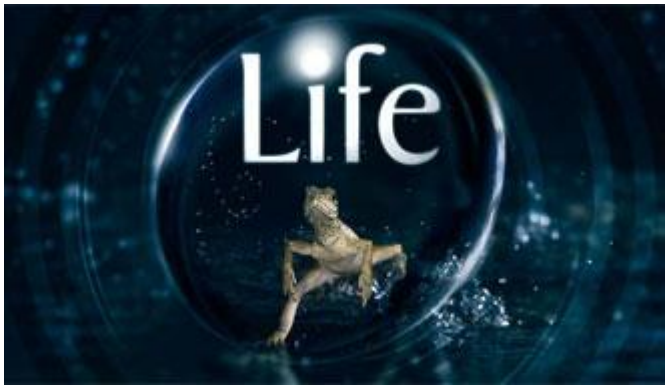


SPOLEČNĚ PRO VÝZKUM,ROZVOJ A INOVACE
CZ/FMP.17A/0436

STRATO-NANOBIOLAB

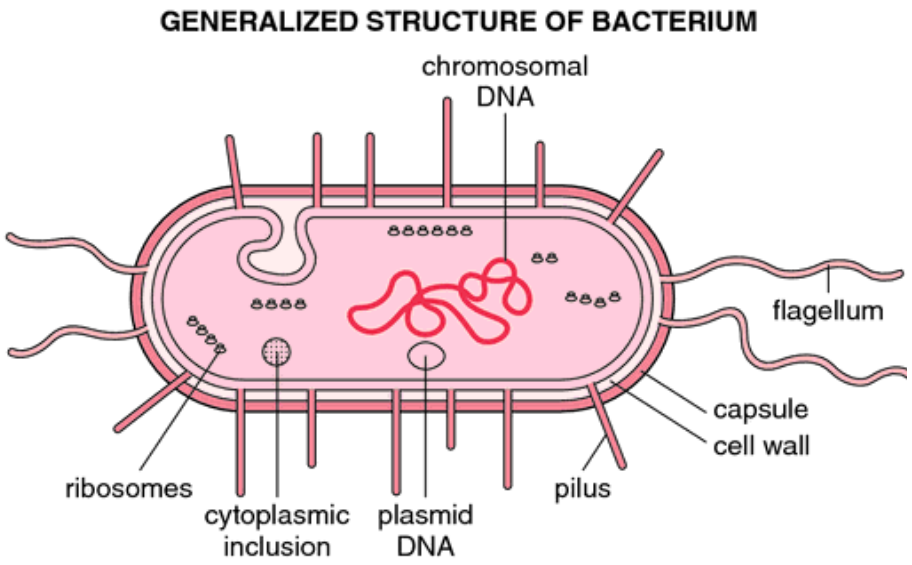
ASTROBIOLOGIE: Bakterie, jaký je jejich metabolismus I

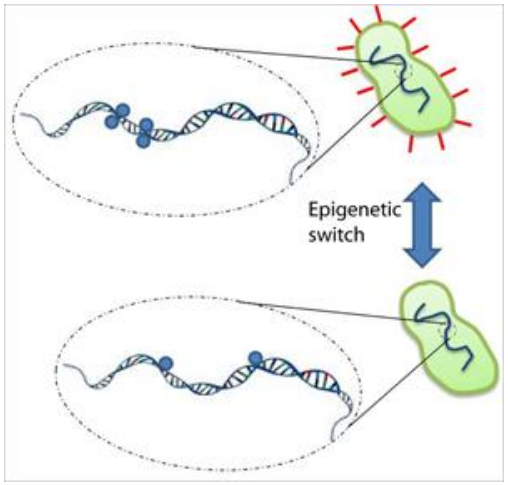
René Kizek

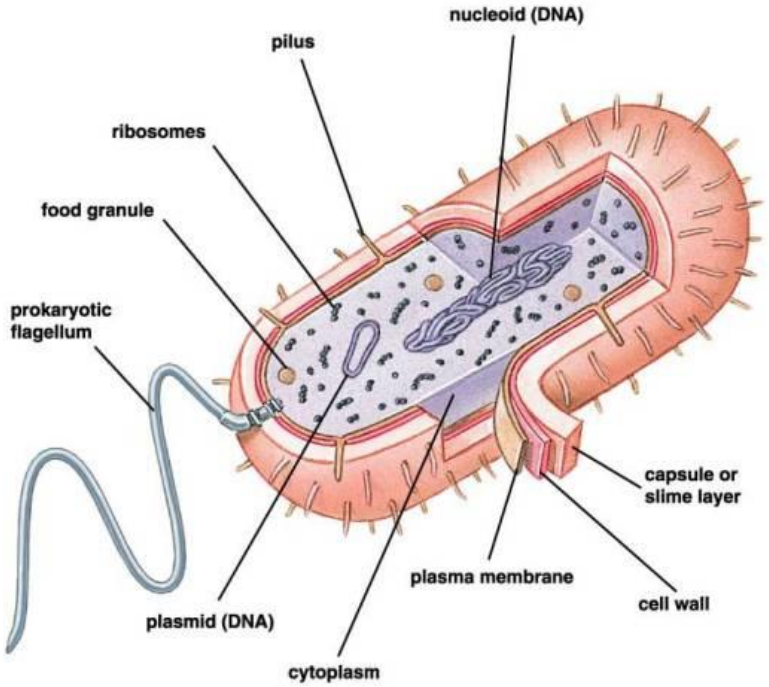
Dne: 09. 04. 2015
Hvězdárna Valašské Meziříčí,p.o., Vsetínská 78, valašské Meziříčí ,
Vstupní hala a hlavní přednáškový sál

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
FOND MIKROPROJEKTŮ

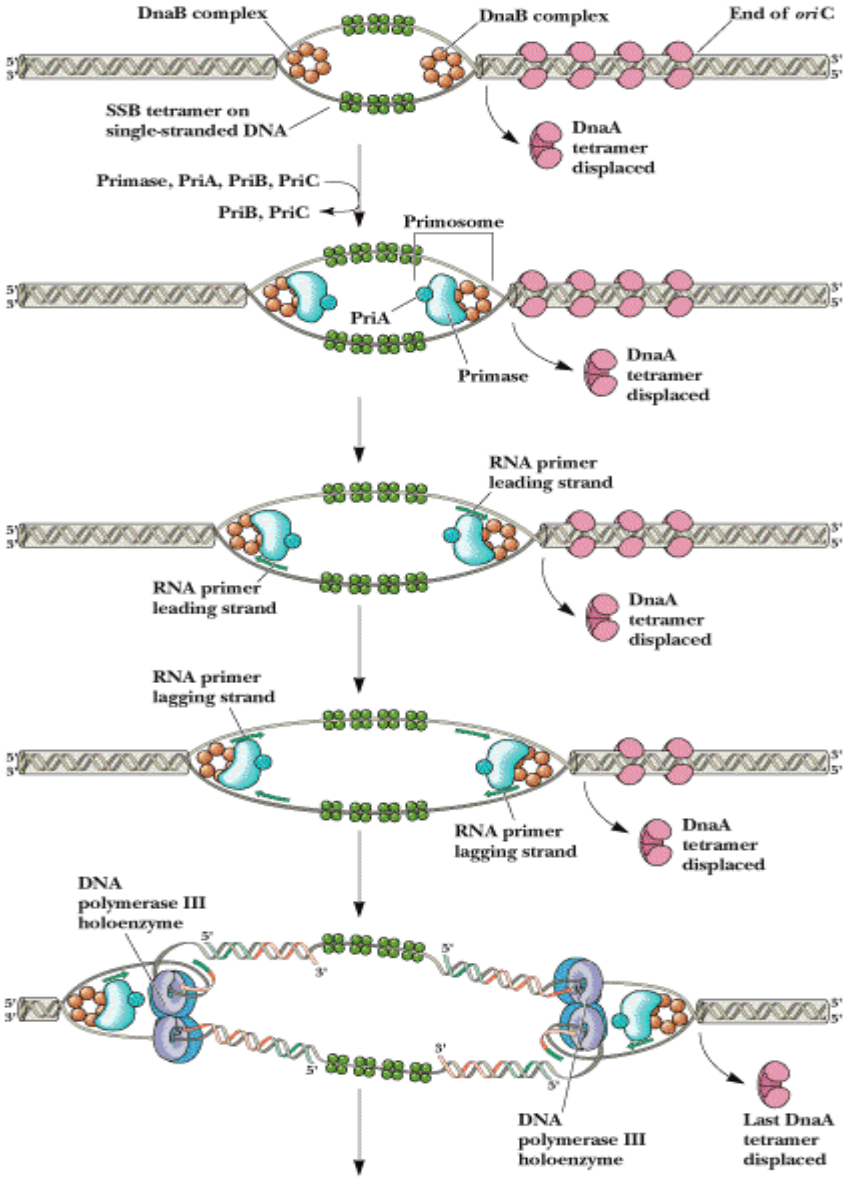
Obecné schéma bakteriální buňky

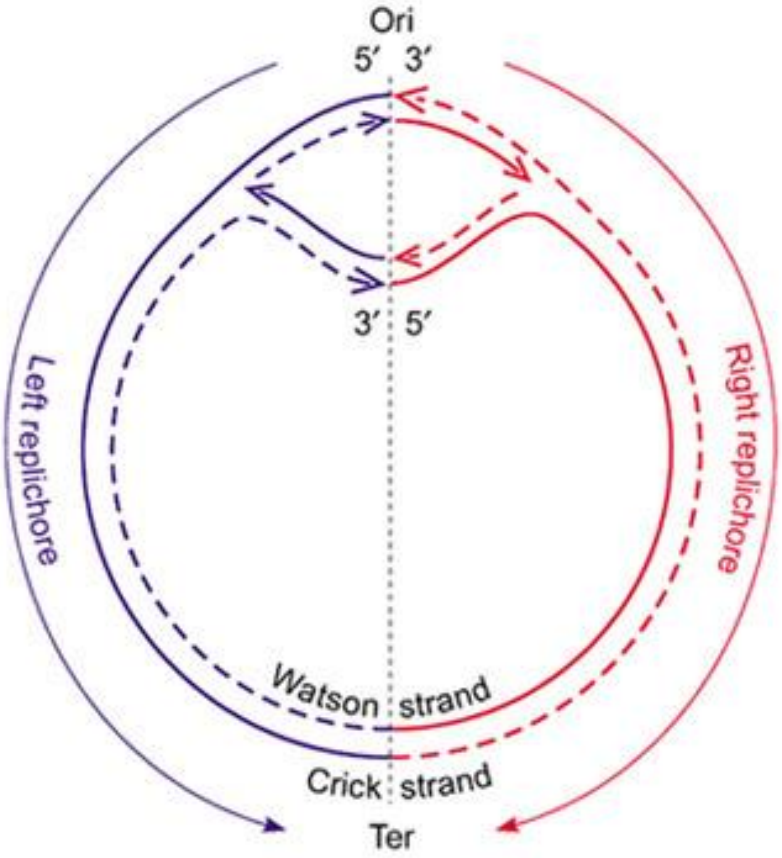




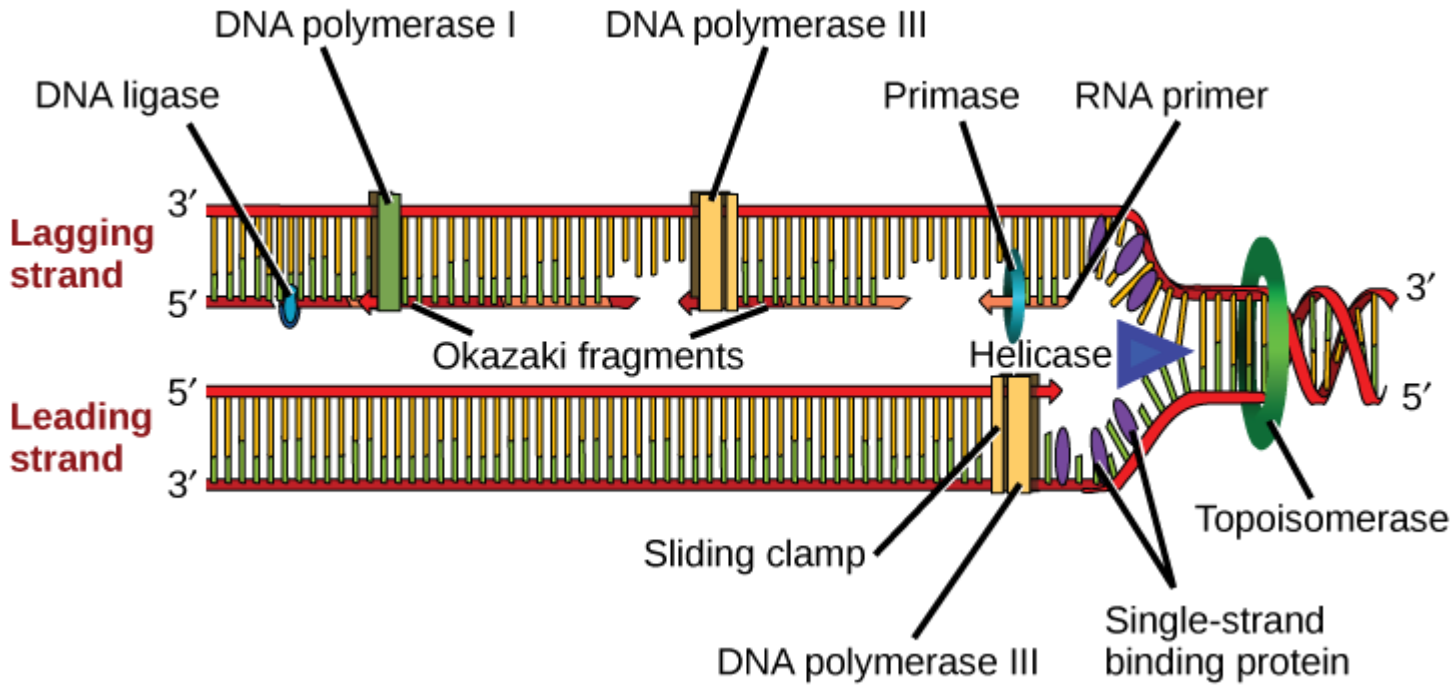


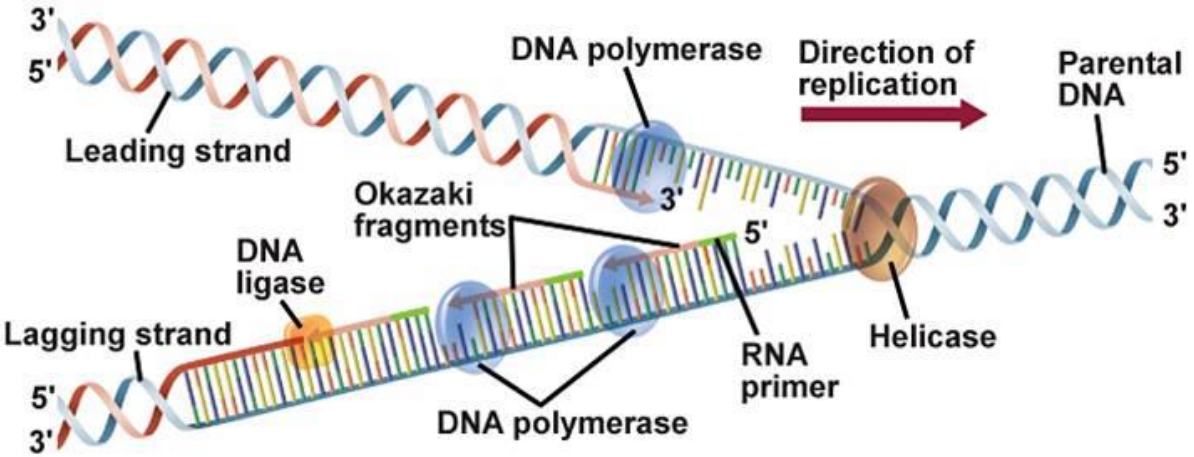
PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

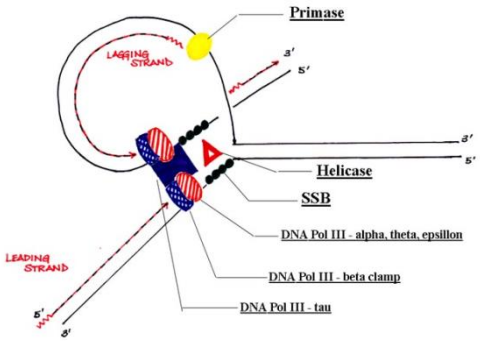


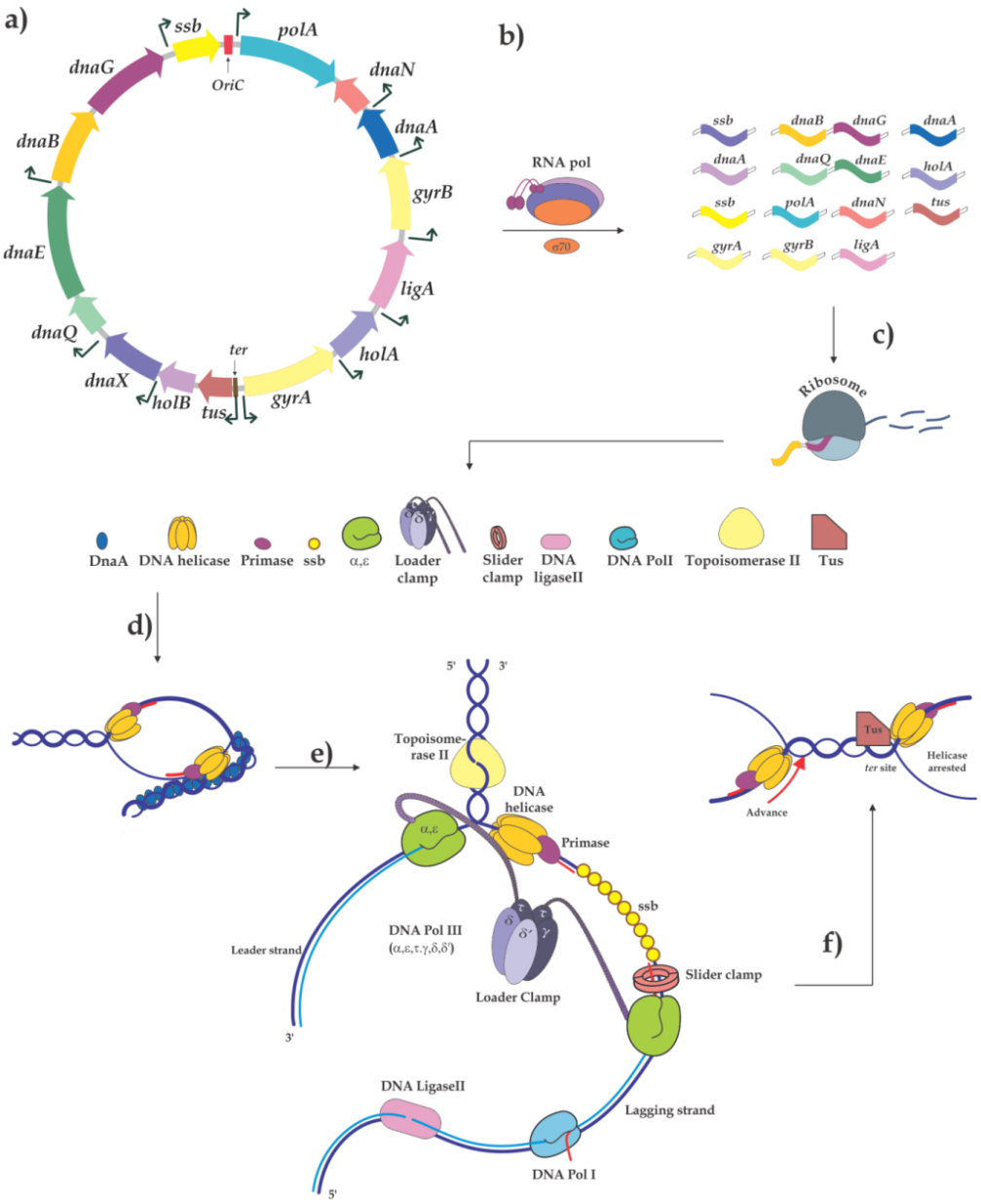


PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ


DNA polymerase I
DNA polymerase III
DNA ligase
Primase
RNA primer
Lagging strand
3′
5′
Okazaki fragments
Helicase
Leading strand
5′
3′
3′
5′
Topoisomerase
Sliding clamp
DNA polymerase III
Single-strand binding protein


3'
5'
Leading strand
DNA polymerase
Direction of replication
Parental DNA
5'
3'
Okazaki fragments
3'
5'
DNA ligase
Lagging strand
5'
3'
RNA primer
Helicase
DNA polymerase


Primase
LAGGING STRAND
3'
5'
Helicase
SSB
DNA Pol III - alpha, theta, epsilon
LEADING STRAND
DNA Pol III - beta clamp
DNA Pol III - tau



PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

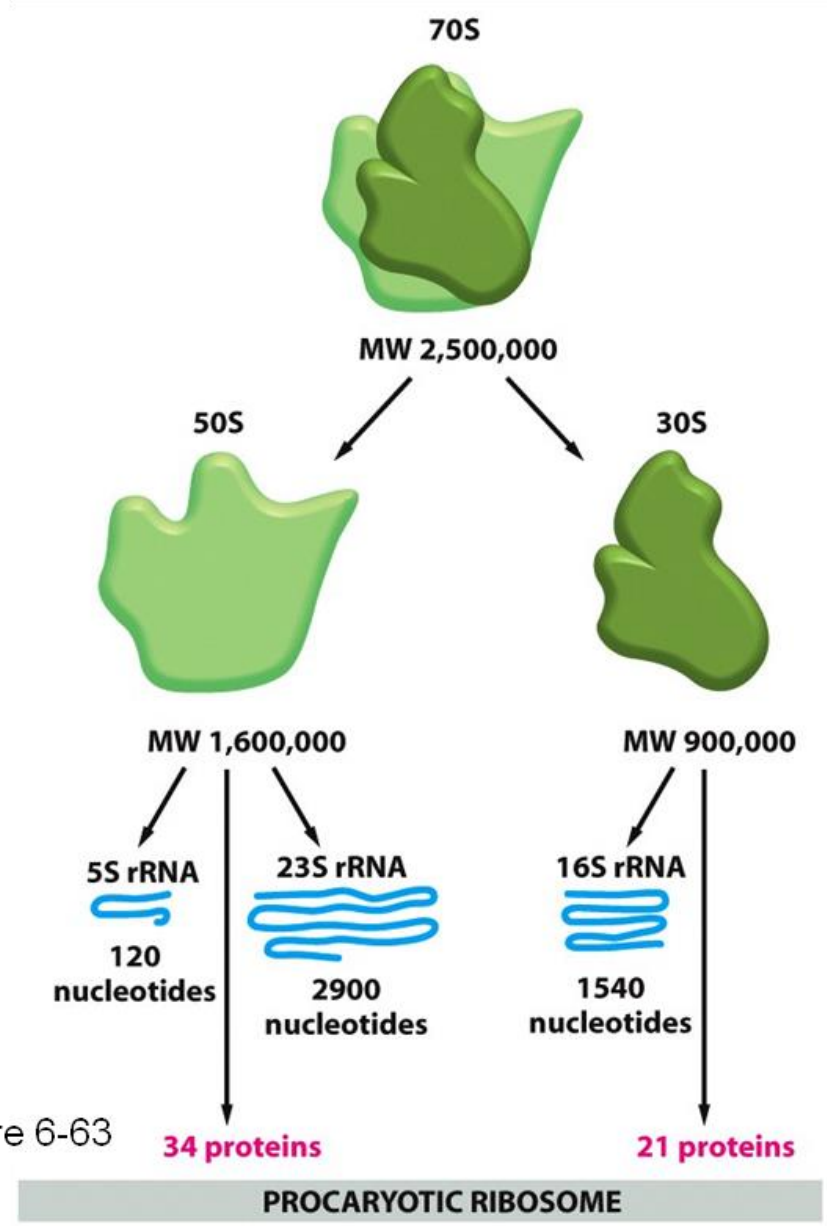
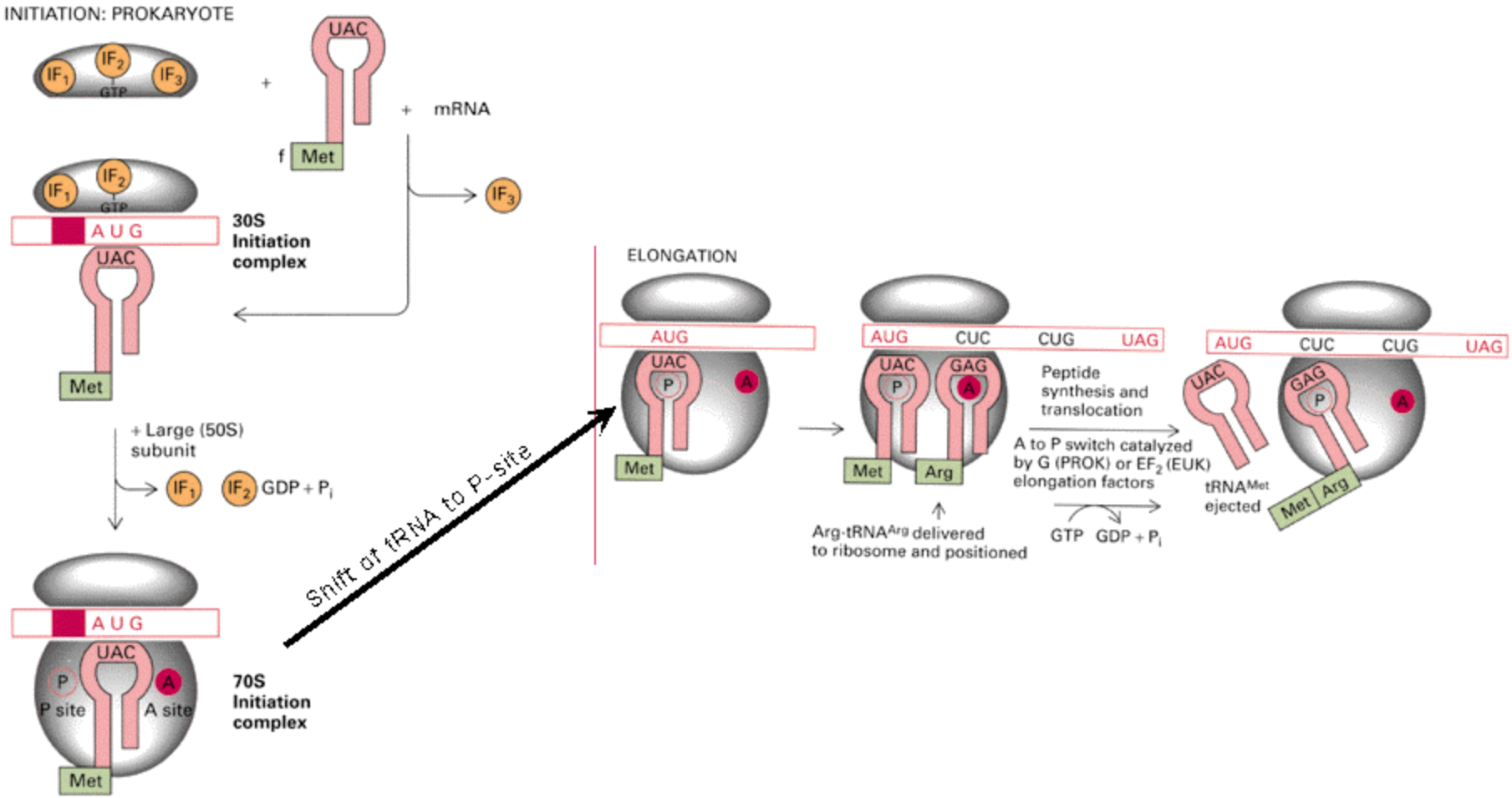
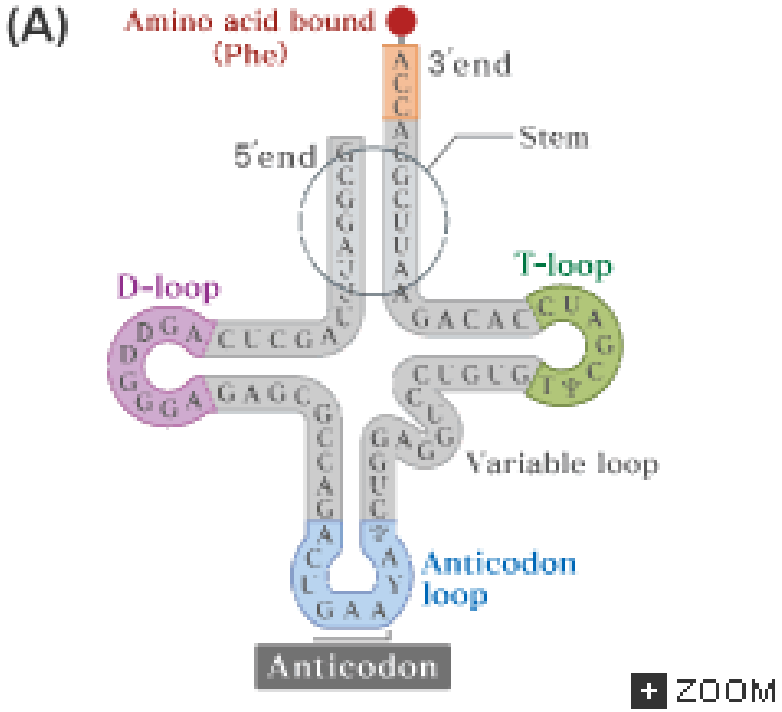
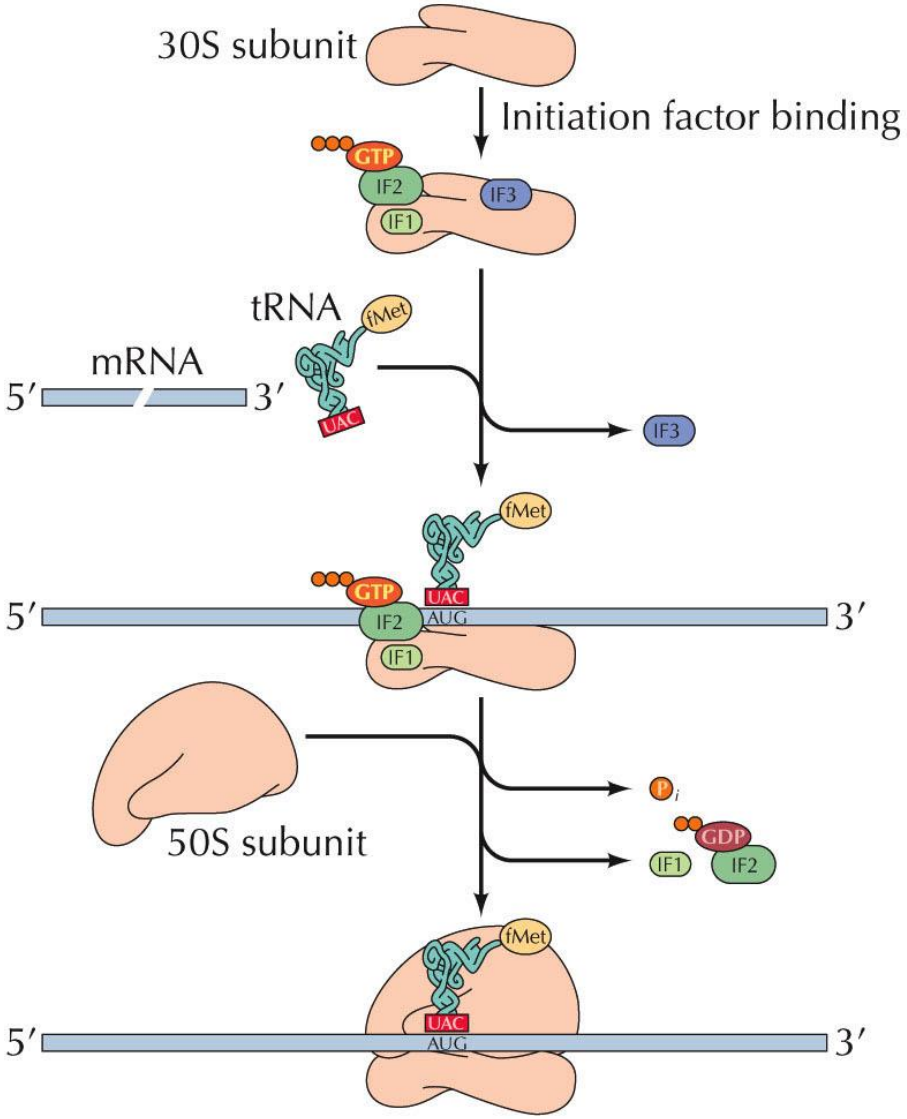

70S
MW 2,500,000
50S
30S
MW 1,600,000
MW 900,000
5S rRNA
23S rRNA
16S rRNA
120 nucleotides
2900 nucleotides
1540 nucleotides
34 proteins
21 proteins
PROCARYOTIC RIBOSOME

Figure 6-63


INITIATION: PROKARYOTE
IF1
IF2
GTP
IF3
+
UAC
f Met
+ mRNA
IF3
IF1
IF2
GTP
A U G
UAC
Met
30S Initiation complex
+ Large (50S) subunit
IF1
IF2 GDP + Pi
A U G
UAC
P
A
P site
A site
Met
70S Initiation complex
Shift of tRNA to P-site
ELONGATION
AUG
UAC
P
A
Met
AUG CUC CUG UAG
UAC
GAG
P
A
Met
Arg
Arg-tRNAArg delivered to ribosome and positioned
Peptide synthesis and translocation
A to P switch catalyzed by G (PROK) or EF2 (EUK) elongation factors
GTP GDP + Pi
AUG CUC CUG UAG
UAC
tRNAMet ejected
GAG
P
A
Met
Arg

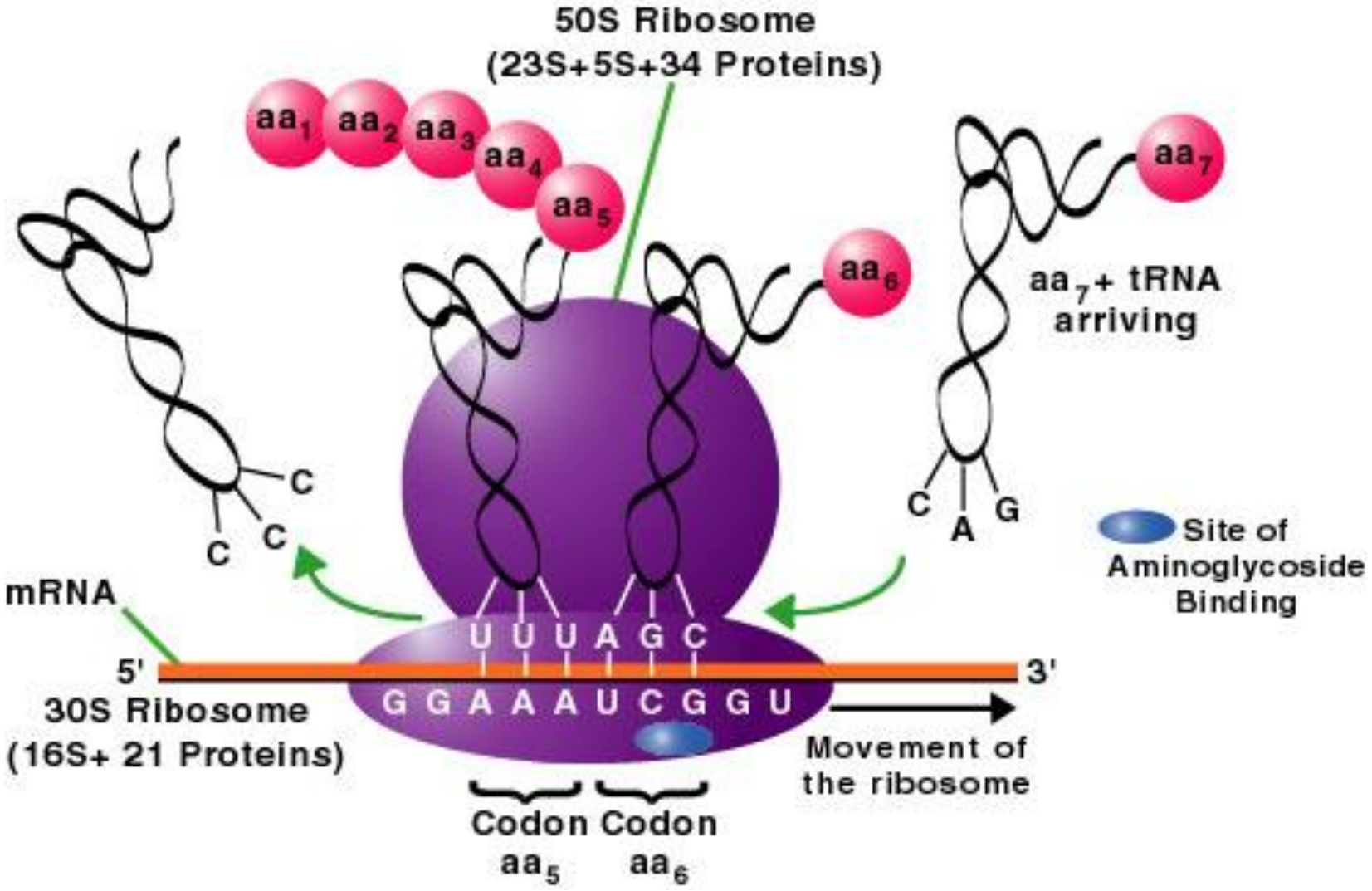

(A)
Amino acid bound
(Phe)
3′end
5′end
Stem
T-loop
D-loop
Variable loop
Anticodon
loop
Anticodon

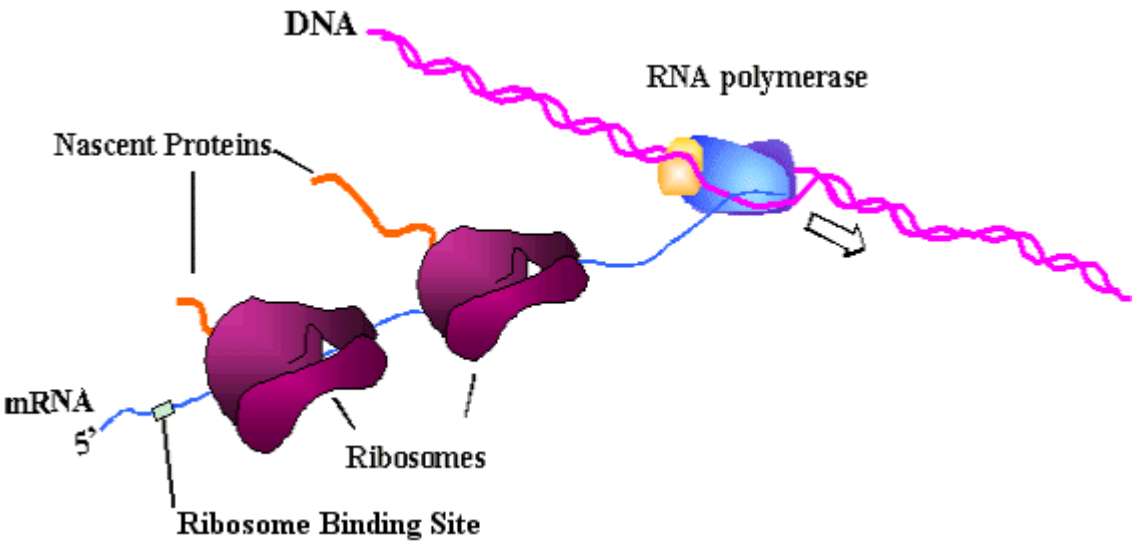
+ ZOOM

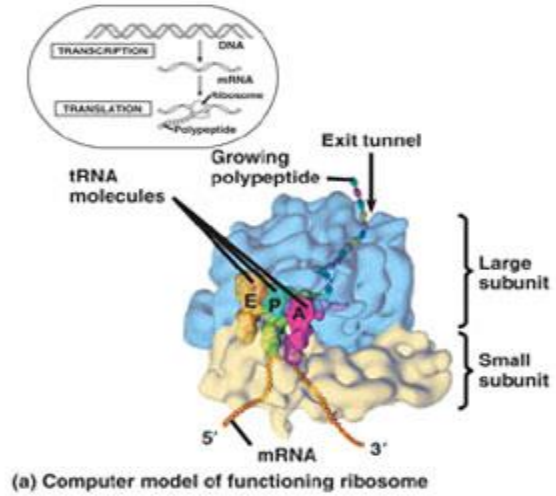


***THE CELL, Fourth Edition,* Figure 8.10** © 2006 ASM Press and Sinauer Associates, Inc.

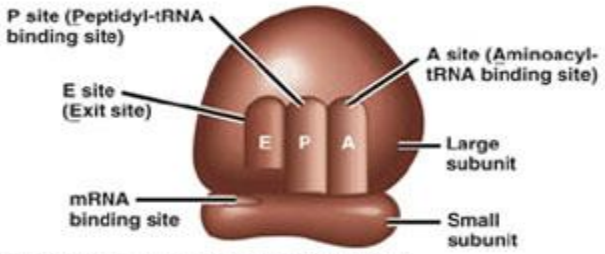
PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ


50S Ribosome
(23S+5S+34 Proteins)
aa1
aa2
aa3
aa4
aa5
aa6
aa7
aa7+ tRNA
arriving
C
C
C
C
A
G
Site of
Aminoglycoside
Binding
mRNA
5'
3'
U U U A G C
G G A A A U C G G U
30S Ribosome
(16S+ 21 Proteins)
Movement of
the ribosome
Codon
aa5
Codon
aa6

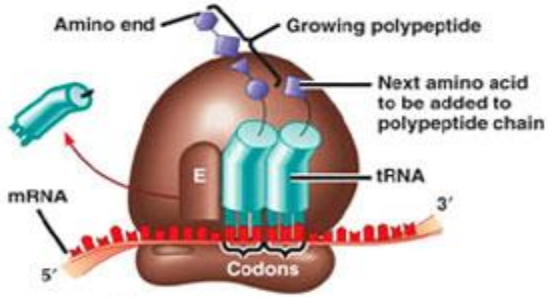




(a) Computer model of functioning ribosome

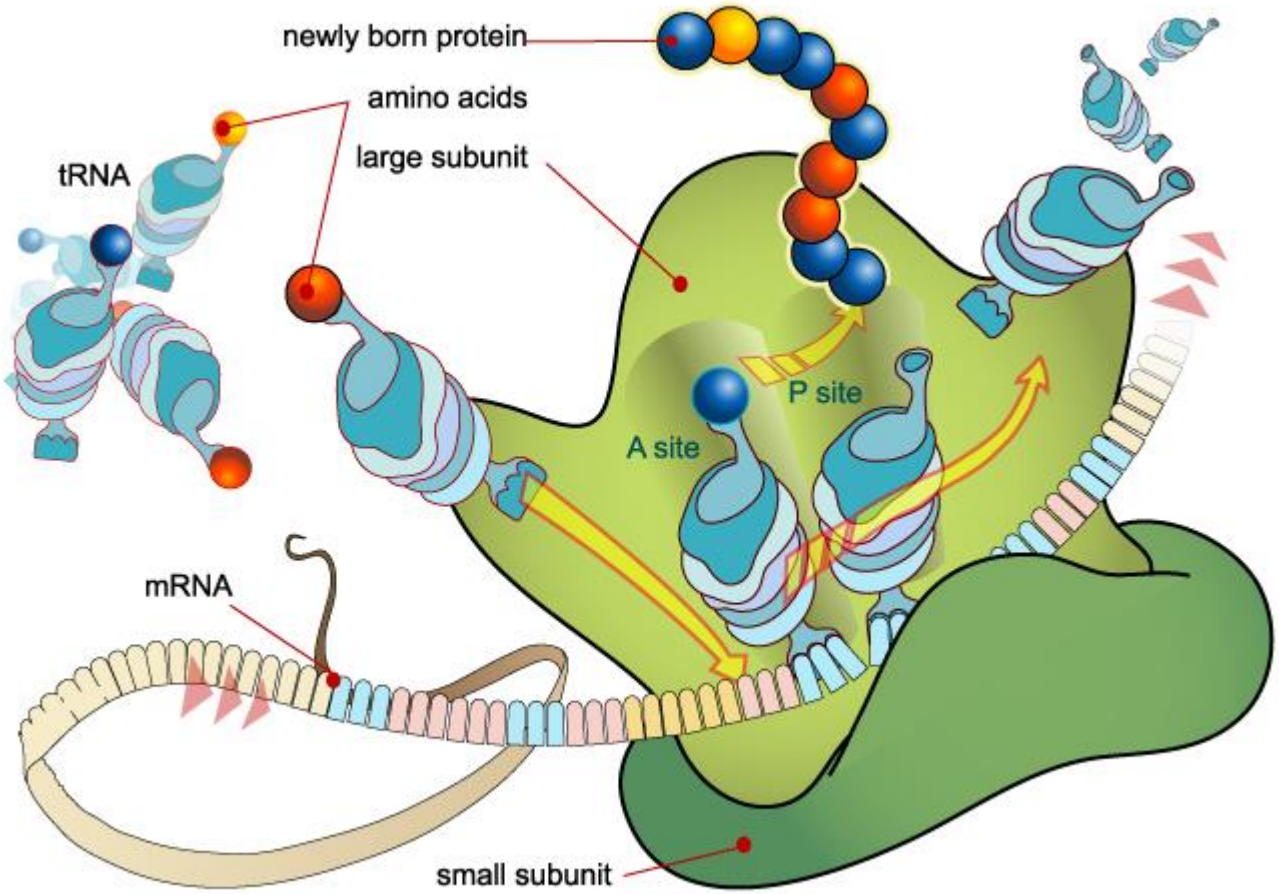


(b) Schematic model showing binding sites



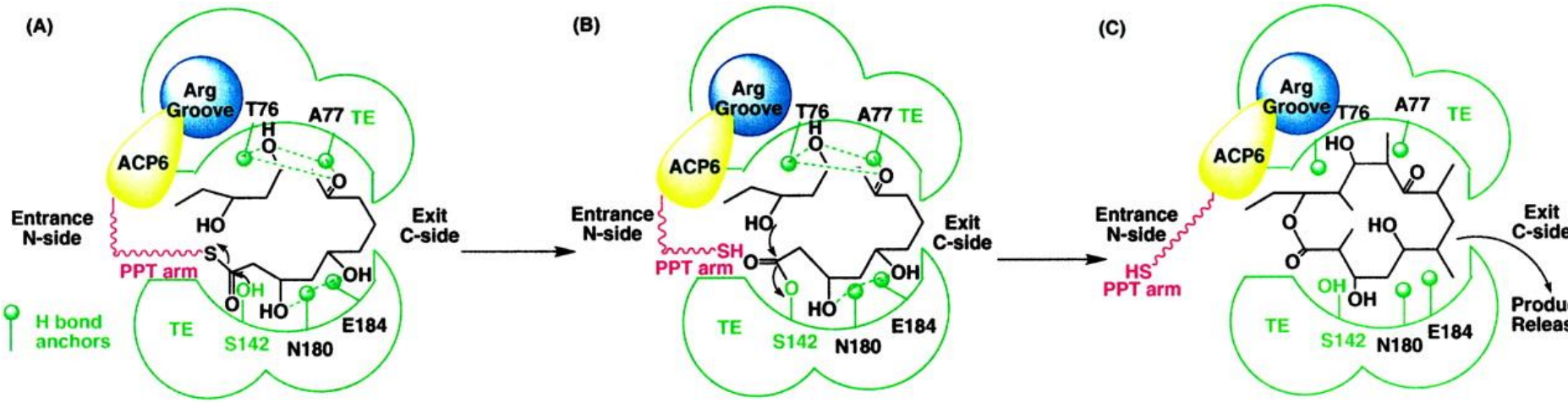
(c) Schematic model with mRNA and tRNA

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

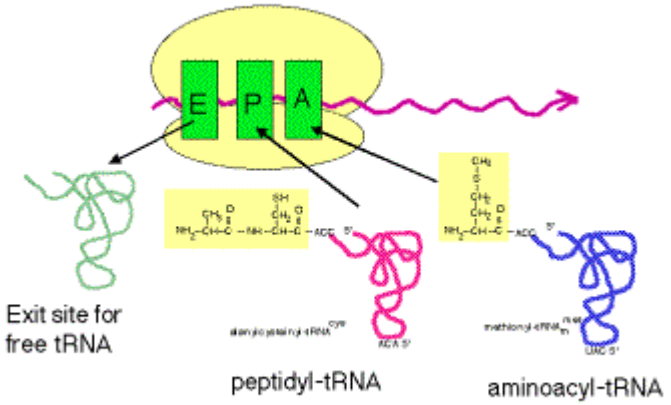


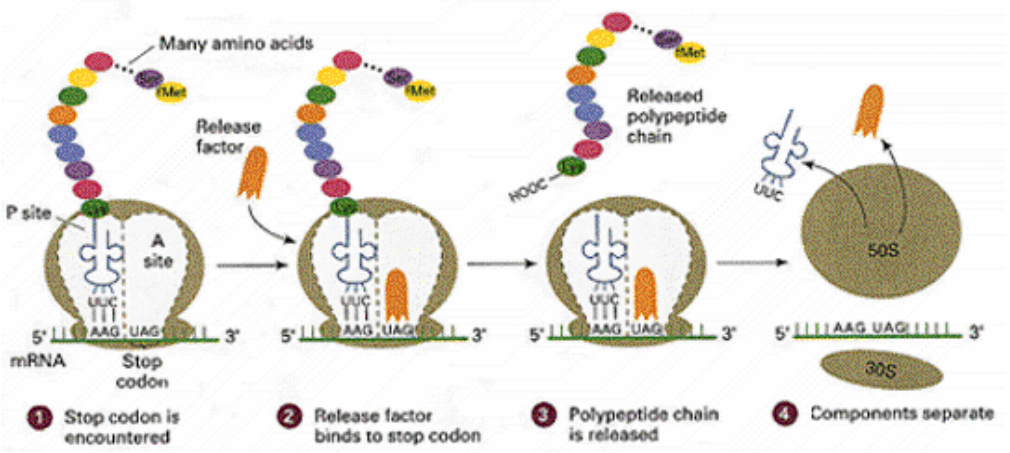
PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně

FOND MIKROPROJEKTŮ



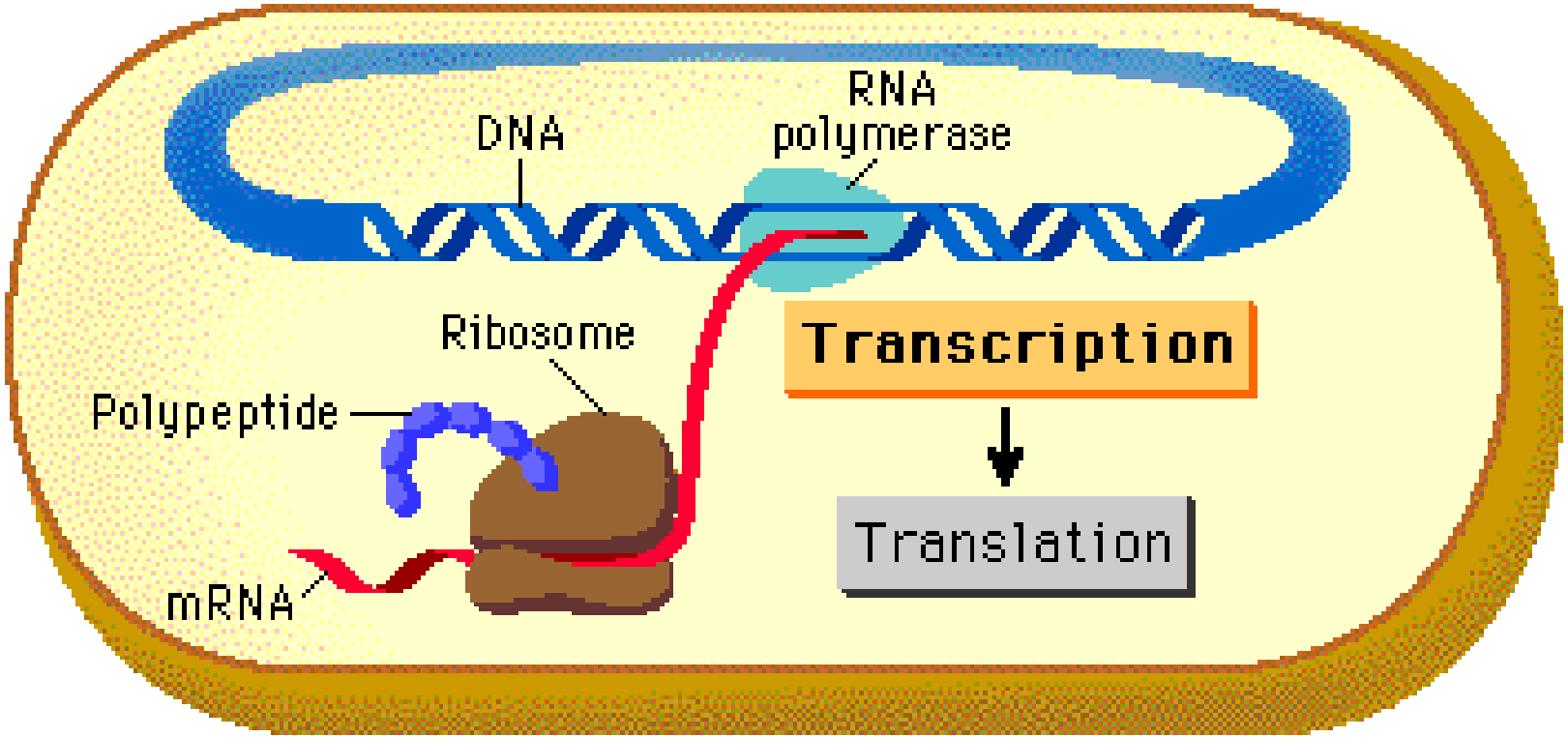
3 sites on ribosome for interaction withtRNAs

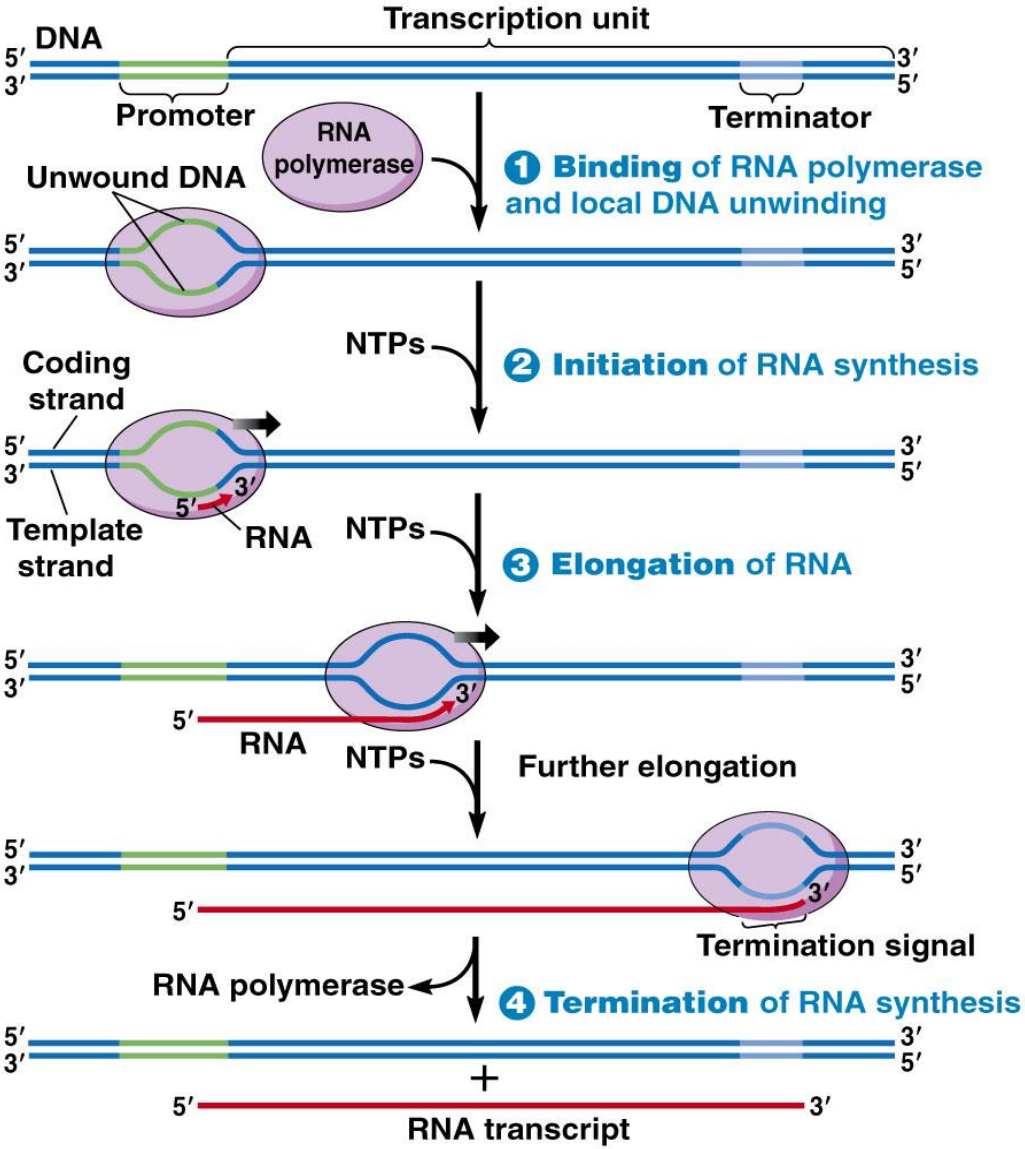


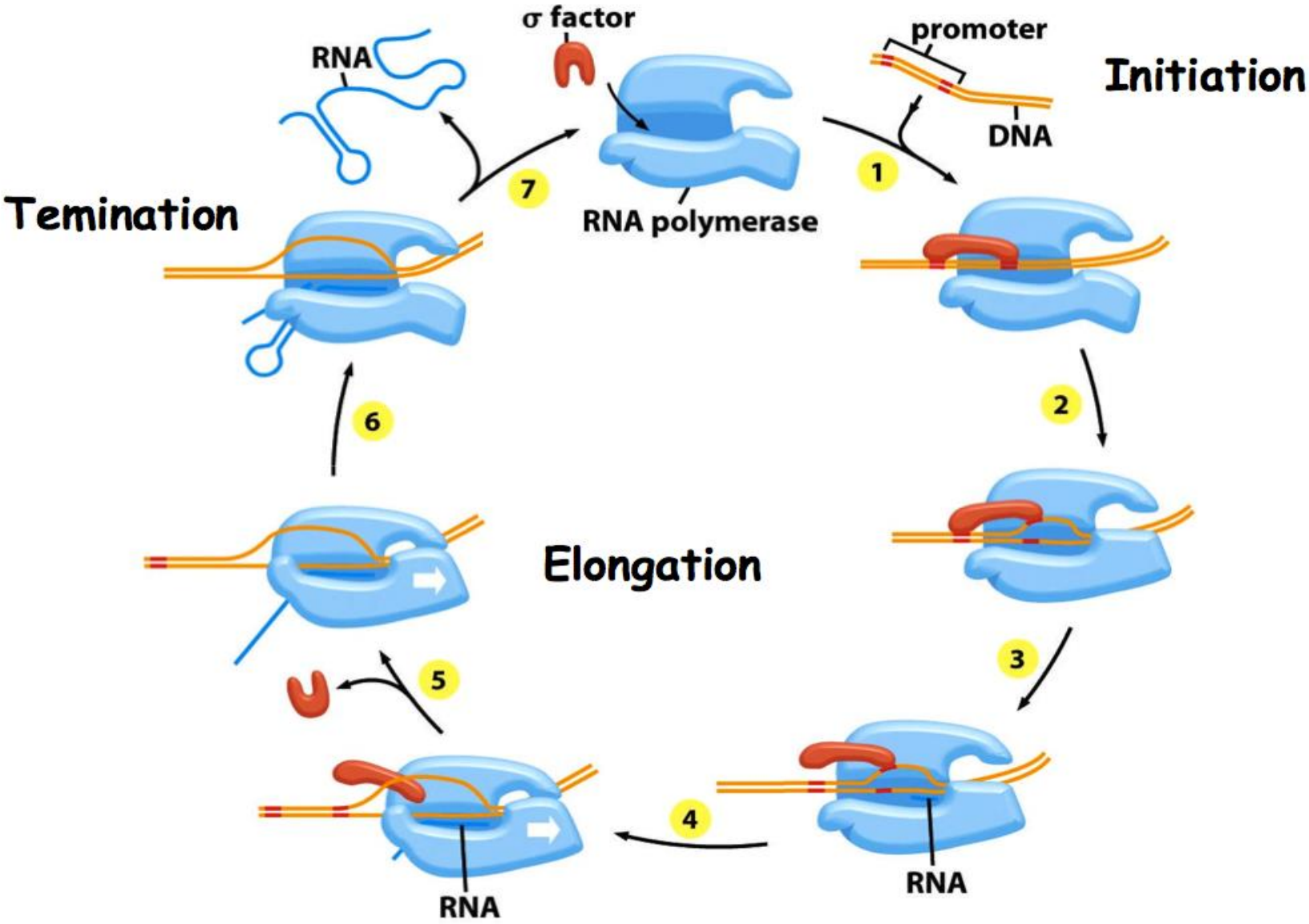


PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně

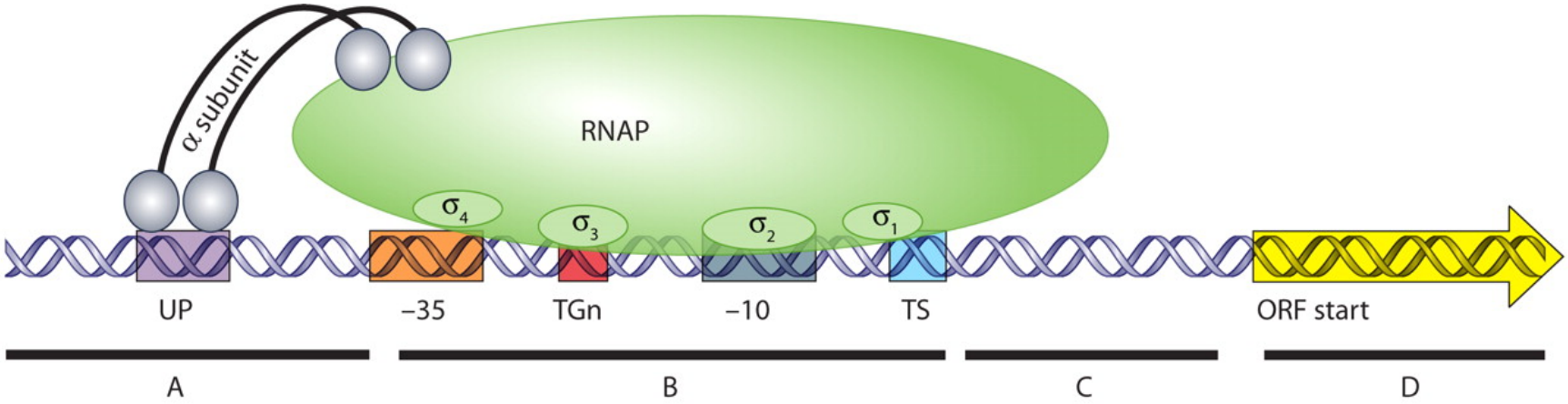
FOND MIKROPROJEKTŮ


DNA
RNA polymerase
Ribosome
Polypeptide
mRNA
Transcription
Translation





PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ



Type	Mechanism	Action	TF binding			
			upstream (A)	core promoter (B)	downstream (C)	ORF (D)
repression	Steric hindrance	No RNAP binding		+		
repression	Roadblock	No transcription elongation			±	+
repression	DNA looping	No RNAP binding	+		+	±
repression	Activator modulation	Prevents activator binding	±	±		
activation	Class I	Interaction α subunit RNAP	+			
activation	Class II	Facilitates σ factor binding	+			
activation	DNA conformational change	DNA helix twist		+		
activation	Repressor modulation	Prevents repressor binding	±	±	±	±

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

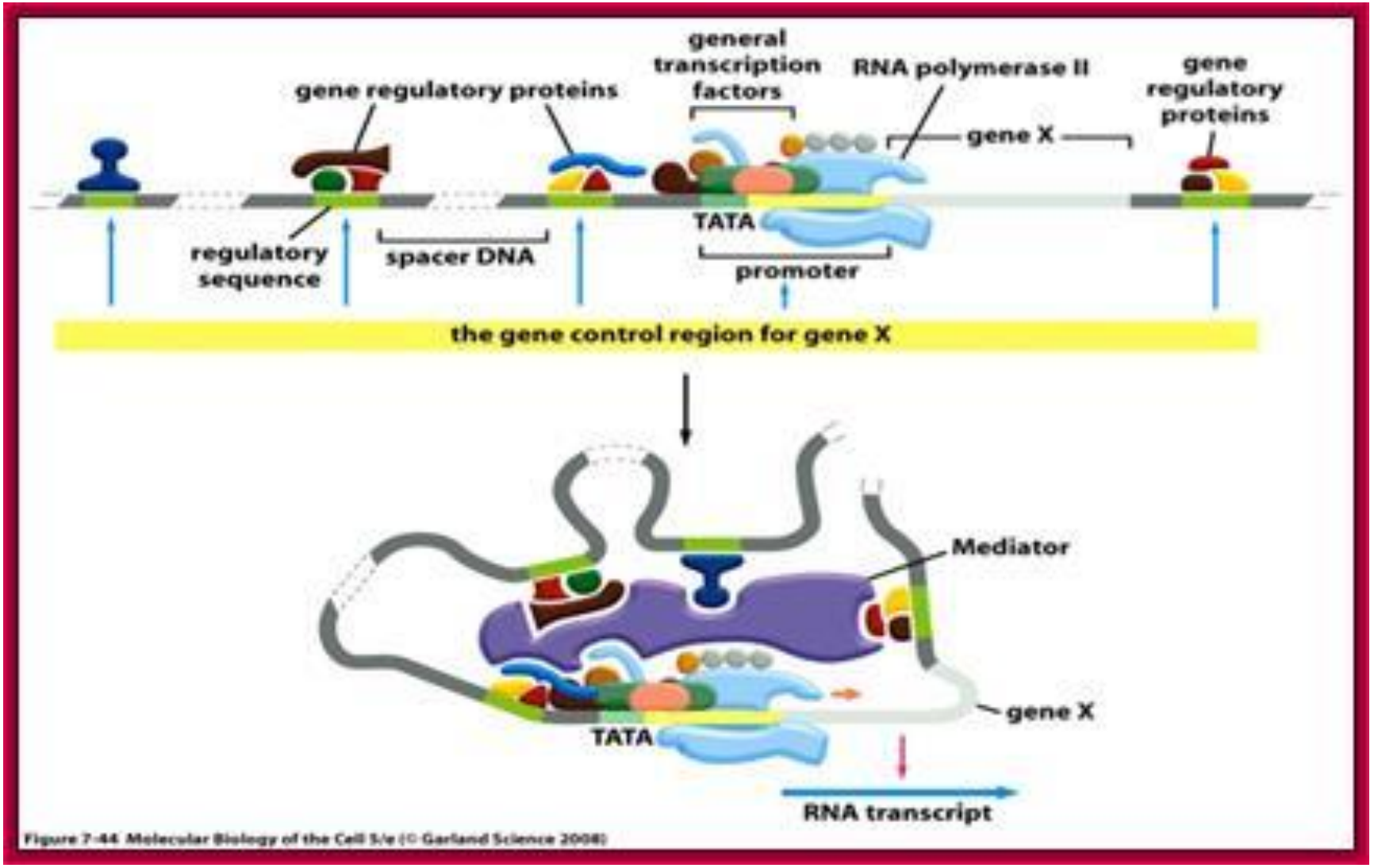
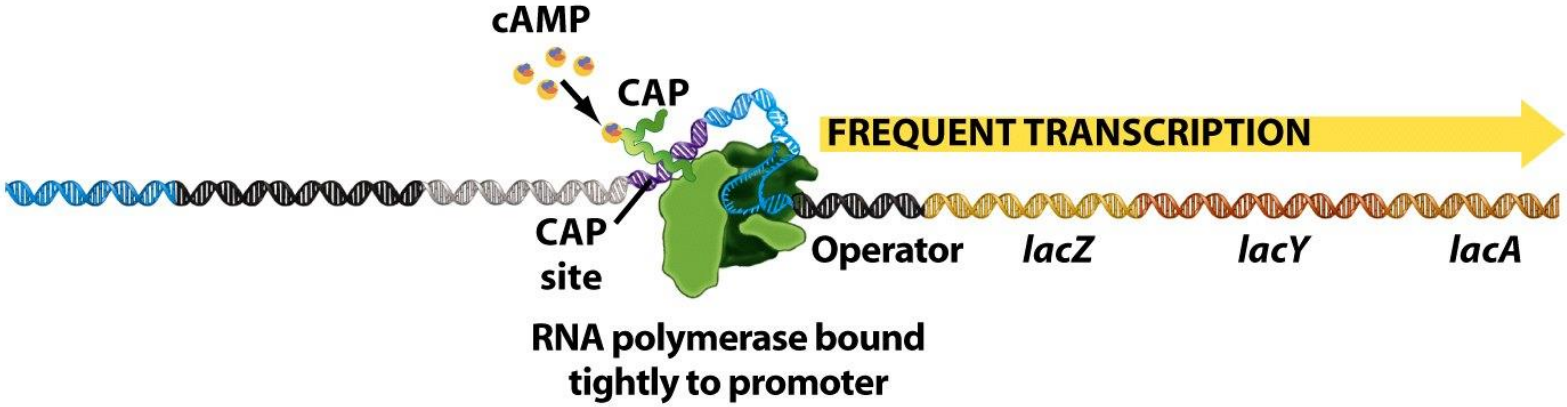


Figure 7-44 Molecular Biology of the Cell 5/e (© Garland Science 2008)

(a) When cAMP is present, it binds to CAP. The cAMP-CAP complex binds to DNA at the CAP site and increases binding of RNA polymerase to promoter. Transcription occurs frequently.



(b) When cAMP is absent, CAP does not bind to DNA. RNA polymerase does not bind the promoter efficiently, and transcription occurs rarely.

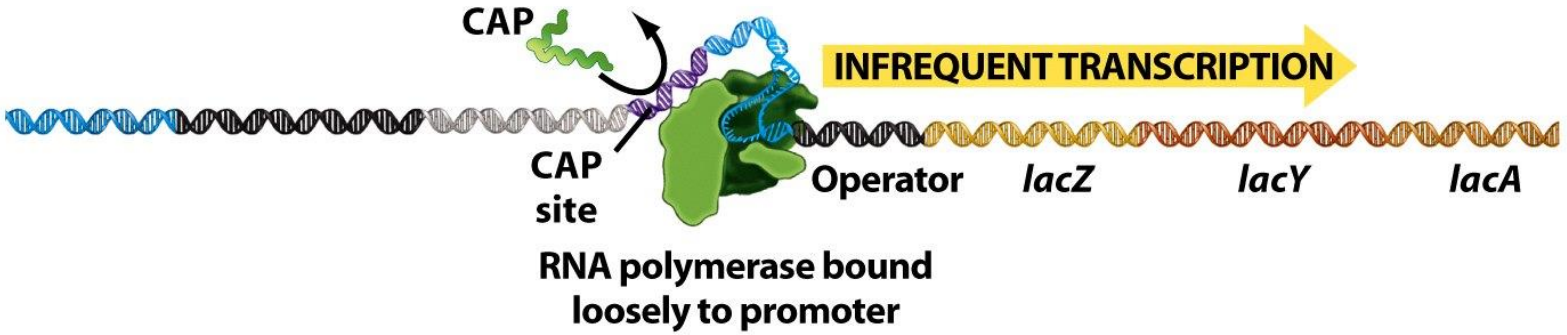
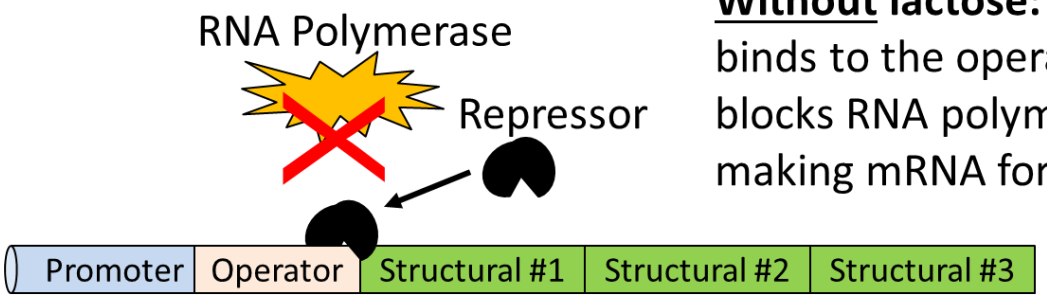
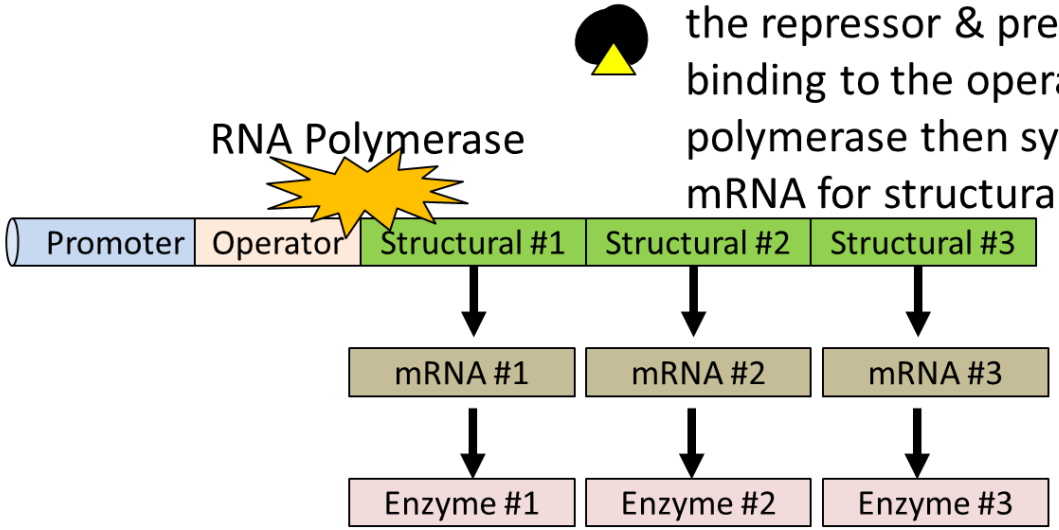


Figure 17-8 Biological Science, 2/e



<u>Without</u> lactose: The repressor binds to the operator and blocks RNA polymerase from making mRNA for enzymes.

<u>With lactose</u>: Lactose binds to the repressor & prevents it from binding to the operator. RNA polymerase then synthesizes mRNA for structural enzymes.



PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
FOND MIKROPROJEKTŮ

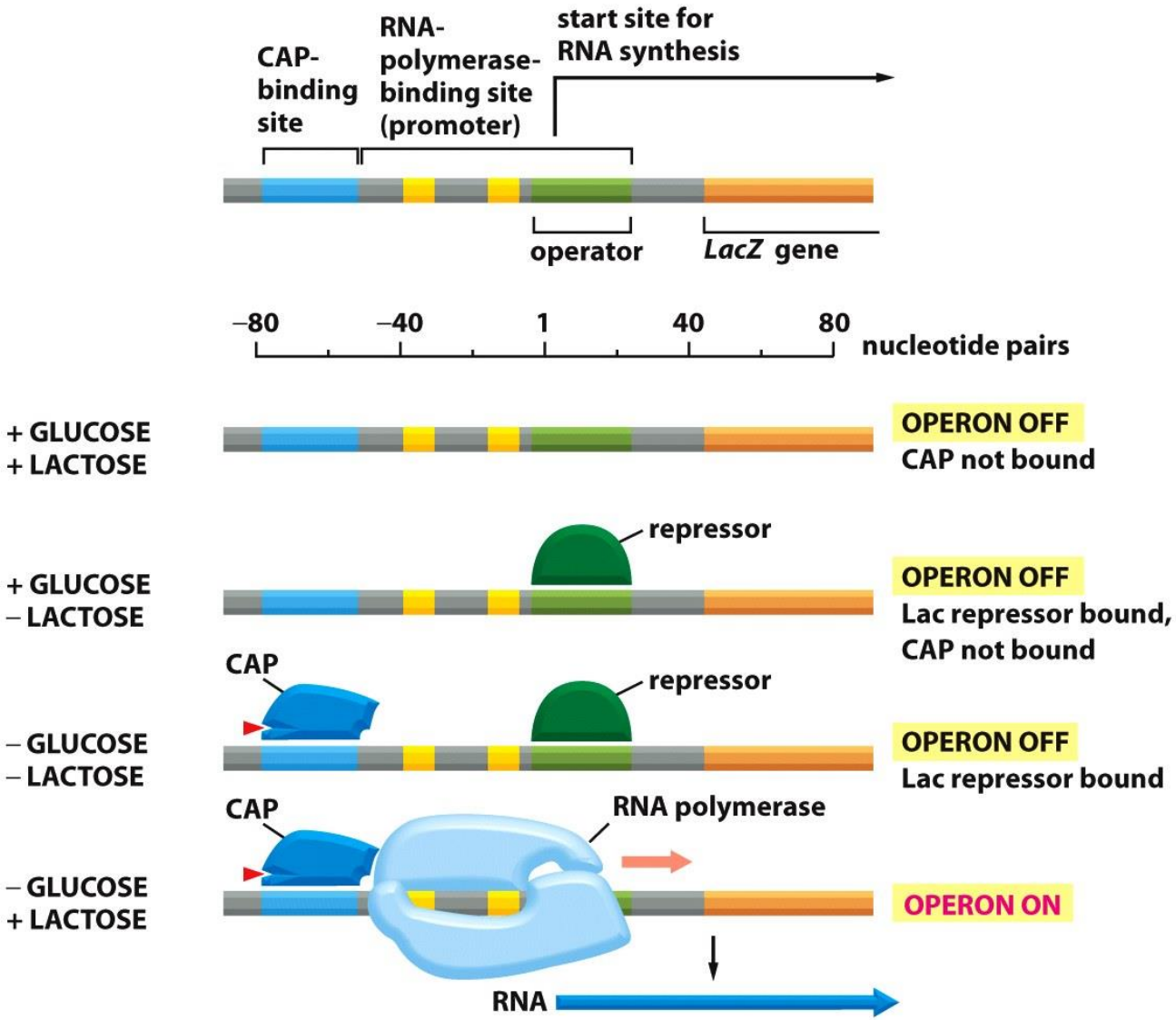


Figure 8-9 Essential Cell Biology 3/e (© Garland Science 2010)

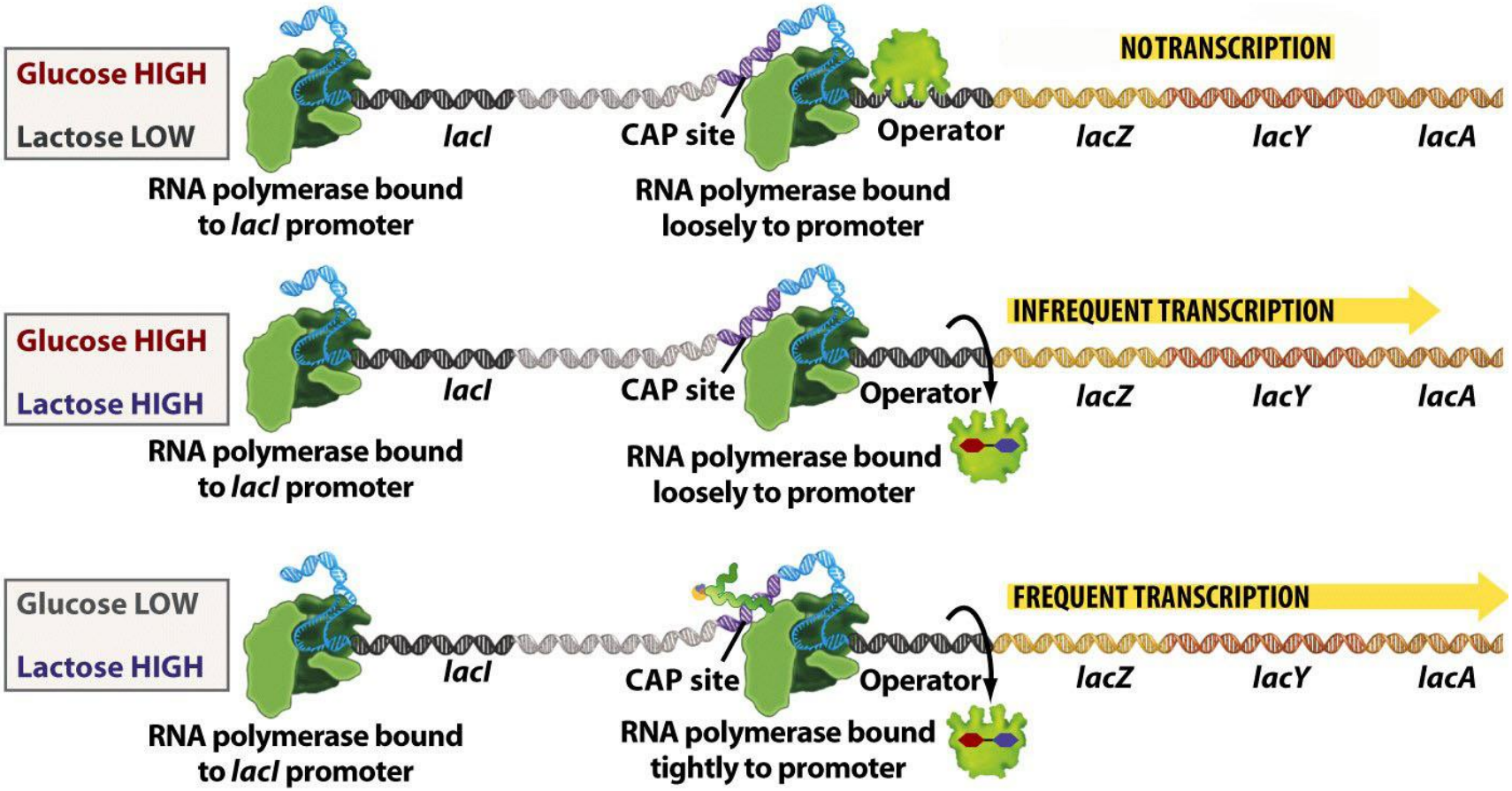


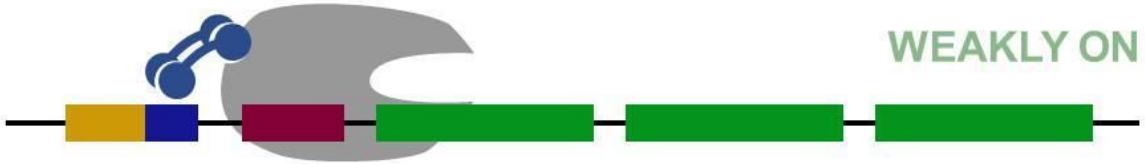
Figure 17-10 Biological Science, 2/e

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE SLOVENSKÁ REPUBLIKA ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA EURÓPSKY FOND REGIONÁLNEHO ROZVOJA SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

Regulatory responses to multiple environments

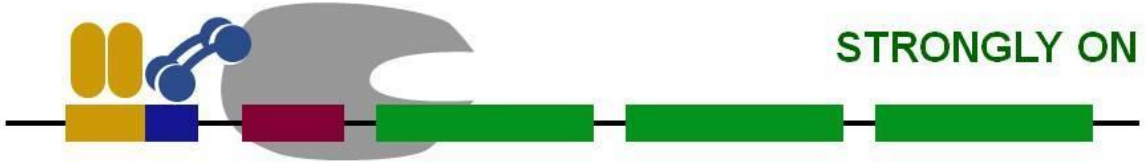
high glucose,
no lactose

high glucose,
lactose present

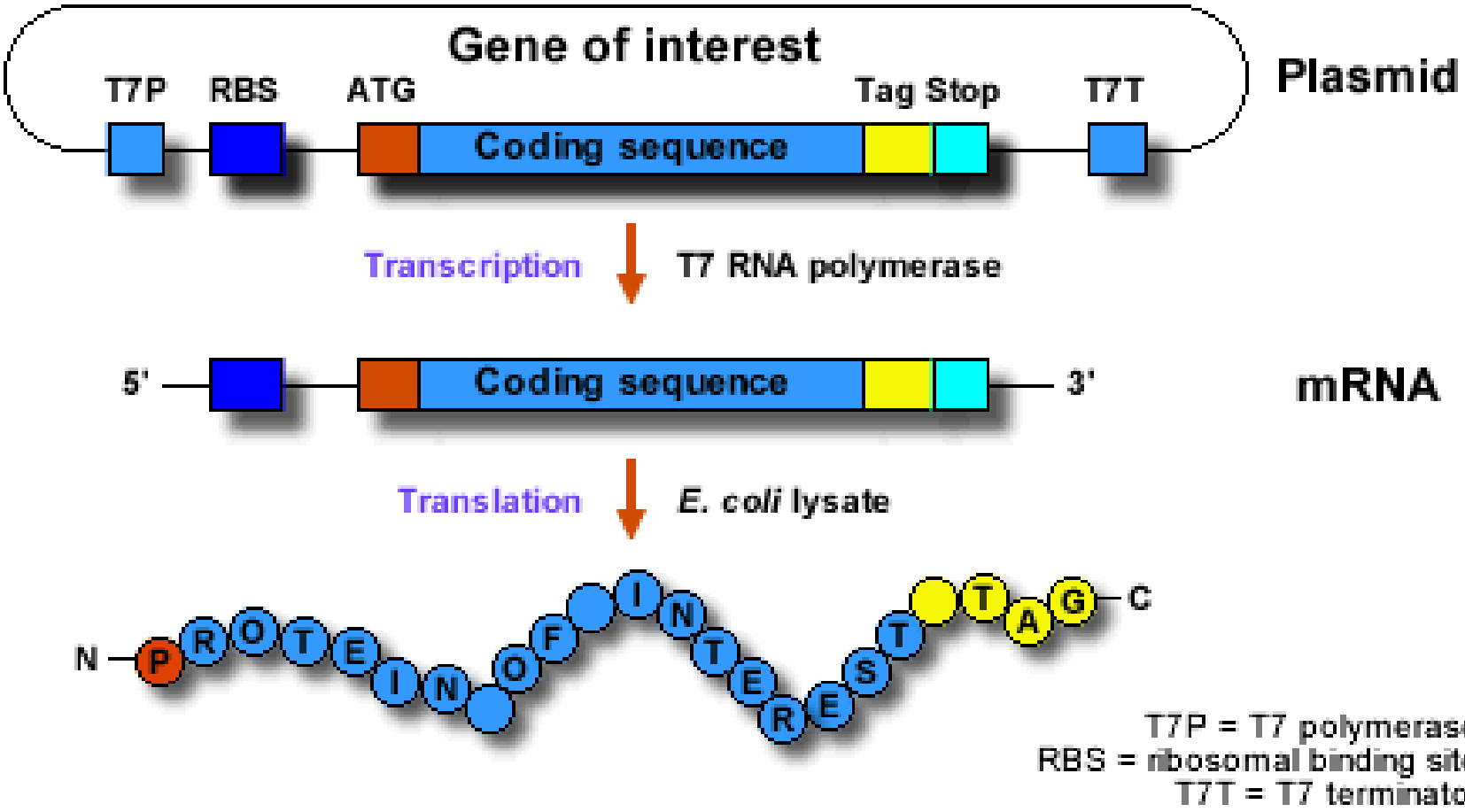


low glucose,
no lactose

low glucose,
lactose present



PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ



PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA
2007 2013
EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC
Mendelova univerzita v Brně
FOND MIKROPROJEKTŮ

STRATO-NANOBIOLAB

Děkuji vám za pozornost

PROGRAM CEZHRANIČNEJ SPOLUPRÁCE
2007 2013
SLOVENSKÁ REPUBLIKA
ČESKÁ REPUBLIKA

EURÓPSKA ÚNIA
EURÓPSKY FOND REGIONÁLNEHO ROZVOJA
SPOLOČNE BEZ HRANÍC

Mendelova univerzita v Brně

FOND MIKROPROJEKTŮ