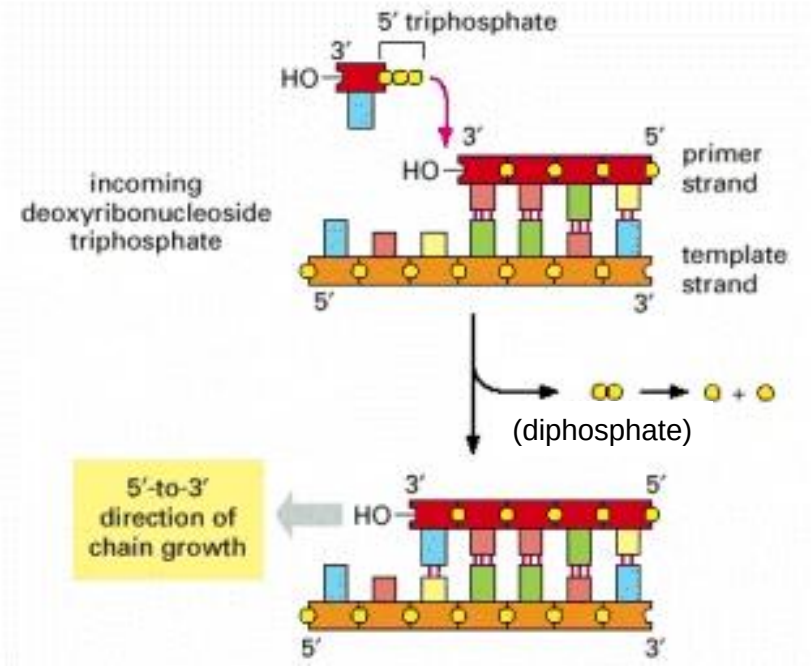
Central Players

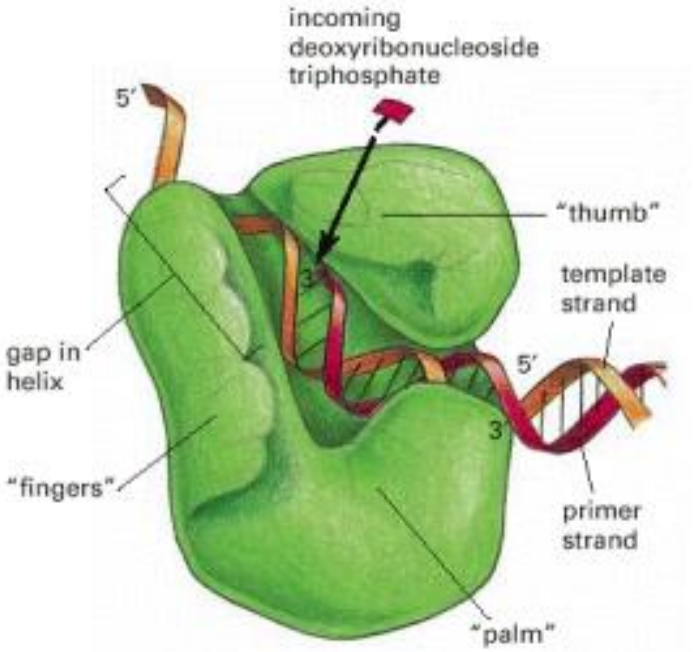


Central Dogma



DNA Replication



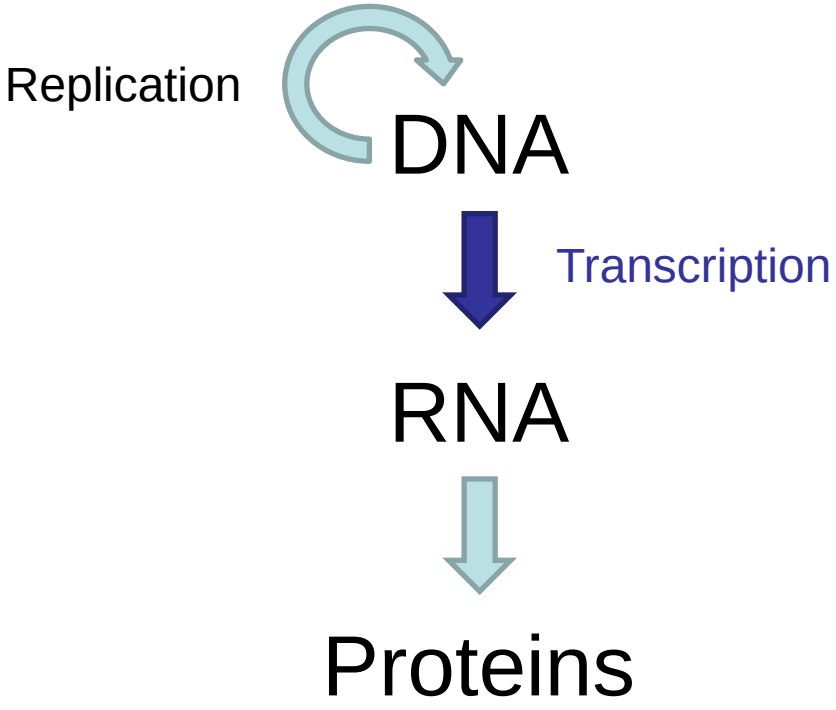


(DNA Polymerase)

Reads DNA 3'→ 5'

Makes DNA 5'→3'

Central Dogma



Transcription

(RNA Polymerase II)

Reads DNA 3'→ 5'
Makes RNA 5'→3'

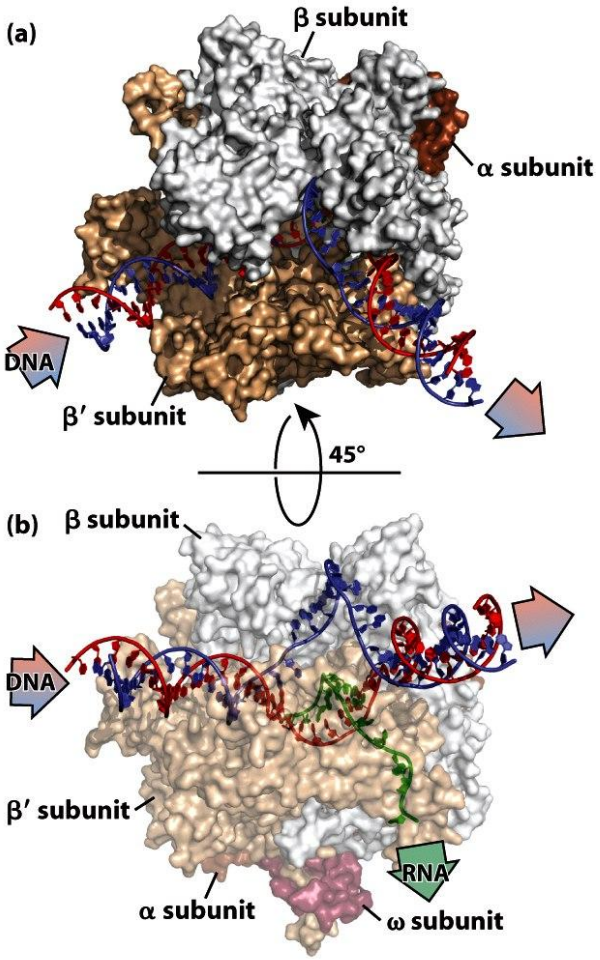
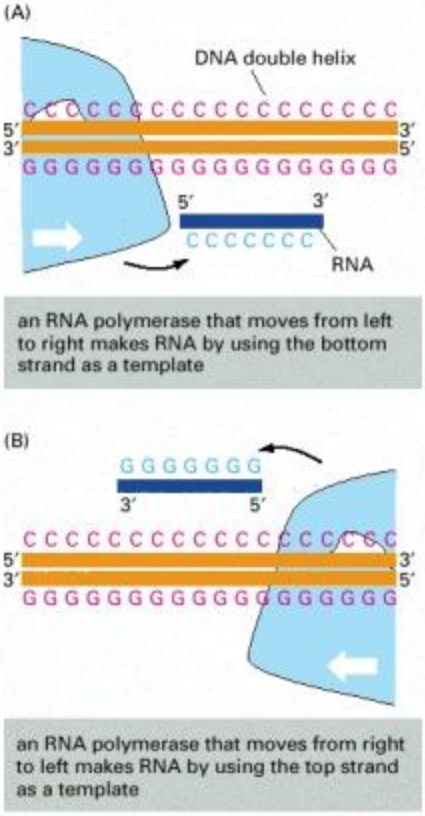


Figure 4-12
Molecular Cell Biology, Sixth Edition



Transcription Factors & Promoter Sequences

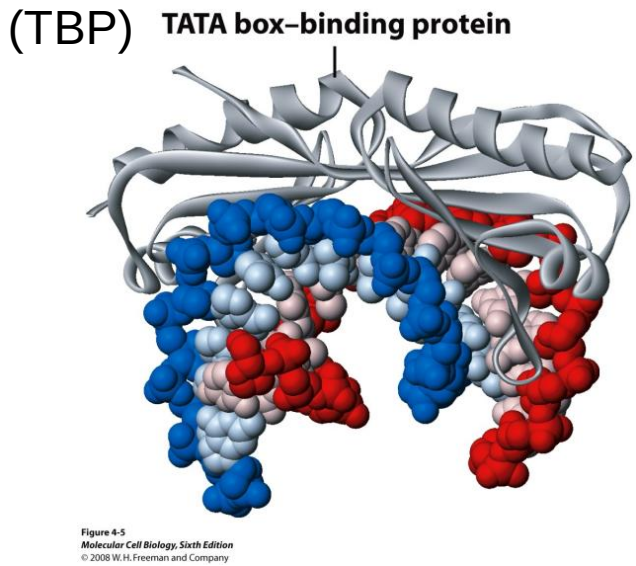


Figure 4-5
Molecular Cell Biology, Sixth Edition
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Element	Promoter Sequence	Transcription Factor
TATA	T A T A A/T A A/T	TBP
BRE	G/C G/C G/A C G C C	TFIIB
INR	C/T C/T A x T/A C/T/ C/T	TFIID
DPE	A/G G A/T C G T G	TFIID

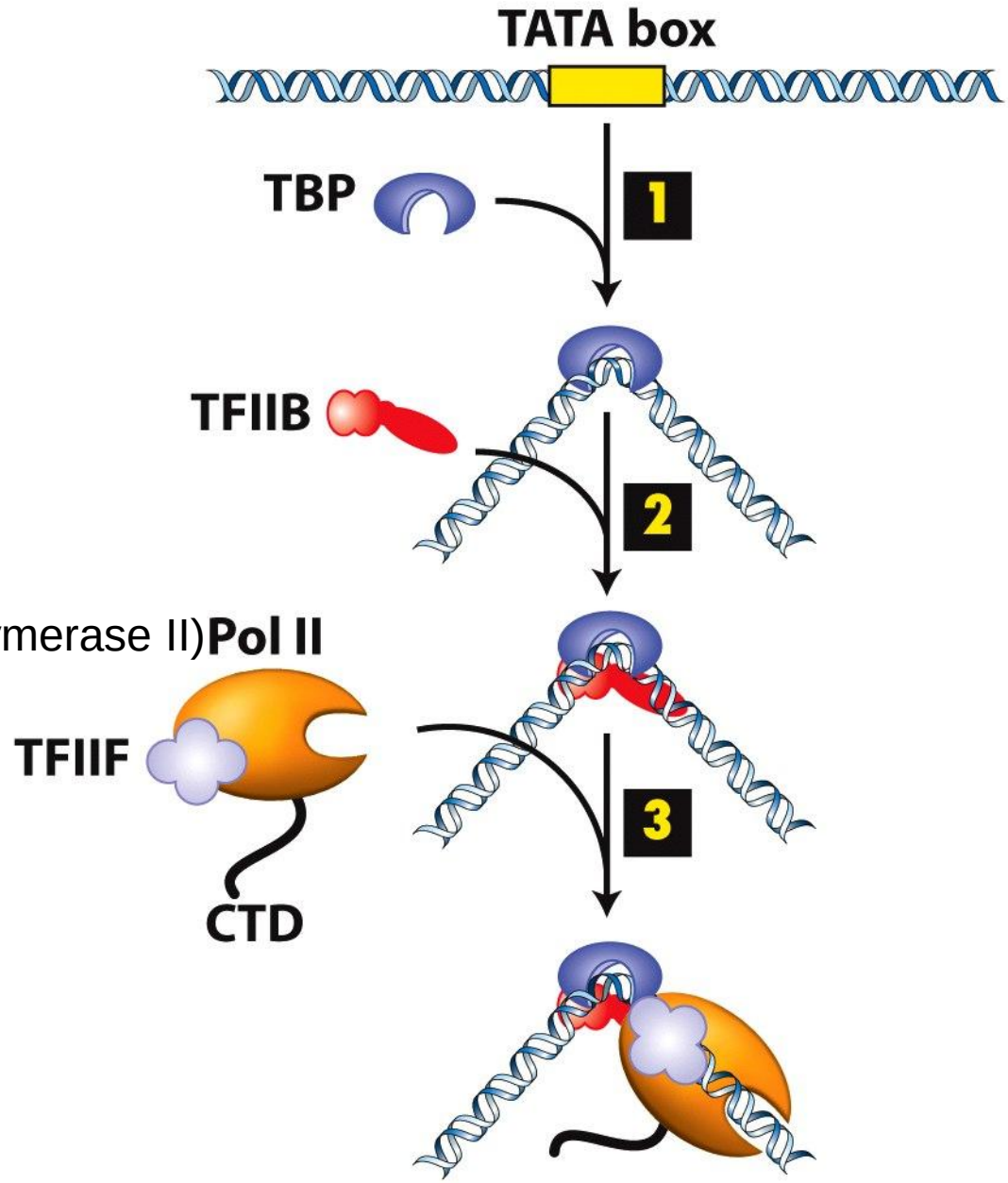


Figure 7-31 part 1
Molecular Cell Biology, Sixth Edition

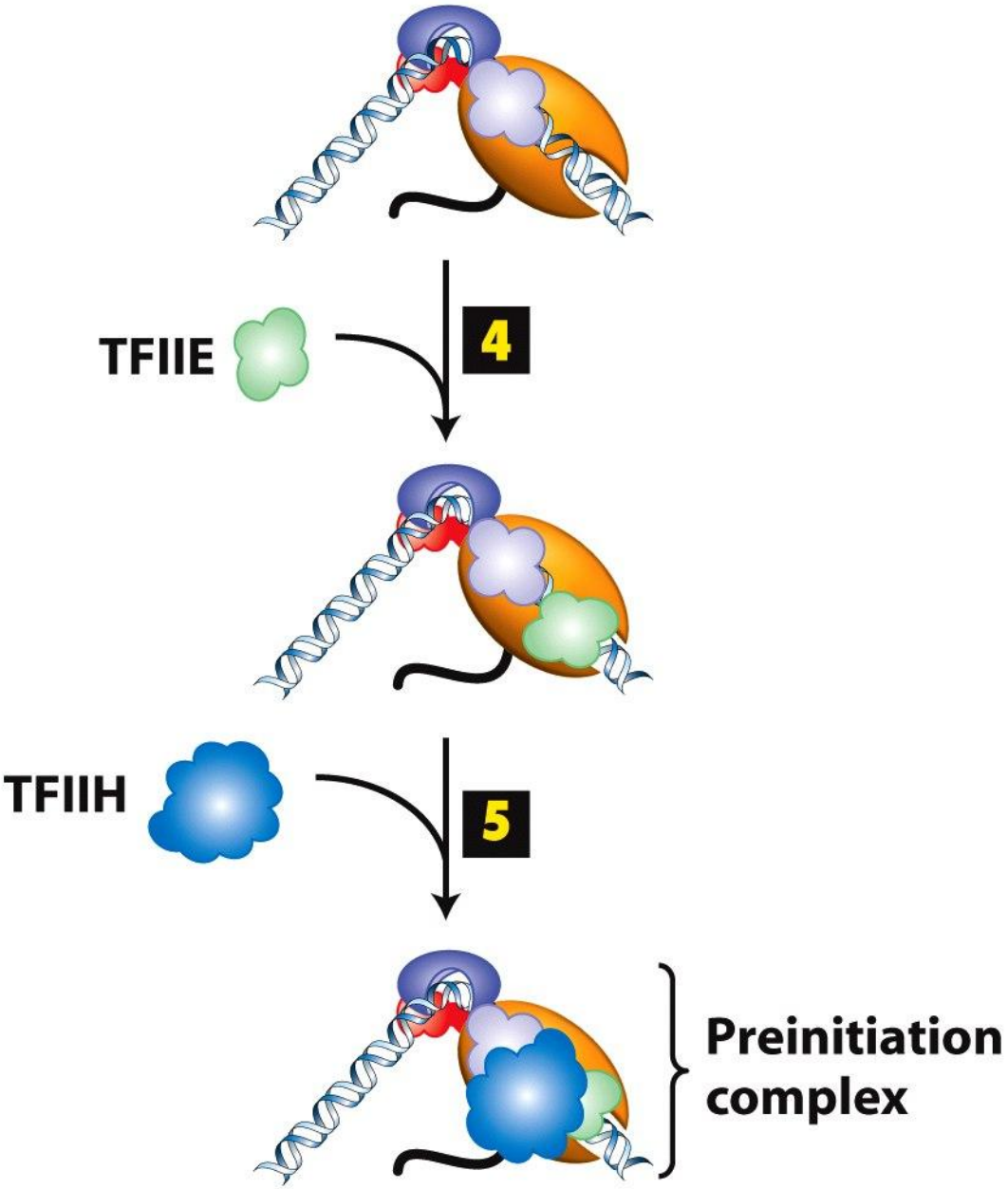


Figure 7-31 part 2
Molecular Cell Biology, Sixth Edition

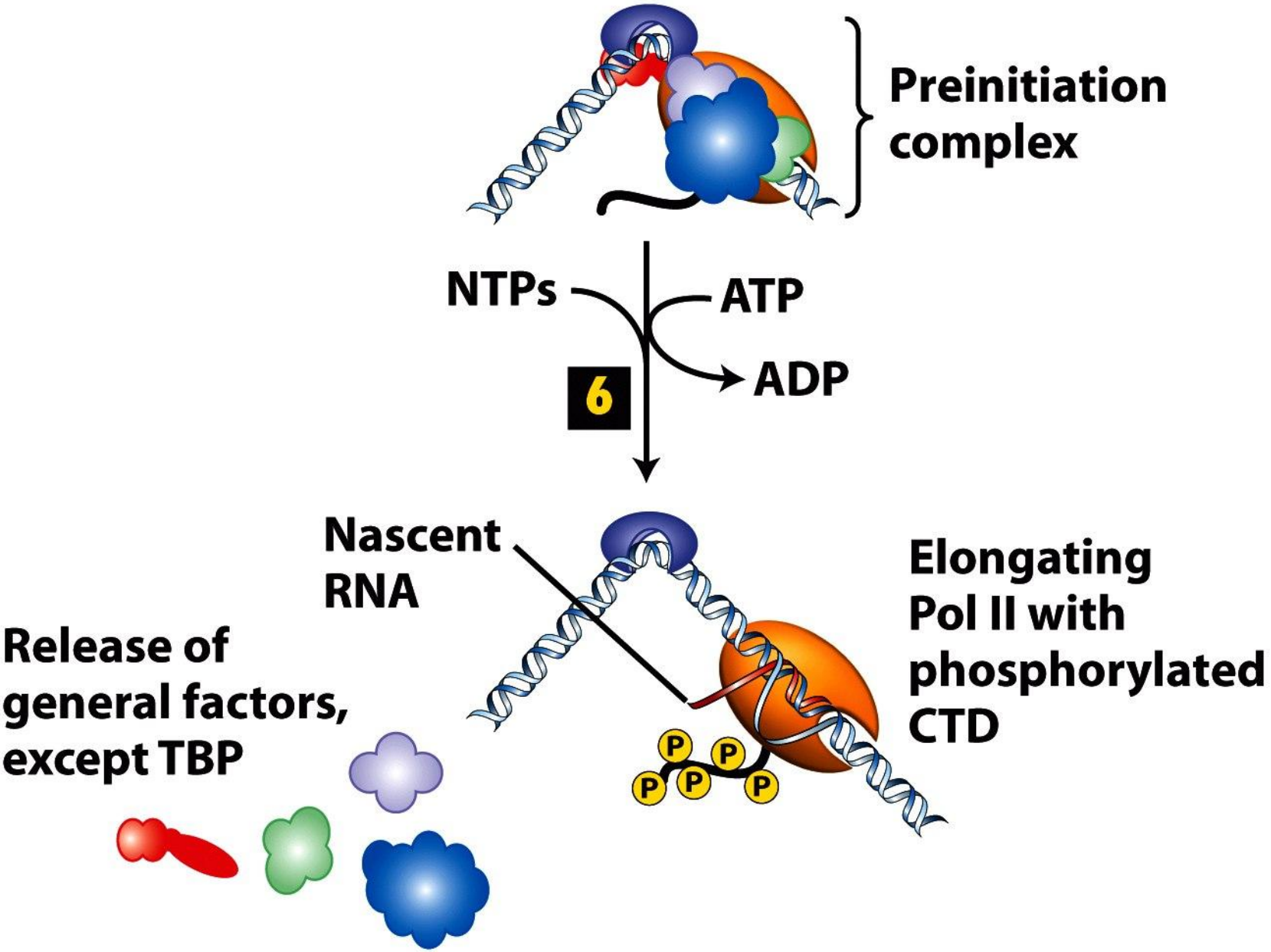
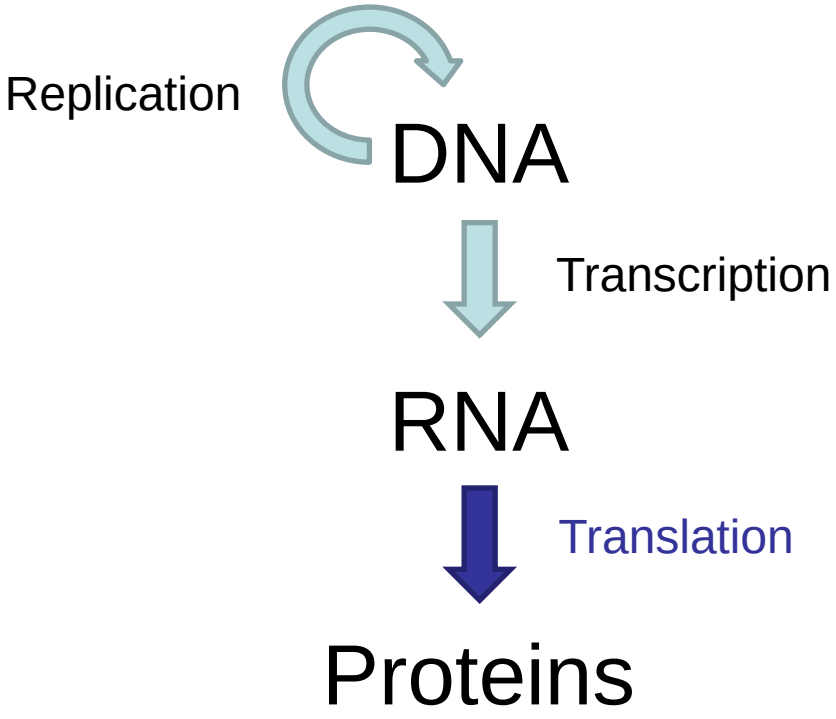


Figure 7-31 part 3
Molecular Cell Biology, Sixth Edition

Central Dogma



Translation

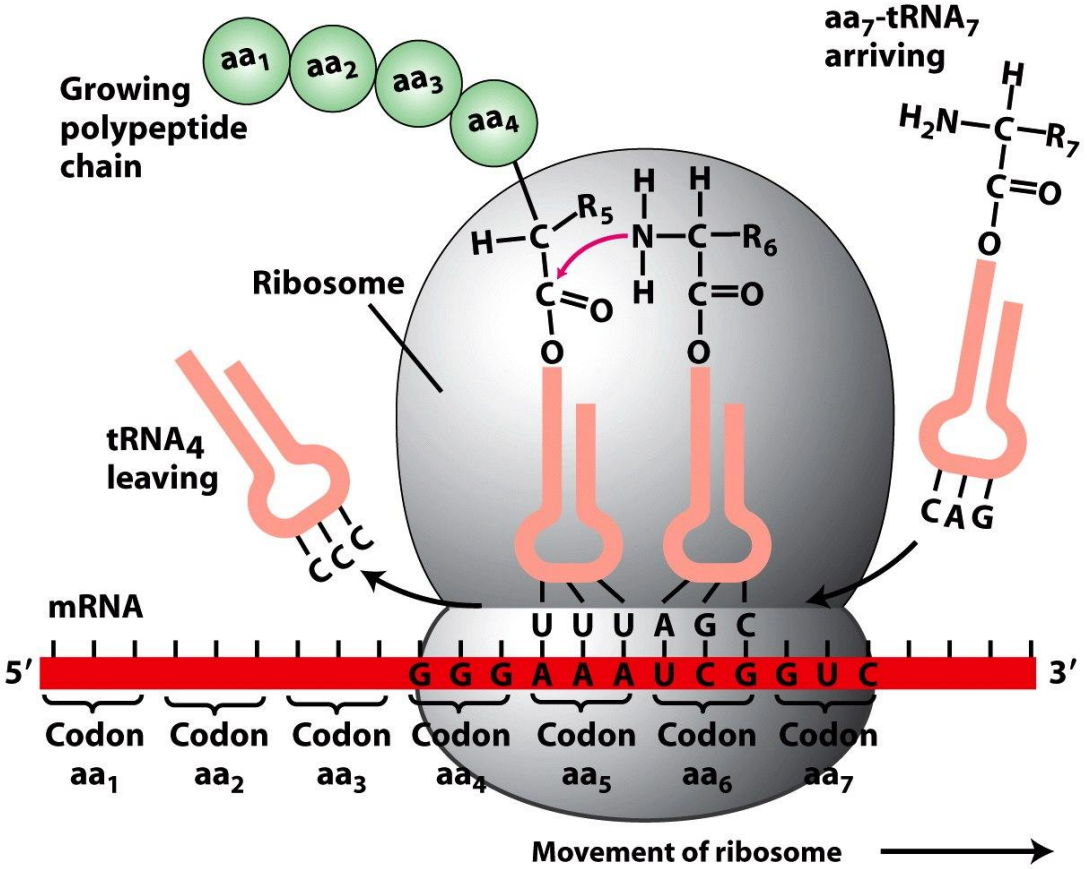
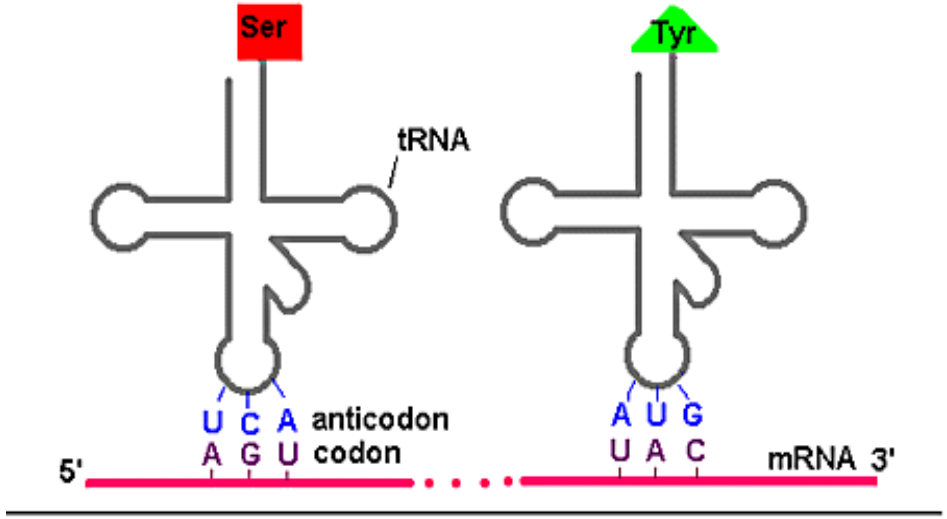


Figure 4-17
Molecular Cell Biology, Sixth Edition



2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
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	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

The Genetic Code

When is a cell like a computer?

WORKSHEET: Genetic Code

DNA (5') G G A T A G C A T G A A A C C C G C A T A A (3')

DNA

mRNA

Amino acid

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
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	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

WORKSHEET: Genetic Code

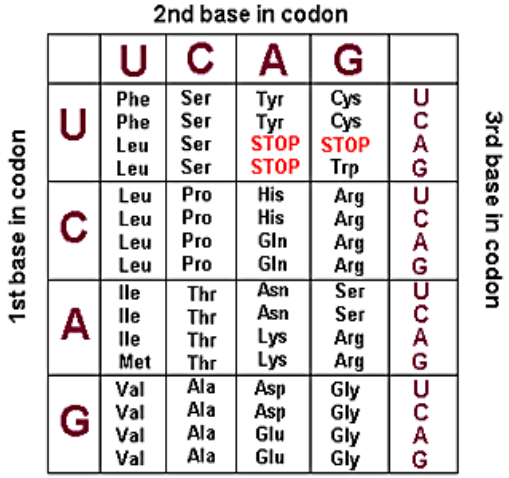
DNA (5') G G A T A G C A T G A A A C C C G C A T A A (3')

Start

DNA (3') C C T A T C G T A C T T T G G G C G T A T T (5')

mRNA

Amino acid



	U	C	A	G	
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

WORKSHEET: Genetic Code

DNA (5') G G A T A G C A T G A A A C C C G C A T A A (3')

DNA (3') C C T A T C G T A C T T T G G G C G T A T T (5')

Start

mRNA (5') G G A U A G C A U G A A A C C C G C A U A A (3')

Amino acid

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
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	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

WORKSHEET: Genetic Code

DNA (5') G G A T A G C A T G A A A C C C G C A T A A (3')

DNA (3') C C T A T C G T A C T T T G G G C G T A T T (5')

Start

mRNA (5') G G A U A G C A U G A A A C C C G C A U A A (3')

Stop

Amino acid Methionine Lysine Proline Alanine

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

Questions ?