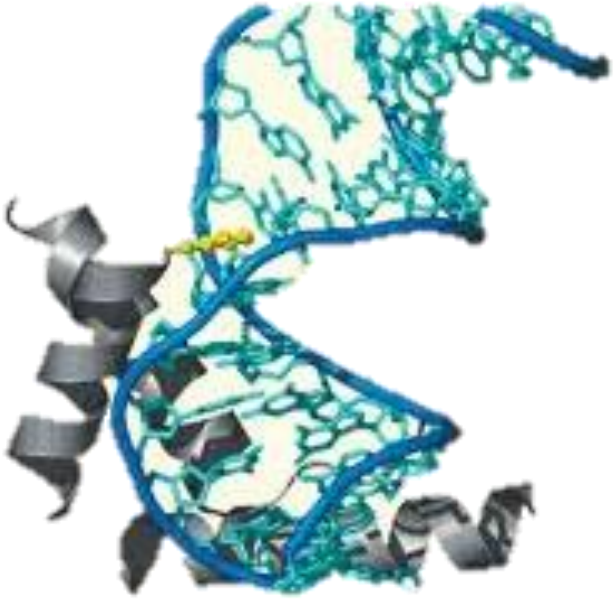
NATUREZA DO GENE: DO DNA À PROTEÍNA

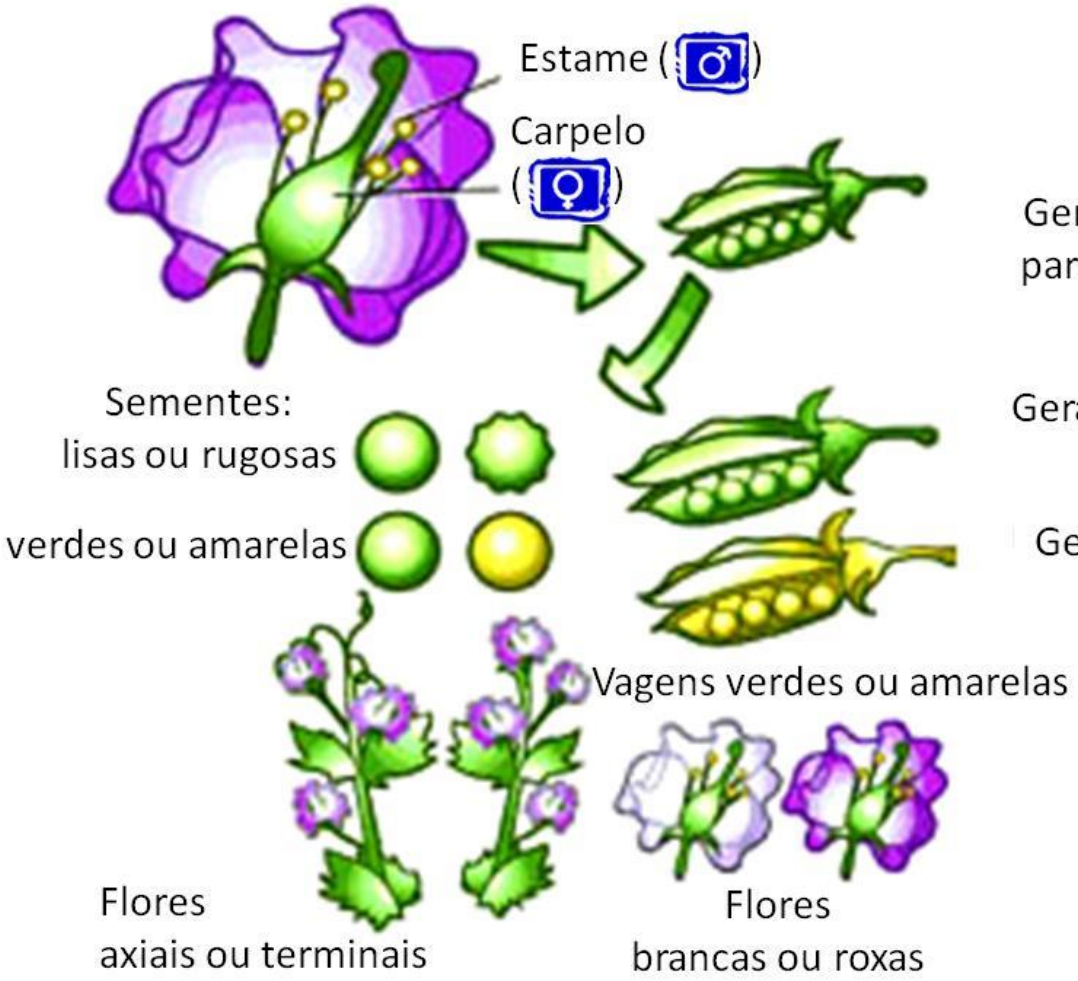
Aula teórica 7

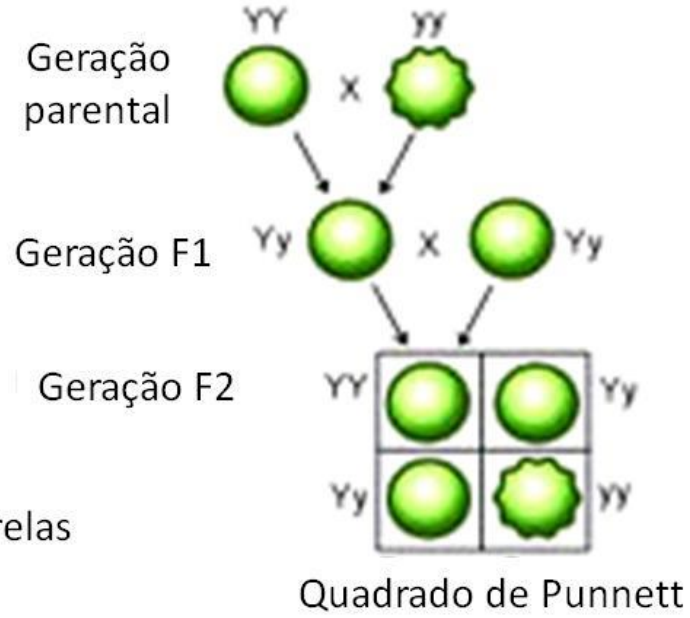
LGN0117 – Biologia Celular



Maria Carolina Quecine
Departamento de Genética
mquecine@usp.br

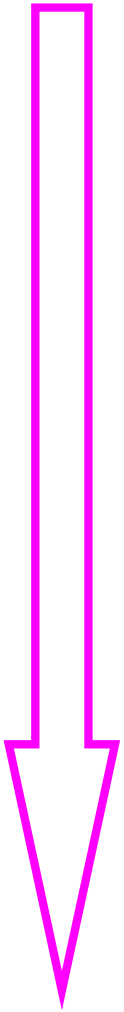
MENDEL: FATORES CONSTANTES QUE CONTROLAM CARACTERÍSTICAS FENOTÍPICAS

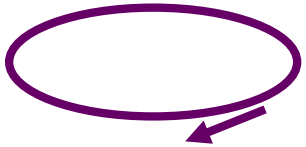




Leis de Mendel (1866)

FLUXO DA INFORMAÇÃO GENÉTICA





5’ ATG GAG TTA TTG AAC TCT TAC AAT 3’

3’ TAC GTC AAT AAC TTG AGA ATC TTA 5’

DNA

REPLICAÇÃO



3’ TAC CTC AAT AAC TTG AGA ATC TTA 5’

5’ AUG GAG UUA UUG AAC UCU UAG AAU 3’

RNA

TRANSCRIÇÃO RNA mensageiro = mRNA





TRADUÇÃO

PROTEÍNA

AUG GAG UUA UUG AAC UCU UAG AAU

M E L L N S Y N

MAS NÃO É TÃO SIMPLES...

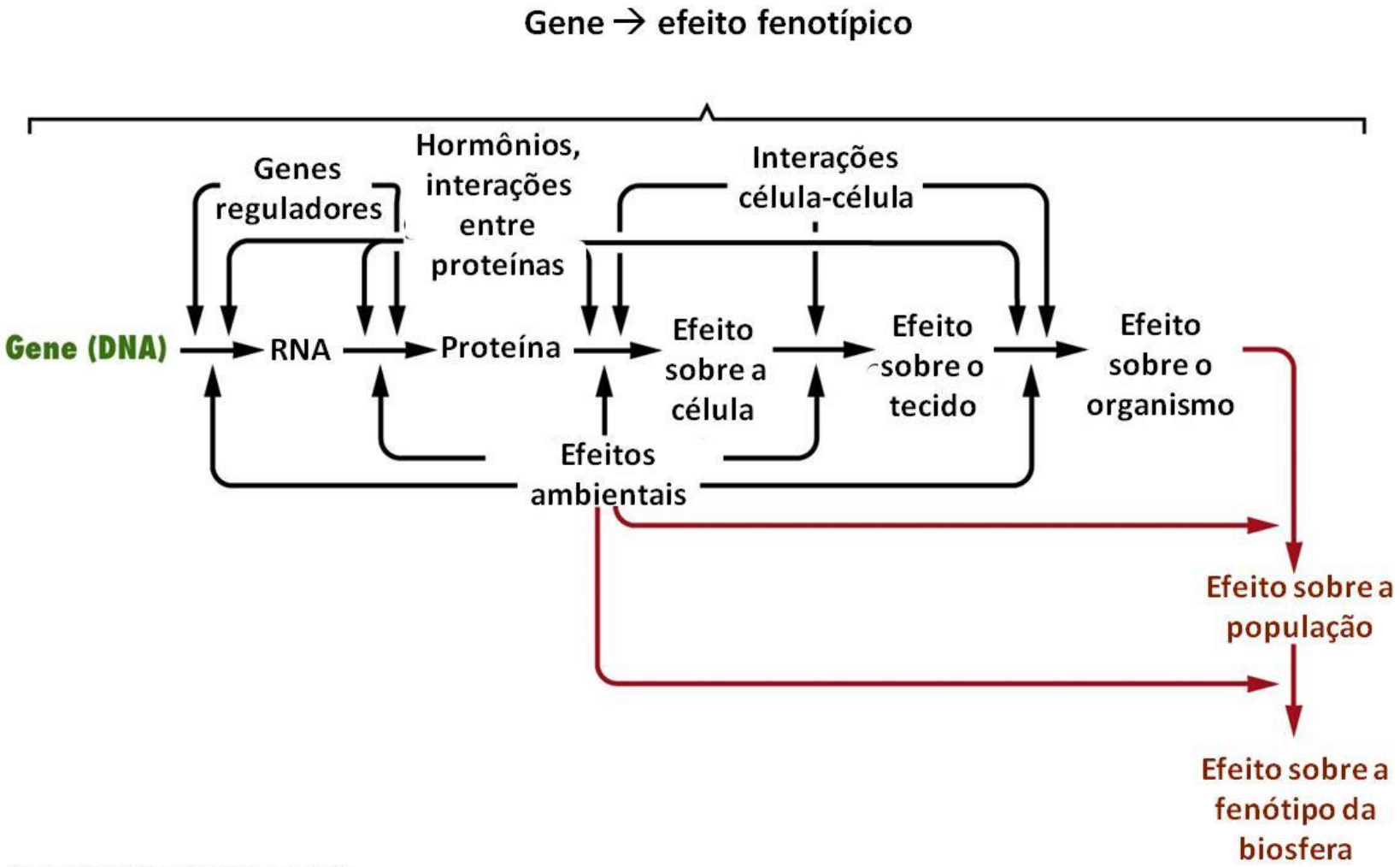
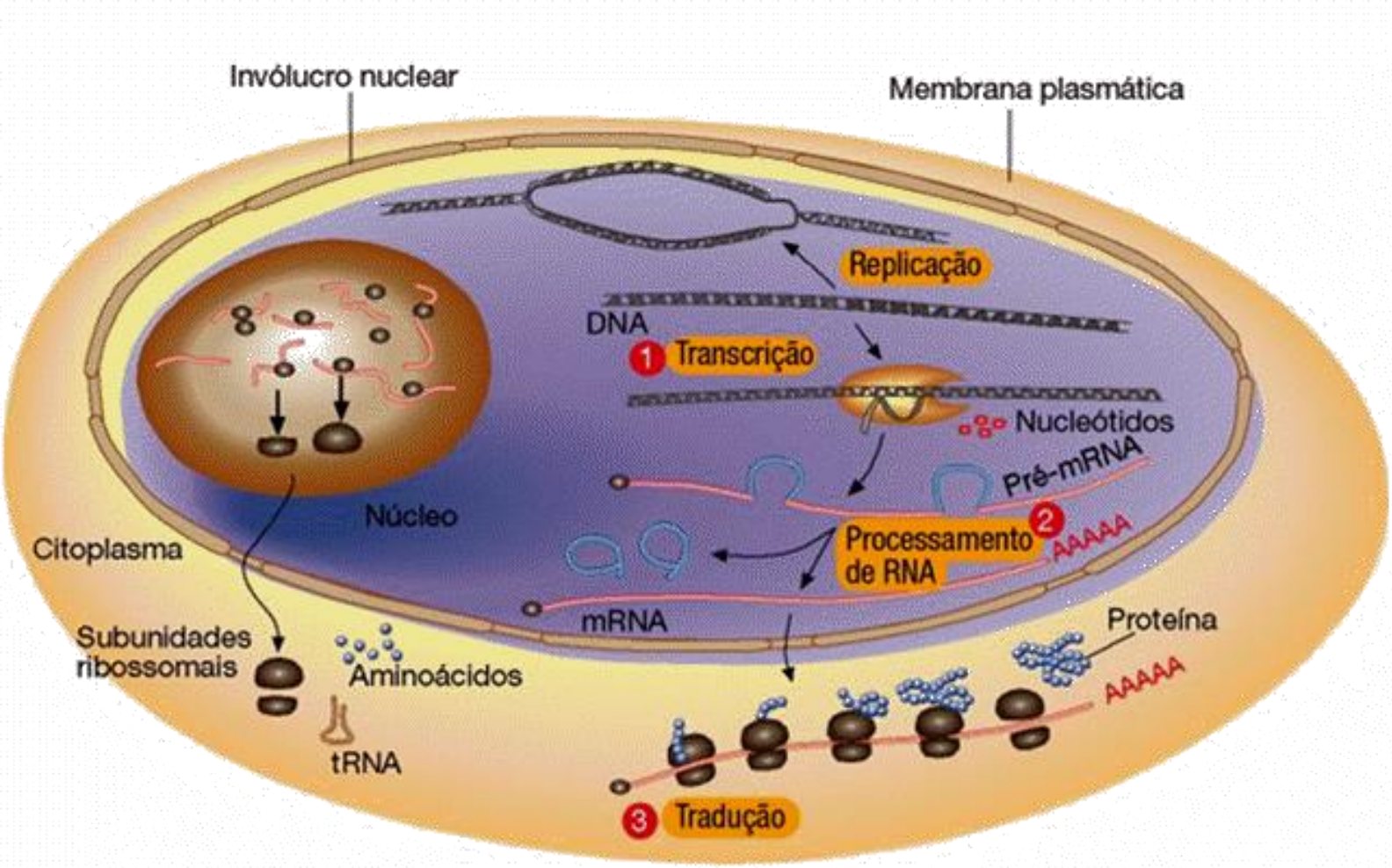


Figure 14-2 Principles of Genetics, 4/e
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PROCESSO DINÂMICO



Quantidade…ponto de checagem…expressão exata…temporalidade

MAS O QUE É UM GENE?



DEFINIÇÃO DE GENE



Wilhelm Johannsen

1909 → gene

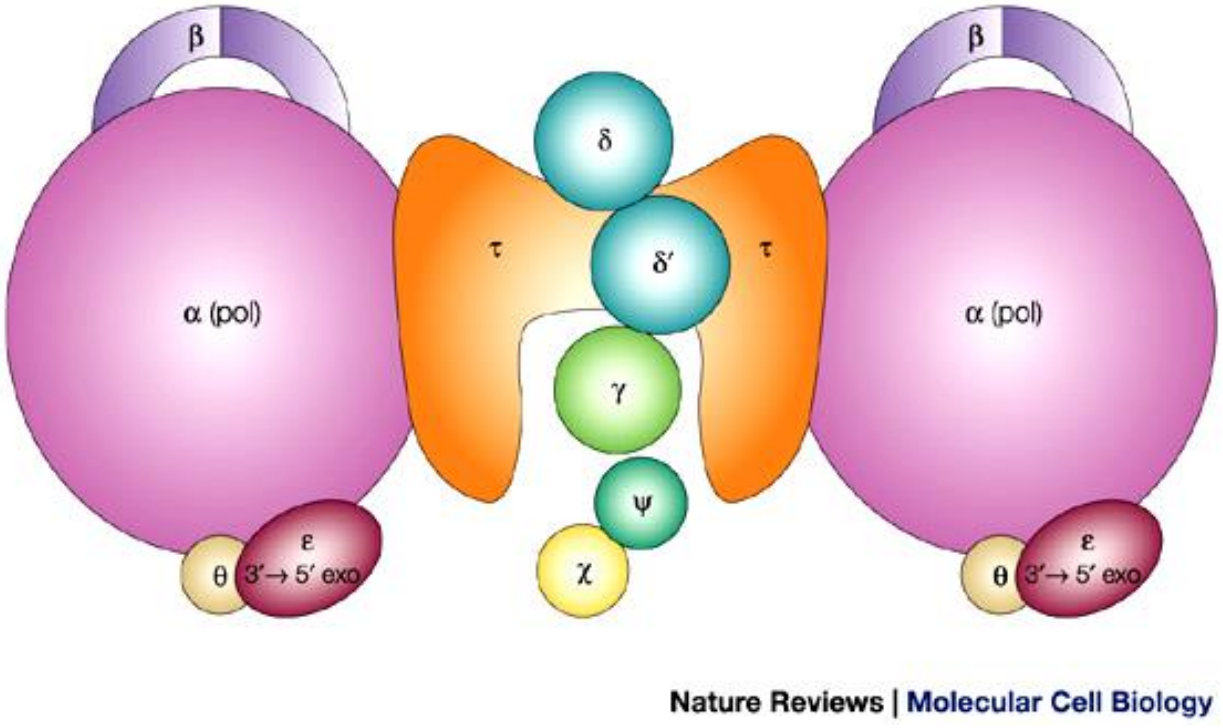
- Um gene → unidade da informação genética que controla a síntese de polipeptídios ou uma molécula de RNA estrutural

mRNA → polipeptídeo

tRNA e rRNA → RNA estrutural

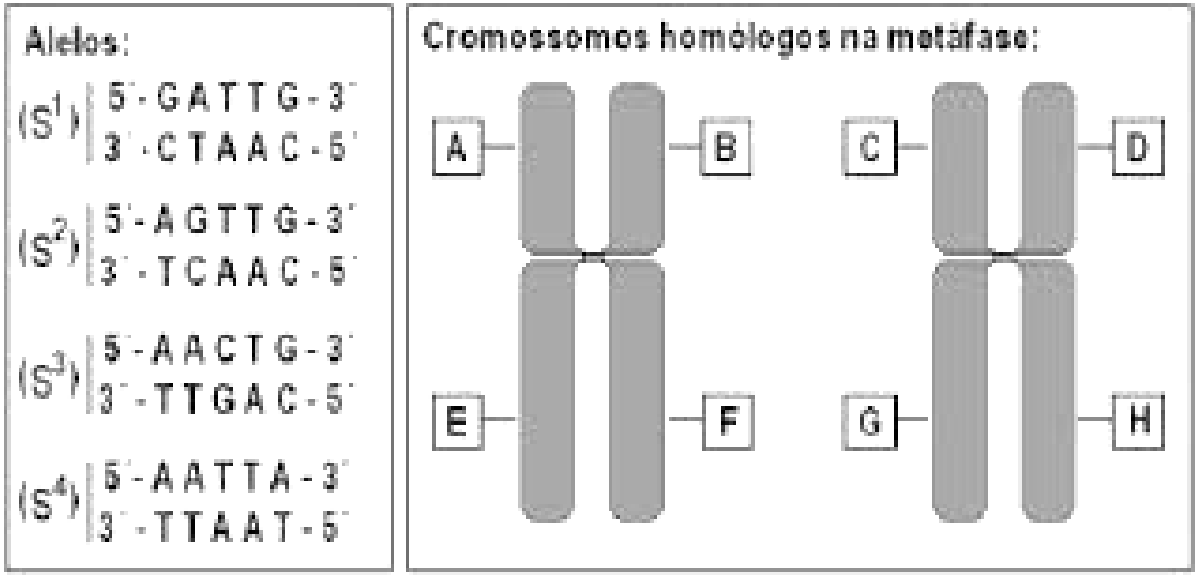
- Gene inclui as regiões 5´e 3´não codificantes, que estão envolvidas na regulação da transcrição e tradução, e todos os introns dentro do gene

Enzimas multiméricas: um gene →um polipeptídio

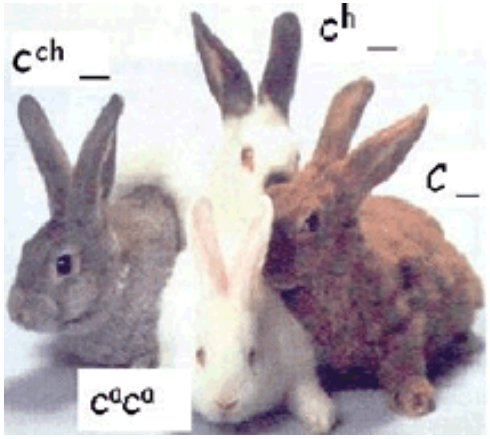


DNA polimerase III (17 polipeptídeos), *Escherichia coli*

ALELO - FORMA ALTERNATIVA DE GENES



- Sequencias distintas de DNA – proteínas distintas (alelos)
- Organismos diploídes – podem carregar somente 2 alelos
- População – todos os alelos possíveis



Perspective

What is a gene, post-ENCODE? History and updated definition

Mark B. Gerstein,[1,2,3,9] Can Bruce,[2,4] Joel S. Rozowsky,[2] Deyou Zheng,[2] Jiang Du,[3] Jan O. Korbel,[2,5] Olof Emanuelsson,[6] Zhengdong D. Zhang,[2] Sherman Weissman,[7] and Michael Snyder[2,8]

"A gene is a union of genomic sequences encoding a coherent set of potentially overlapping functional products"

HISTÓRICO DA DEFINIÇÃO DE GENE

Gene é uma unidade discrete de hereditariedade;

Gene é um locus distinto;

Gene codifica uma proteína;

Gene é uma molécula fisica;

Gene é uma unidade de transcrito;

Gene é um quadro aberto de leitura (ORF);

SERÁ?

Table 1. Phenomena complicating the concept of the gene

Phenomenon	Description	Issue
Gene location and structure		
Intronic genes	A gene exists within an intron of another (Henikoff et al. 1986)	Two genes in the same locus
Genes with overlapping reading frames	A DNA region may code for two different protein products in different reading frames (Contreras et al. 1977)	No one-to-one correspondence between DNA and protein sequence
Enhancers, silencers	Distant regulatory elements (Spilianakis et al. 2005)	DNA sequences determining expression can be widely separated from one another in genome. Many-to-many relationship between genes and their enhancers.
Structural variation		
Mobile elements	Genetic element appears in new locations over generations (McClintock 1948)	A genetic element may be not constant in its location
Gene rearrangements/structural variants	DNA rearrangement or splicing in somatic cells results in many alternative gene products (Early et al. 1980)	Gene structure is not hereditary, or structure may differ across individuals or cells/tissues
Copy-number variants	Copy number of genes/regulatory elements may differ between individuals (Iafrate et al. 2004; Sebat et al. 2004; Tuzun et al. 2005)	Genetic elements may differ in their number
Epigenetics and chromosome structure		
Epigenetic modifications, imprinting	Inherited information may not be DNA-sequence based (e.g., Dobrovic et al. 1988); a gene's expression depends on whether it is of paternal or maternal origin (Sager and Kitchin 1975)	Phenotype is not determined strictly by genotype
Effect of chromatin structure	Chromatin structure, which does influence gene expression, only loosely associated with particular DNA sequences (Paul 1972)	Gene expression depends on packing of DNA. DNA sequence is not enough to predict gene product.
Post-transcriptional events		
Alternative splicing of RNA	One transcript can generate multiple mRNAs, resulting in different protein products (Berget et al. 1977; Gelinas and Roberts 1977)	Multiple products from one genetic locus; information in DNA not linearly related to that on protein
Alternatively spliced products with alternate reading frames	Alternative reading frames of the INK4a tumor suppressor gene encodes two unrelated proteins (Quelle et al. 1995)	Two alternative splicing products of a pre-mRNA produce protein products with no sequence in common
RNA *trans*-splicing, homotypic *trans*-splicing	Distant DNA sequences can code for transcripts ligated in various combinations (Borst 1986). Two identical transcripts of a gene can *trans*-splice to generate an mRNA where the same exon sequence is repeated (Takahara et al. 2000).	A protein can result from the combined information encoded in multiple transcripts
RNA editing	RNA is enzymatically modified (Eisen 1988)	The information on the DNA is not encoded directly into RNA sequence
Post-translational events		
Protein splicing, viral polyproteins	Protein product self-cleaves and can generate multiple functional products (Villa-Komaroff et al. 1975)	Start and end sites of protein not determined by genetic code
Protein *trans*-splicing	Distinct proteins can be spliced together in the absence of a *trans*-spliced transcript (Handa et al. 1996)	Start and end sites of protein not determined by genetic code
Protein modification	Protein is modified to alter structure and function of the final product (Wold 1981)	The information on the DNA is not encoded directly into protein sequence
Pseudogenes and retrogenes		
Retrogenes	A retrogene is formed from reverse transcription of its parent gene's mRNA (Vanin et al. 1980) and by insertion of the DNA product into a genome	RNA-to-DNA flow of information
Transcribed pseudogenes	A pseudogene is transcribed (Zheng et al. 2005, 2007)	Biochemical activity of supposedly dead elements

GENE TÍPICO DE PROCARIOTOS

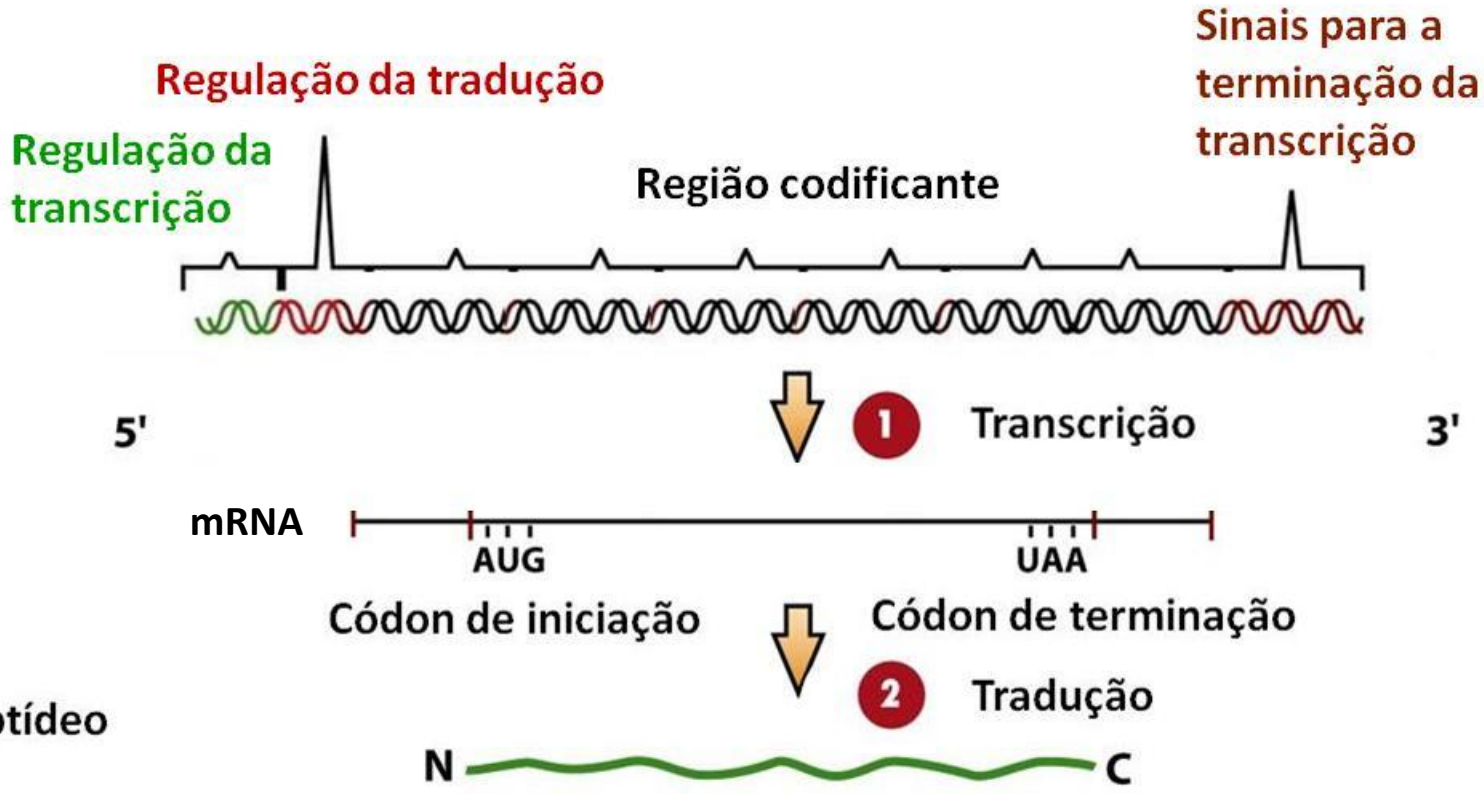


Figure 14-1b Principles of Genetics, 4/e
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GENE TÍPICO DE EUCARIOTOS

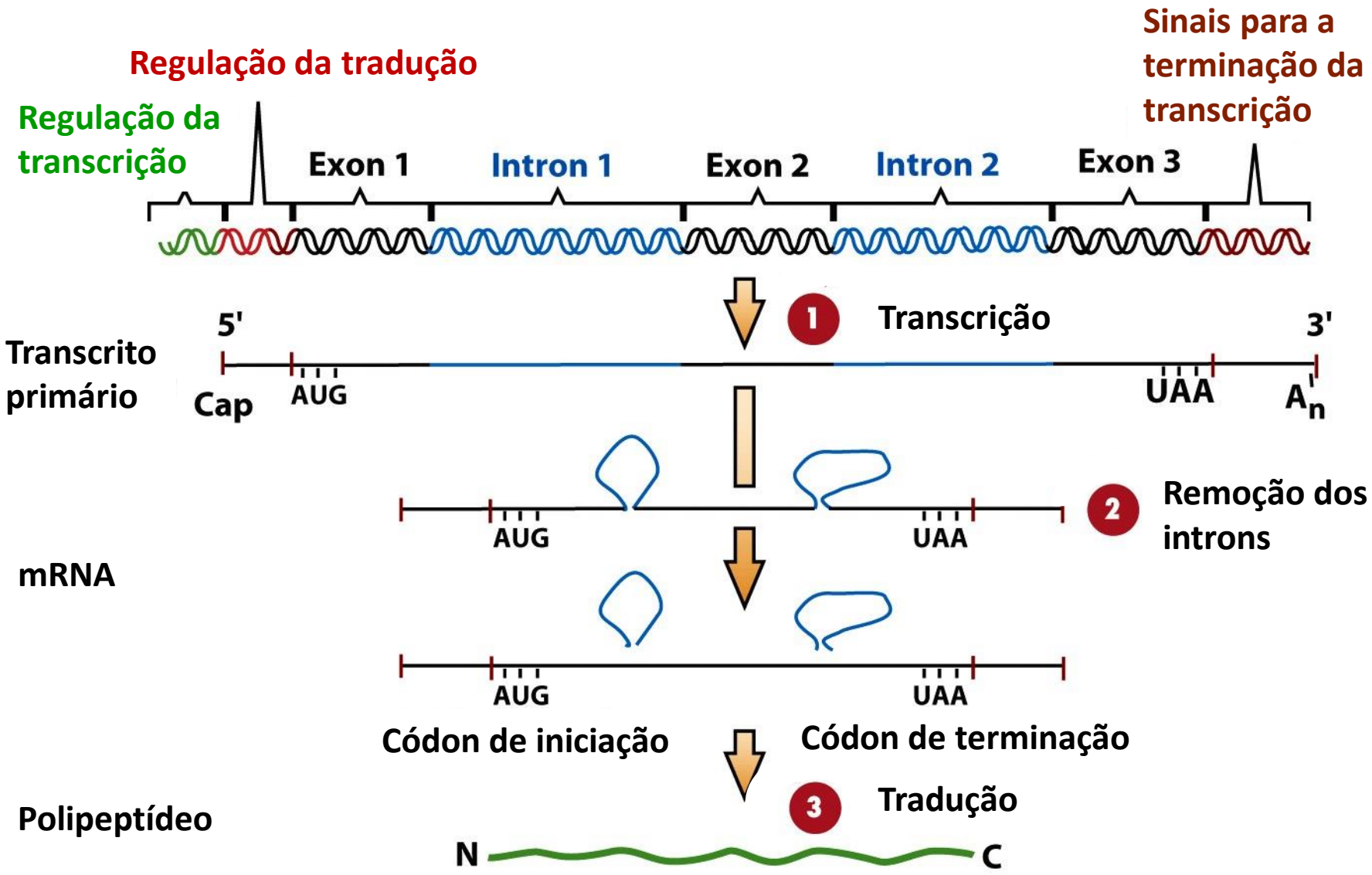


Figure 14-1b Principles of Genetics, 4/e
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NÚMERO DE GENES EM EUCARIOTOS

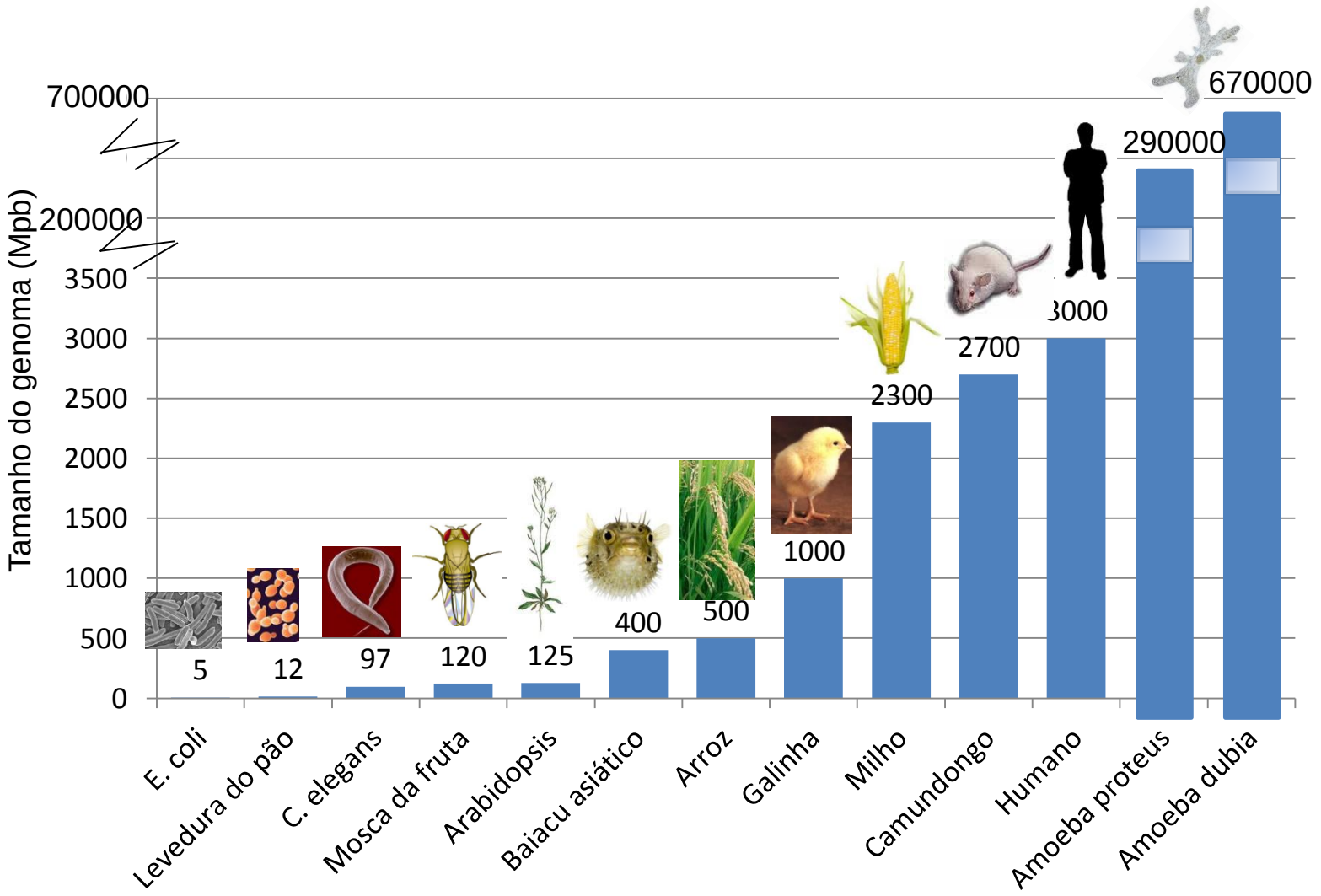
Espécies	Genoma (Mb)	Genes
D. melanogaster	165	~12.000
S. cerevisiae	13	~6.000
C. elegans	97	~20.000
H. sapiens	3.300	~30.000





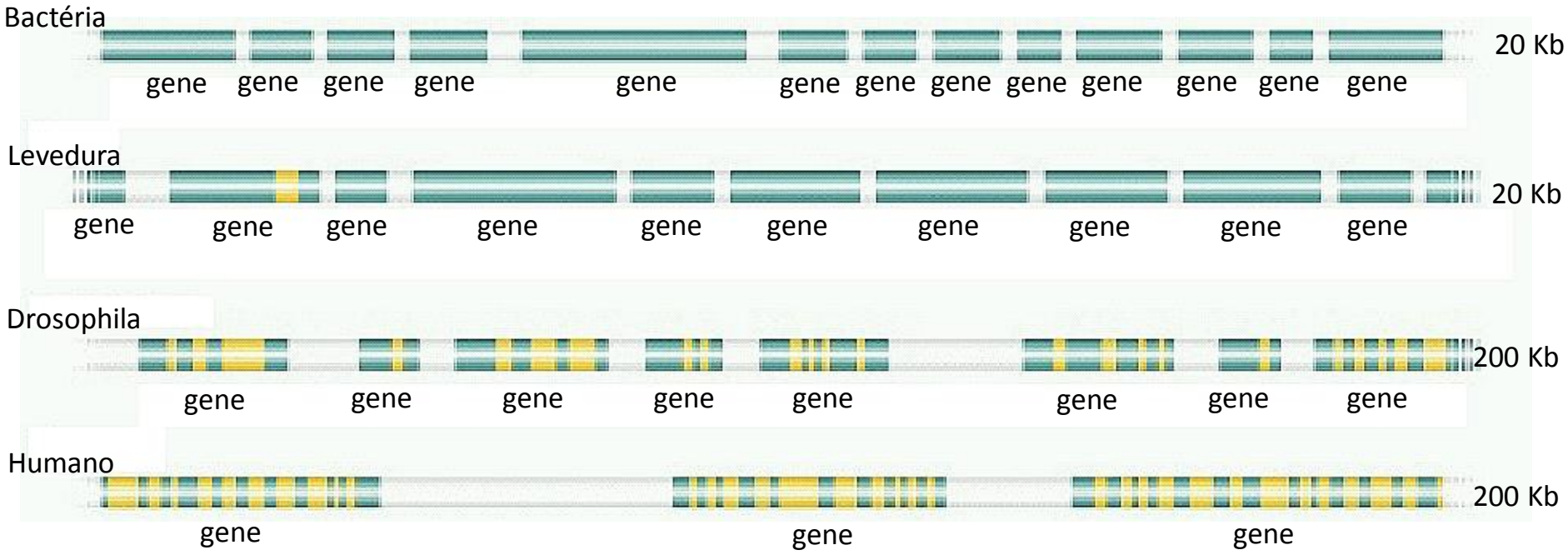


COMPARAÇÃO NO TAMANHO DE GENOMAS



A complexidade de um organismo não é diretamente proporcional ao tamanho do genoma; alguns organismos unicelulares possuem muito mais DNA que os humanos.

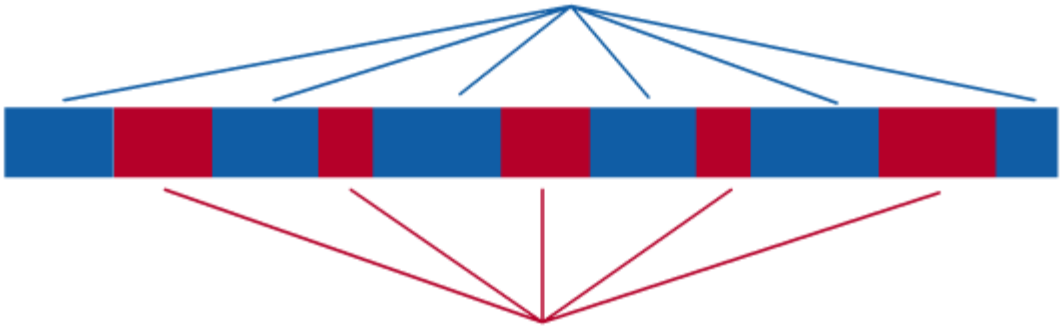
GENES NA MOLÉCULA DE DNA



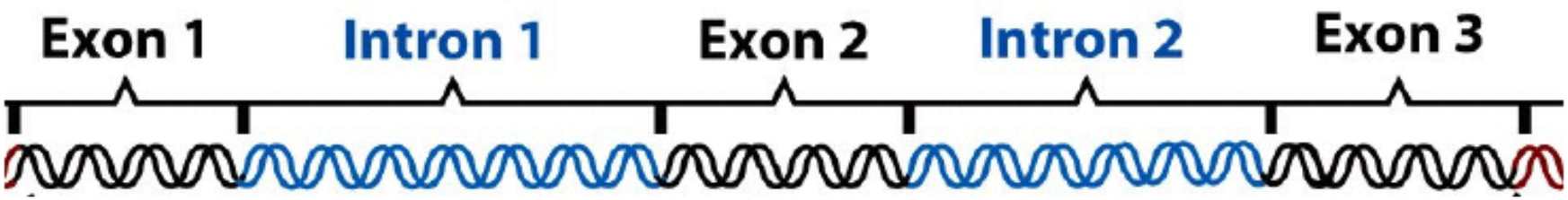
Grande variação nos tamanho dos genes geradas pela presença dos introns!

CIDADES X DESERTOS

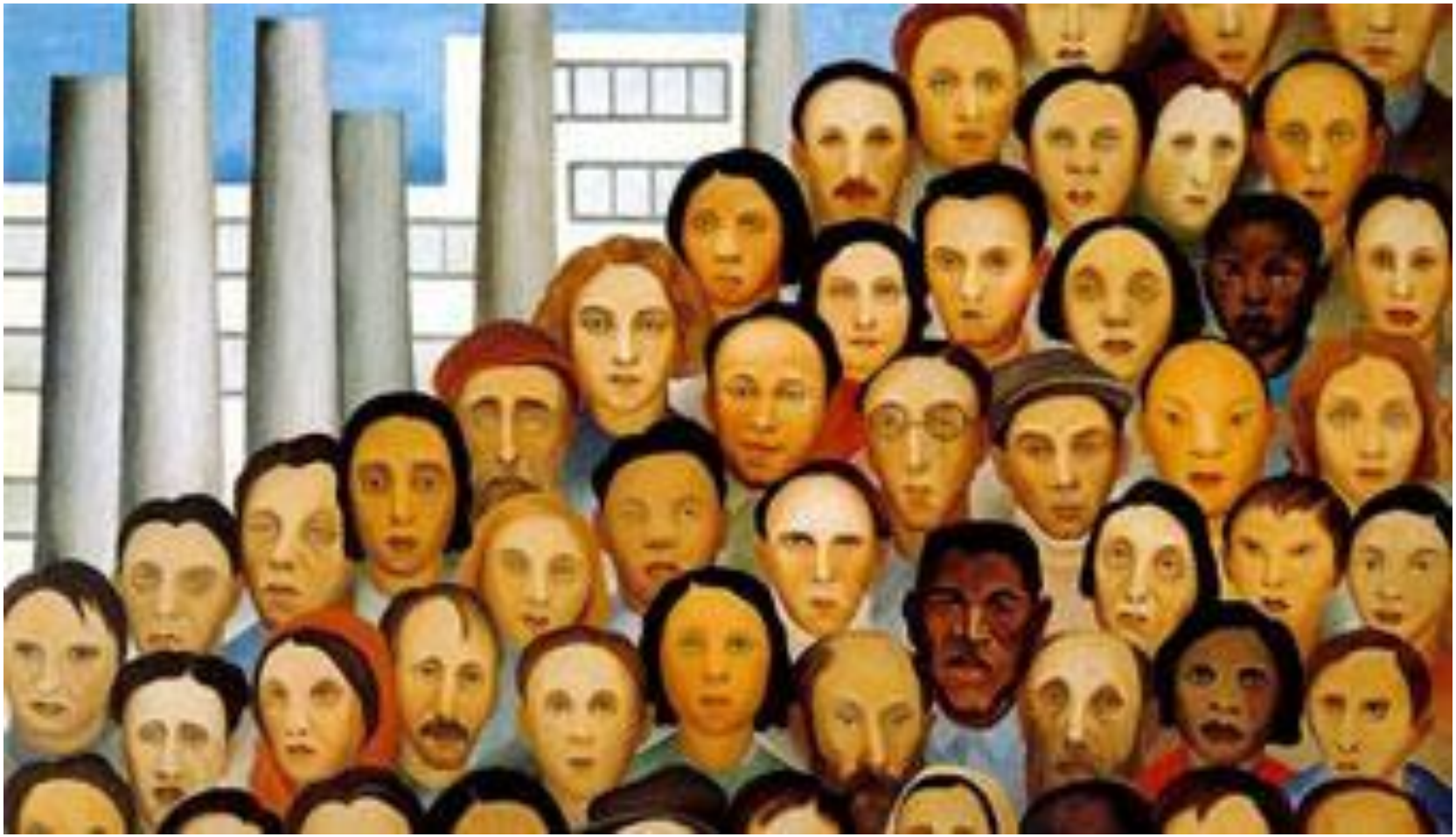
EXONS (CODIFICAM PROTEÍNA)



INTRONS

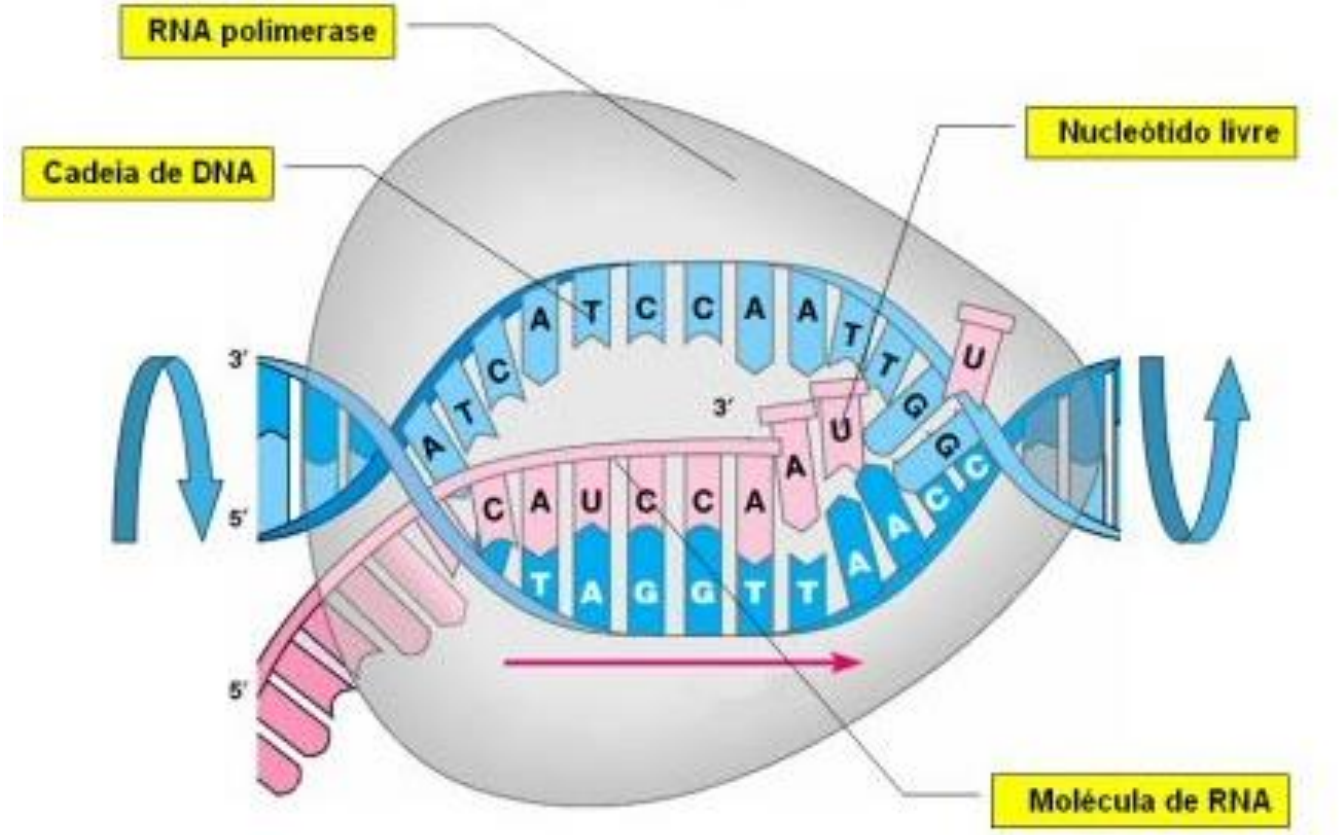


Apenas 0,1 % do genoma é responsável pela diferença entre dois humanos



O segredo é entender como essa informação é processada!

POR QUE É PRECISO CONHECER A ESTRUTURA DE GENES DE PROCARIOTOS E EUCARIOTOS?



TRANSCRIÇÃO = SÍNTESE DE mRNA

http://www.biostudio.com/d_%20Transcription.htm

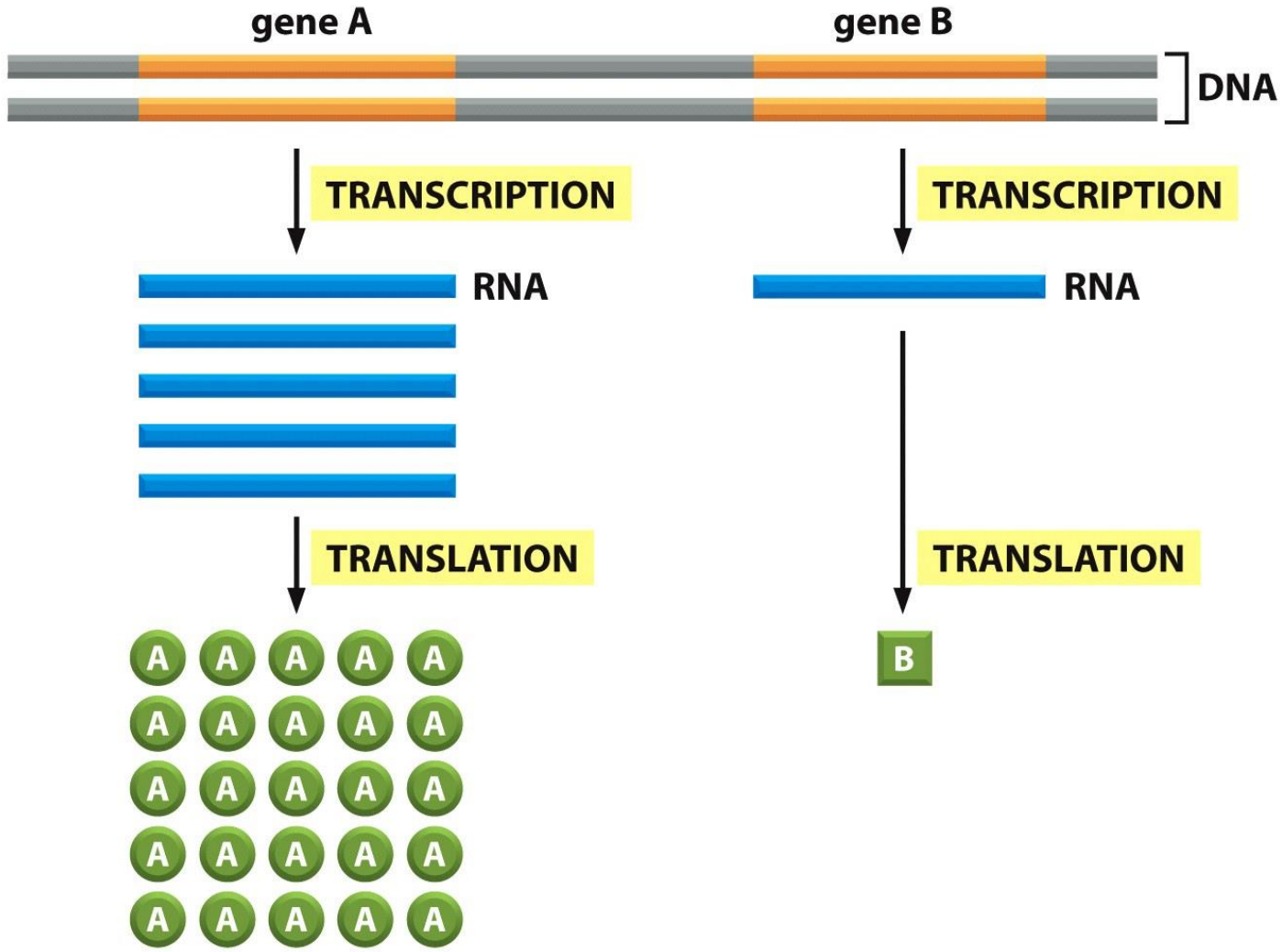


Figure 7-2 Essential Cell Biology 3/e (© Garland Science 2010)

Controle quantitativo e temporal das moléculas "subsequentes" ao DNA

TRANSCRIÇÃO

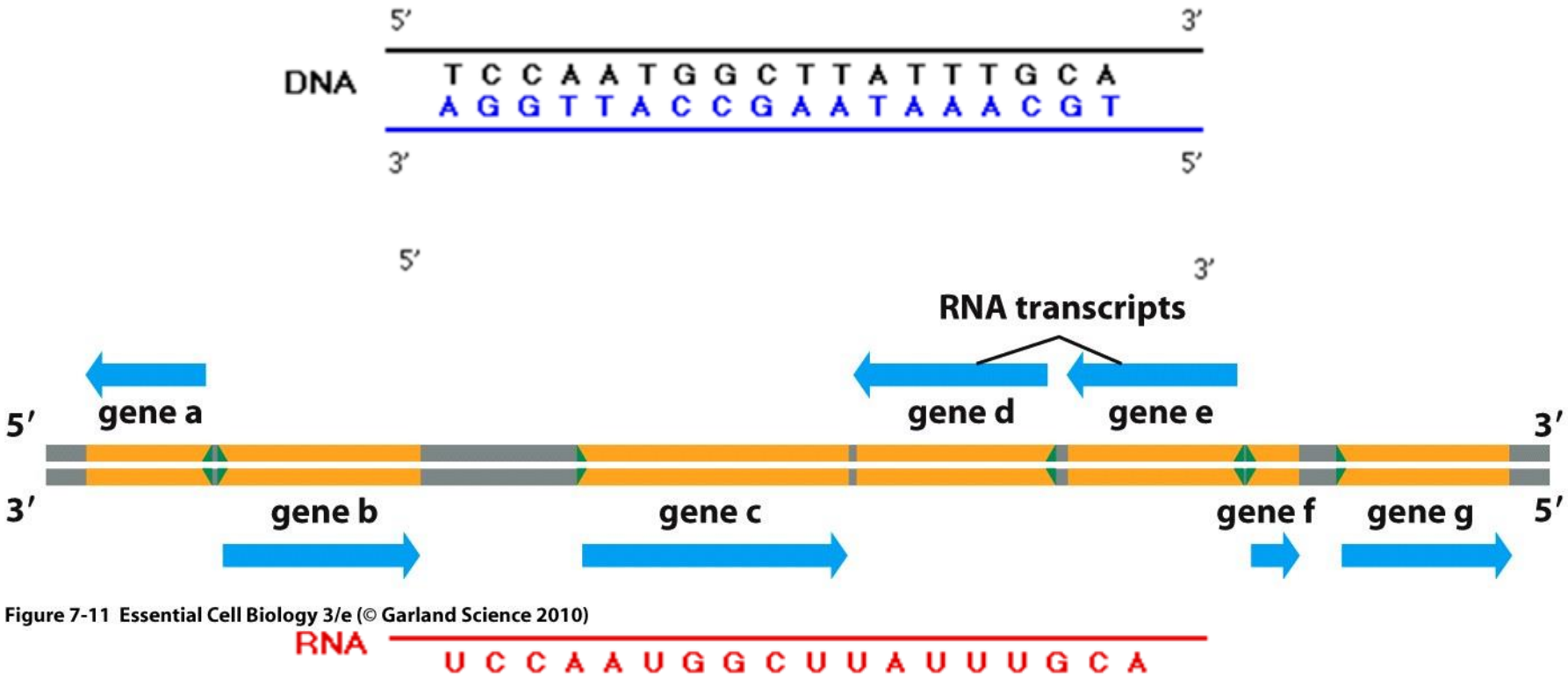


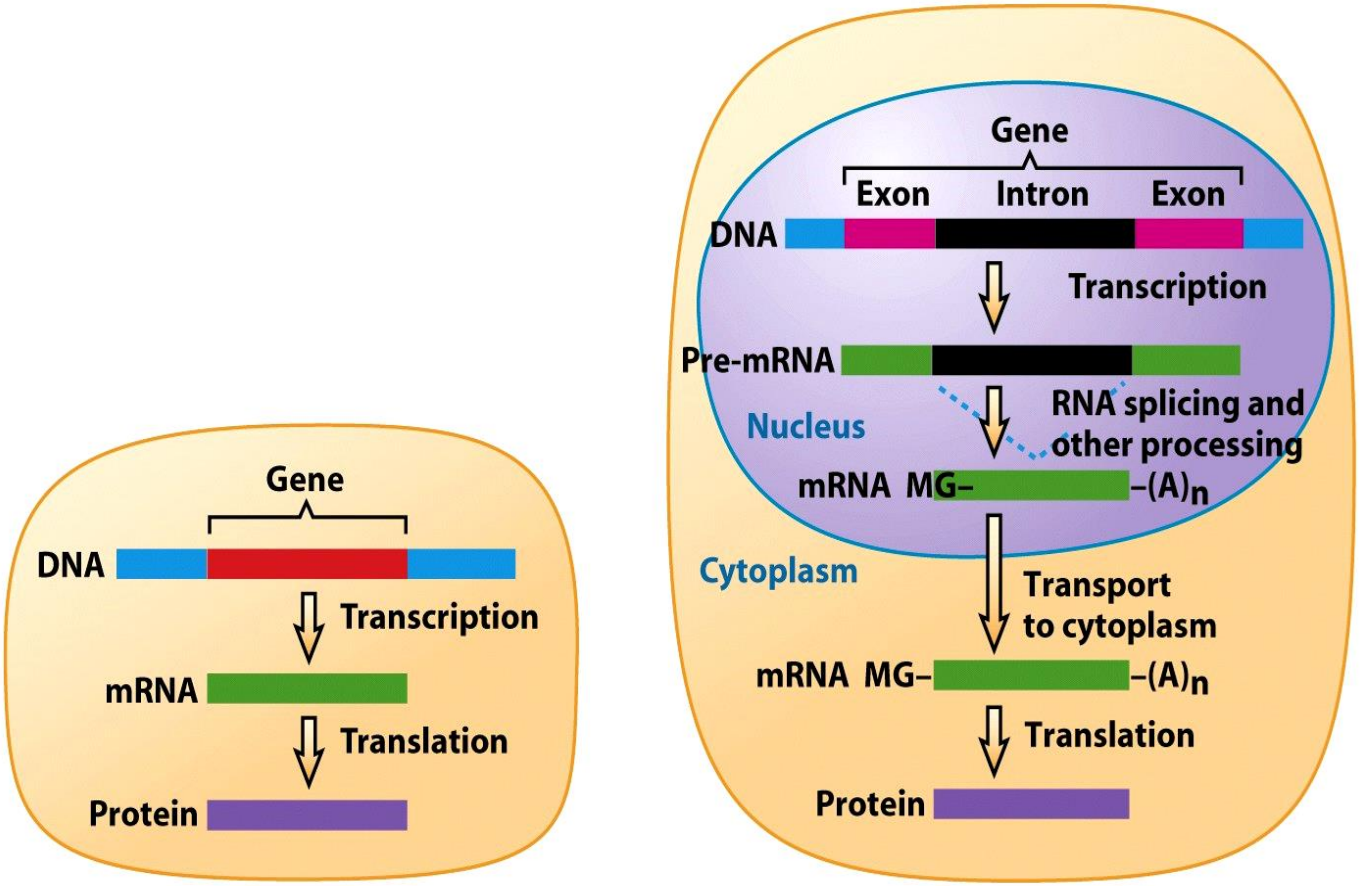
Figure 7-11 Essential Cell Biology 3/e (© Garland Science 2010)

- A informação genética contida num segmento do DNA é **reescrita** em uma fita simples de RNA;
- Esta fita apresenta uma sequência de ribonucleotídeos complementar a uma das fitas da dupla hélice de DNA (**molde**) e idêntica à sequência da outra fita (**codificadora**), com substituição de T por U.

TRANSCRIÇÃO

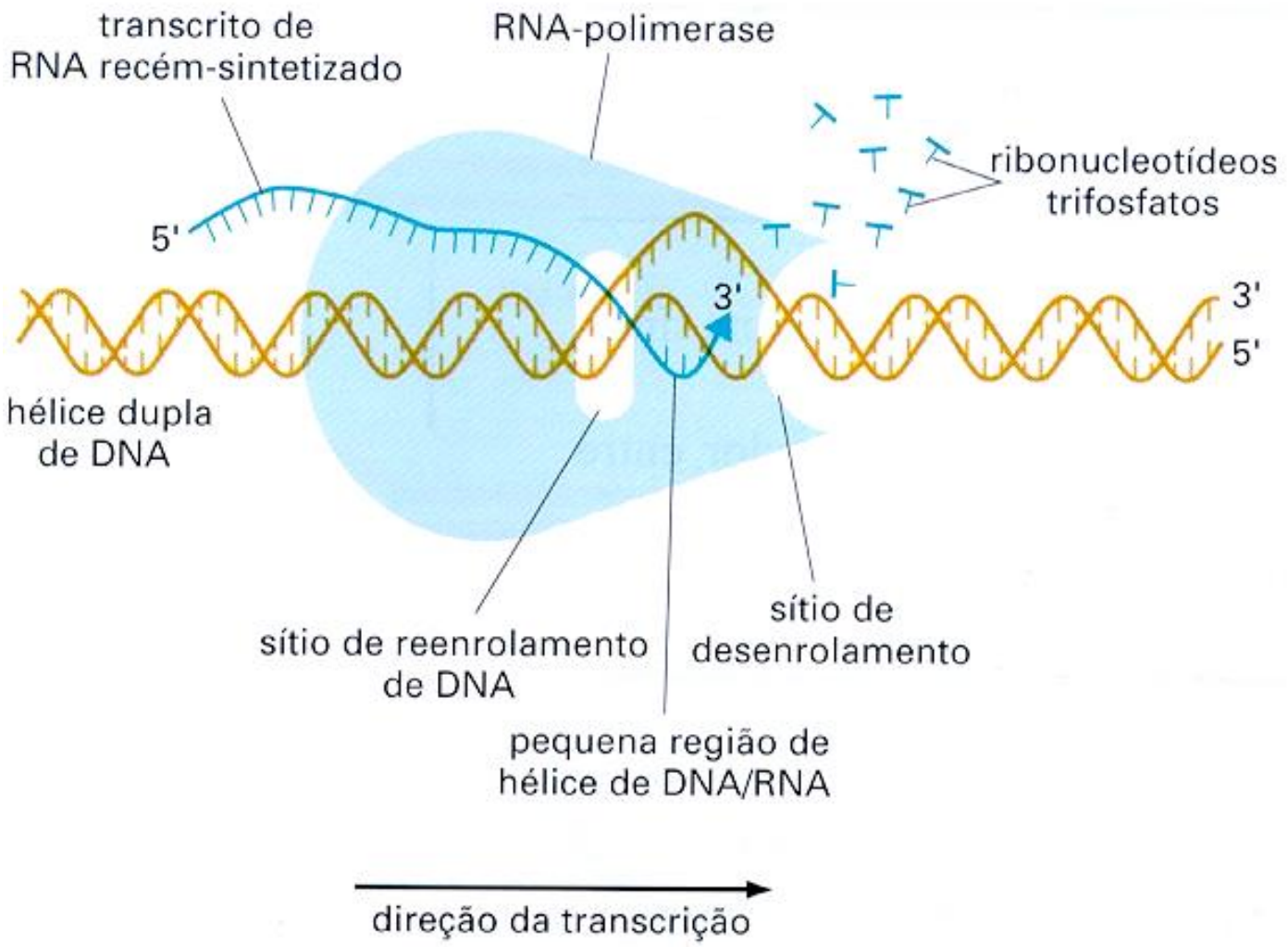
✓Nos **eucariotos** a transcrição ocorre no núcleo, enquanto a tradução ocorre no citoplasma.

✓Já nos **procariotos** tal separação celular não existe, sendo os dois processos acoplados.



(a) **Prokaryotes.** *(b)* **Eukaryotes.**

ENZIMA RNA POLIMERASE



(Alberts et al., 1999)

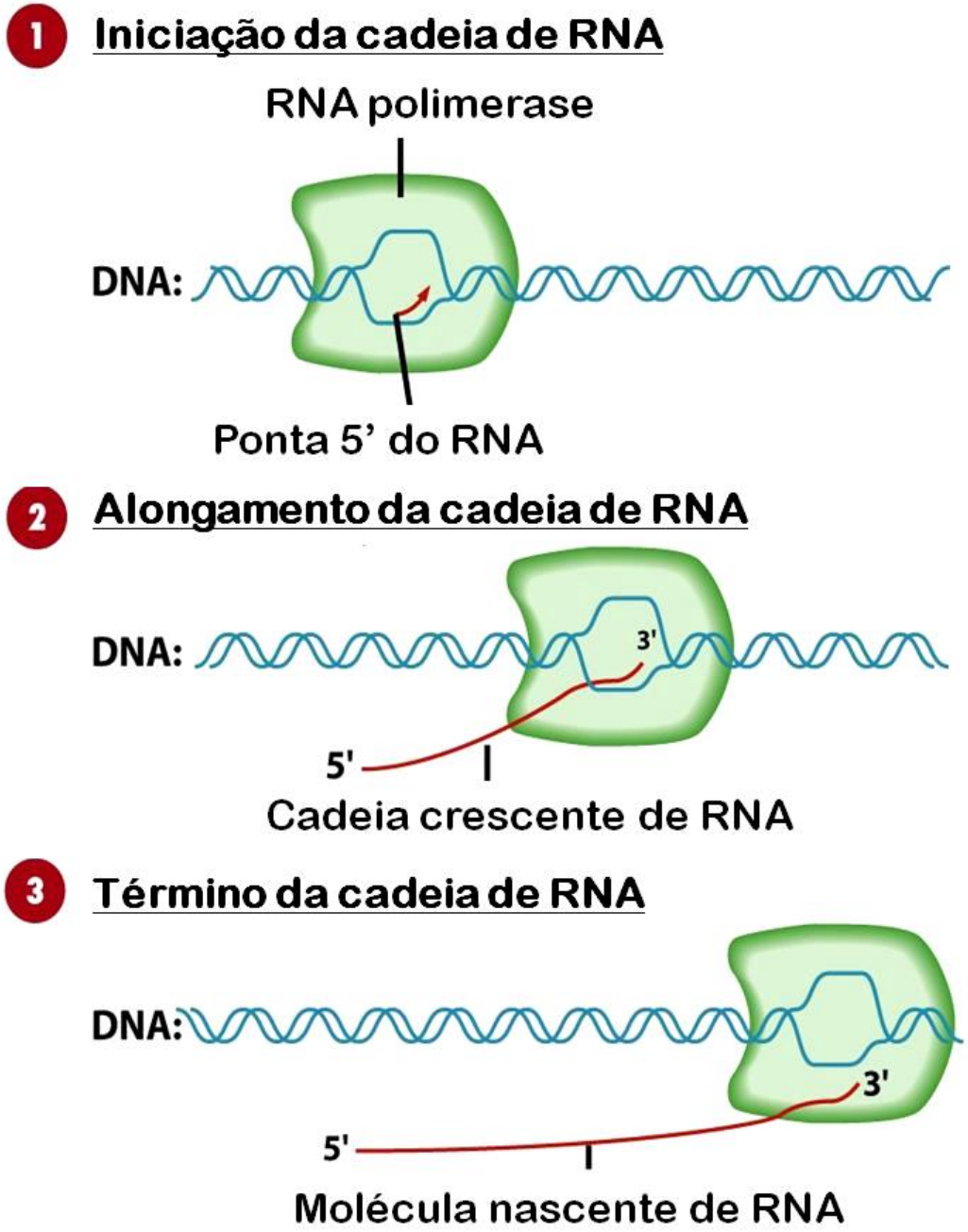
RNA POLIMERASE

- Reconhece e se liga à sequências específicas de DNA (promotor);
- Desnatura o DNA expondo a sequência de nucleotídeos a ser copiada;
- Mantém as fitas de DNA separadas na região de síntese;
- Mantém o híbrido DNA:RNA estável
- Renatura o DNA na região imediatamente posterior à da síntese;
- Sozinha, ou com o auxílio de algumas proteínas específicas, termina a síntese do RNA.

FATORES DE TRANSCRIÇÃO

Proteínas que auxiliam o processo de transcrição **no reconhecimento do promotor.**

ETAPAS DA TRANSCRIÇÃO



CARACTERÍSTICAS GERAIS DA SÍNTESE DE RNA

1. Os precursores são ribonucleotídeos;

2. Apenas 1 fita de DNA é utilizada como molde para a síntese de RNA complementar;

3. As cadeias de RNA são sintetizadas **sem** a necessidade de um filamento *primer* preexistente (atuação da RNA polimerase);

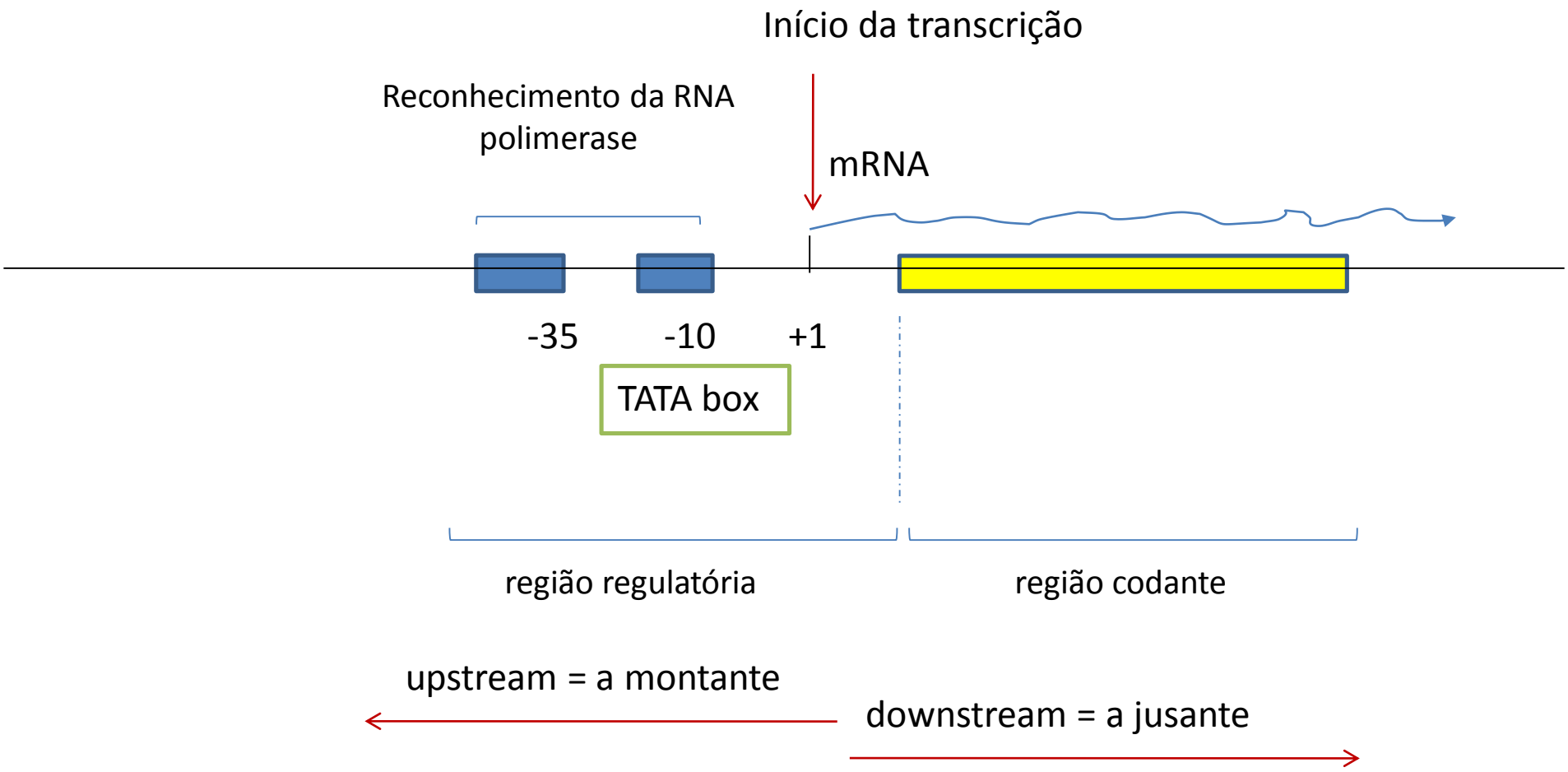
4. Síntese é complementar ao DNA, no entanto A → U;

5. Polimerização sentido 5' → 3';

6. RNA polimerase inicia a transcrição em **sequências específicas** de nucleotídeos → promotores;

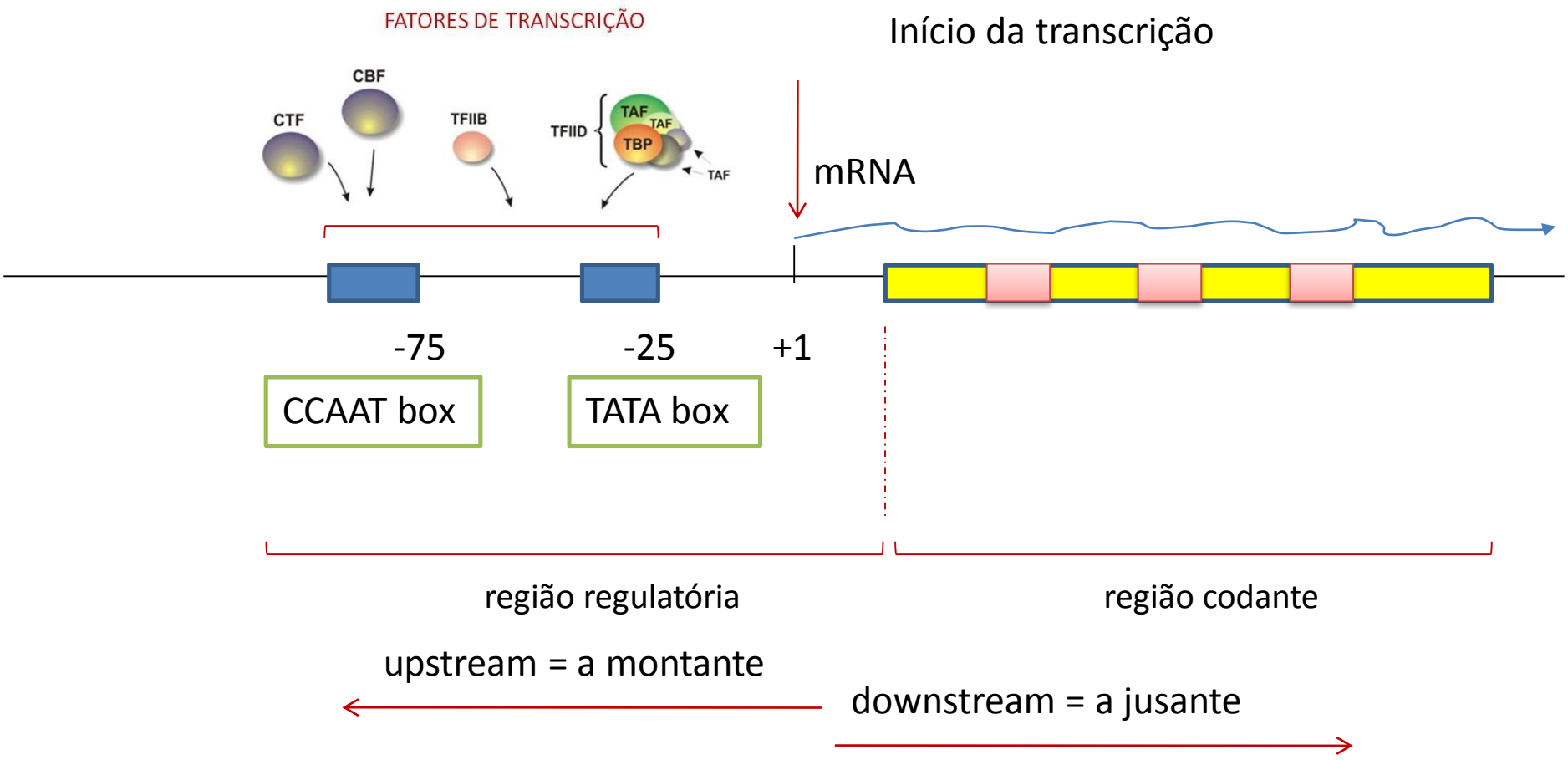
7. RNA polimerase termina a transcrição em **sequências específicas** de nucleotídeos → terminadores (finalizadores).

ESTRUTURA DO PROMOTOR EM PROCARIOTOS



ESTRUTURA DO PROMOTOR EM EUCARIOTOS

Reconhecimento da RNA polimerase



TERMINO DA TRANSCRIÇÃO

✓ o término das cadeias de RNA ocorre quanto a RNA polimerase encontra um sinal de término, quando isso ocorre o complexo é liberado;

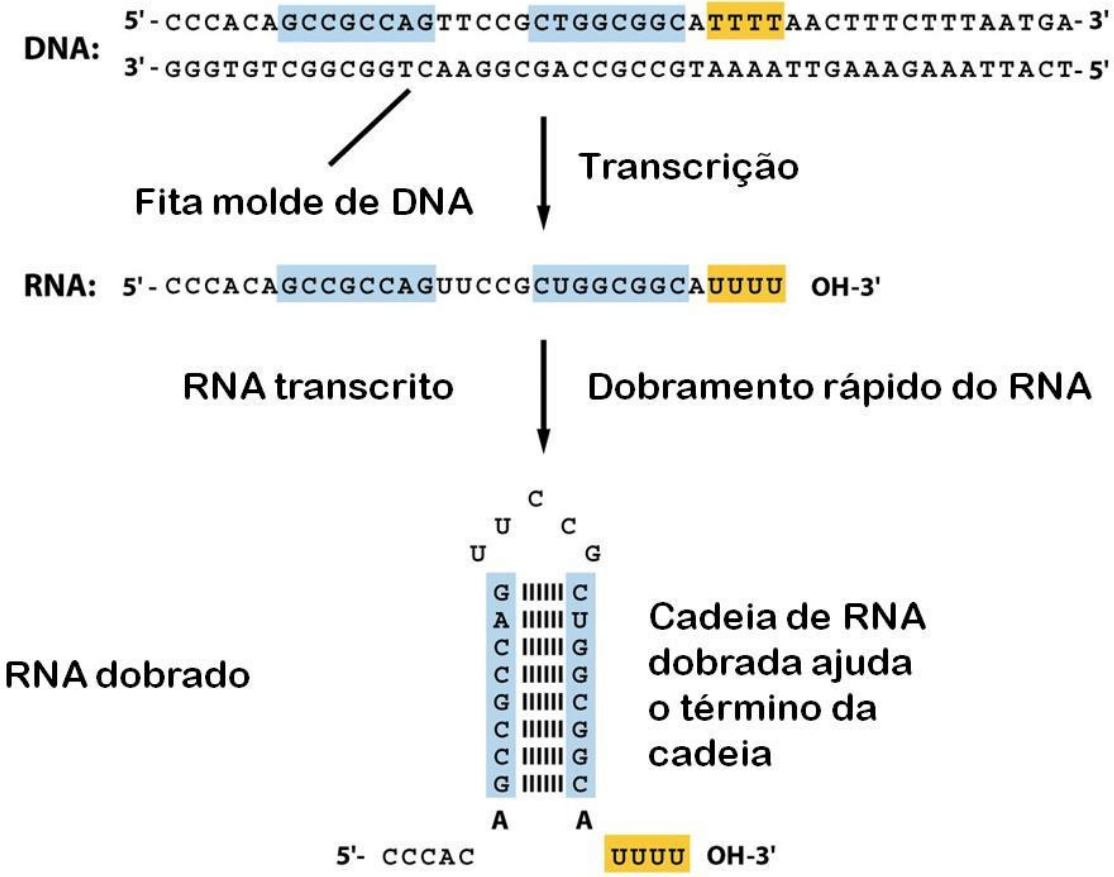


Figure 11-13 Principles of Genetics, 4/e
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AÇÃO DOS FATORES DE TRANSCRIÇÃO

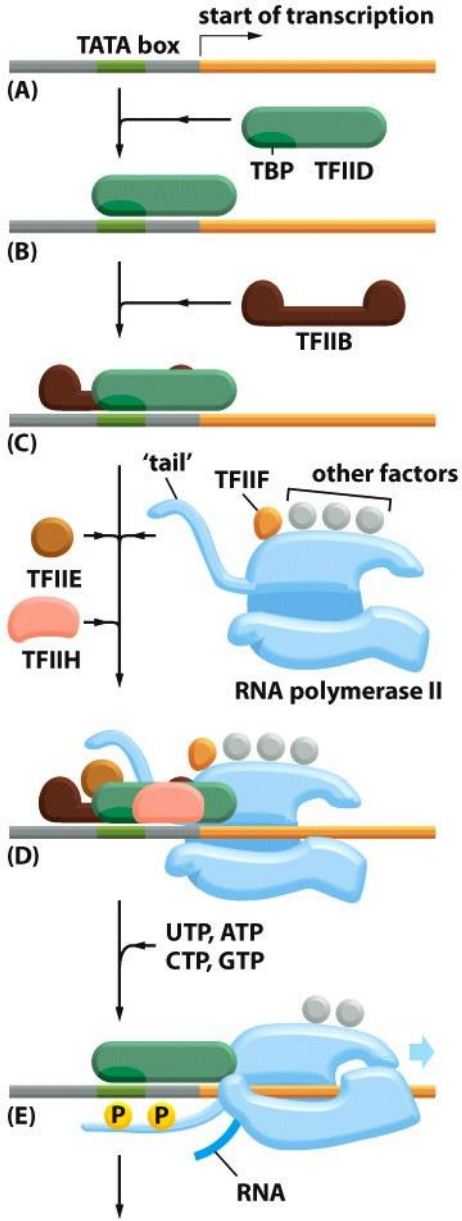


Figure 7-12 Essential Cell Biology 3/e (© Garland Science 2010)

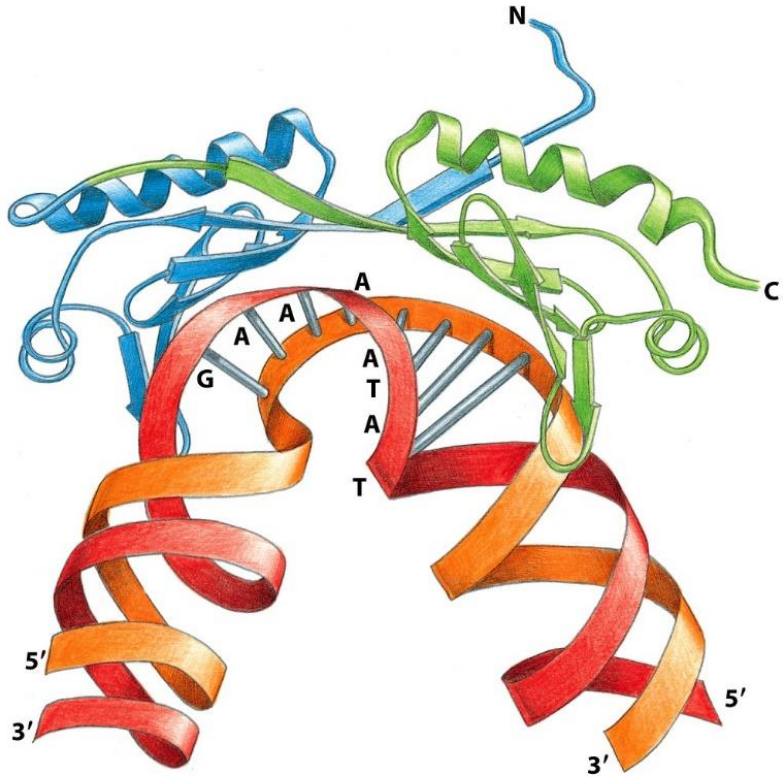
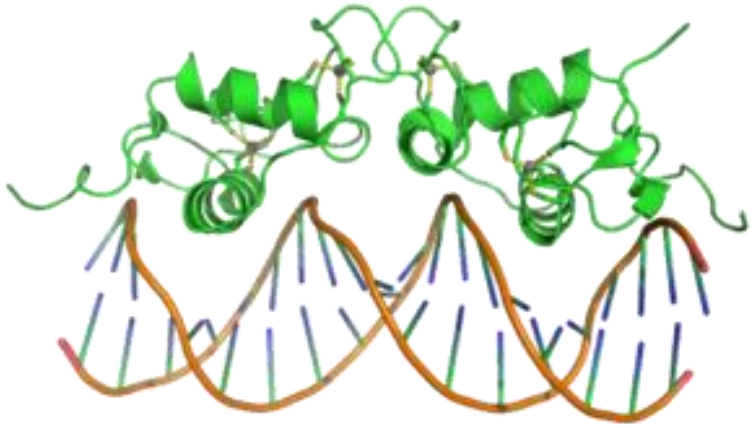


Figure 7-13 Essential Cell Biology 3/e (© Garland Science 2010)

FATORES DE TRANSCRIÇÃO

Proteínas que se ligam ao DNA de células eucarióticas para permitir que haja uma ligação entre a enzima RNA-polimerase e o DNA, permitindo assim a transcrição. Qualquer proteína necessária para o início da transcrição, mas que não seja parte integrante do RNA polimerase.

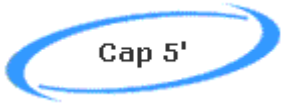


Sequências regulatórias x Reguladores transcricionais

PROCESSAMENTO DO RNA (TRANSCRITO) PRIMÁRIO EM EUCARIOTOS

- As modificações que podem ocorrer nos transcritos nucleares são basicamente de três tipos:

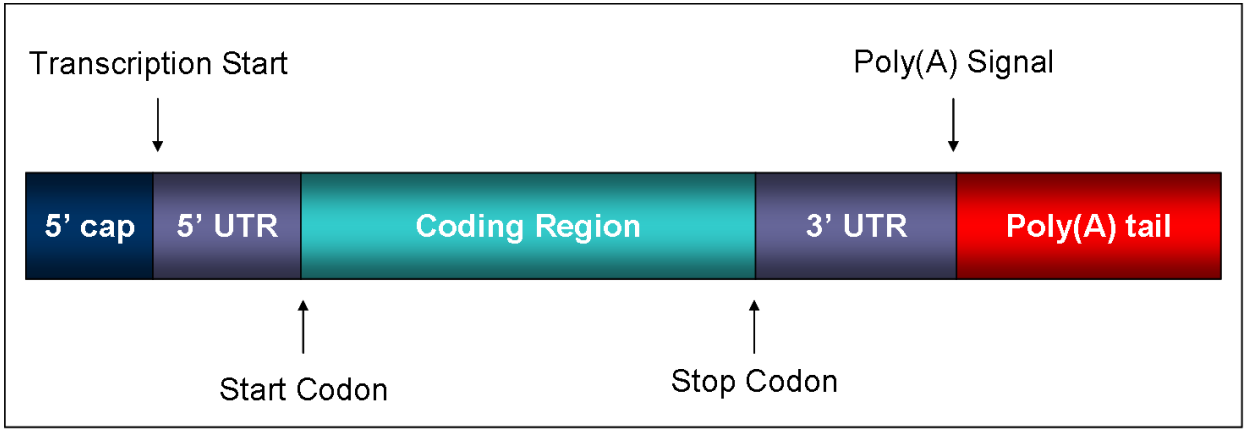
  – Capeamento ("capping") do terminal 5';

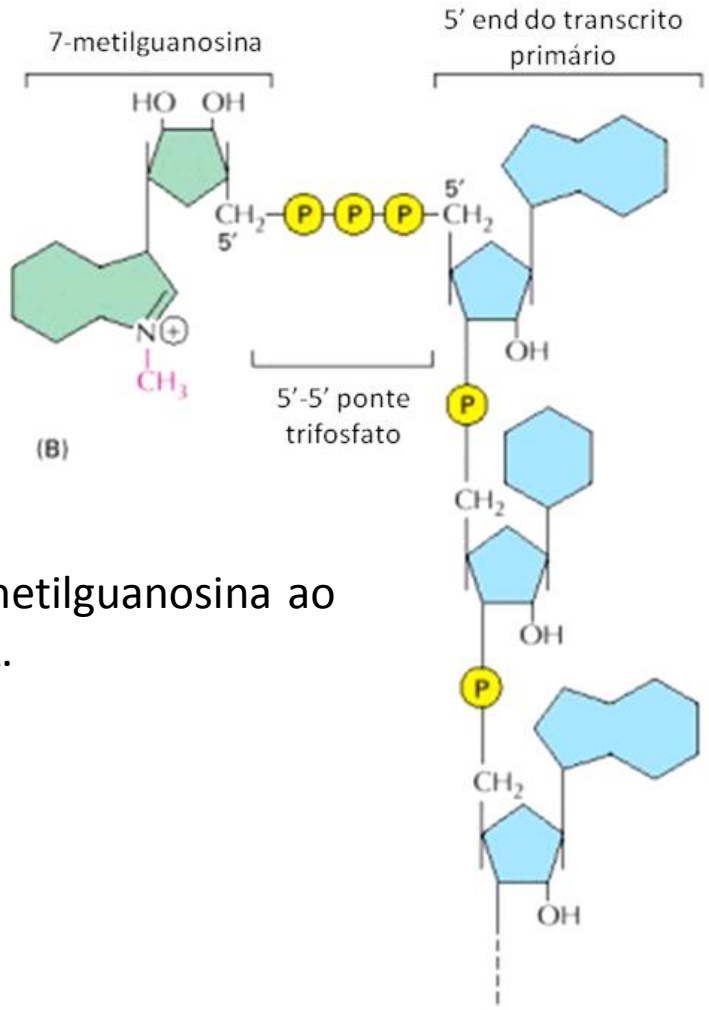
  – Poliadenilação do terminal 3';

  – Montagem de segmentos codificadores ("*splicing*").

- Este conjunto de modificações no transcrito nuclear originará o mRNA, pronto para migrar para o citoplasma.



PROCESSAMENTO DO RNA PRIMÁRIO



Capeamento:

- Logo após a transcrição, há a ligação de 7-metilguanosina ao primeiro nucleotídeo 5' do transcrito de RNA.

FUNÇÕES:

. Proteger o transcrito do ataque de exonucleases;
. Facilitar transporte para citoplasma;
. Auxilia o encaixe dos ribossomos no mRNA.

PROCESSAMENTO DO RNA PRIMÁRIO

Poliadenilação:

- ❖ Após o término da transcrição – clivagem terminal do RNA;
- ❖ Adição de cerca de 200 resíduos de adenilato (AMP)

FUNÇÕES:

. Facilitar transporte para o citoplasma;
. Estabilizar o mRNA;
. Facilitar a tradução.

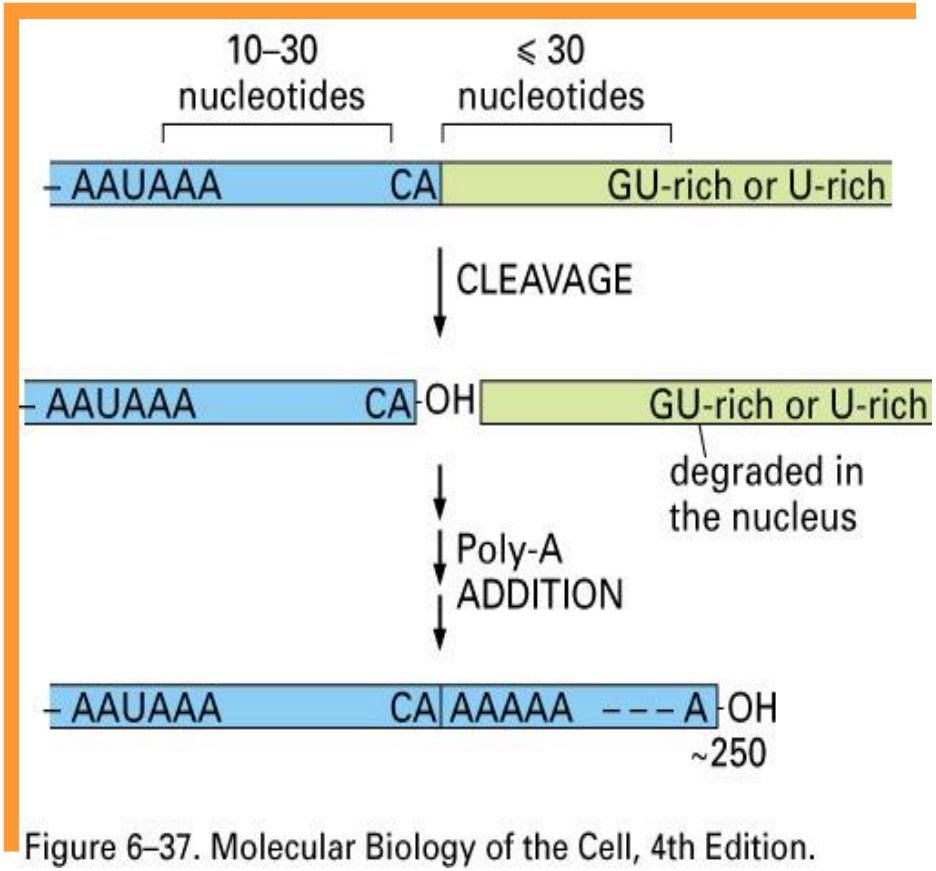
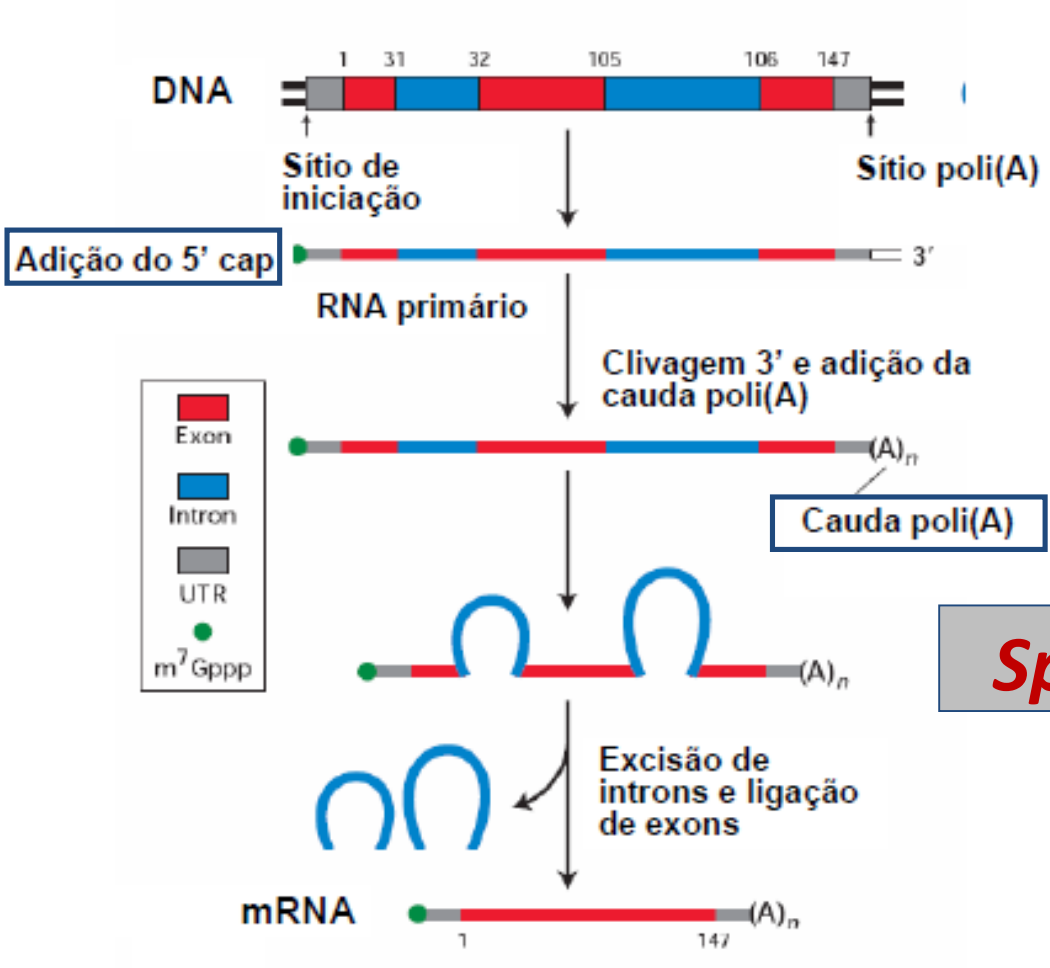


Figure 6–37. Molecular Biology of the Cell, 4th Edition.

PROCESSAMENTO DO RNA PRIMÁRIO



Splicing

Sequências especificas e snRNA (*small nucleolar* RNA – pequenos RNA nucleares) auxiliam junto a proteínas (RPN) na retirada do introns

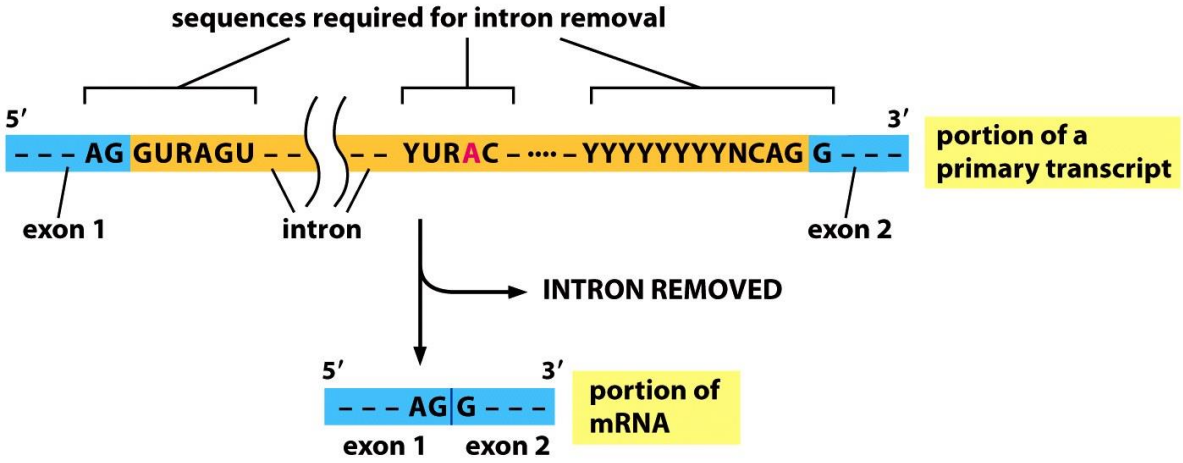


Figure 7-19 Essential Cell Biology 3/e (© Garland Science 2010)

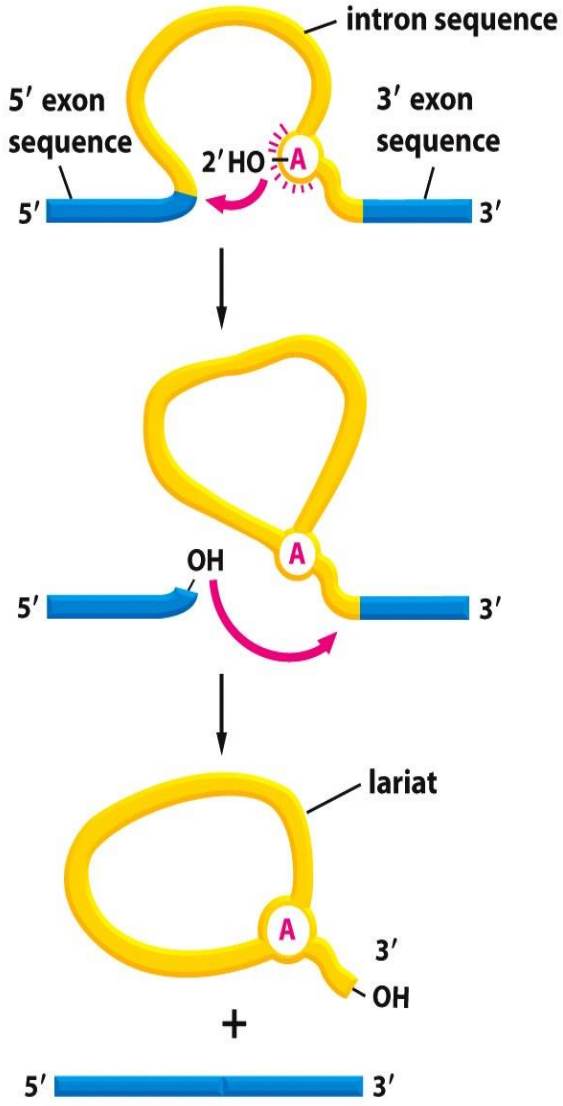
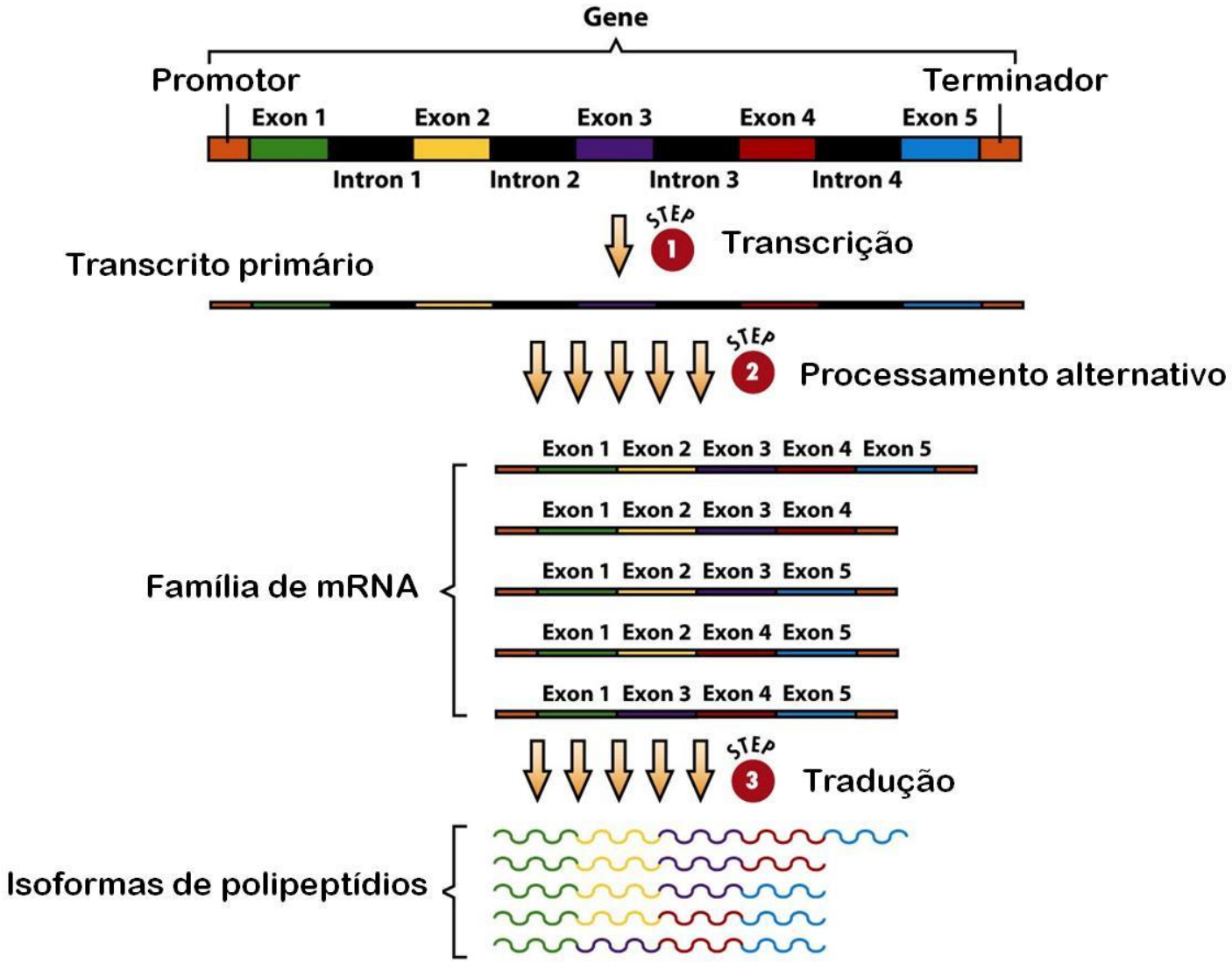
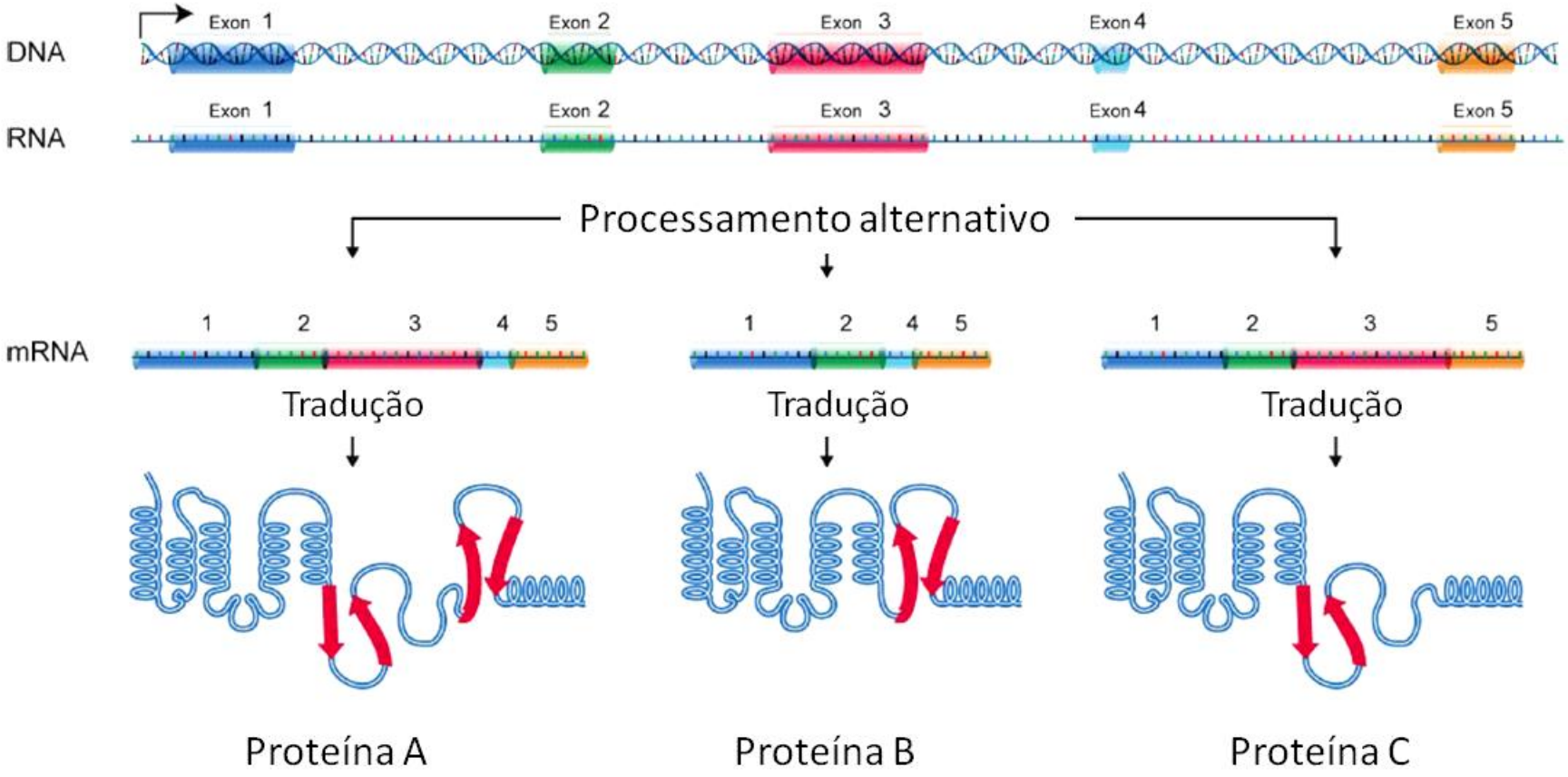


Figure 7-20 Essential Cell Biology 3/e (© Garland Science 2010)

ISOFORMAS DE PROTEÍNAS

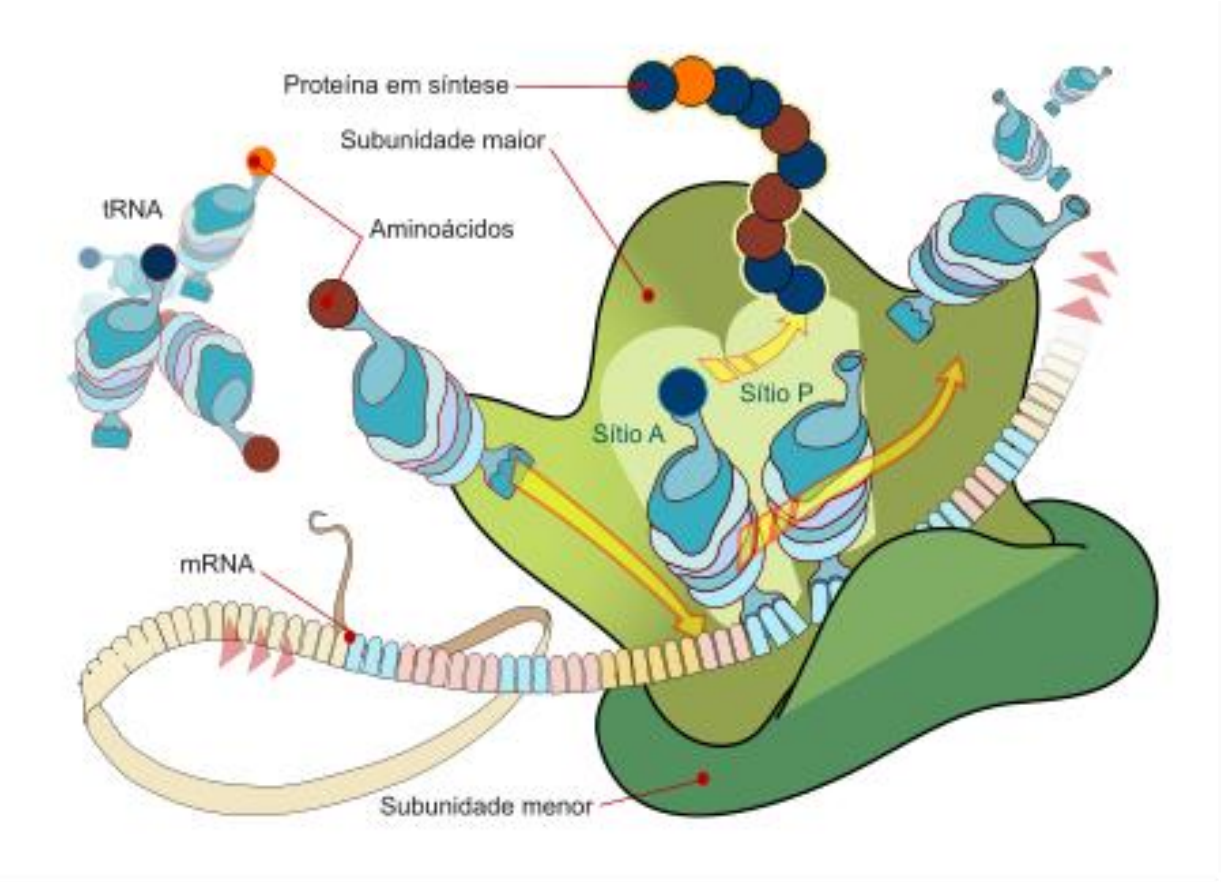


SPLICING ALTERNATIVO GERANDO DIVERSAS PROTEÍNAS

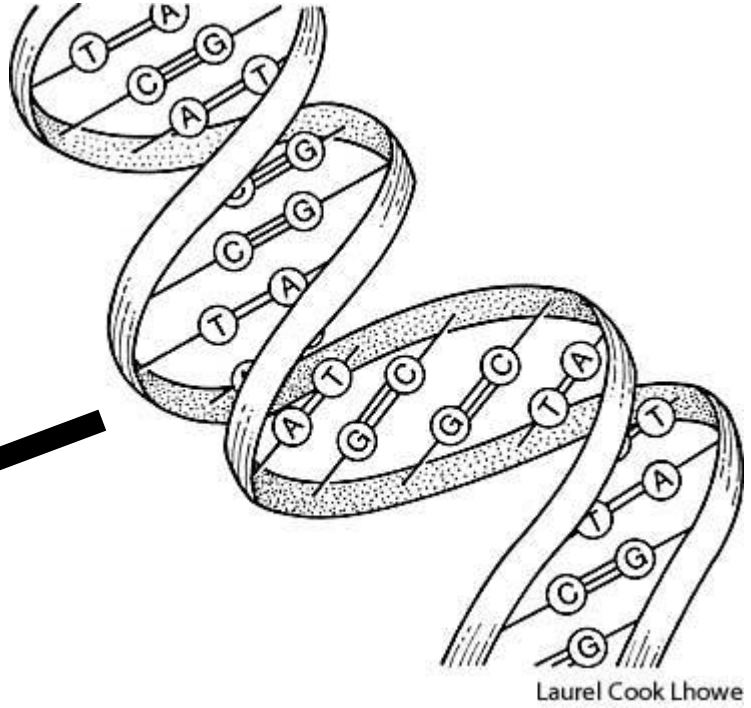


TRADUÇÃO

Processo altamente conservado no qual as proteínas são sintetizadas a partir dos moldes de mRNA com auxílio de RNA estruturais.



TRADUÇÃO



Interpretação

AAGTCCTTTTAAATAAATAATTCTAGCTATATTTGCAAC
GTTGGAAAATTAGCTATTCTAATGTTATCGAAAGAAGAA
CACAGTTACTTAGTTTCTCGGCAAACTATATCAAAATGA
GAAGGTGAAAGAGTGGCATAATGATAAGCAAATCTGAAA
ATTTTTTGGTATAATAATCTTGATTGAAATTTGAATGGA
GTAGGCTTACCAAATGTTGGTAAATCAACCTTATTTAAC
ATTATCCTTTTGCGACTATTGATCCCAATGTTGGTATGG
GACAGAATTGATTACACCTAAAAAAACAGTTCCGACAAC
AAAGGTGCTTCTAGAGGGGAAGGTCTAGGAAATAAATTT
TTCATGTGGTACGTGCTTTTGATGATGAAAATGTCATGC
TCCTATAGCAGATATTGACACTATTAATCTTGAATTAAT
TATGCGCGTGTTGAAAAAATGGCACGAACTCAAAAAGAT
AAAAGATTAAACCTGTTTTGGAAGATGGGAAATCAGCTA
AGTTGTTAAAGGTCTCTTTTTATTAACAACTAAACCTGT
GTTGCTAATCTAGATGGTATTGATTATGTCAAACAAATT
TAGTTGTTATCTCAGCGCGTGCAGAAGAAGAAATTTCAG
GGAAGCTATCGGTCTTACTGAATCAGGCGTTGATAAATT
GGAACCTATTTTACAGCAGGTGAAAAAGAGGTTCGTGCT
AAGCTGCTGGTATTATCCATTCAGATTTTGAAAGAGGTT

Colocar em outra linguagem!!

Met -Lys –Trp...

CARACTERÍSTICAS GERAIS DA TRADUÇÃO

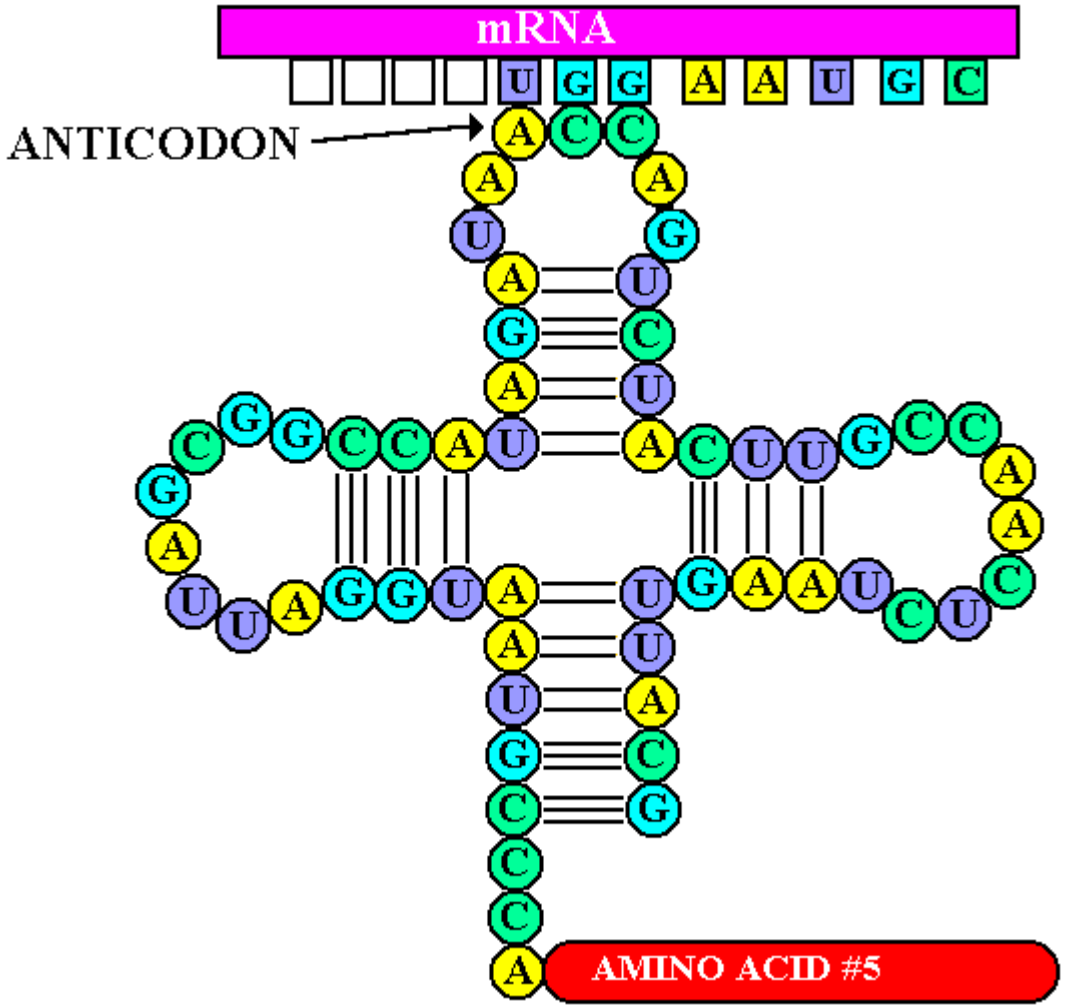
✓ Todos os RNAs mensageiros são lidos na direção 5'- 3';

✓ As cadeias polipeptídicas são sintetizadas da extremidade amina (NH_3) para a carboxila terminal (COOH) – ligação peptídica;

✓ A tradução é realizada nos ribossomos, com os RNA transportadores como adaptadores entre o molde de mRNA e os aminoácidos;

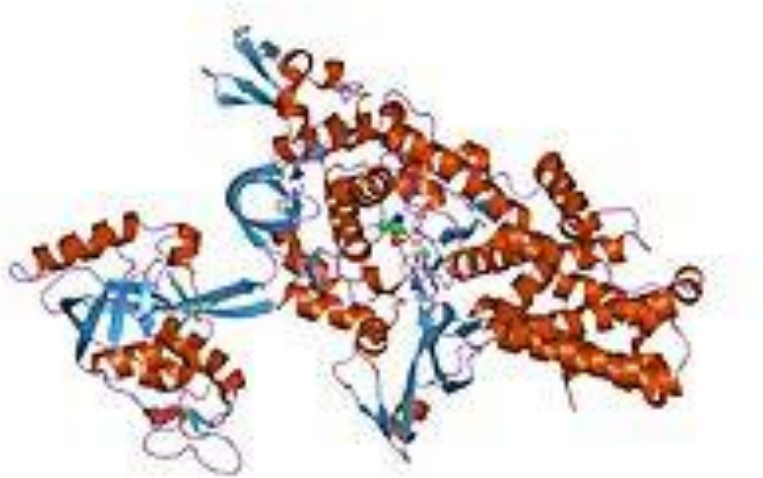
✓Cada aminoácido é especificado por três bases (códon) no mRNA – código genético universal.

CÓDON E ANTICÓDON

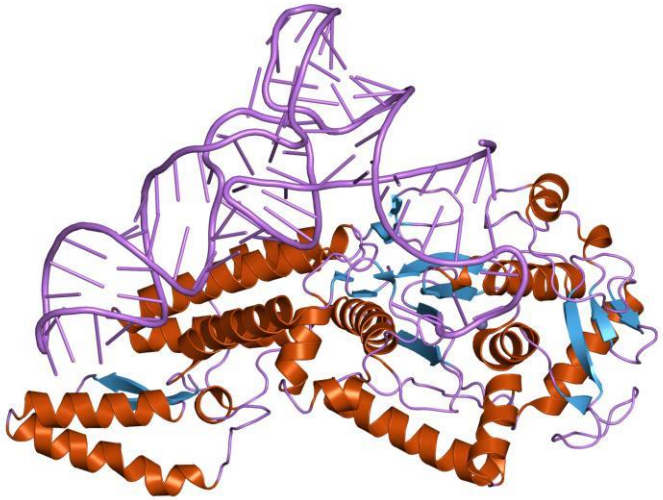


As aminoacil - tRNA sintetases:

- Para que uma molécula de tRNA se ligue ao aminoácido correto são necessárias 20 enzimas diferentes que reconheçam, especificamente, aminoácidos e seus tRNAs compatíveis.
- Cada enzima liga um aminoácido específico a seu tRNA correspondente e é capaz de reconhecer diferentes tRNAs para o mesmo aminoácido. Estas enzimas ligam o aminoácido à hidroxila 3' livre da adenosina terminal do tRNA.



LeuRS



ProRS

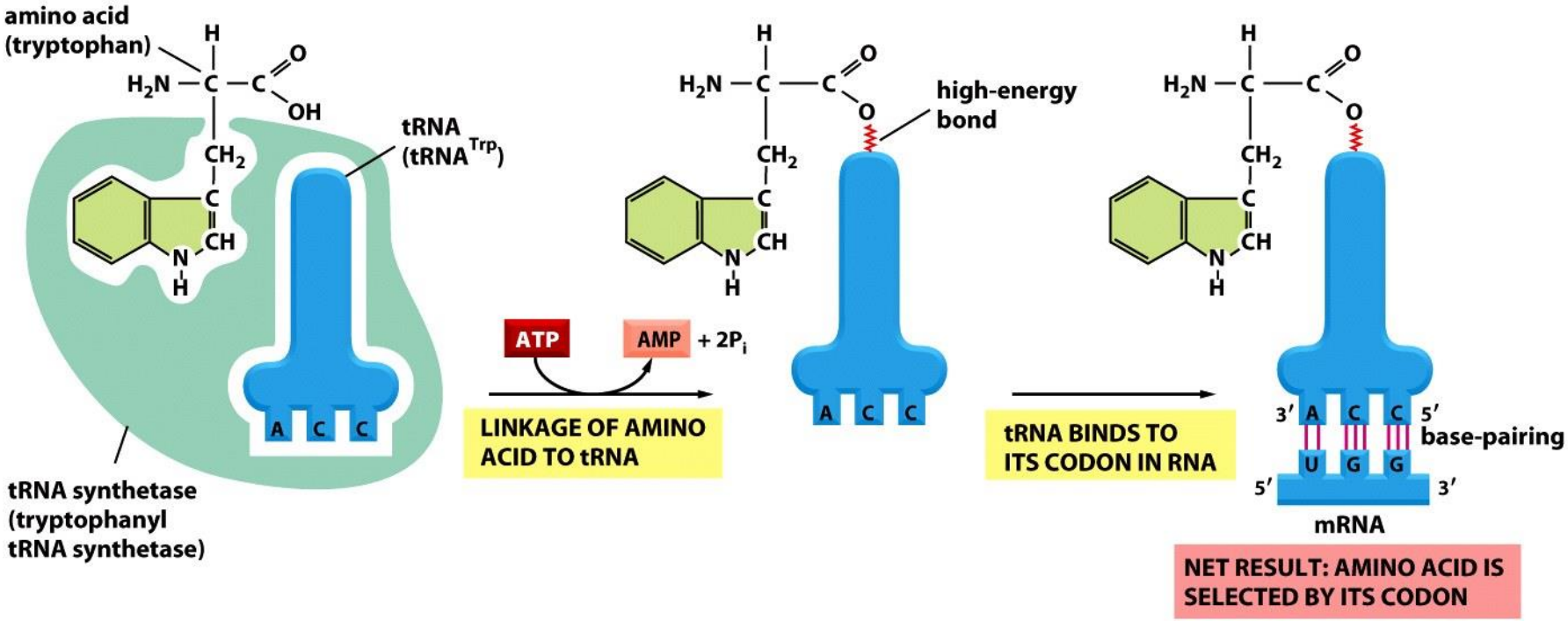
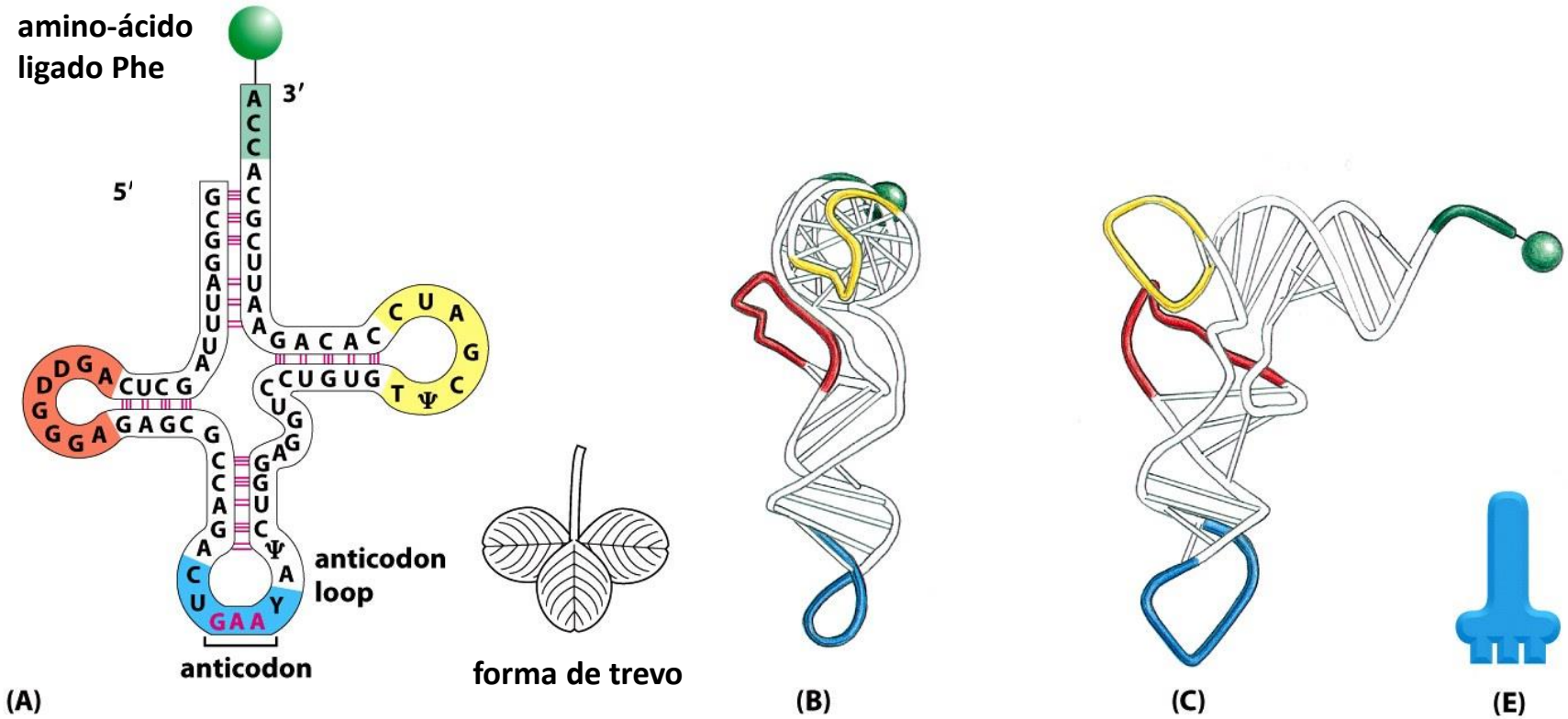


Figure 7-29 Essential Cell Biology 3/e (© Garland Science 2010)



5′ GCGGAUUUAGCUCAGDDGGGAGAGCGCCAGACUGAAYAΨCUGGAGGUCCUGUGTΨCGAUCCACAGAAUUCGCACCA 3′

anticodon

(D)

Figure 7-28 Essential Cell Biology 3/e (© Garland Science 2010)

MAS O QUE É CÓDIGO GENÉTICO?



Primeira Posição Extremidade 5'	Segunda Posição				Terceira Posição Extremidade 3'
	U	C	A	G	
U	Fen Fen Leu Leu	Ser Ser Ser Ser	Tir Tir FIM FIM	Cis Cis FIM 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	Trn Trn Trn Trn	Asn Asn Lis Lis	Ser Ser Arg Arg	U C A G
G	Val Val Val VAl	Ala Ala Ala Ala	Asp Asp Glu Glu	Gli Gli Gli Gli	U C A G

O CÓDIGO GENÉTICO É REDUNDANTE E DEGENERADO!

Amino acid	3-Letter code	1-Letter code	Codons
Alanine	Ala	A	GCC, GCU, GCG, GCA
Arginine	Arg	R	CGC, CGG, CGU, CGA, AGA, AGG
Asparagine	Asn	N	AAU, AAC
Aspartic acid	Asp	D	GAU, GAC
Cysteine	Cys	C	UGU, UGC
Glutamic acid	Glu	E	GAA, GAG
Glutamine	Gln	Q	CAA, CAG
Glycine	Gly	G	GGU, GGC, GGA, GGG
Histidine	His	H	CAU, CAC
Isoleucine	Ile	I	AUU, AUC, AUA
Leucine	Leu	L	UUA, UUG, CUA, CUG, CUU, CUC
Lysine	Lys	K	AAA, AAG
Methionine	Met	M	AUG
Phenylalanine	Phe	F	UUC, UUU
Proline	Pro	P	CCU, CCC, CCA, CCG
Serine	Ser	S	UCU, UCC, UCA, UCG, AGU, AGC
Threonine	Thr	T	ACU, ACC, ACA, ACG
Tyrosine	Tyr	Y	UAU, UAC
Tryptophan	Trp	W	UGG
Valine	Val	V	GUU, GUC, GUA, GUG
"Stop"	—	—	UAA, UAG, UGA

start codon -iniciador

stop codon -terminador

GCA GCC GCG GCU	AGA AGG CGA CGC CGG CGU	GAC GAU	AAC AAU	UGC UGU	GAA GAG	CAA CAG	GGA GGC GGG GGU	CAC CAU	AUA AUC AUU	UUA UUG CUA CUC CUG CUU	AAA AAG	AUG	UUC UUU	CCA CCC CCG CCU	AGC AGU UCA UCC UCG UCU	ACA ACC ACG ACU	UGG	UAC UAU	GUA GUC GUG GUU	UAA UAG UGA
Ala	Arg	Asp	Asn	Cys	Glu	Gln	Gly	His	Ile	Leu	Lys	Met	Phe	Pro	Ser	Thr	Trp	Tyr	Val	stop
A	R	D	N	C	E	Q	G	H	I	L	K	M	F	P	S	T	W	Y	V	

Figure 7-24 Essential Cell Biology 3/e (© Garland Science 2010)

A leitura correta do código genético pelo ribossomo é vital!!!

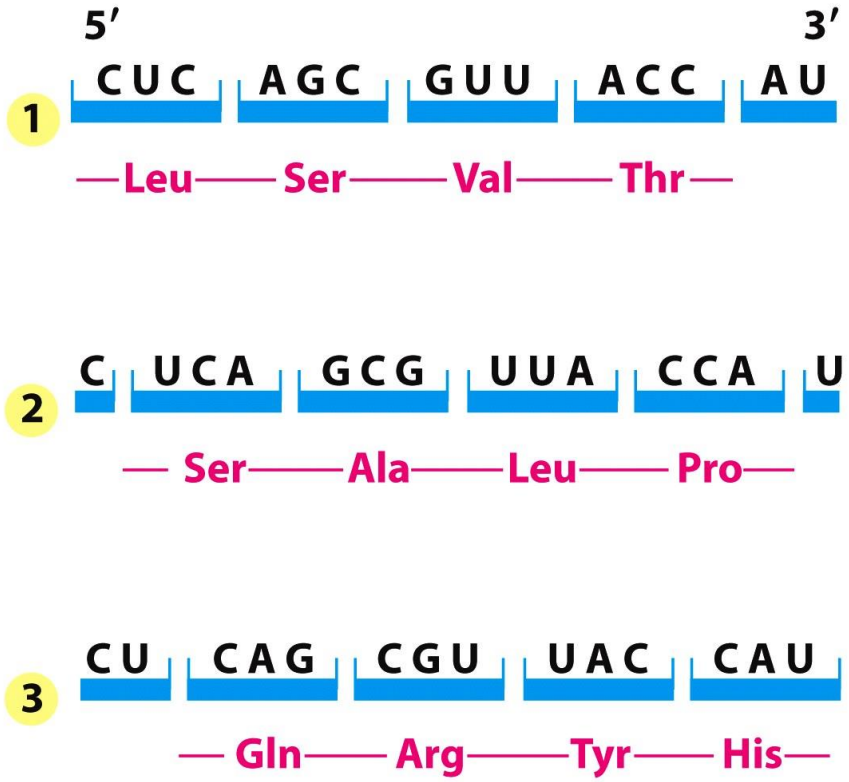


Figure 7-25 Essential Cell Biology 3/e (© Garland Science 2010)

SINAIS PARA O INÍCIO DA TRADUÇÃO

PROCARIOTO

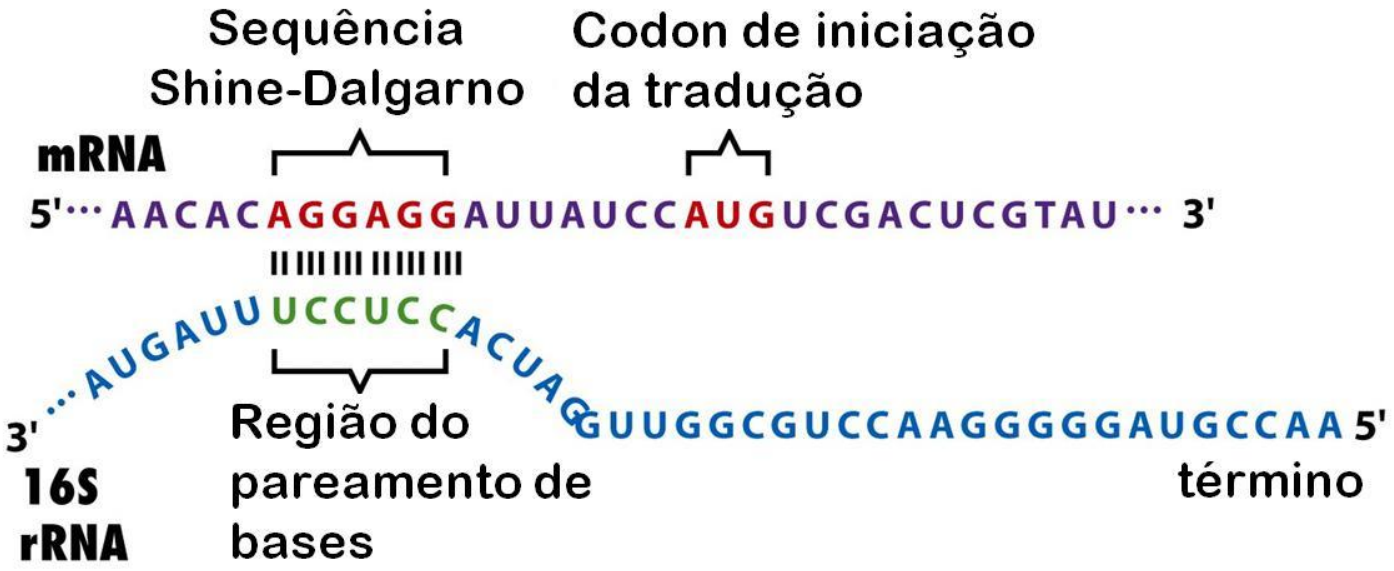


Figure 12-16 Principles of Genetics, 4/e
© 2006 John Wiley & Sons

EUCARIOTO

(Sequência de Kozak)

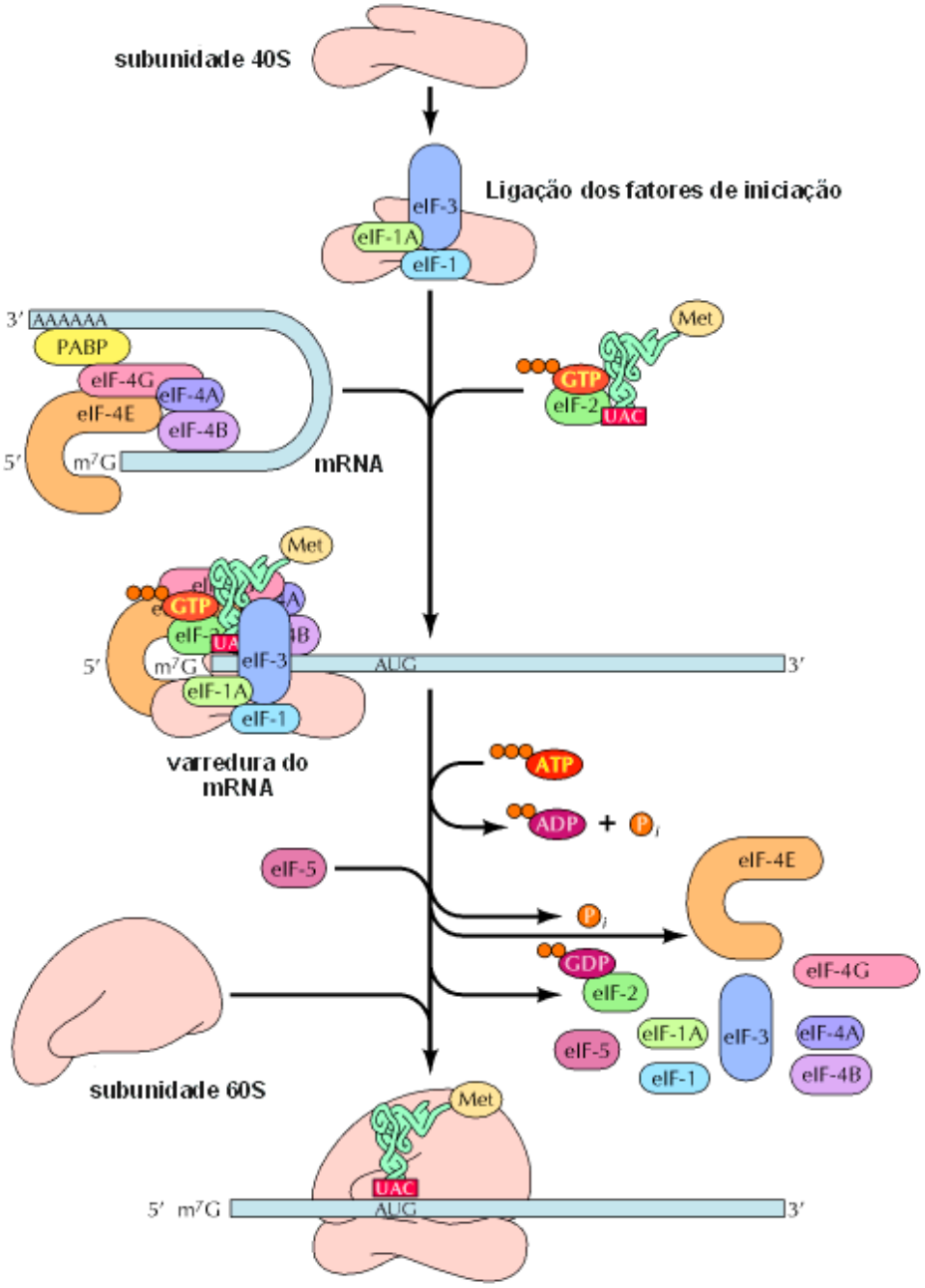
5´ - GCC (A ou G) CC **AUG**G - 3`

SINAL PARA O INÍCIO DA TRADUÇÃO EM EUCARIOTOS



Vários polipeptideos auxiliam o início da tradução!





START CODON E STOP CODON

Início: códon de iniciação da síntese protéica

– AUG -

↓

METIONINA

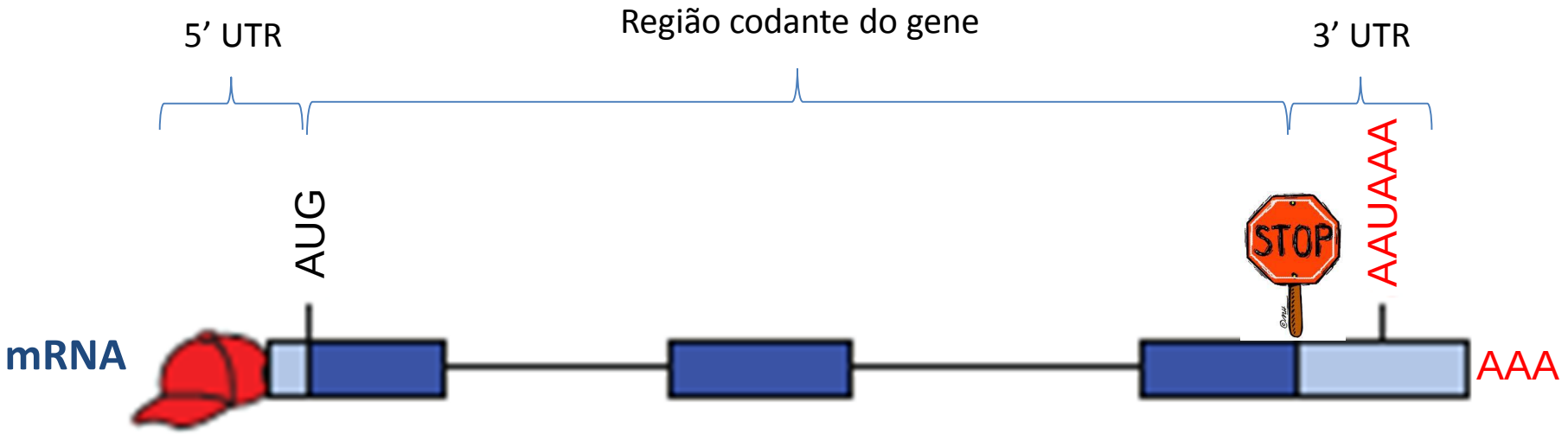
Terminação: três códons terminam a síntese protéica

– UAG – UAA – UGA -



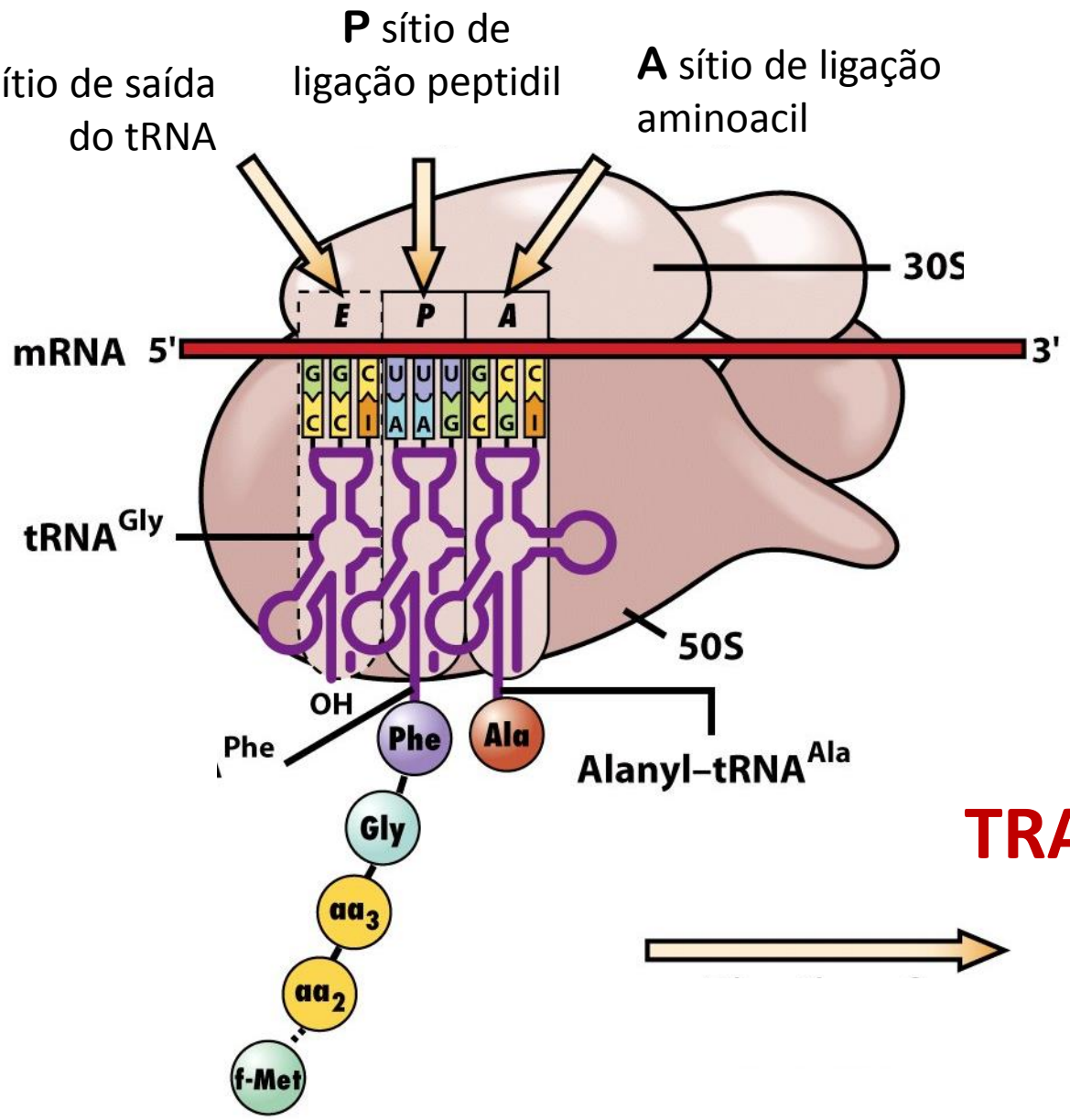
START CODON E STOP CODON

- Delimitam a região codante (região que é transcrita e traduzida!)



TRADUÇÃO: INÍCIO E FIM

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AGTGTCGTCCTTTACGCACCGAATCCCTTTATCATTGAATTAGT
AGAAGAGCGATACTTAGGACGTCTTCGG**ATG**GAATCTTGGTCCC
GTTGCCTGGAACGTCTTGAAACTGAATTCCCGCCAGAAGATGTT
CATACTTGGTTAAGACCTTTACAAGCCGACCAACGTGGTGACAG
TGTCGTCCTTTACGCACCGAATCCCTTTATCATATTGAATTAGT
AGAAGAGCGATACTTAGGACGTCTTCGGGAATTGTTATCCTATT
TCTCAGGAATACGTGAAGTAGTCCTTGCAATTGGCTCACGACCT
AAAACAACAGAACTACCCGTACCAGTAGACACTACAGGACGTTT
GTCTTCAACAGTCCCATTTAACGGAAATCTCGACACACACTATA
ACTT**TGA**TAATTTTGTTGAGGGACGAAGCAATCAACTCGCTCGT
GCTGCAGCTTGGCAAGCGGCACAGAAACCGGGAGACCGTACTCA
CAACCCTCTATTGCTCTATGGTGGGACTGGTTTGGGTAAAACCC
ATTTAATGTTTGCTGCAGGTAACGTAATGCGGCAAGTAAACCCA
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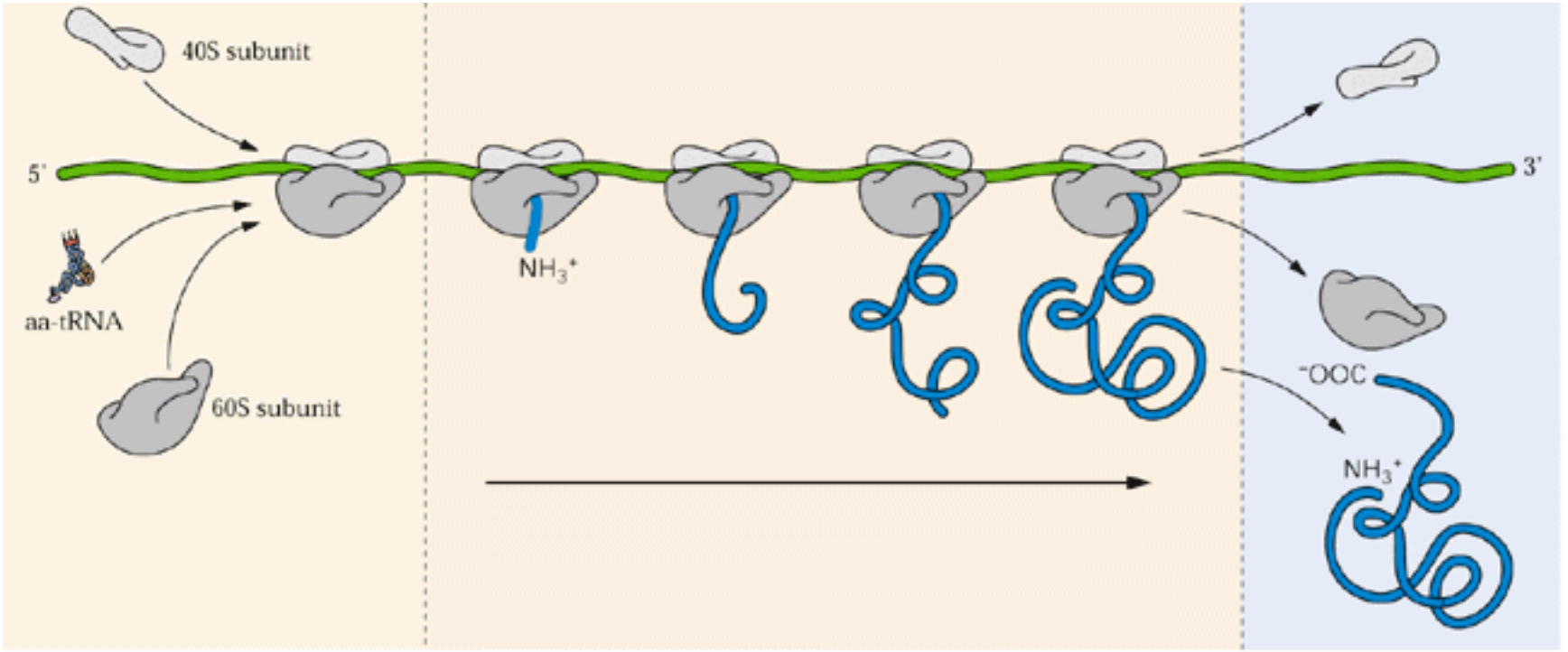


TRADUÇÃO

Figure 12-14a Principles of Genetics, 4/e
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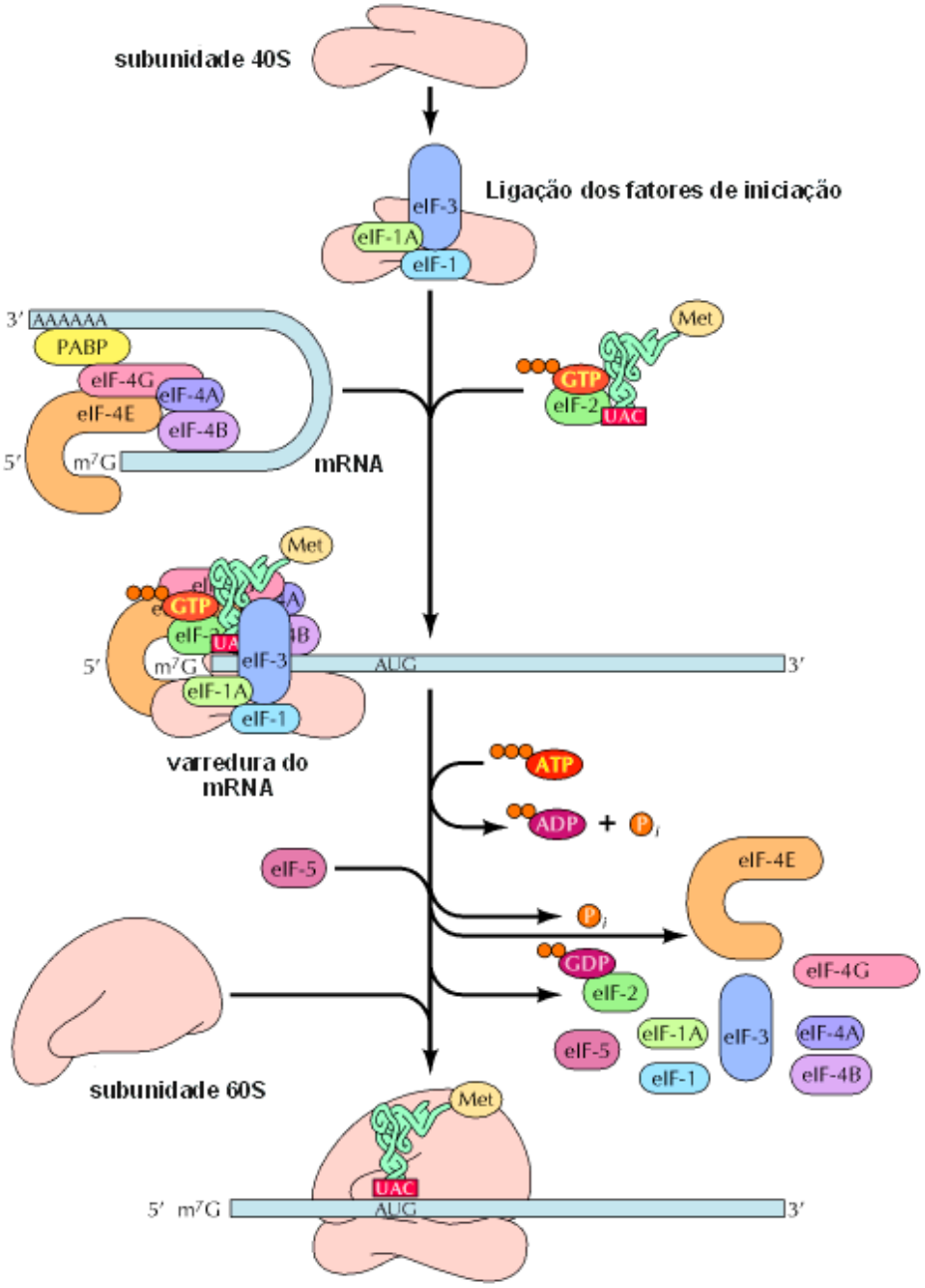
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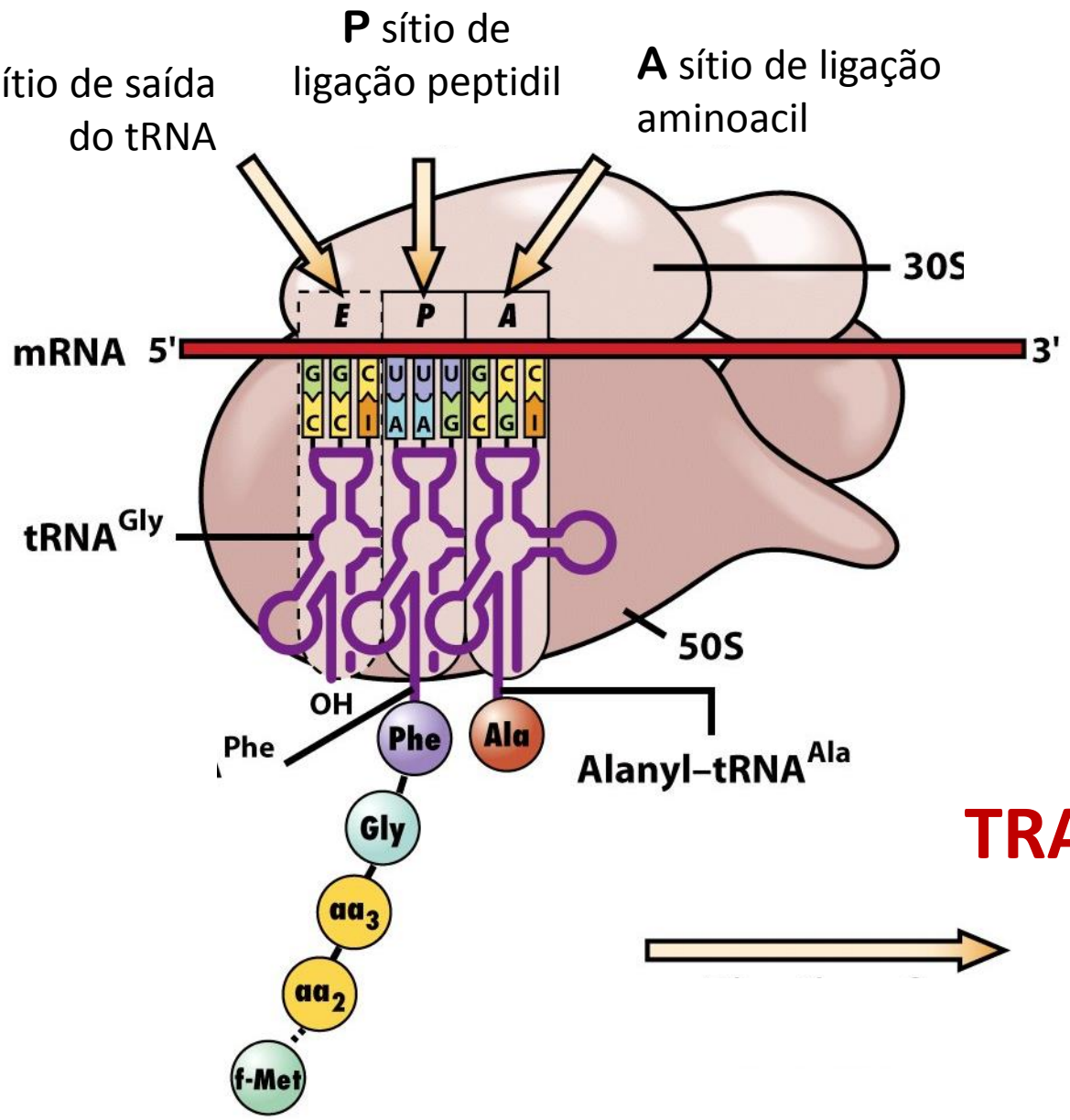
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DOBRAMENTO DE PROTEÍNAS

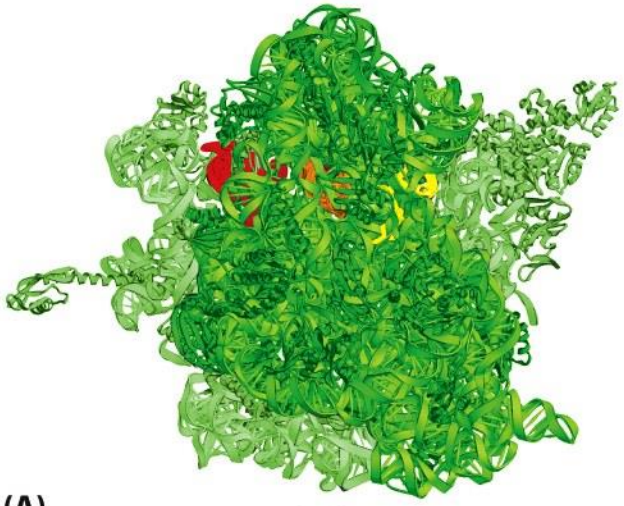
Vários polipeptideos auxiliam o início da tradução!





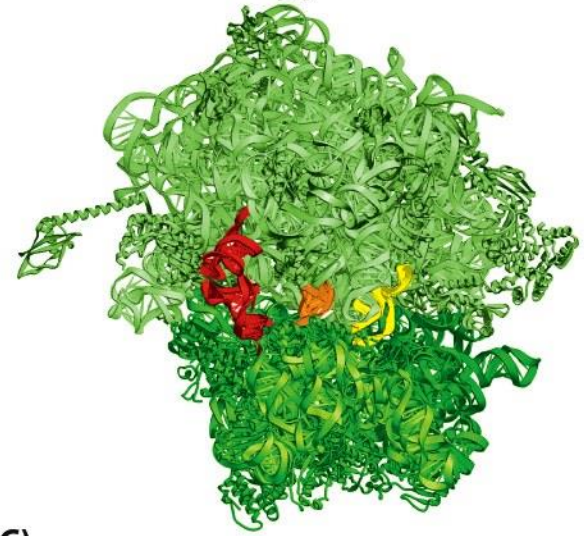
TRADUÇÃO

Figure 12-14a Principles of Genetics, 4/e
© 2006 John Wiley & Sons

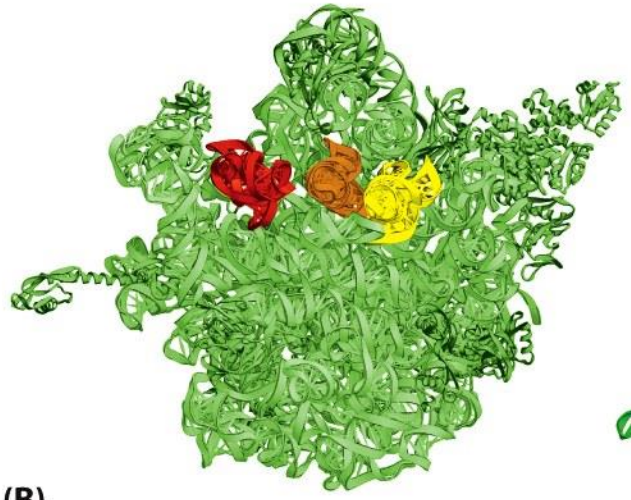


(A)

90°

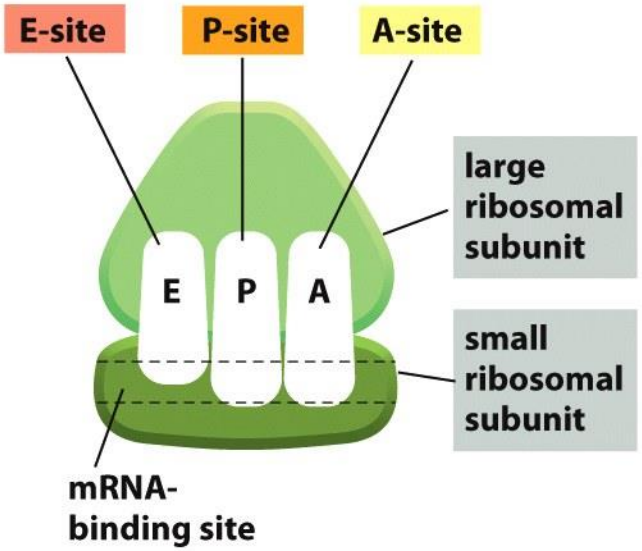


(C)





(B)



(D)

Figure 7-32 Essential Cell Biology 3/e (© Garland Science 2010)

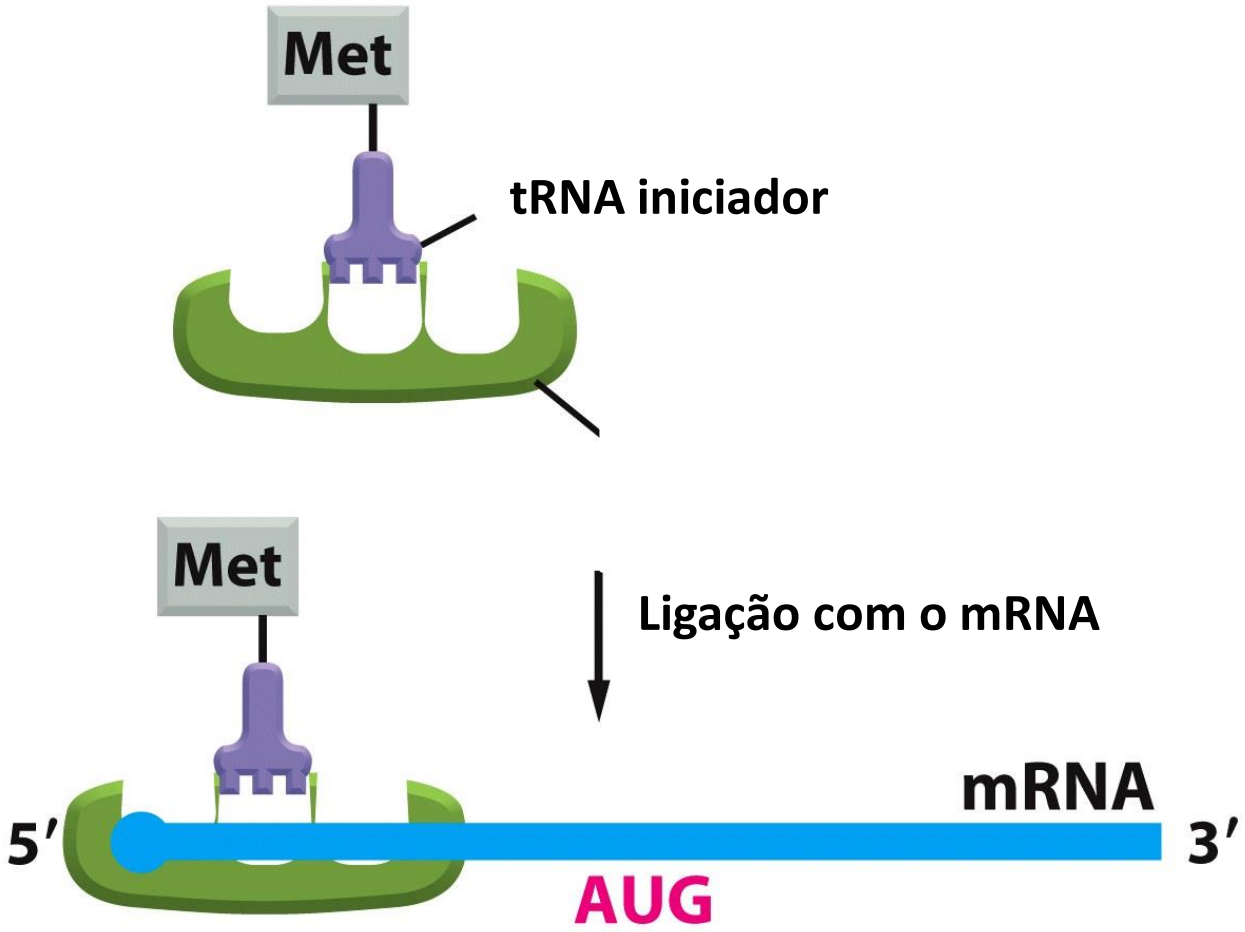


Figure 7-35 part 1 of 5 Essential Cell Biology 3/e (© Garland Science 2010)

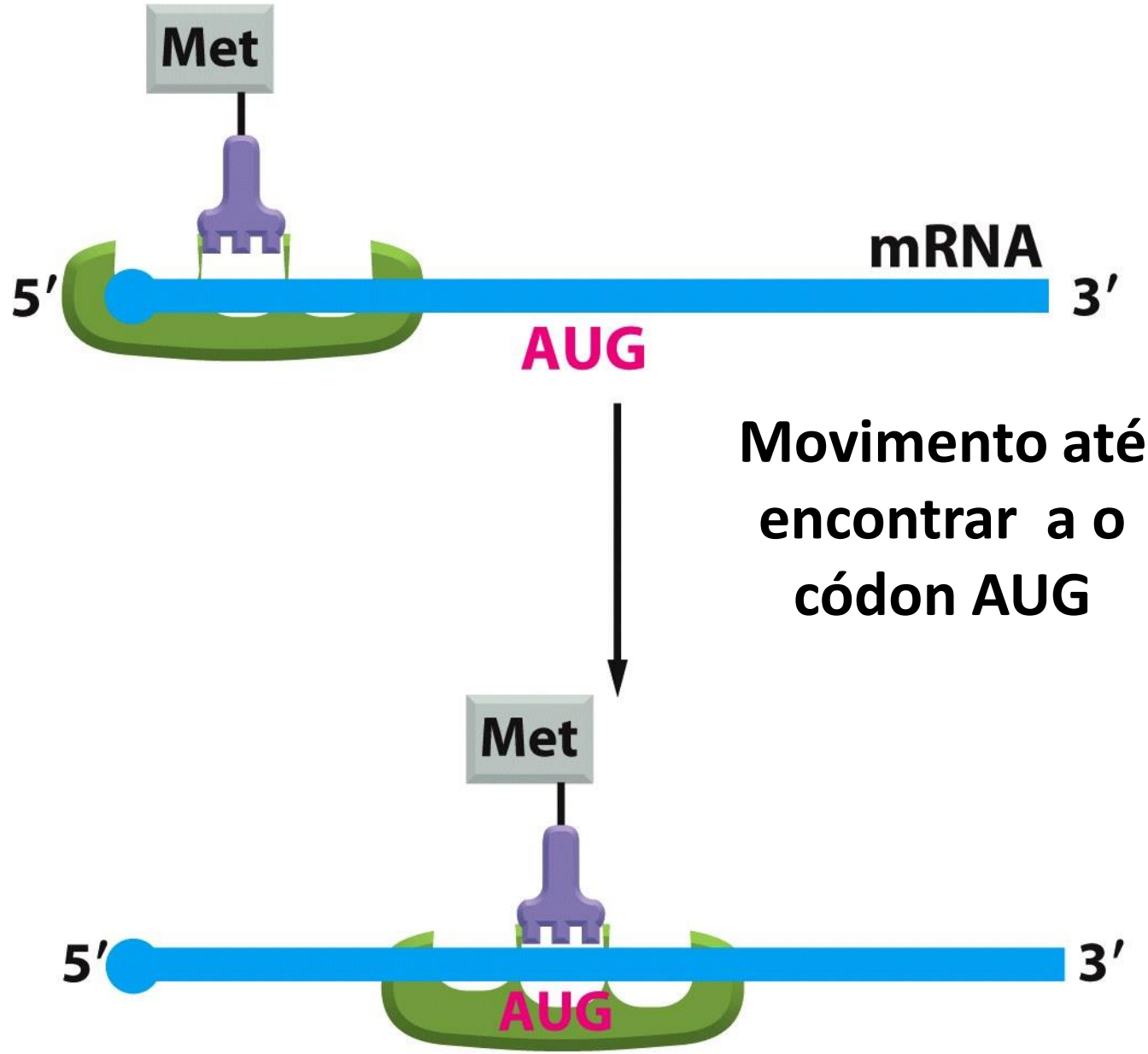


Figure 7-35 part 2 of 5 Essential Cell Biology 3/e (© Garland Science 2010)

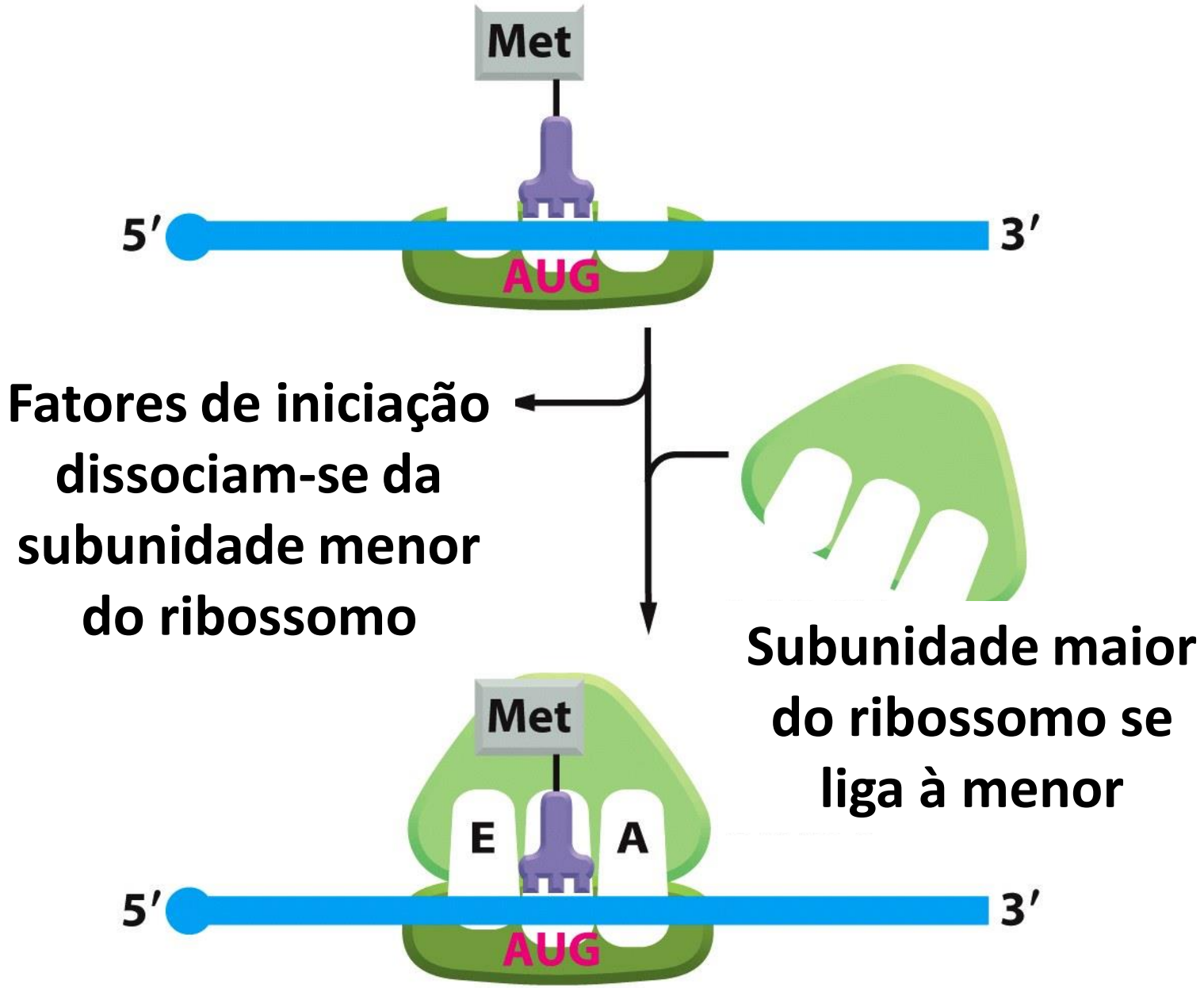
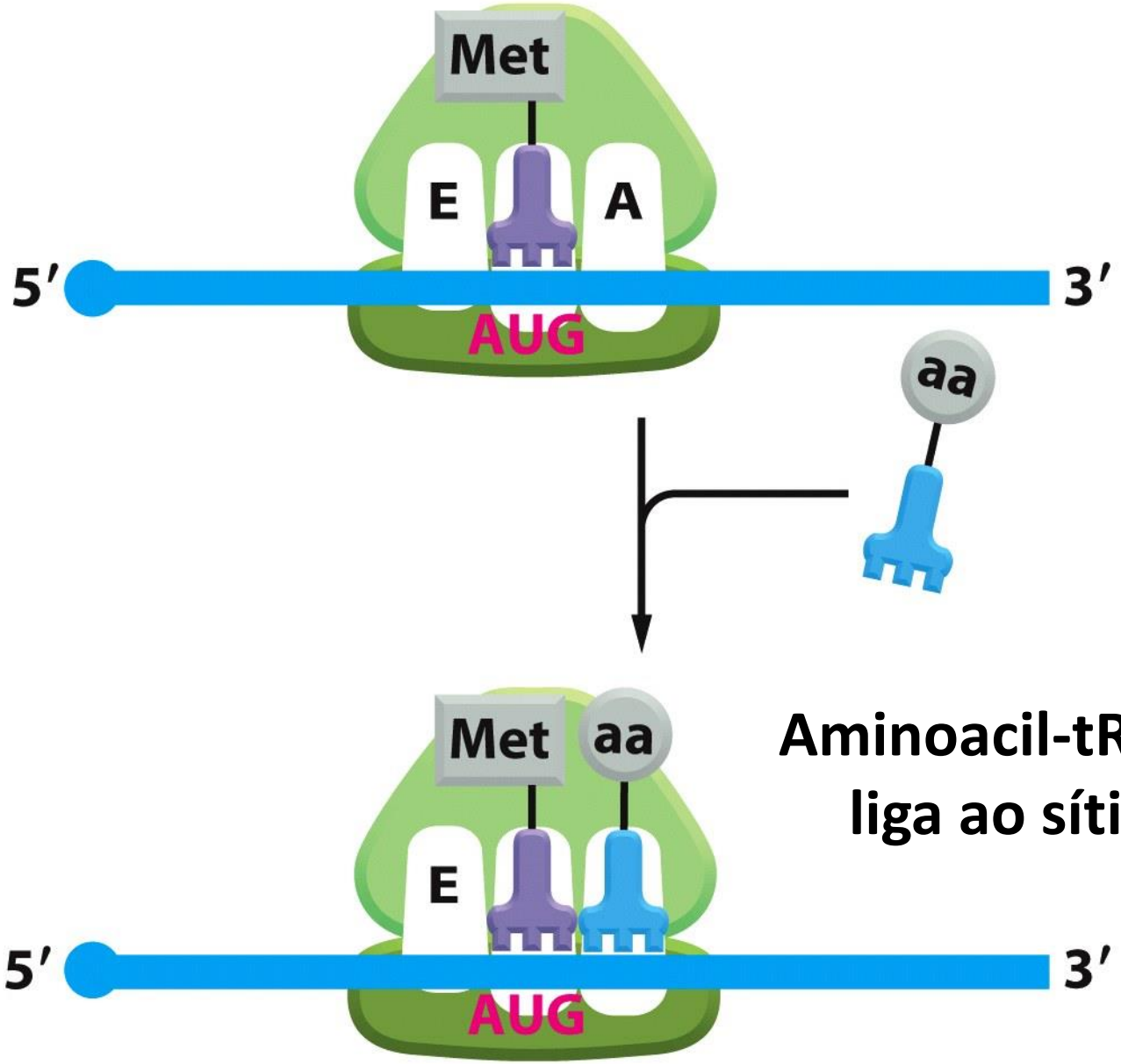
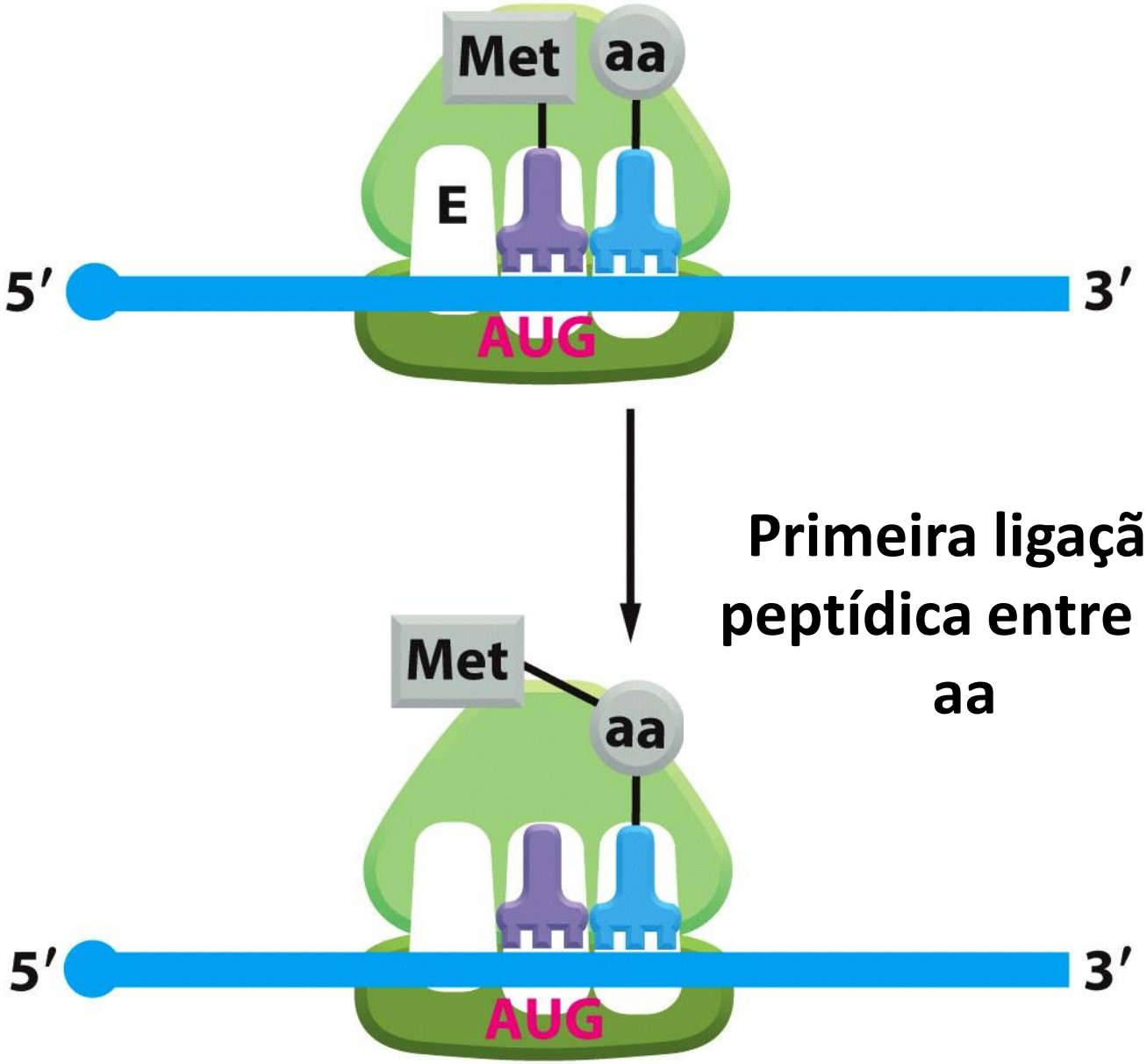


Figure 7-35 part 3 of 5 Essential Cell Biology 3/e (© Garland Science 2010)



Aminoacil-tRNa se liga ao sítio A

Figure 7-35 part 4 of 5 Essential Cell Biology 3/e (© Garland Science 2010)



Primeira ligação peptídica entre os aa

Figure 7-35 part 5 of 5 Essential Cell Biology 3/e (© Garland Science 2010)

E continuadamente....

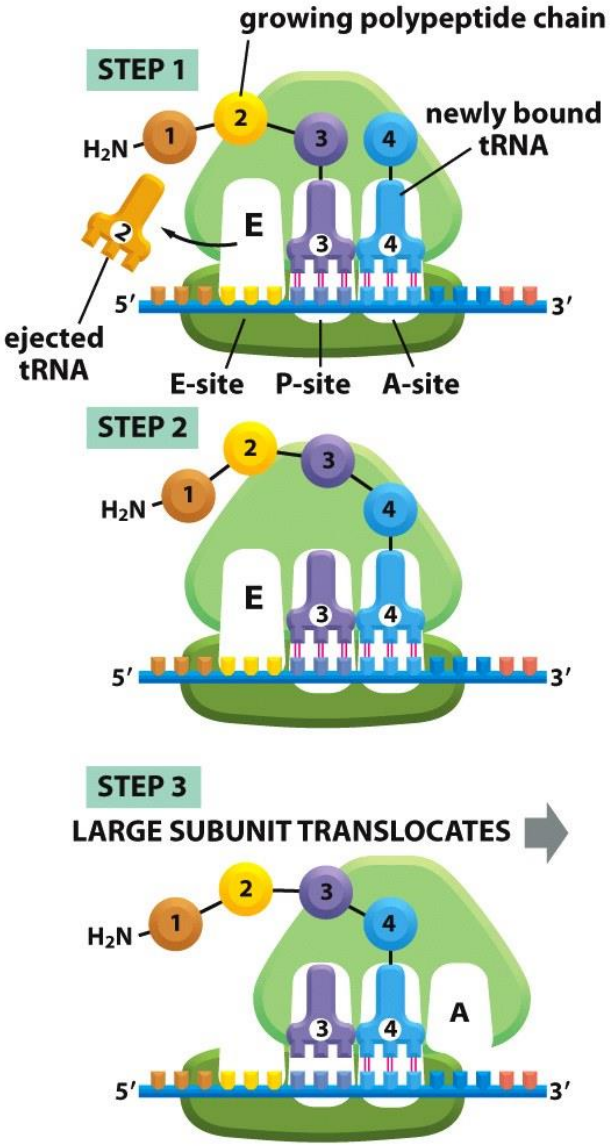
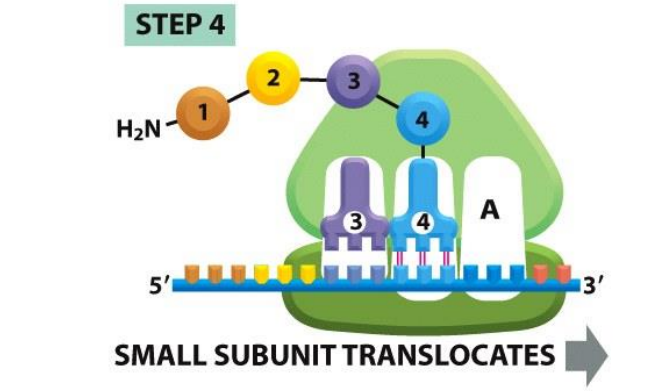
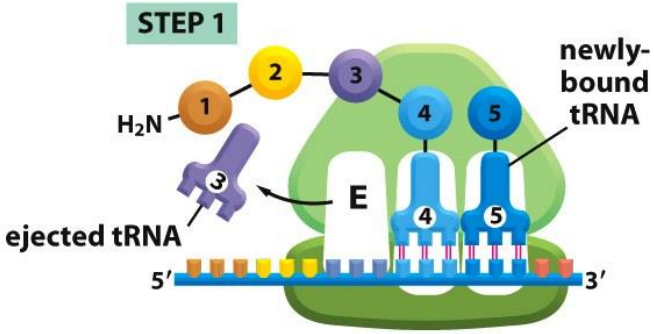
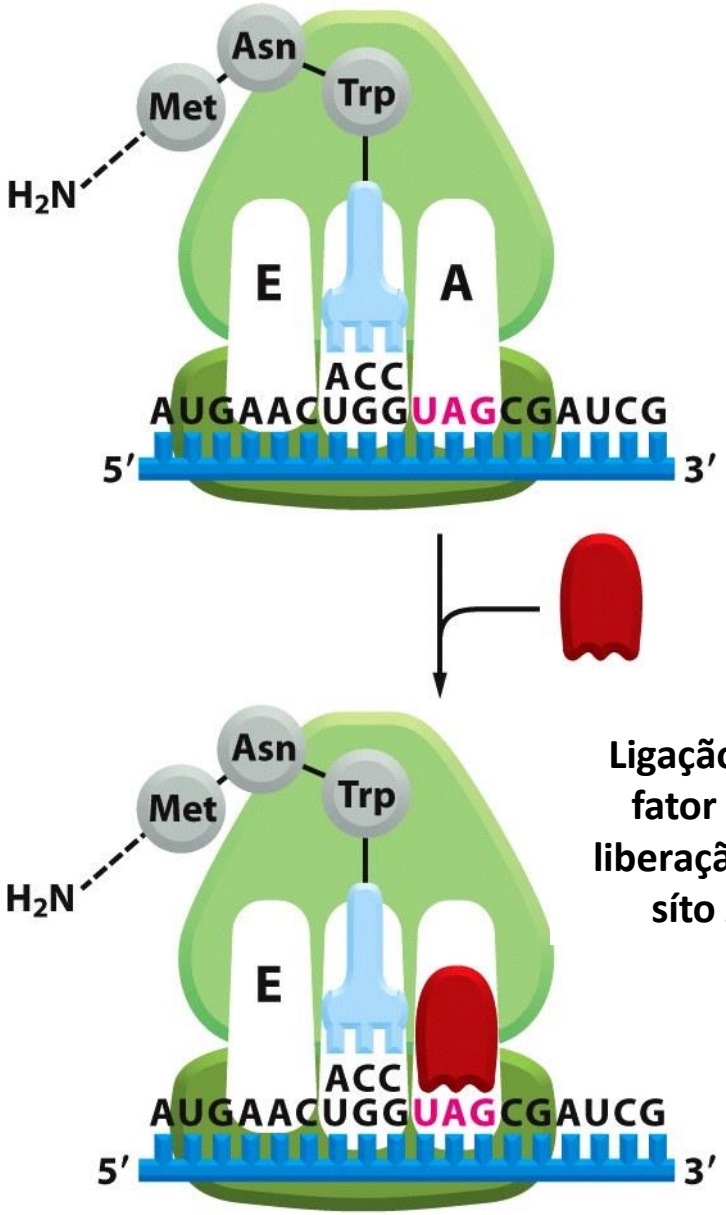


Figure 7-33 Essential Cell Biology 3/e (© Garland Science 2010)



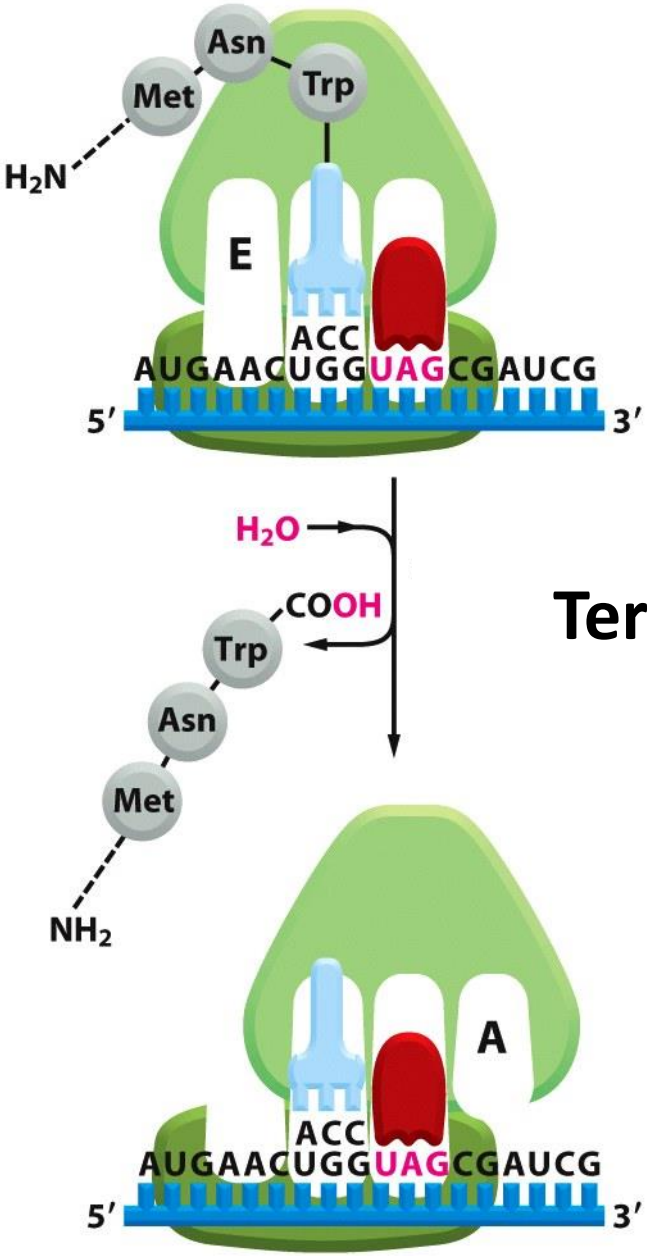


Vários fatores controlam a continuação da tradução!



Ligação do fator de liberação no síto A

Figure 7-37 part 1 of 3 Essential Cell Biology 3/e (© Garland Science 2010)



Terminação

Figure 7-37 part 2 of 3 Essential Cell Biology 3/e (© Garland Science 2010)

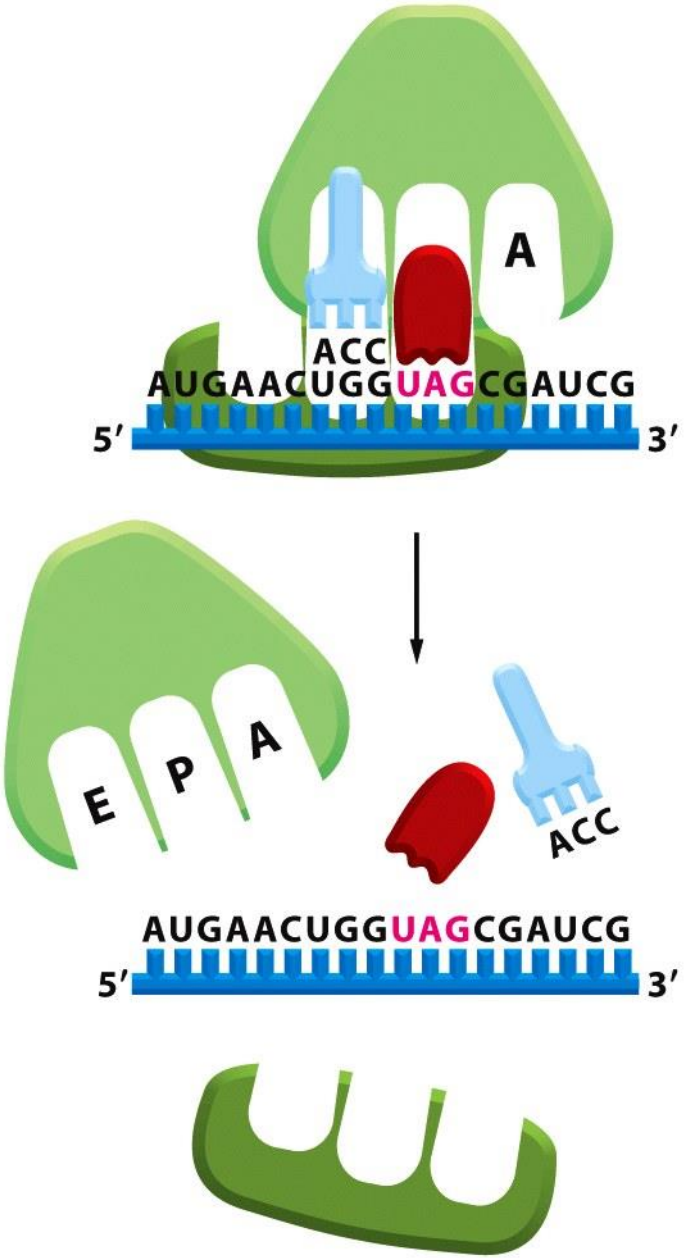
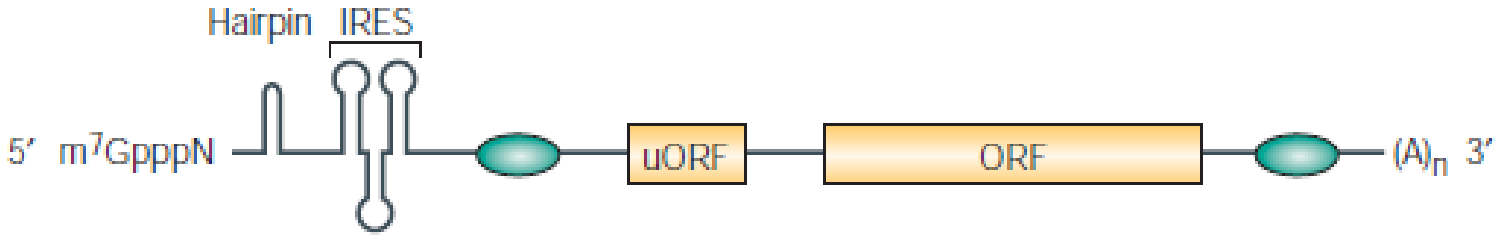
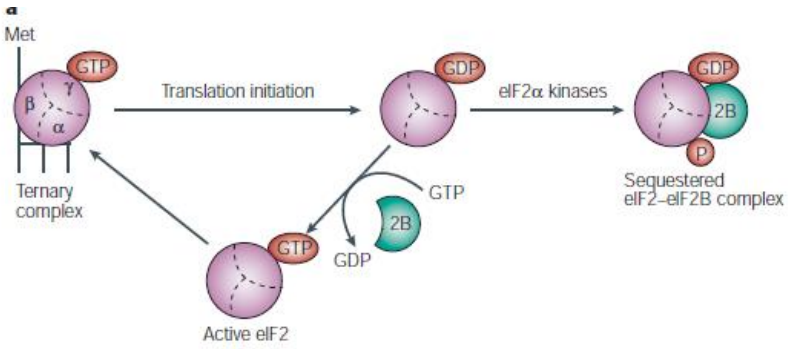
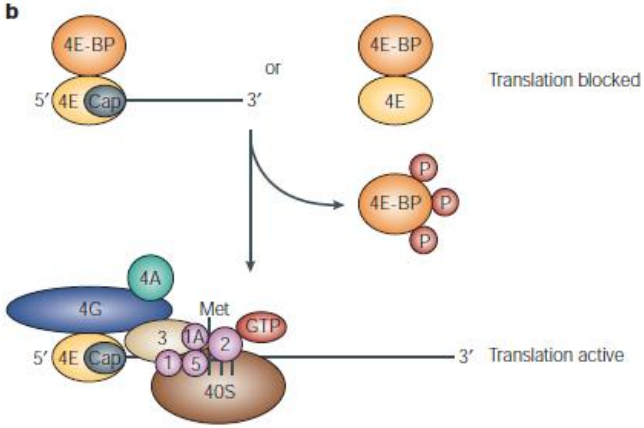


Figure 7-37 part 3 of 3 Essential Cell Biology 3/e (© Garland Science 2010)







MOLECULAR MECHANISMS OF TRANSLATIONAL CONTROL

Fátima Gebauer and Matthias W. Hentze‡*

Interferência de microRNAs é comum em complexos polirribossômicos!

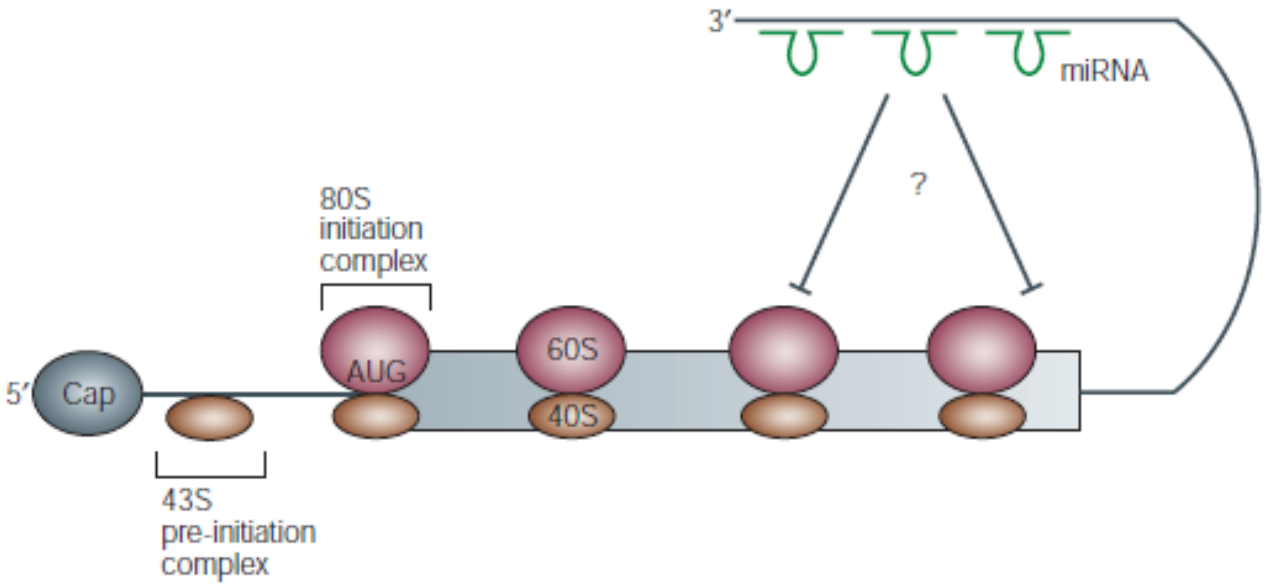
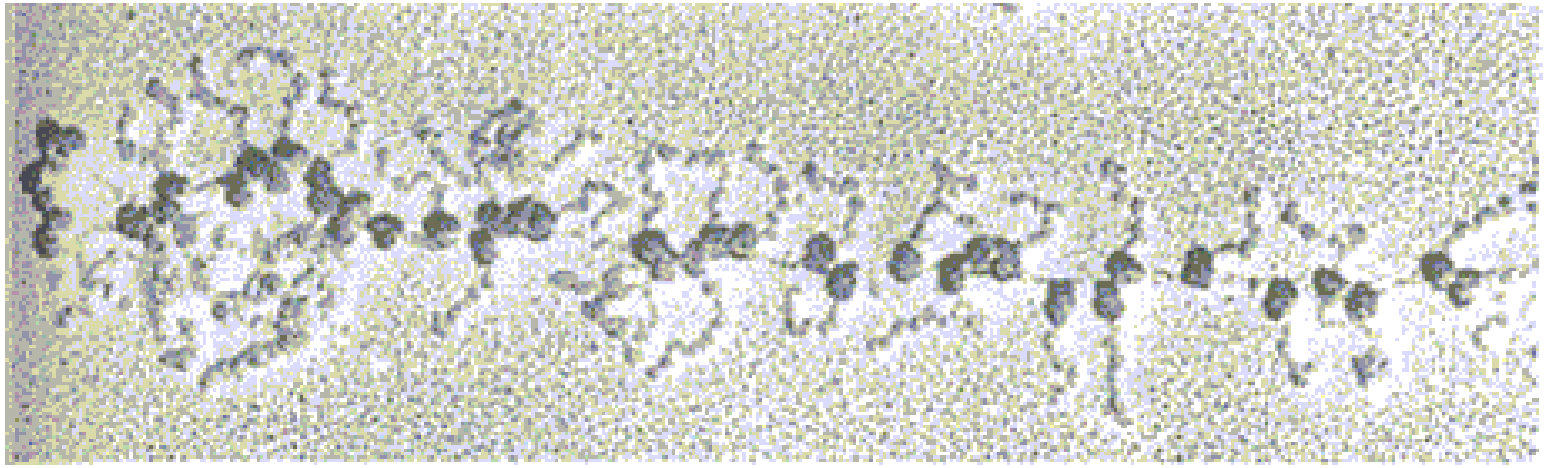
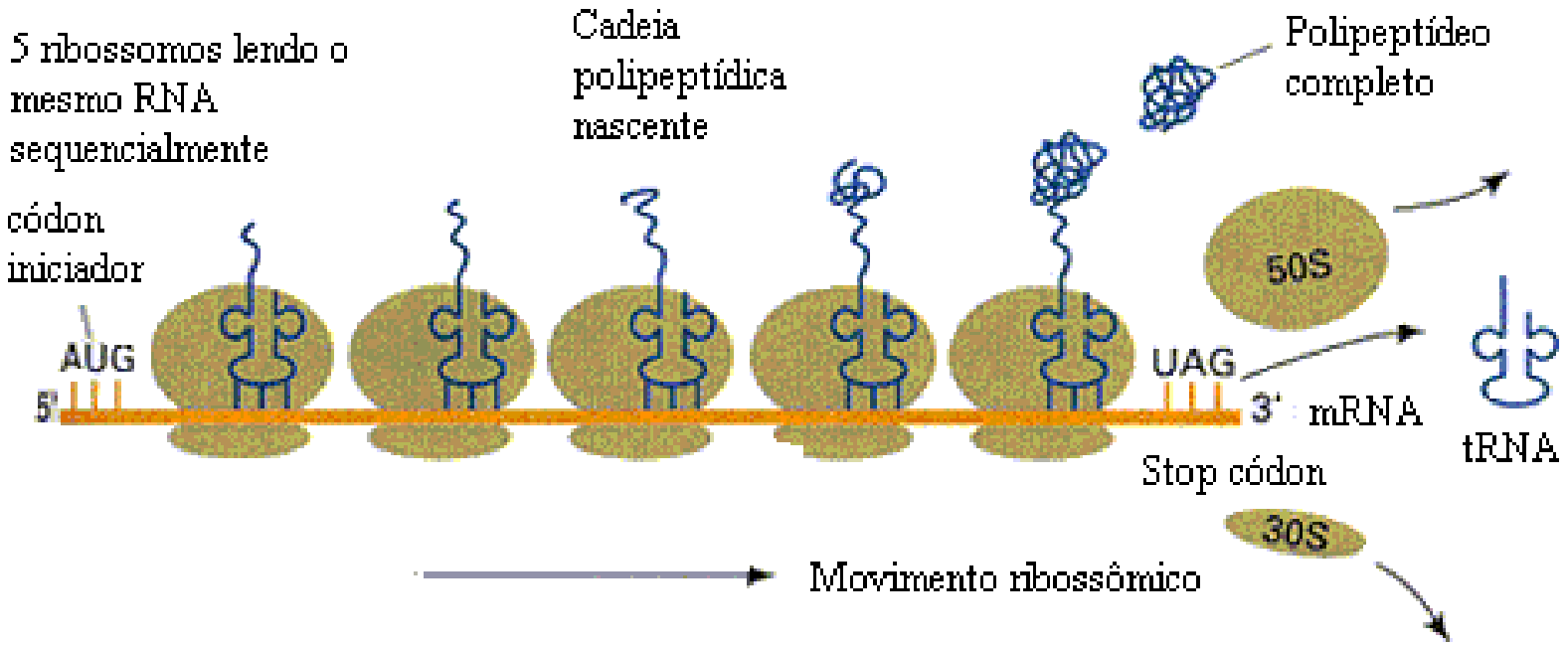
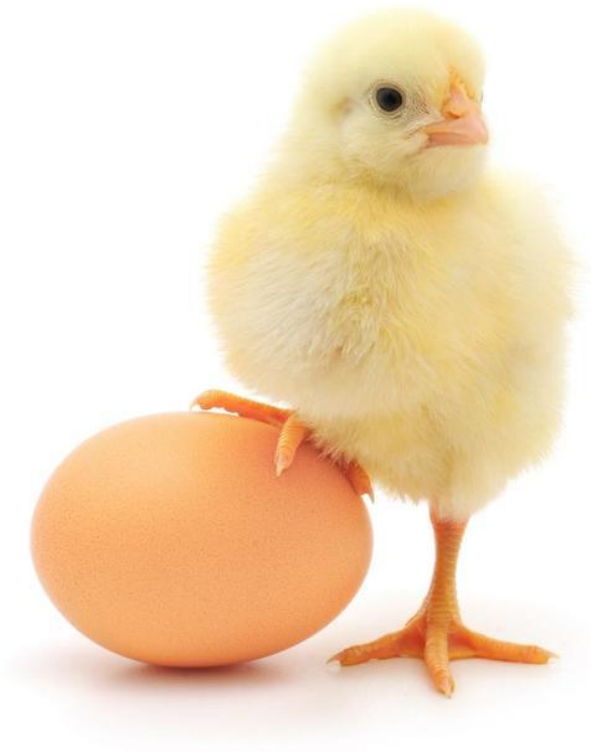


Figure 6 | **Translational control by micro RNAs.** Micro RNAs (miRNAs; shown in green) engage in imperfect base-pairing interactions with the 3′ untranslated region (UTR) and cause translational arrest. At present, evidence indicates that this occurs in polysomal complexes after the initiation of polypeptide synthesis.




5 ribossomos lendo o mesmo RNA sequencialmente
Cadeia polipeptídica nascente
Polipeptídeo completo
códon iniciador
AUG
5'
UAG
3'
mRNA
50S
tRNA
Stop códon
30S
Movimento ribossômico

QUEM VEIO PRIMEIRO RNA OU O DNA?



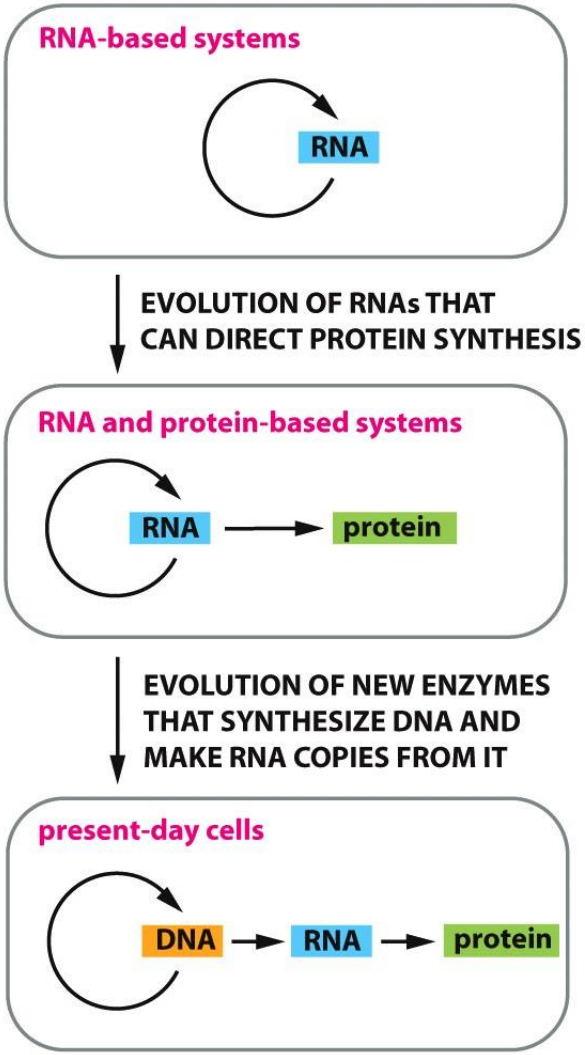


Figure 7-46 Essential Cell Biology 3/e (© Garland Science 2010)

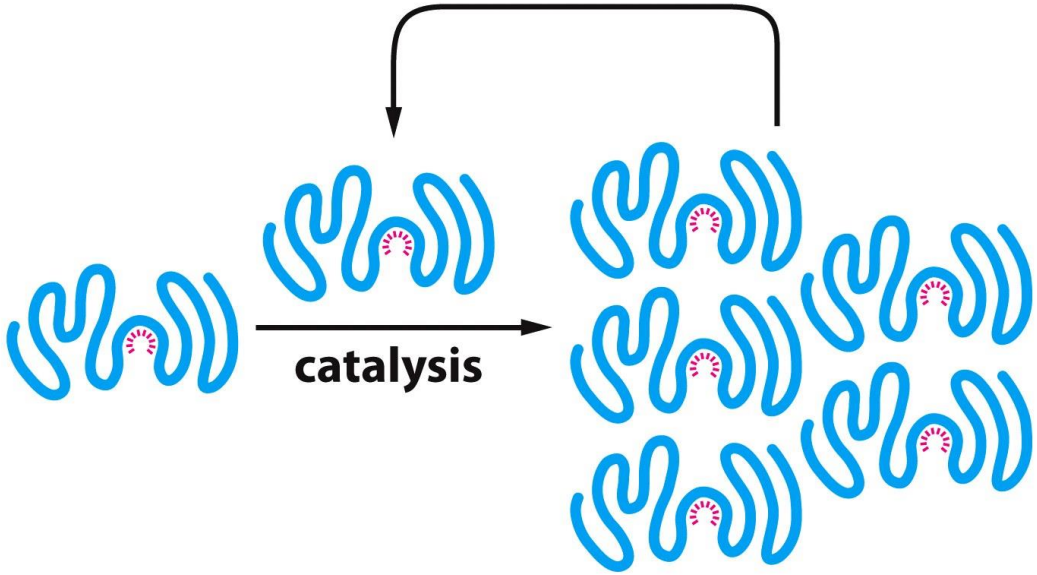


Figure 7-45 Essential Cell Biology 3/e (© Garland Science 2010)

TABLE 7–4 BIOCHEMICAL REACTIONS THAT CAN BE CATALYZED BY RIBOZYMES

ACTIVITY	RIBOZYMES
RNA cleavage, RNA ligation	self-splicing RNAs
DNA cleavage	self-splicing RNAs
Peptide bond formation in protein synthesis	ribosomal RNA
DNA ligation	*in vitro* selected RNA
RNA splicing	self-splicing RNAs, RNAs of the spliceosome (?)
RNA polymerization	*in vitro* selected RNA
RNA phosphorylation	*in vitro* selected RNA
RNA aminoacylation	*in vitro* selected RNA
RNA alkylation	*in vitro* selected RNA
C–C bond rotation (isomerization)	*in vitro* selected RNA

Table 7-4 Essential Cell Biology 3/e (© Garland Science 2010)

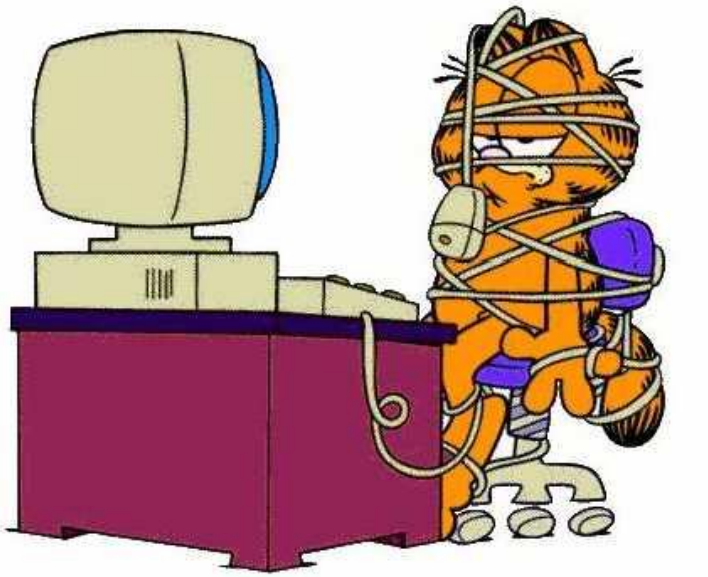
VISUALIZANDO O PROCESSO…

http://www.youtube.com/watch?v=983lhh20rGY&feature=related

http://www.youtube.com/watch?v=-ygpqVr7_xs&feature=related

http://www.biostudio.com/demo_freeman_protein_synthesis.htm

http://www.youtube.com/watch?v=DcCnmPeutP4



ESTUDO DIRIGIDO

1. Definição de gene e suas regiões;
2. Diferença na estrutura dos genes de eucariotos e procariotos;
3. Região promotora e sua importância para a transcrição em eucariotos e procariotos;
4. Processamento do RNA mensageiro
5. Componentes da tradução;
6. Características gerais da tradução;
7. Código genético;

