

Academie toegepaste biowetenschappen en chemie

# Life science



2. Van gen naar eiwit

# Agenda

Hoofdstuk	Onderwerp	Planning
21	Viruses	Week 1
15	From Gene to Protein	Week 2
16	Regulation of Gene Expression	Week 3
18	How evolution works	Week 4
19	Microevolution	Week 5
18	Species and speciation	Week 6
	Uitloop	Week 7

# Week 2

Transcriptie

Translatie

Verschillen tussen pro- en eukaryoten

# Overzicht

[15.1 The Genetic Code](#)

[15.2 Prokaryotic Transcription](#)

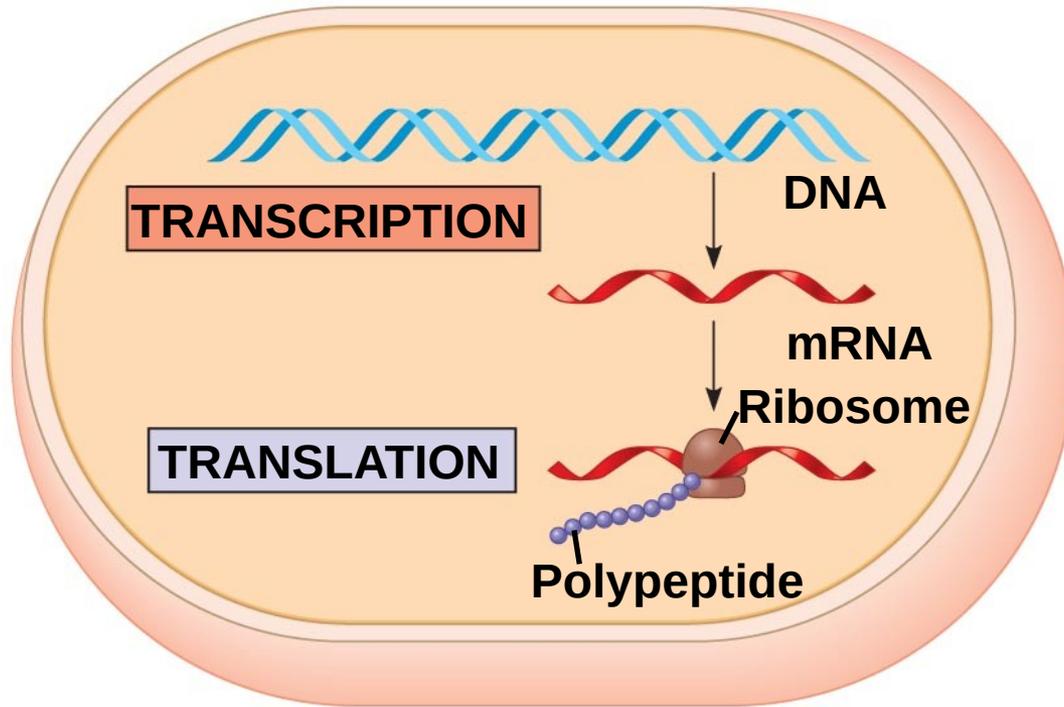
[15.3 Eukaryotic Transcription](#)

[15.4 RNA Processing in Eukaryotes](#)

[15.5 Ribosomes and Protein Synthesis](#)

# Van Gen naar RNA naar Eiwit

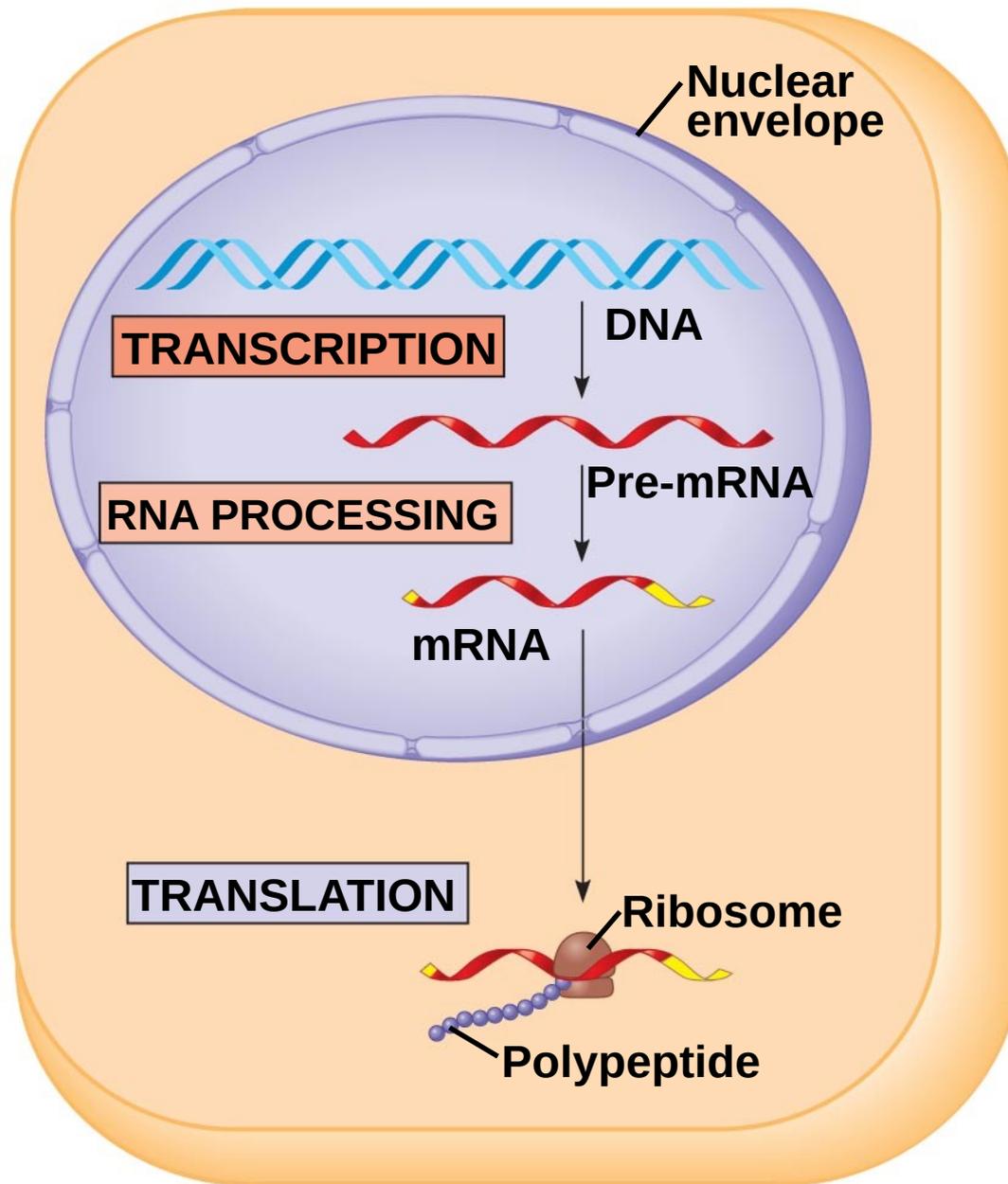
Het centrale dogma van de biologie



**(a) Bacterial cell**

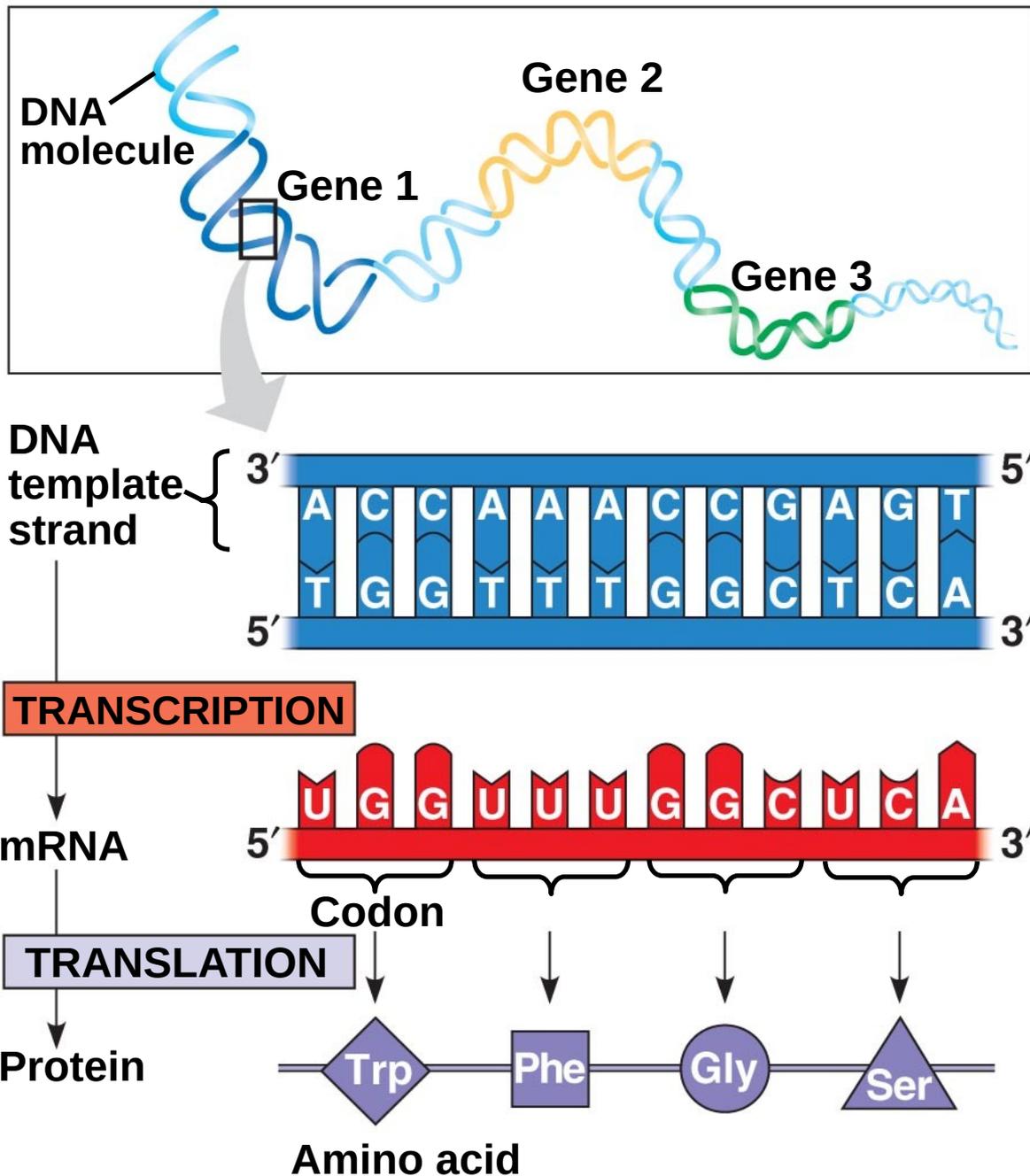
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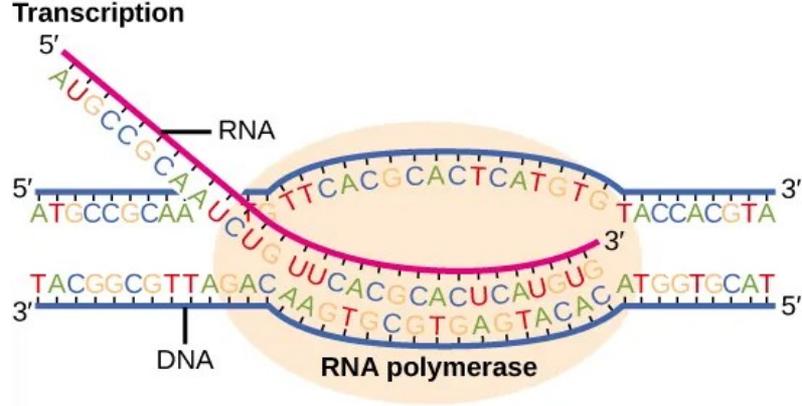
Fig. 17-3b-3



**(b) Eukaryotic cell**

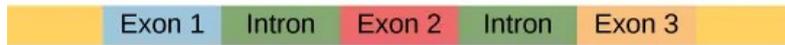
Fig. 17-4



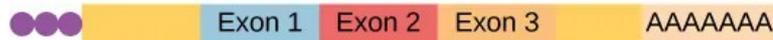


**RNA processing**

Primary RNA transcript



Spliced RNA



**Translation**

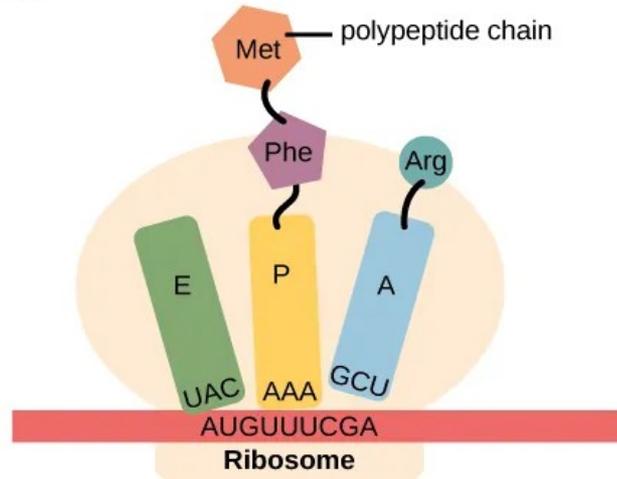


Fig. 17-5

		Second mRNA base						
		U	C	A	G			
First mRNA base (5' end of codon)	U	UUU	UCU	UAU	UGU	U		
		UUC	UCC	UAC	UGC			C
		UUA	UCA	UAA Stop	UGA Stop			A
		UUG	UCG	UAG Stop	UGG Trp			G
	C	CUU	CCU	CAU	CGU	U		
		CUC	CCC	CAC	CGC			C
		CUA	CCA	CAA	CGA			A
		CUG	CCG	CAG	CGG			G
	A	AUU	ACU	AAU	AGU	U		
		AUC	ACC	AAC	AGC			C
		AUA	ACA	AAA	AGA			A
		AUG Met or start	ACG	AAG	AGG			G
	G	GUU	GCU	GAU	GGU	U		
		GUC	GCC	GAC	GGC			C
		GUA	GCA	GAA	GGA			A
		GUG	GCG	GAG	GGG			G

Third mRNA base (3' end of codon)

# 17.2 Transcriptie

Fig. 17-7

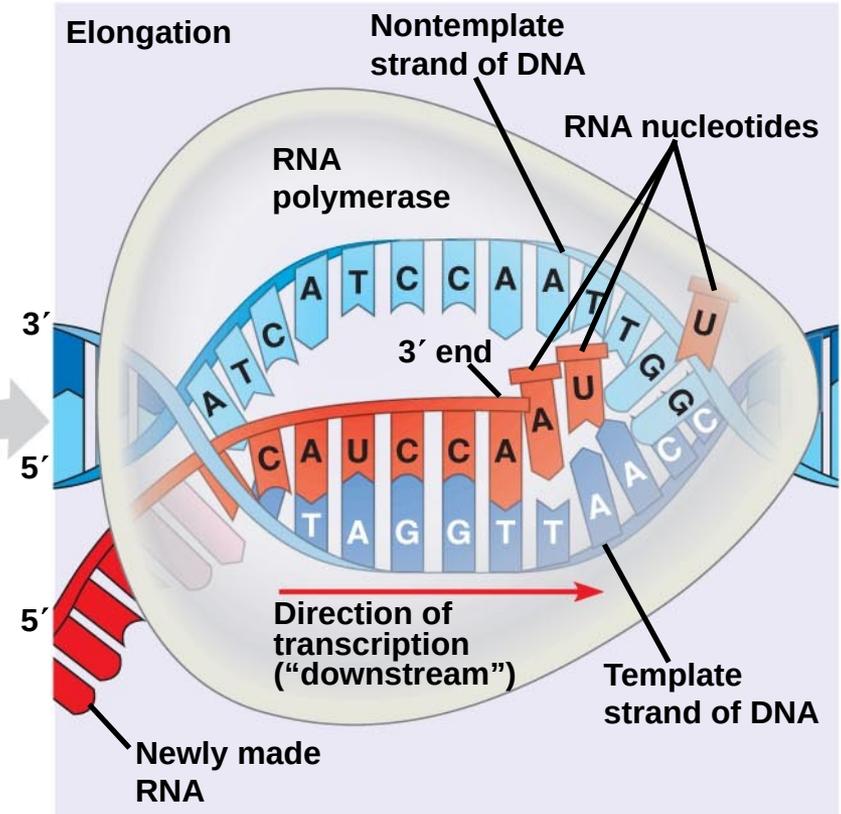
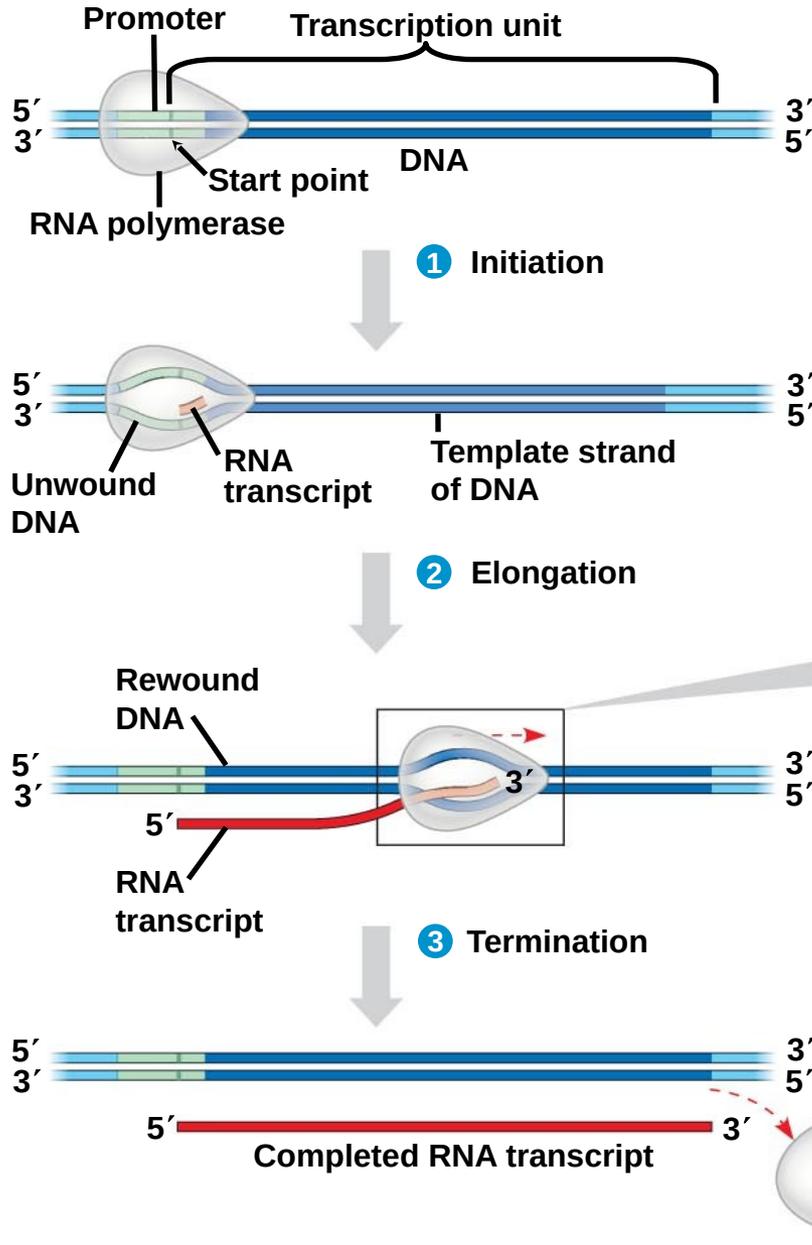


Fig. 17-7a-1

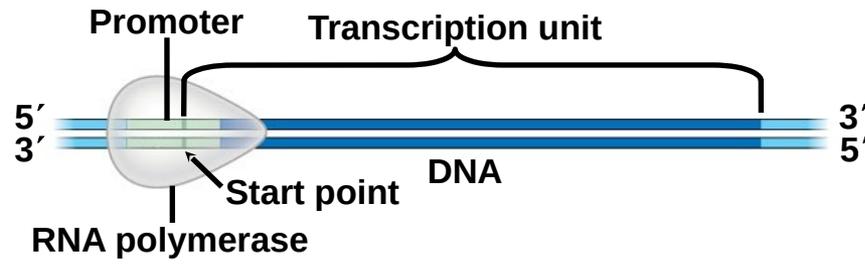


Fig. 17-7a-2

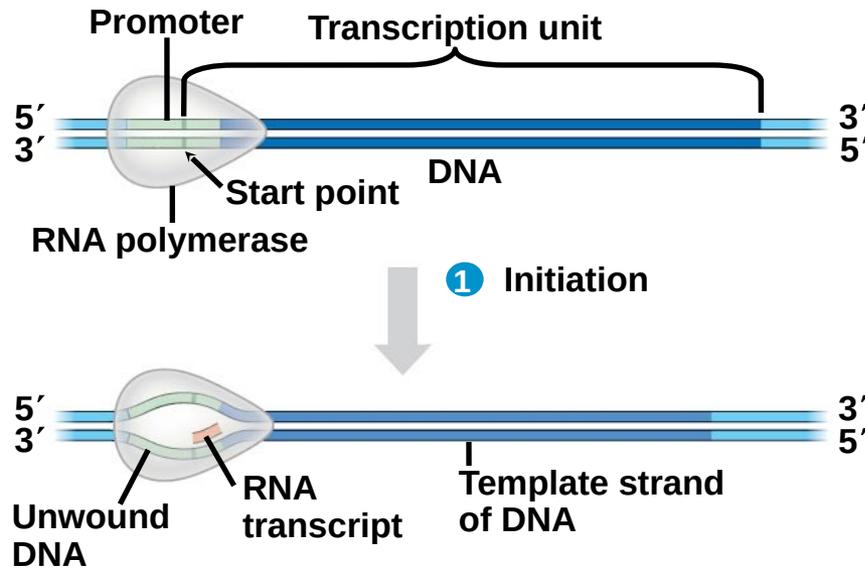


Fig. 17-7a-3

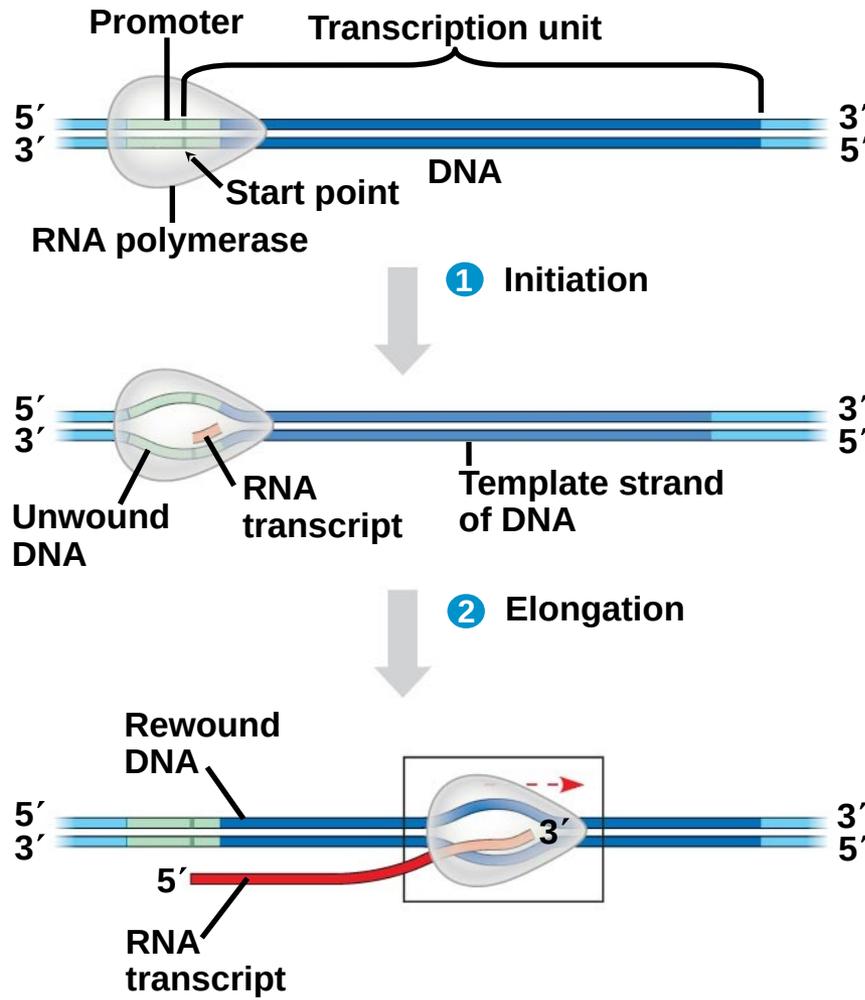


Fig. 17-7a-4

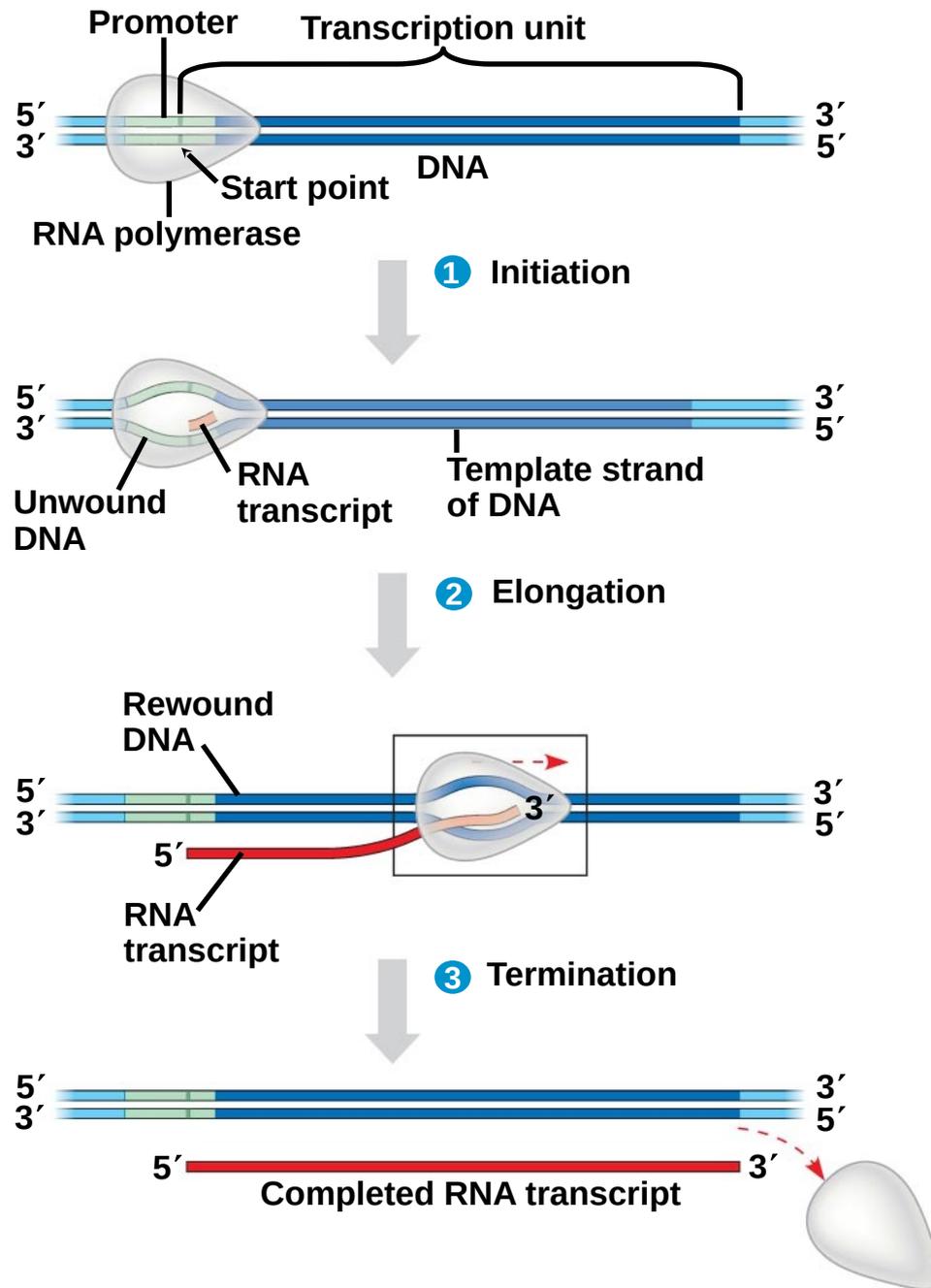
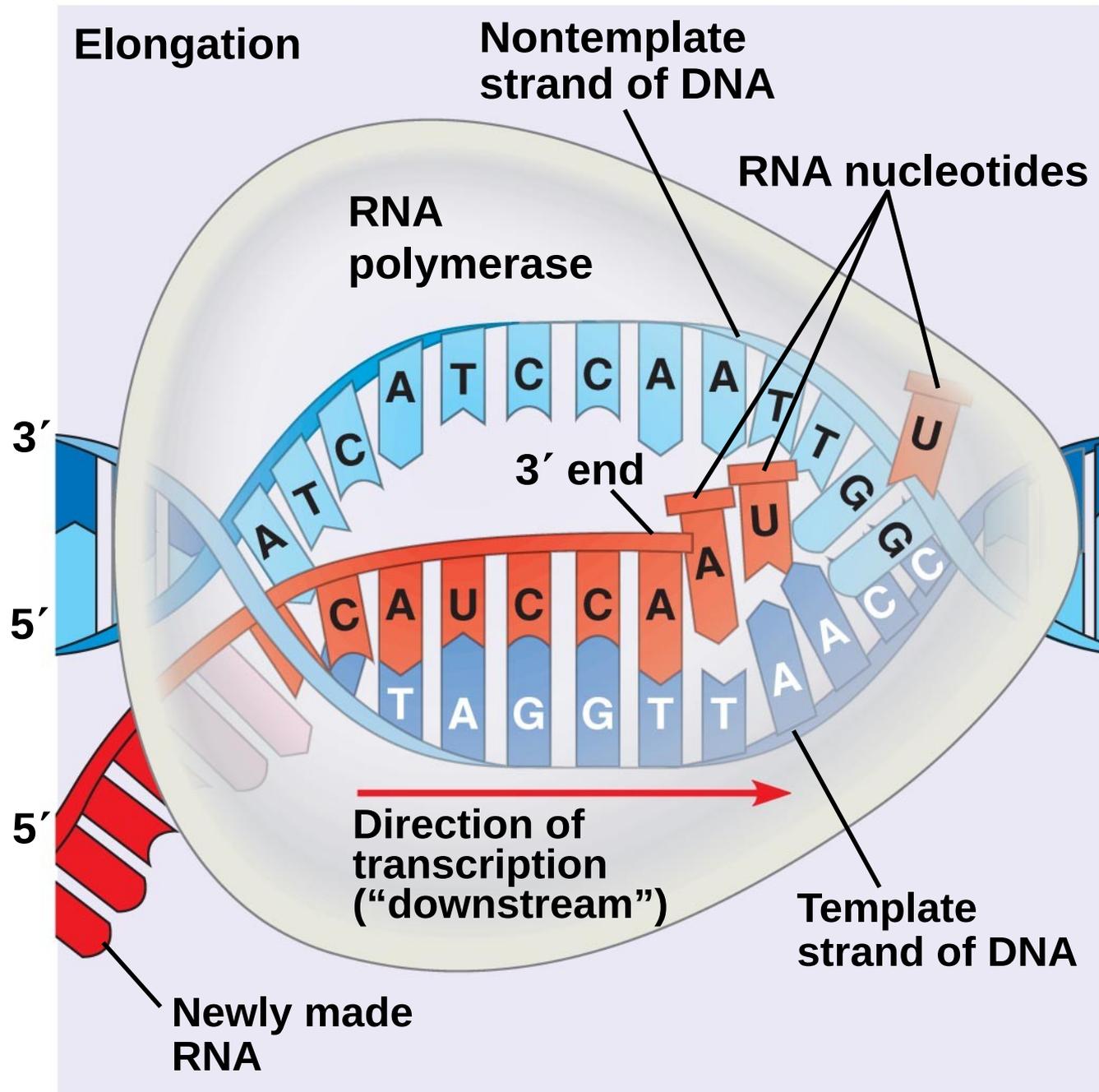


Fig. 17-7b



# Stadia

## De stadia van transcriptie

- Initiatie
- Elongatie
- Terminatie

# Initiatie

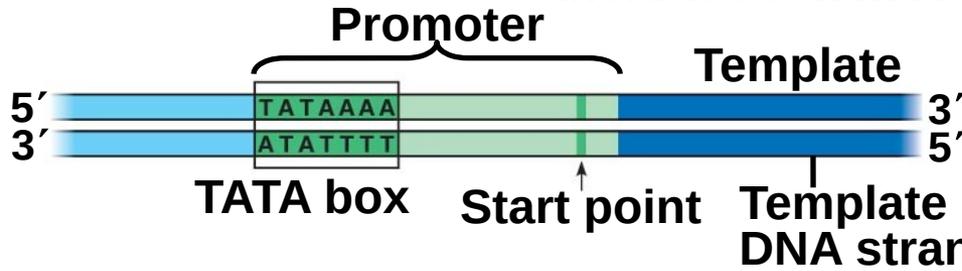
Of een transcriptie start is afhankelijk van verschillende factoren

Onder andere de aanwezigheid van transcriptiefactoren bepaalt of RNA-Polymerase II zal binden aan het DNA

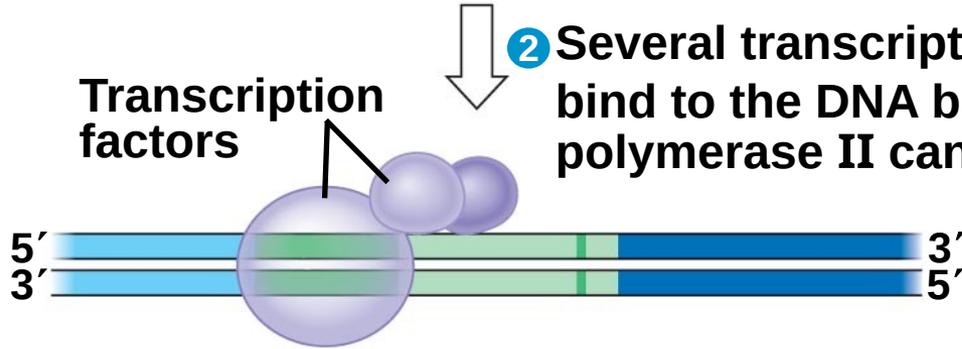
Zo kan een transcriptie initialisatie complex worden gevormd

In eukaryoten is vaak een promoter met TATA cruciaal voor initialisatie

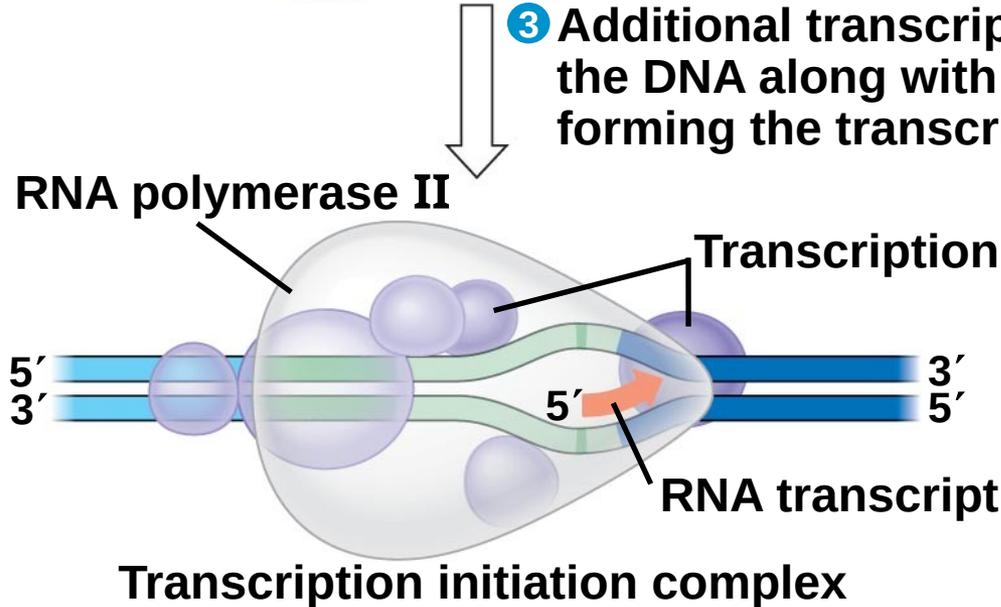
1 A eukaryotic promoter includes a TATA box



2 Several transcription factors must bind to the DNA before RNA polymerase II can do so.



3 Additional transcription factors bind to the DNA along with RNA polymerase II, forming the transcription initiation complex.



# Eukaryoten modificeren RNA na transcriptie

# RNA processing

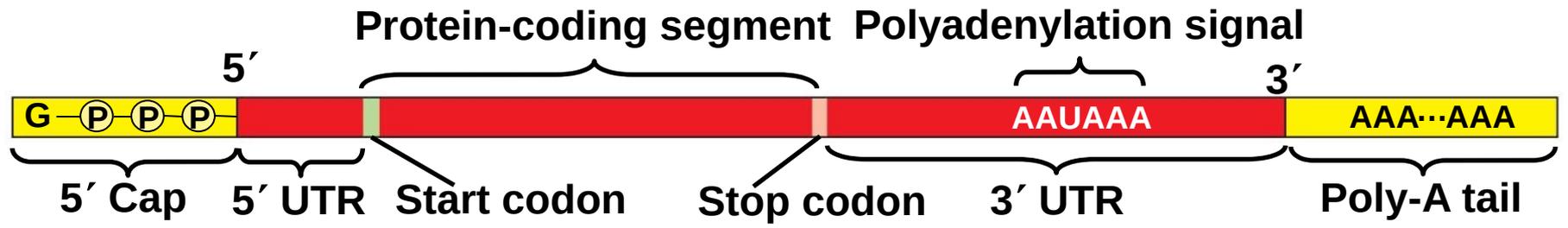
Na transcriptie vindt in eukaryoten modificatie van het pre-mRNA plaats

Deze modificaties tezamen wordt processing genoemd

# Processing

Wijzigingen aan 5' en 3' kant van mRNA  
Verwijderen van intronen

Fig. 17-9



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# Eukaryoten

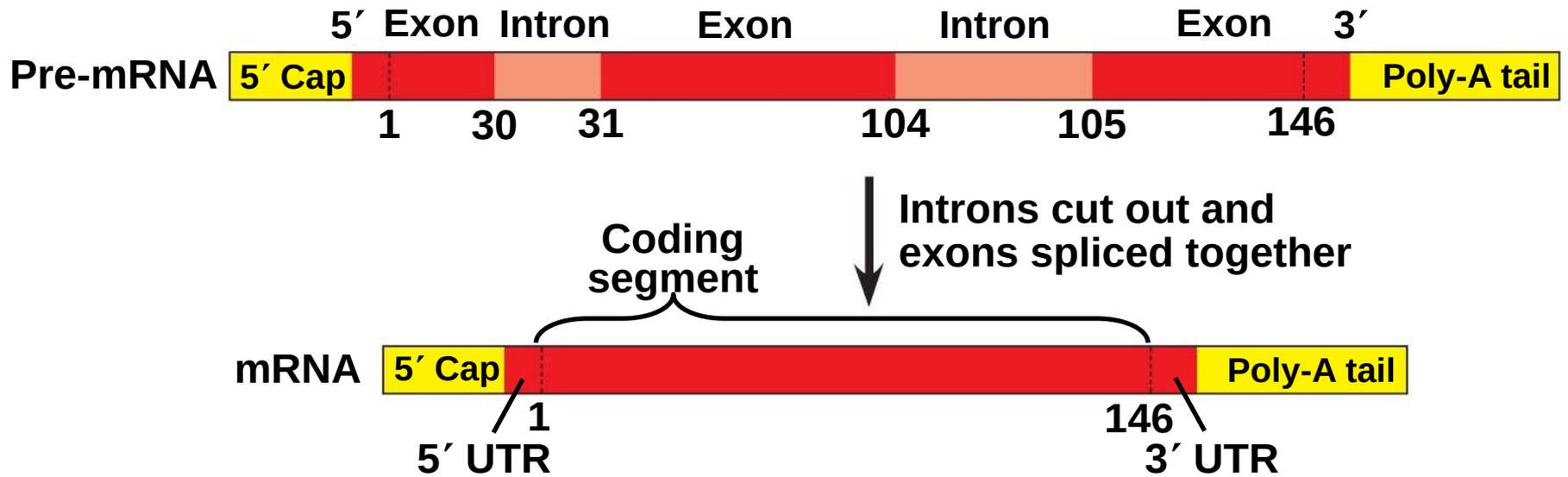
Eukaryotische genen bevatten niet coderende stukken intronen  
(**int**ervening **regi**ons)

De coderende stukken gen noemen we exonen (**ex**pressed **regi**ons)

# Splicing

Het proces van verwijderen van intronen uit genen noemen we splicing

Fig. 17-10

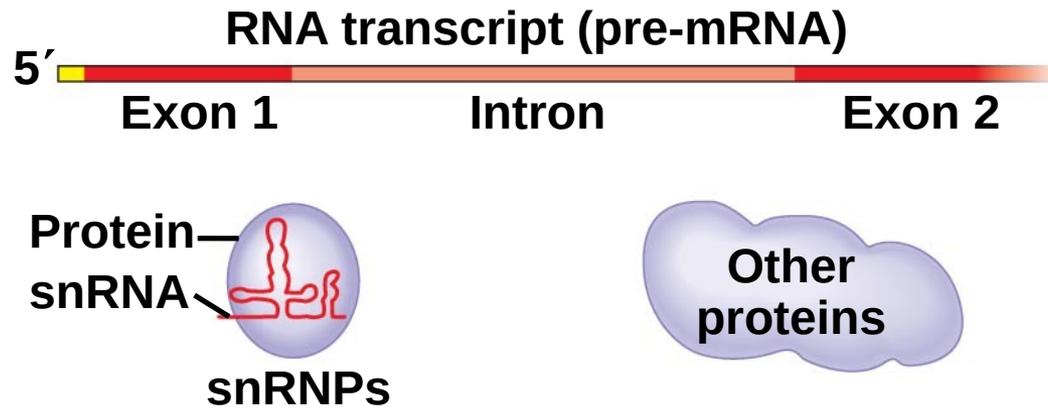


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# Spliceosomen

In een aantal gevallen zijn spliceosomen betrokken bij splicing

Fig. 17-11-1



*snRNP = small  
nuclear  
ribonucleo-  
proteins*

Fig. 17-11-2

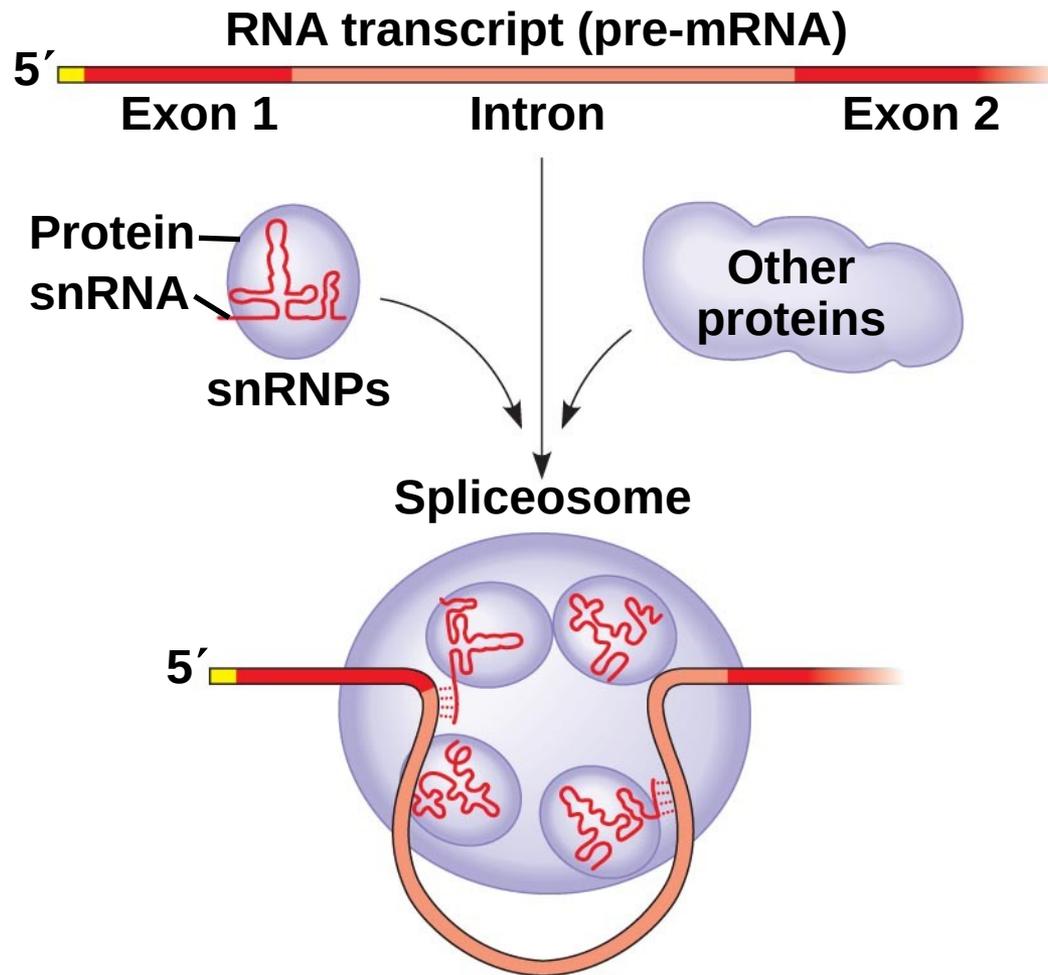


Fig. 17-11-3

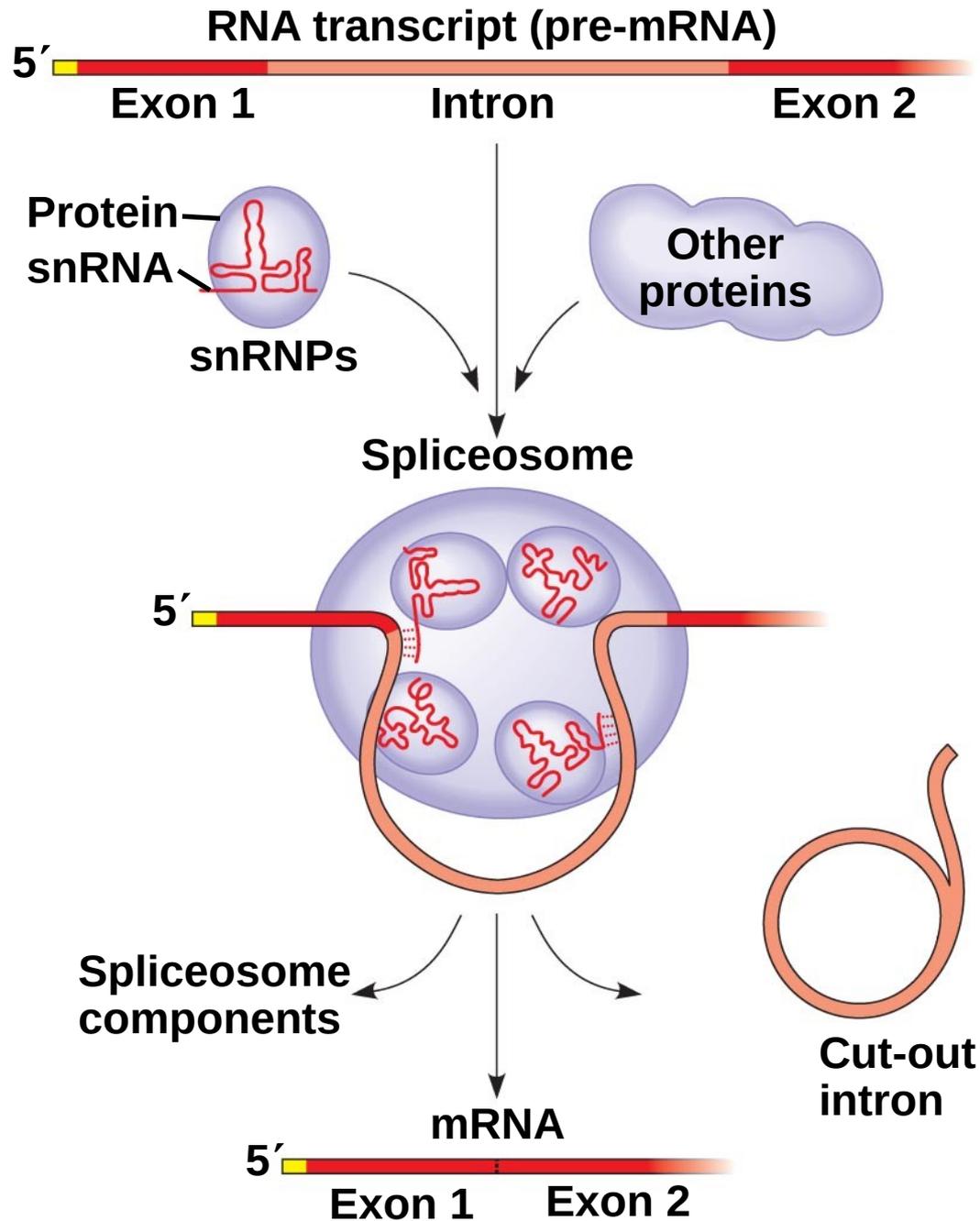
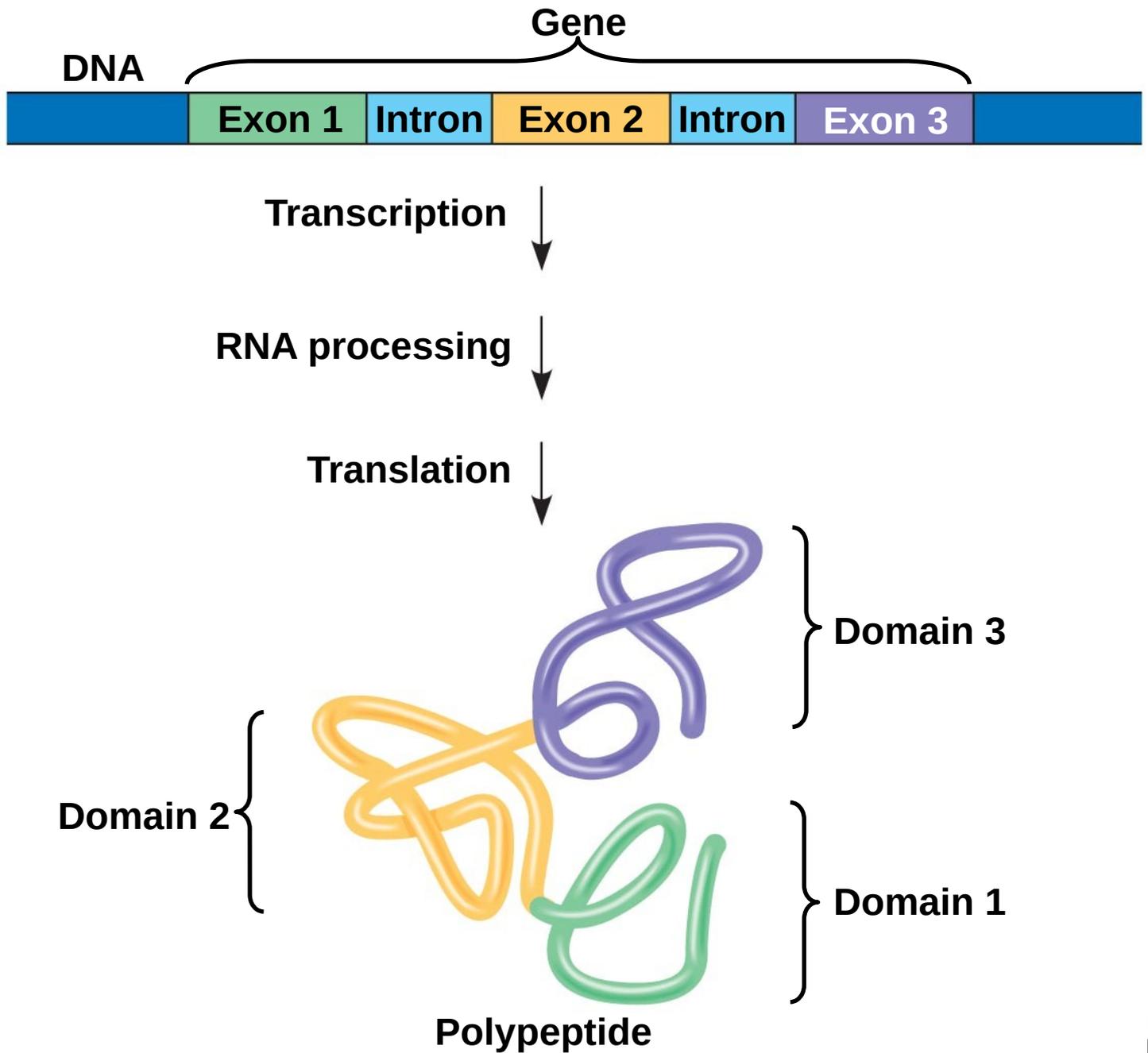
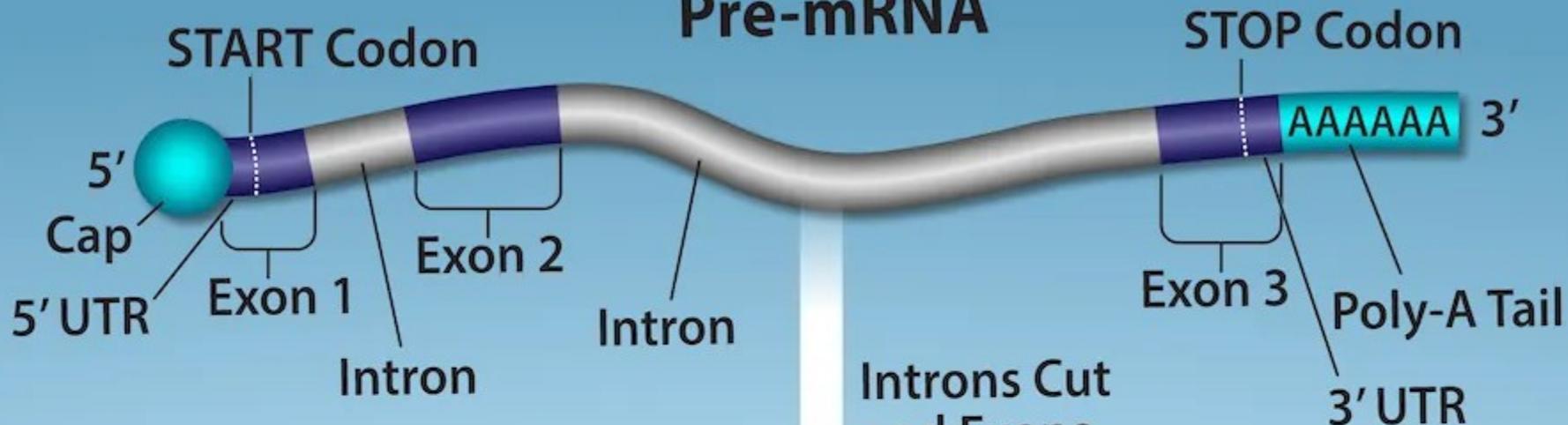


Fig. 17-12

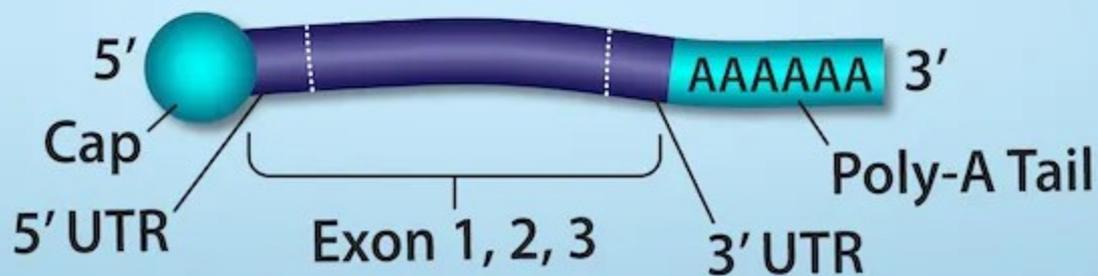


# Pre-mRNA



Introns Cut  
and Exons  
Spliced Together

# mRNA



# Translatie

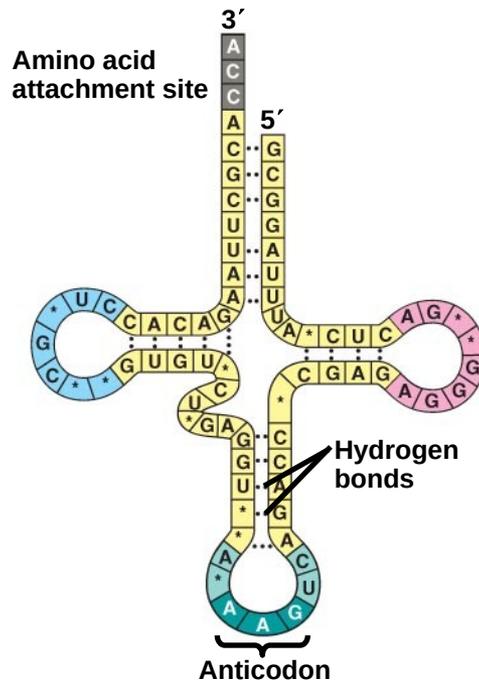
# Translatie

Translatie is de bouw van een polypeptiden op basis van de codering in het mRNA

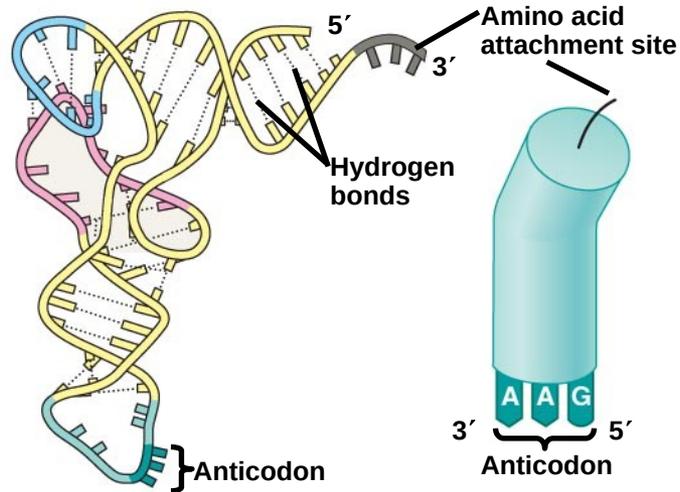
Hierbij zijn onder andere ribosomen en tRNA moleculen betrokken



Fig. 17-14

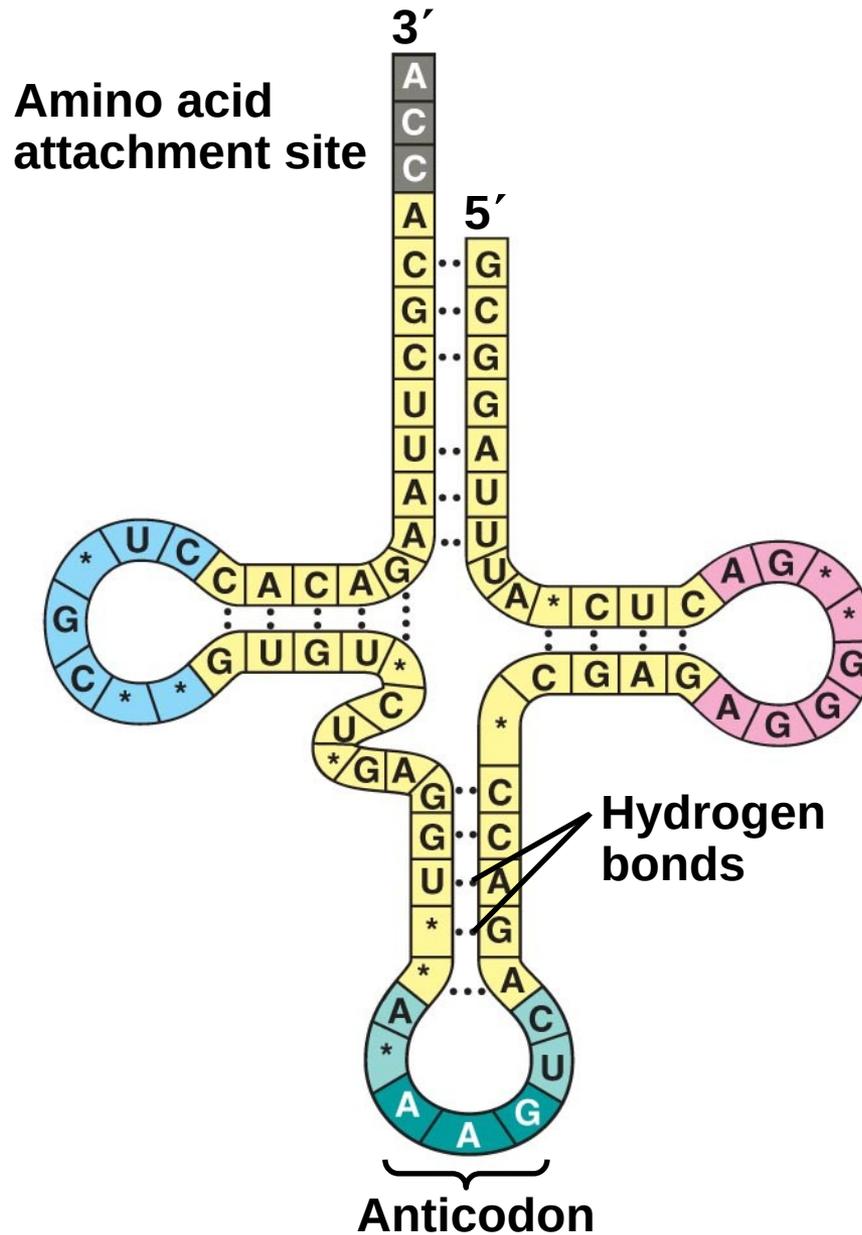


(a) Two-dimensional structure

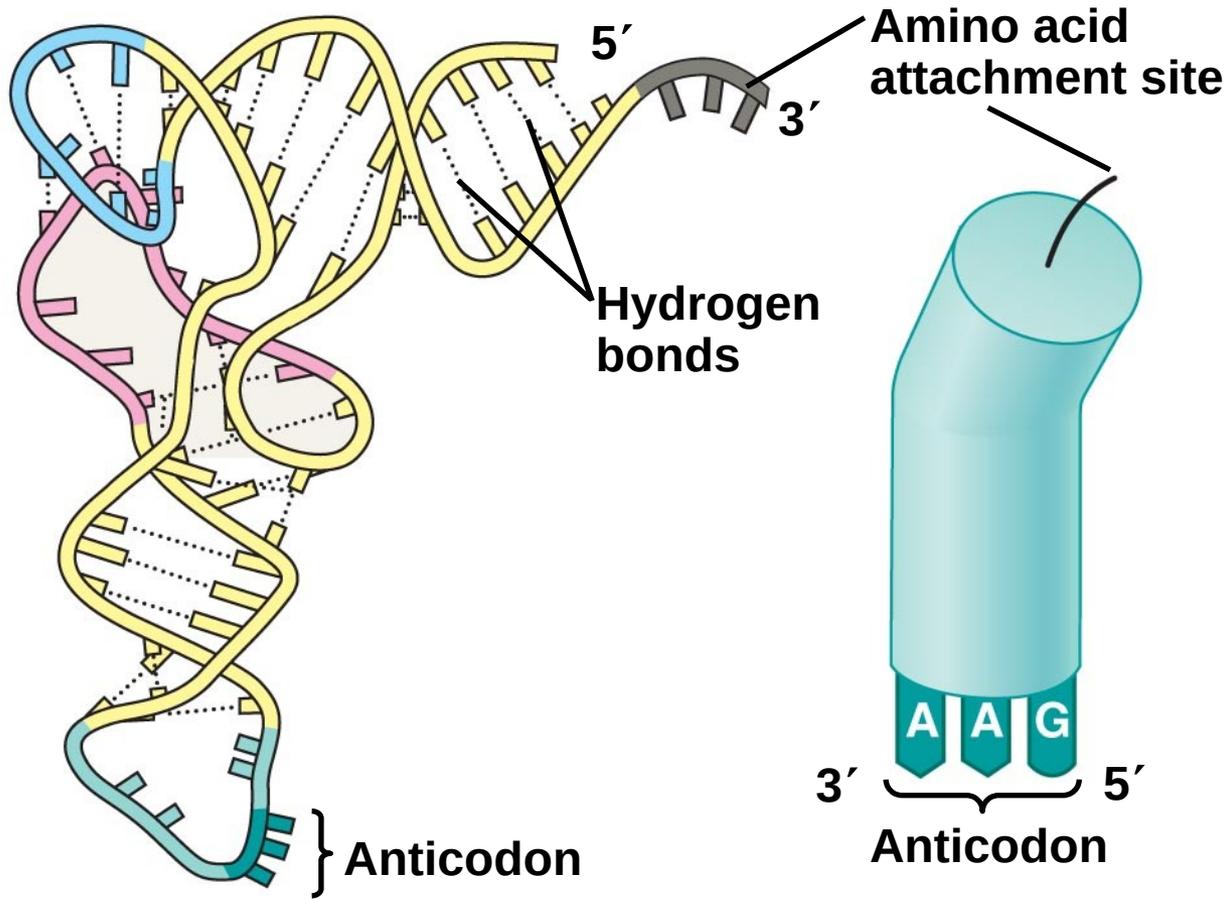


(b) Three-dimensional structure

(c) Symbol used in this book



**(a) Two-dimensional structure**

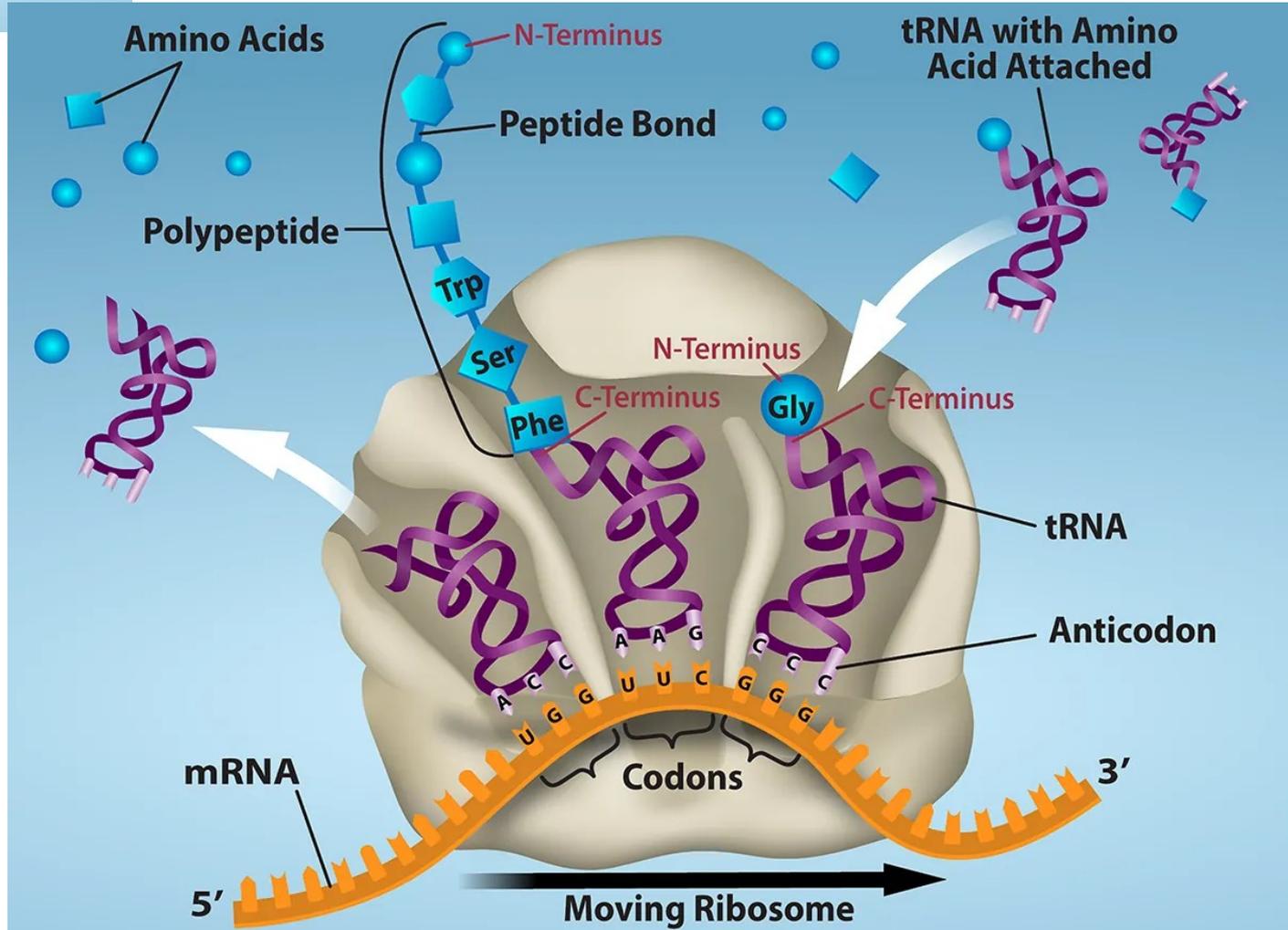
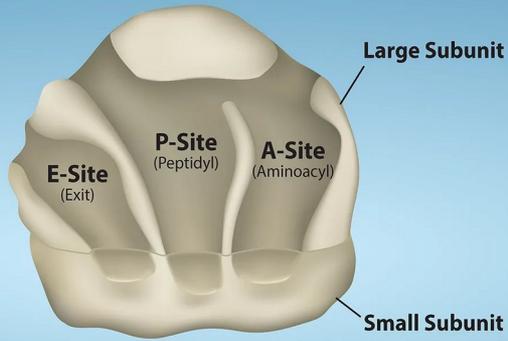


**(b) Three-dimensional structure**

**(c) Symbol used in this book**

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# Ribosome Structure



# Ribosomen

Ribosomen zijn grote eiwitten die de synthese van polypeptiden uitvoeren

Ribosomen bestaan uit twee subunits

Er is een grote subunit en een kleine subunit

In het ribosoom zit ook RNA: rRNA

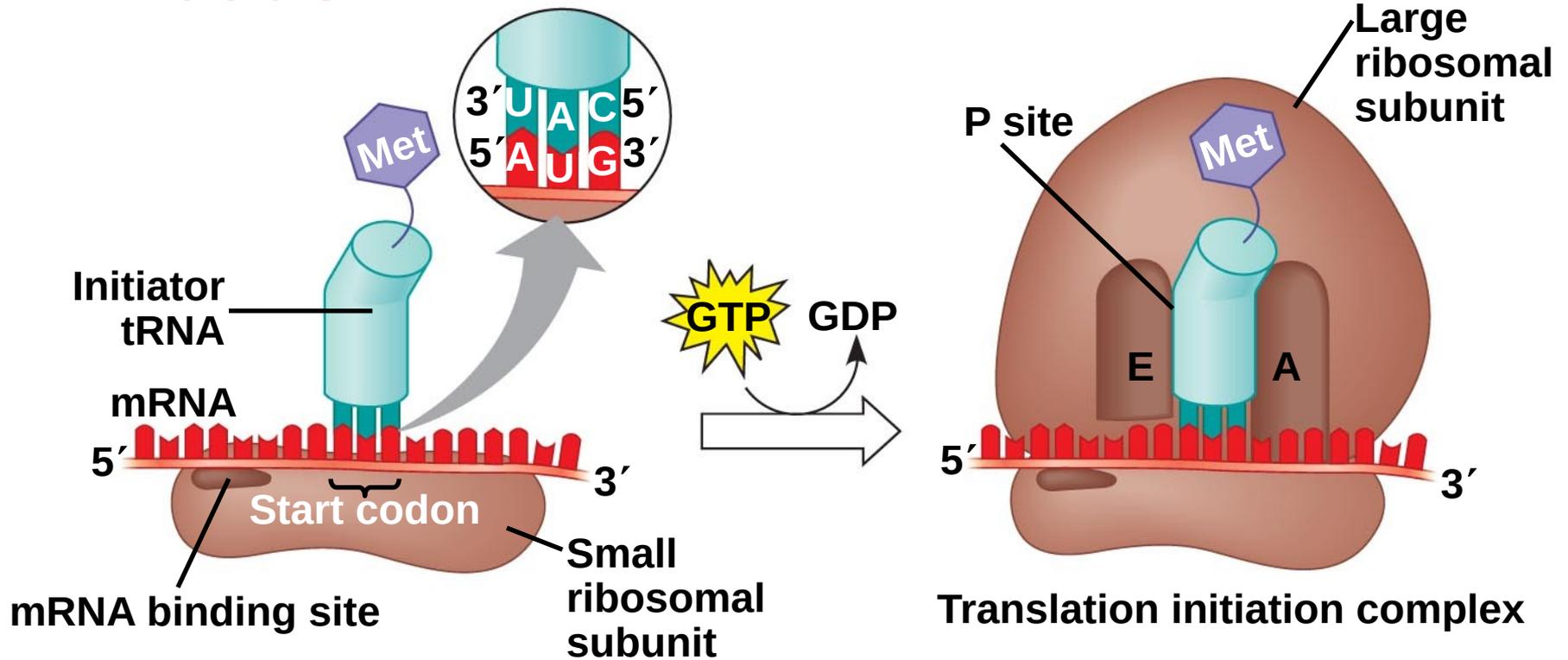
# Translatie

Translatie bestaat uit drie stappen

- Initiatie
- Elongatie
- Terminatie



# Initiation



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# Elongatie

Fig. 17-18-1

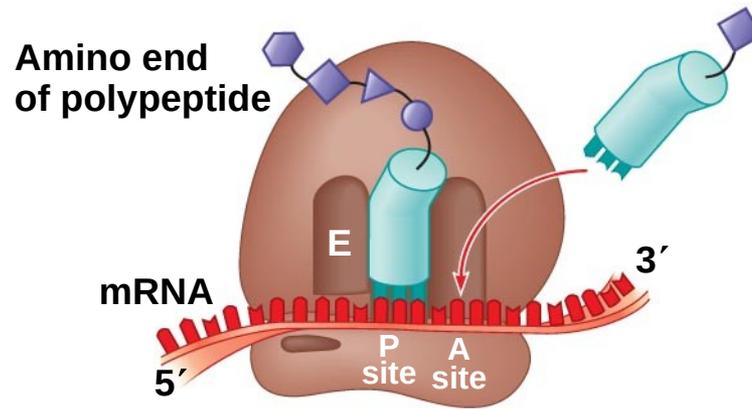


Fig. 17-18-2

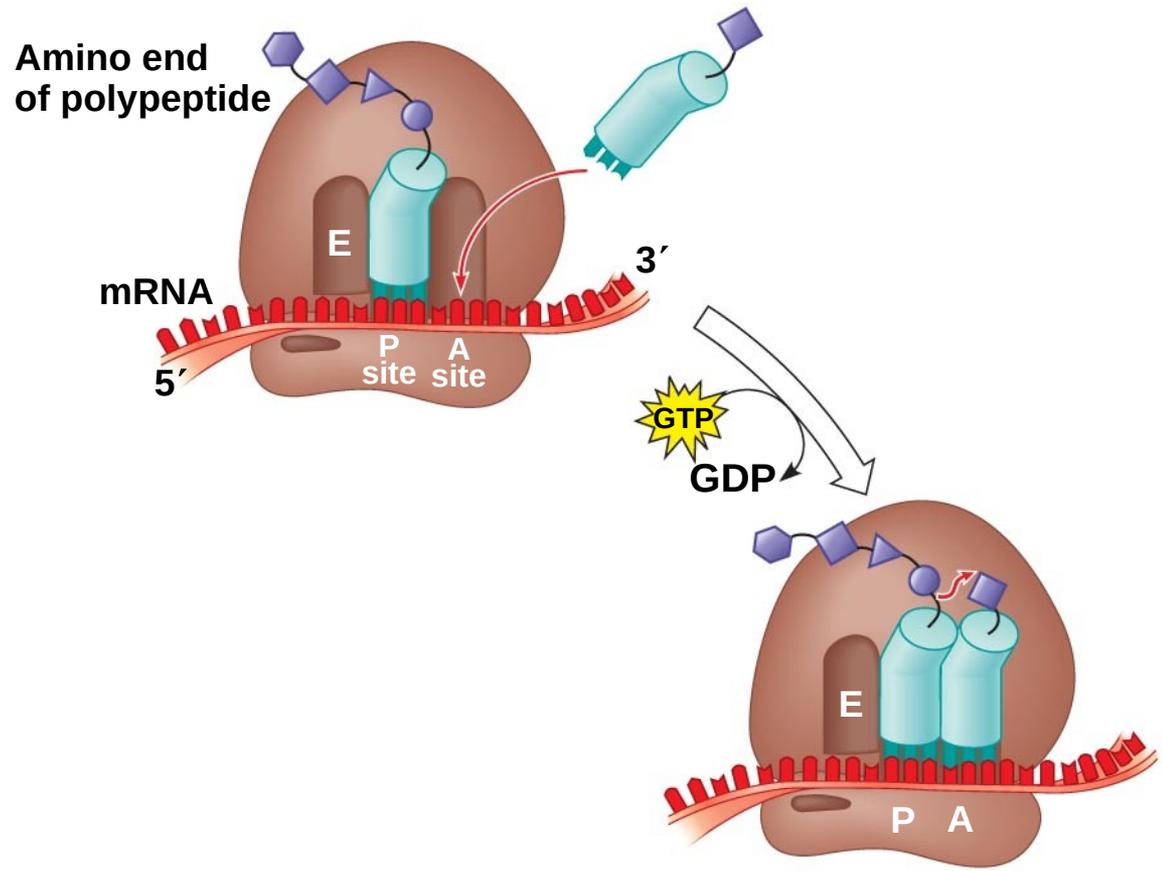


Fig. 17-18-3

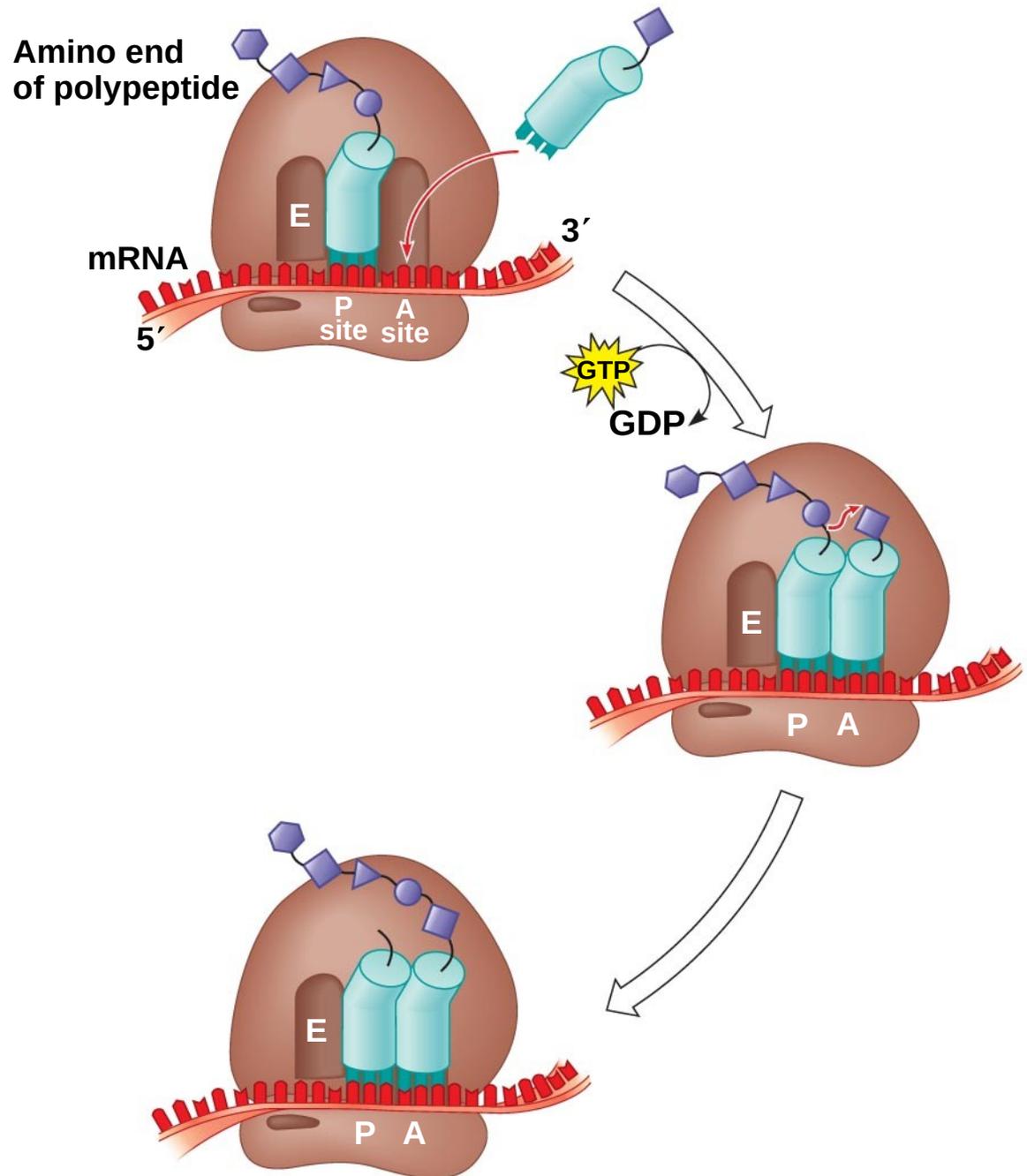
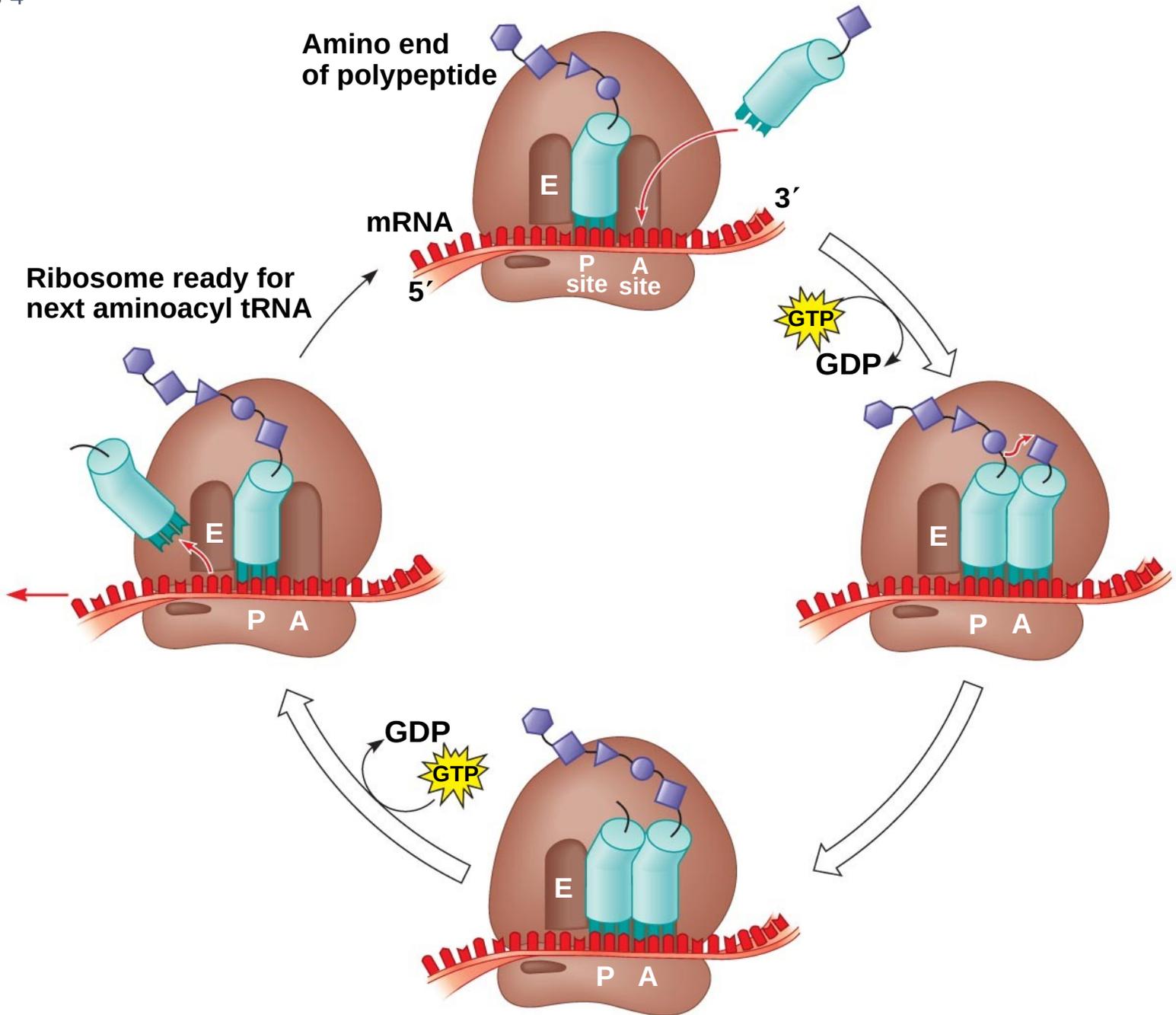


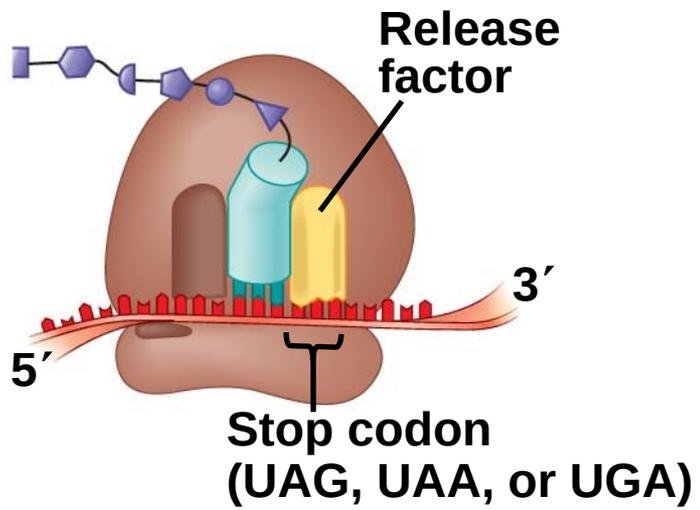
Fig. 17-18-4



# Terminatie

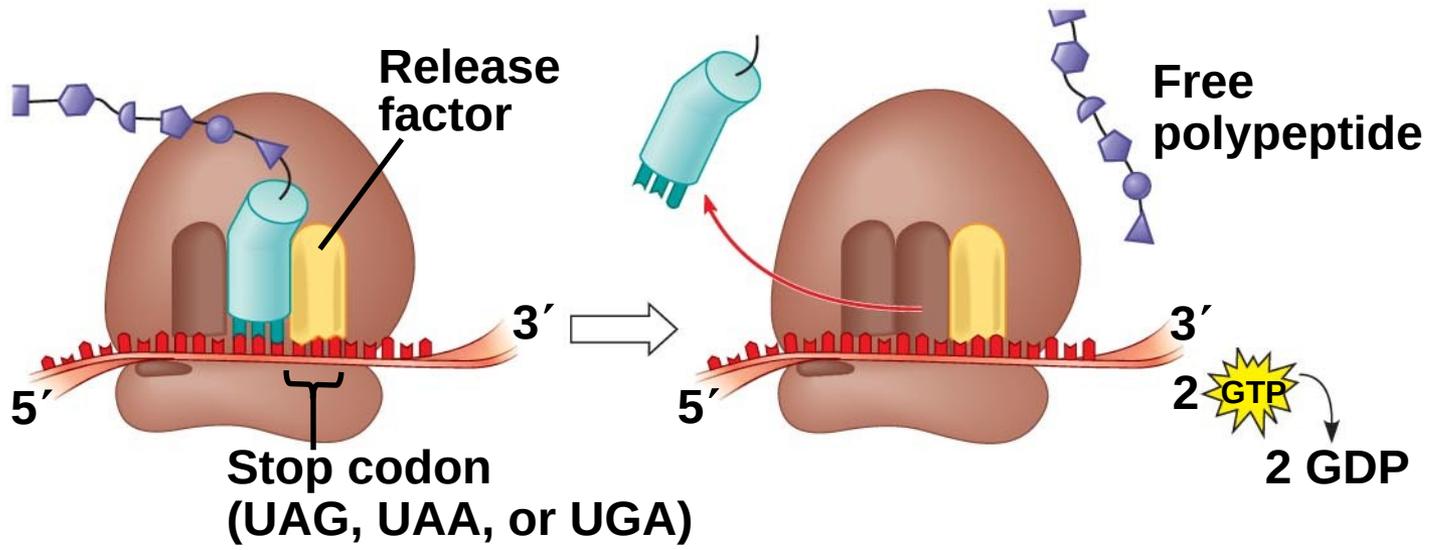
Indien een stop codon wordt aangetroffen is daar geen tRNA voor  
Hier stopt de elongatie: terminatie

Fig. 17-19-1



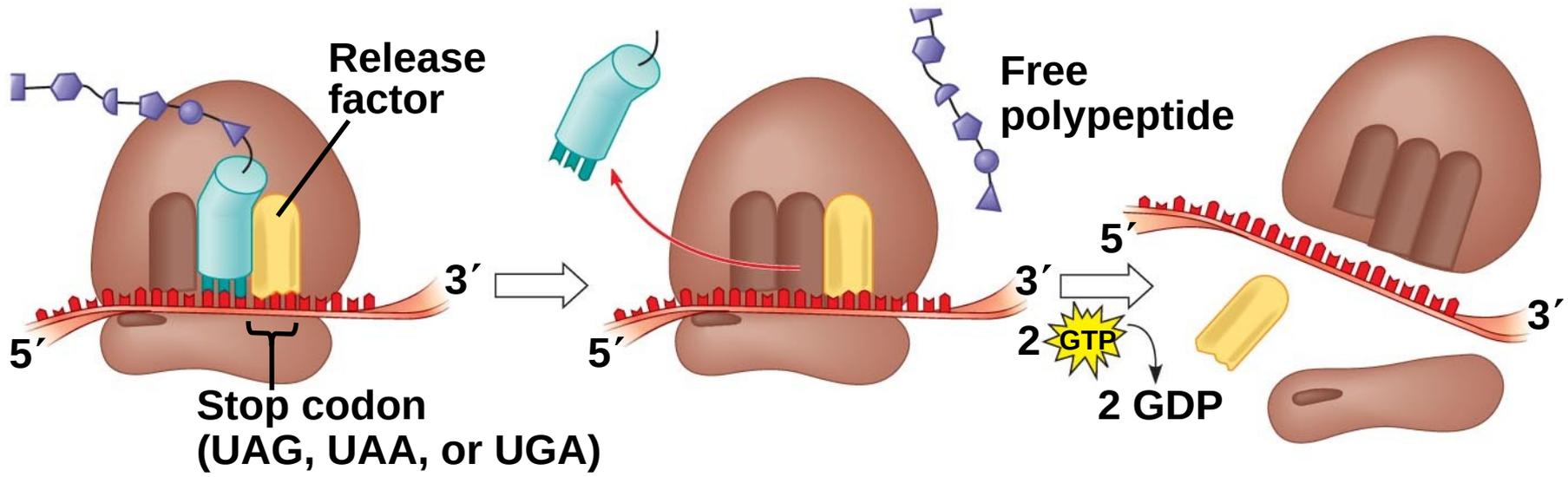
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Fig. 17-19-2

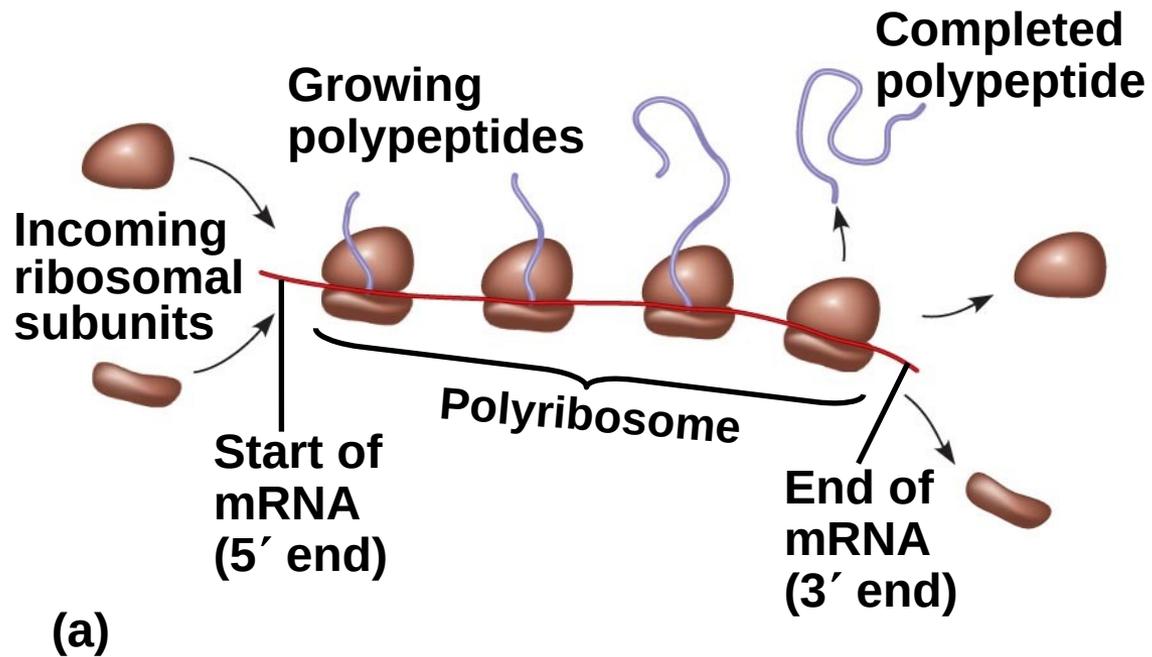


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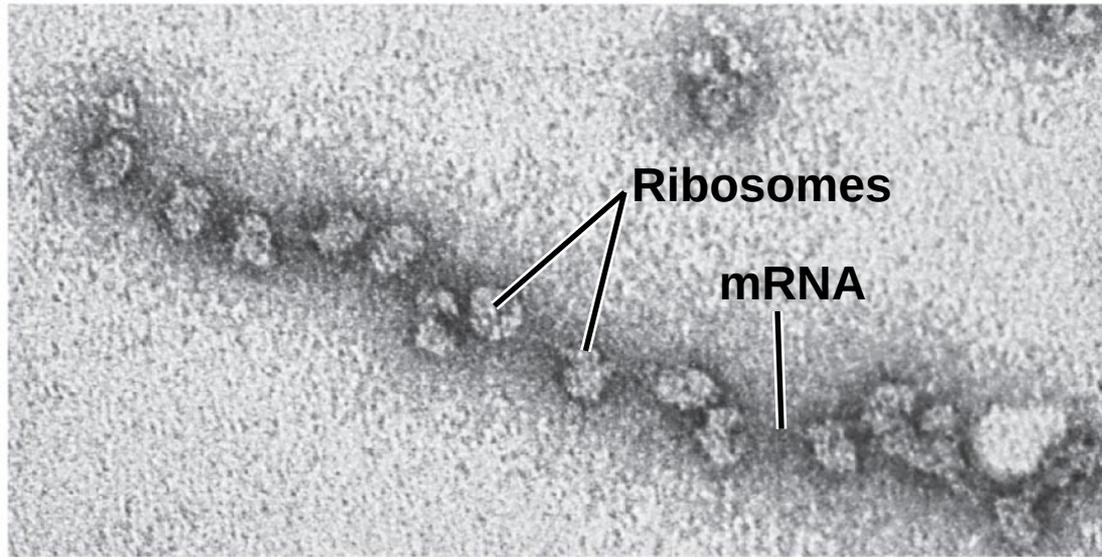
Fig. 17-19-3



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(a)



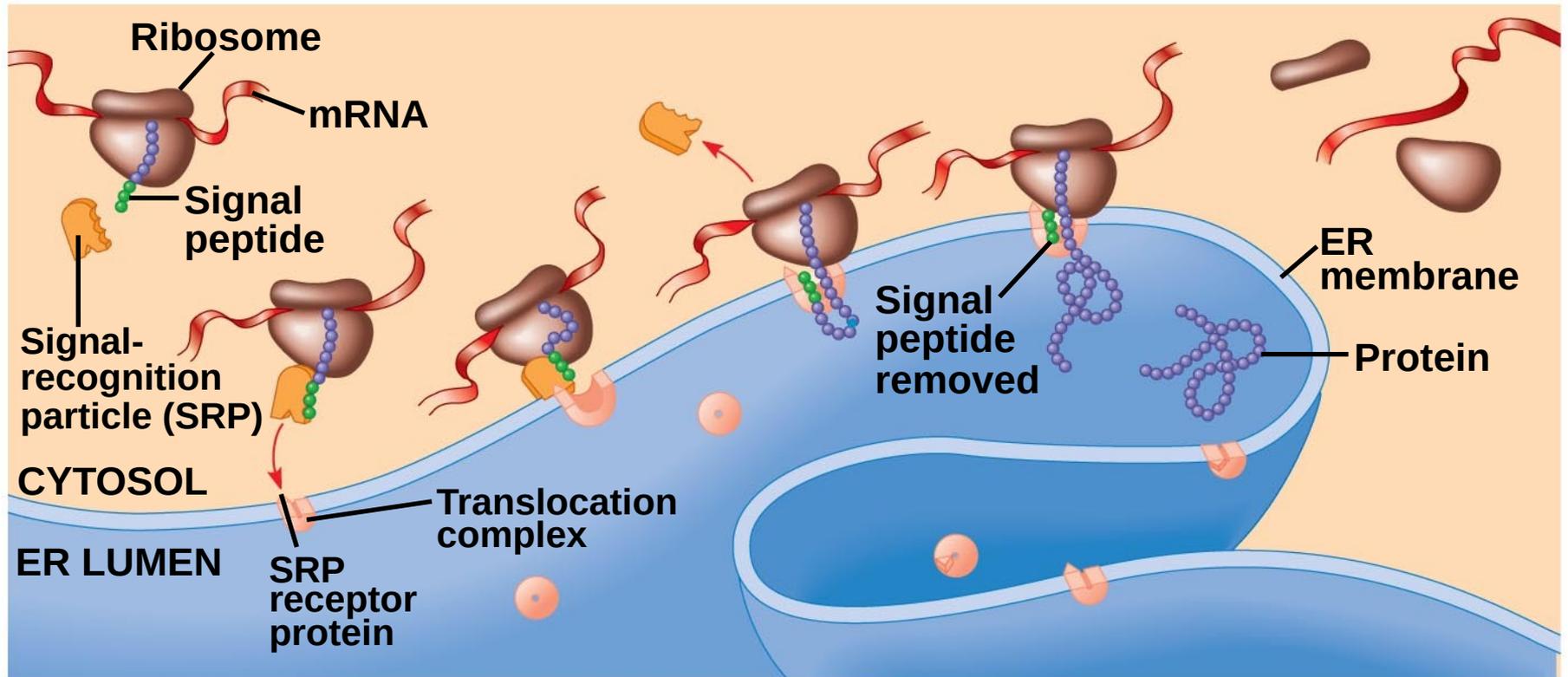
(b)

# Na de translatie...

Na de translatie worden de meeste polypeptiden nog gemodificeerd voordat ze werkzaam zijn

Daarna worden de proteïnen naar de juiste locatie in de cel gebracht

Fig. 17-21



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# Vraag

Wat is het verschil tussen een polypeptide en een proteïne?

Wat is het verschil in translatie tussen pro- en eukaryoten

# Vraag

Coding streng =  
3'TAT CAT CCT GGG 5'

Polypeptide?

		Second mRNA base						
		U	C	A	G			
U	UUU	Phe	Ser	UAU	Tyr	UGU	Cys	
	UUC			UAC		UGC		
	UUA	Leu		UCA	UAA Stop	UGA Stop		
	UUG			UCG	UAG Stop	UGG Trp		
C	CUU	Leu	Pro	CAU	His	CGU	Arg	
	CUC			CAC		CGC		
	CUA			CCA	CAA	Gln		CGA
	CUG			CCG	CAG	CGG		
A	AUU	Ile	Thr	AAU	Asn	AGU	Ser	
	AUC			AAC		AGC		
	AUA			AAA	AGA	Arg		
	AUG Met or start	ACG		AAG	AGG			
G	GUU	Val	Ala	GAU	Asp	GGU	Gly	
	GUC			GAC		GGC		
	GUA			GAA	GGA			
	GUG			GAG	GGG			

# 17.5 Punt mutaties

# Punt mutatie

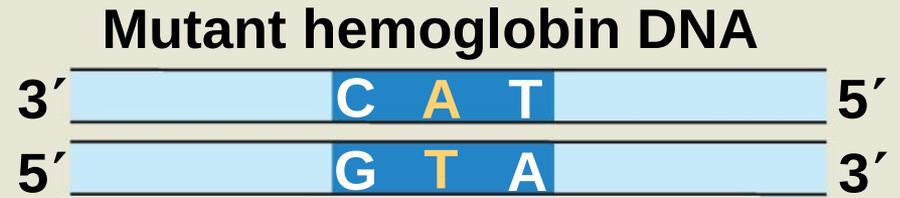
Punt mutaties zijn chemische wijzigingen op slechts een basepaar van een gen

Dit kan leiden tot een ander aminozuur

# Vraag

Wanneer zal een puntmutatie geen gevolgen hebben op het polypeptide

Fig. 17-22

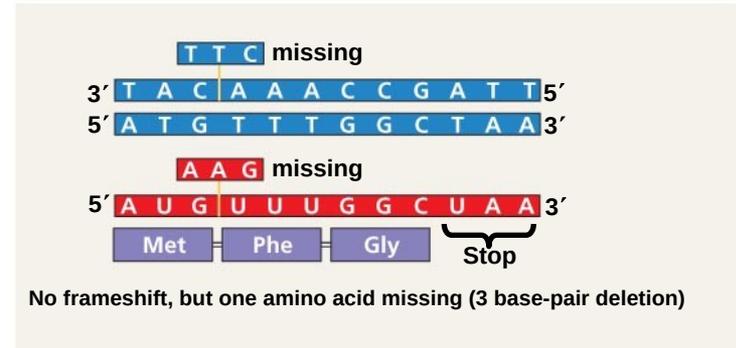
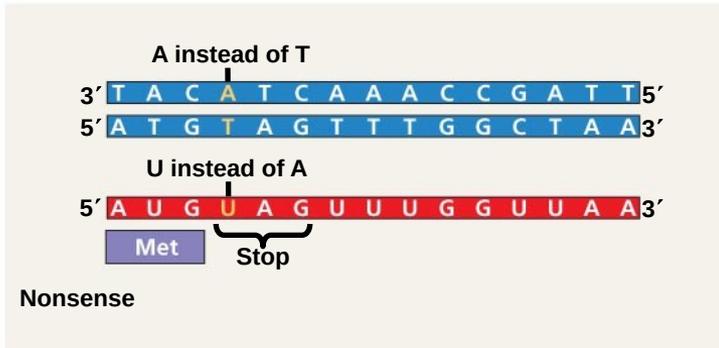
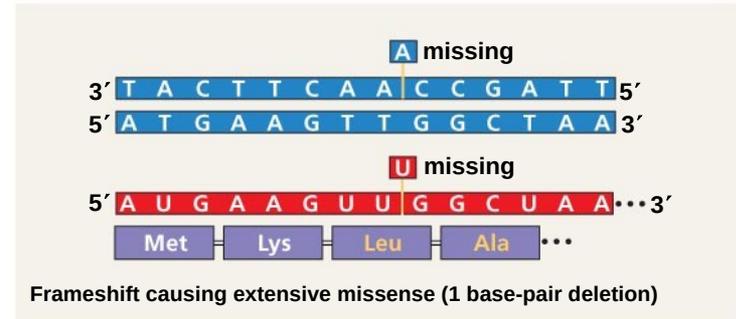
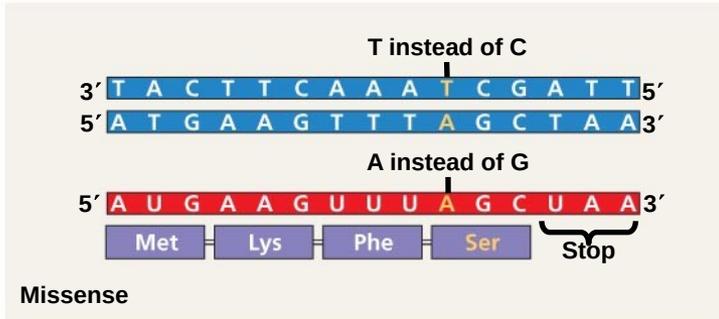
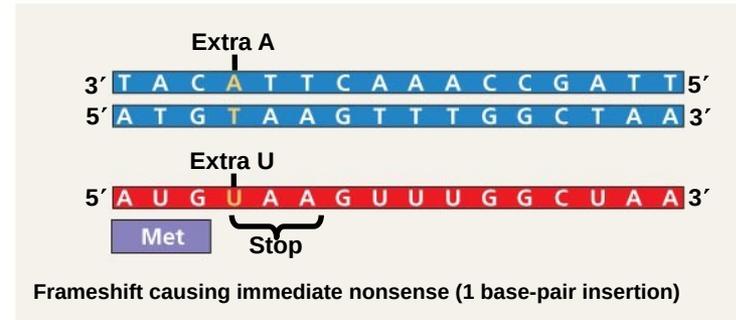
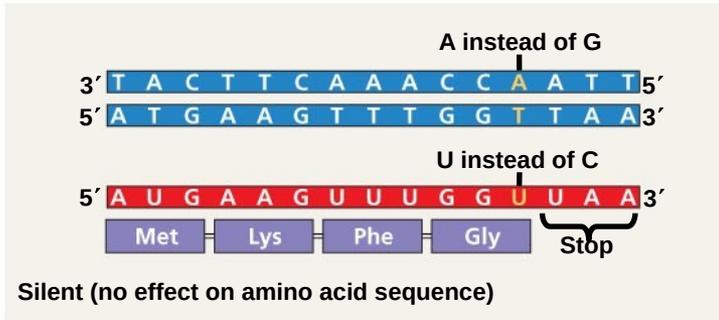
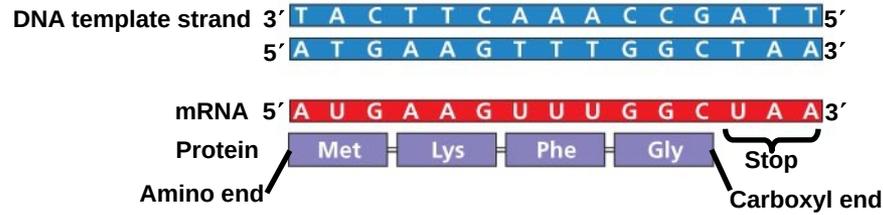


# Type puntmutaties

Er zijn twee hoofd categorieën:

- Substitutie
- Insertie of deletie (indels)

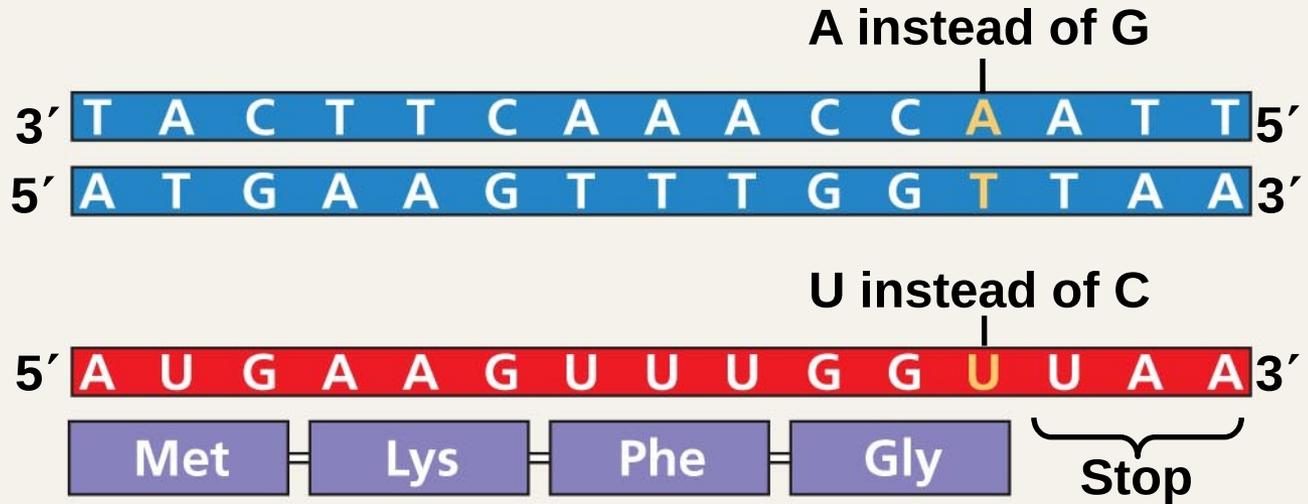
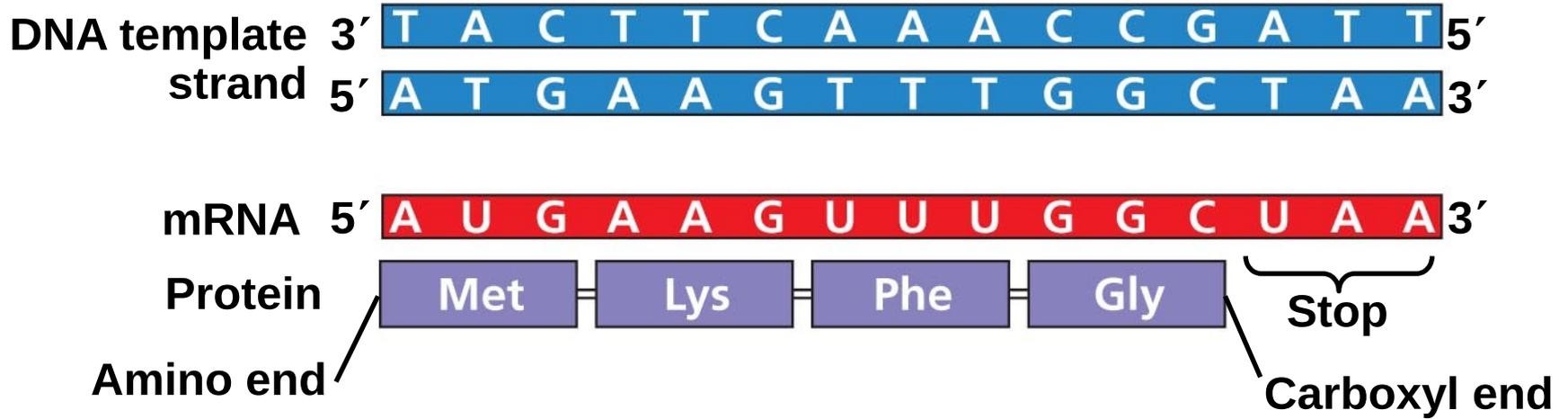
Wild-type



(a) Base-pair substitution

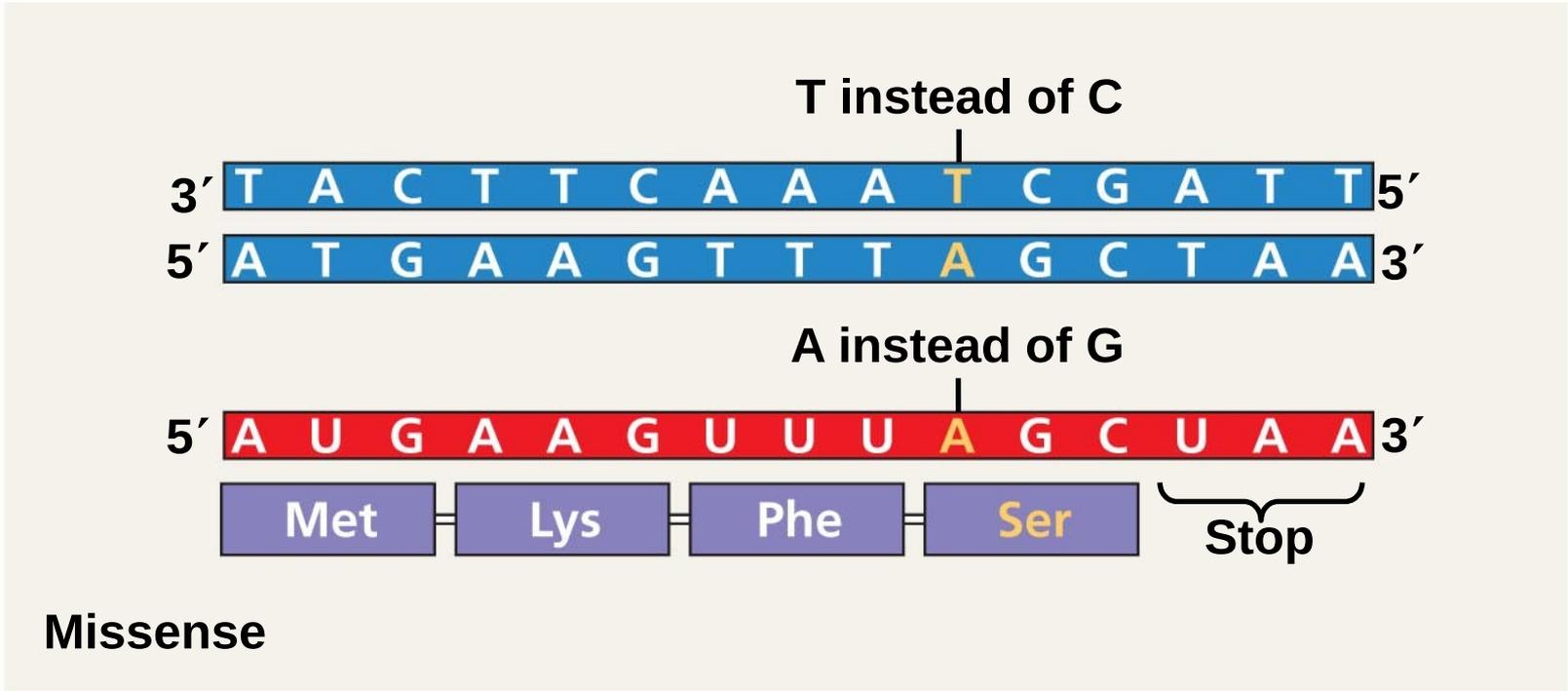
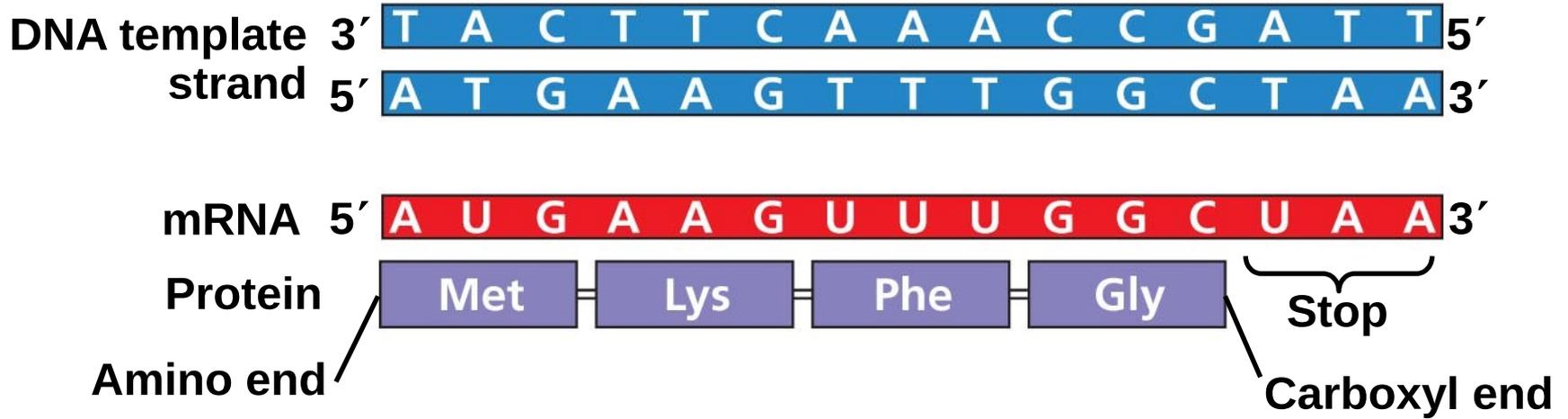
(b) Base-pair insertion or deletion

### Wild type

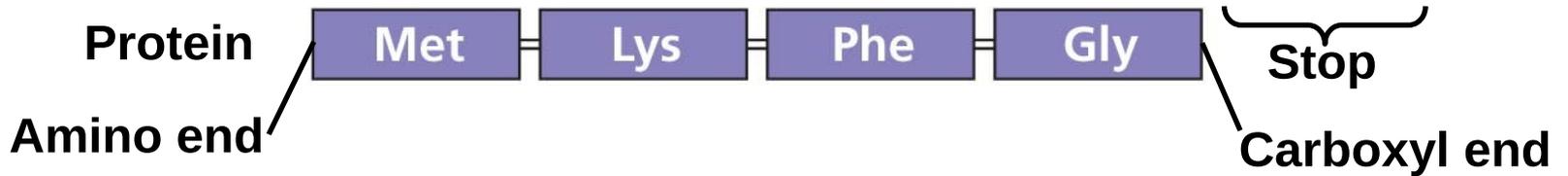


**Silent (no effect on amino acid sequence)**

### Wild type

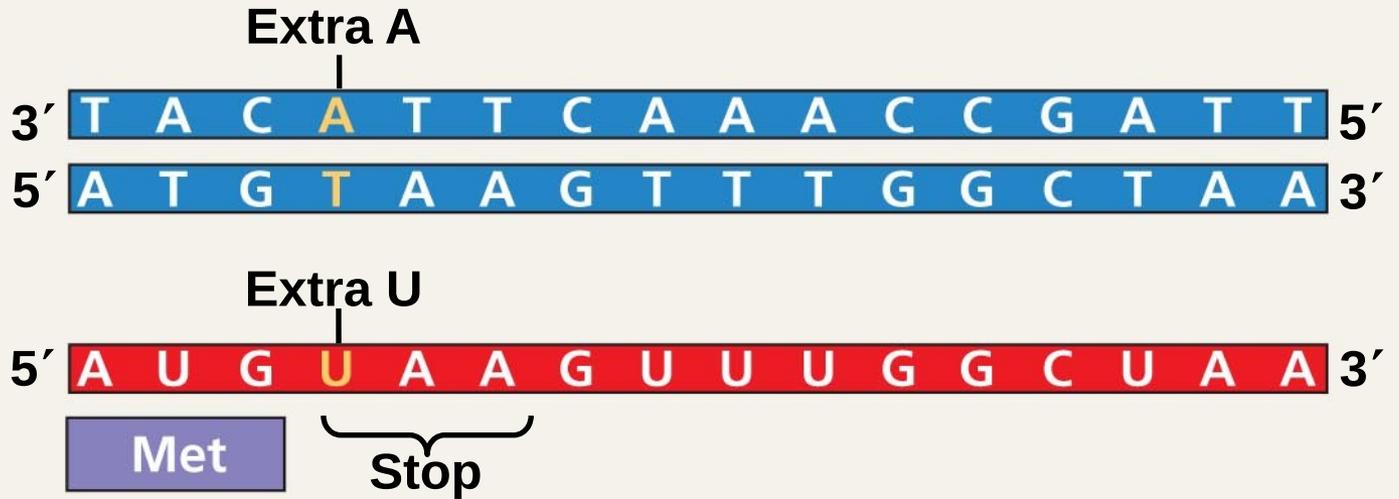
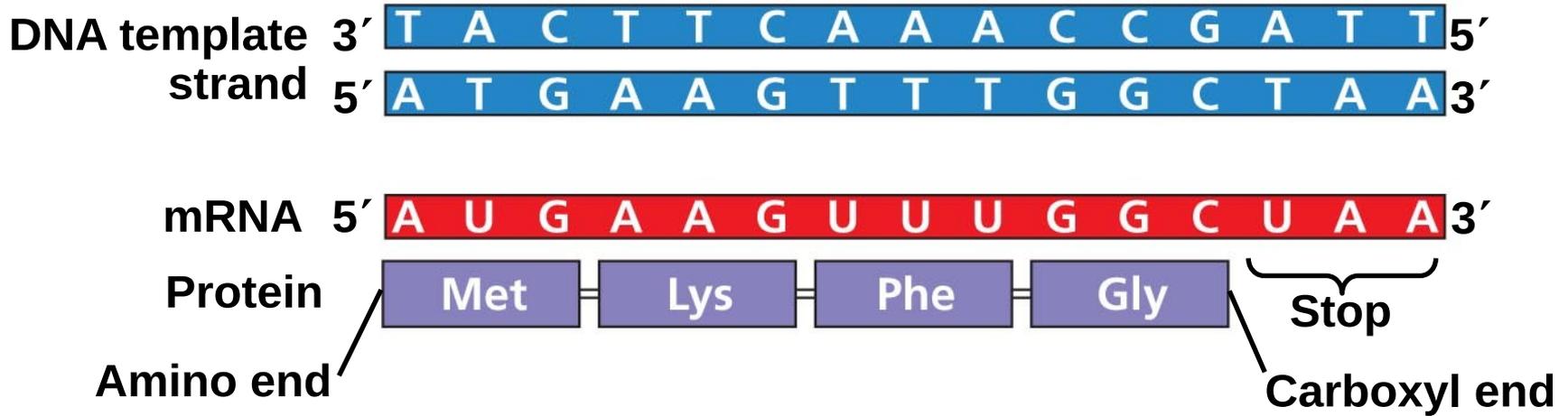


### Wild type



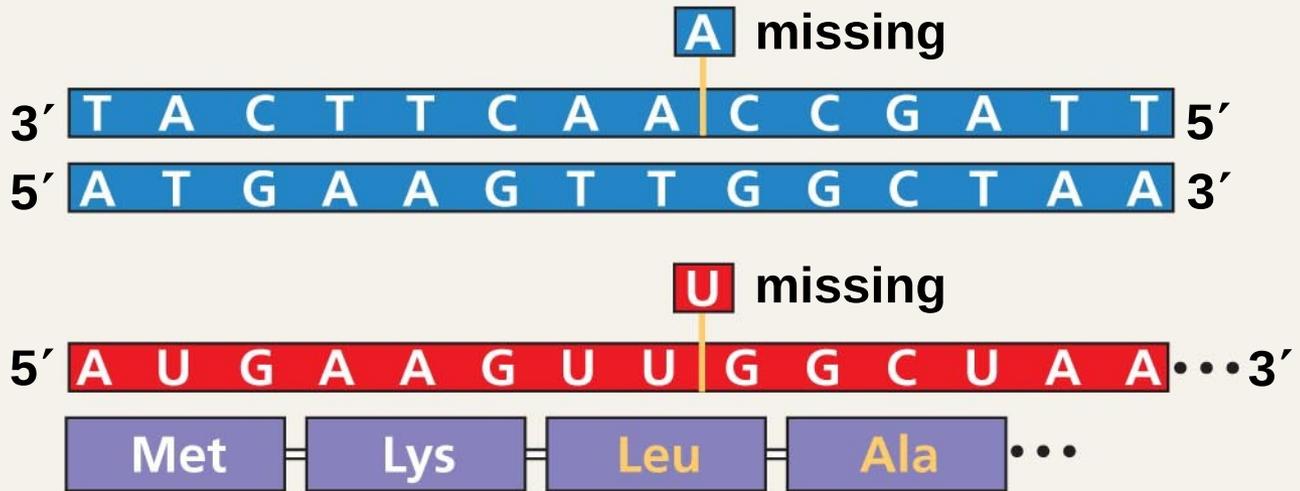
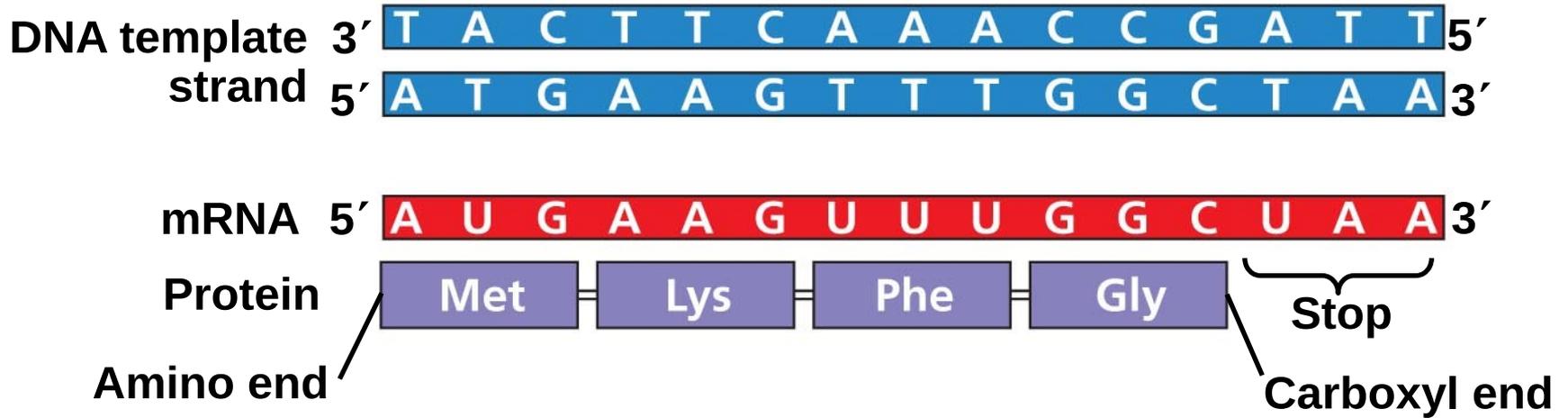
**Nonsense**

### Wild type



**Frameshift causing immediate nonsense (1 base-pair insertion)**

### Wild type



**Frameshift causing extensive missense (1 base-pair deletion)**

### Wild type

DNA template strand 3' T A C T T C A A A C C G A T T 5'  
 5' A T G A A G T T T G G C T A A 3'

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

Protein Met = Lys = Phe = Gly } Stop  
 Amino end Carboxyl end

T T C missing  
 3' T A C A A A C C G A T T 5'  
 5' A T G T T T G G C T A A 3'

A A G missing  
 5' A U G U U U G G C U A A 3'  
 Met = Phe = Gly } Stop

No frameshift, but one amino acid missing (3 base-pair deletion)

# Substituties

## Substituties leiden tot

- Silent mutation: geen effect op het aminozuur
- Missense mutation: het polypeptide bevat een ander aminozuur
- Nonsense mutation: het polypeptide bevat een stopcodon op de verkeerde plaats

# Indels

Een deletie of insertie van een nucleotide leidt tot een frameshift  
Dit heeft meestal desastreuze gevolgen voor het proteïne

# Vraag

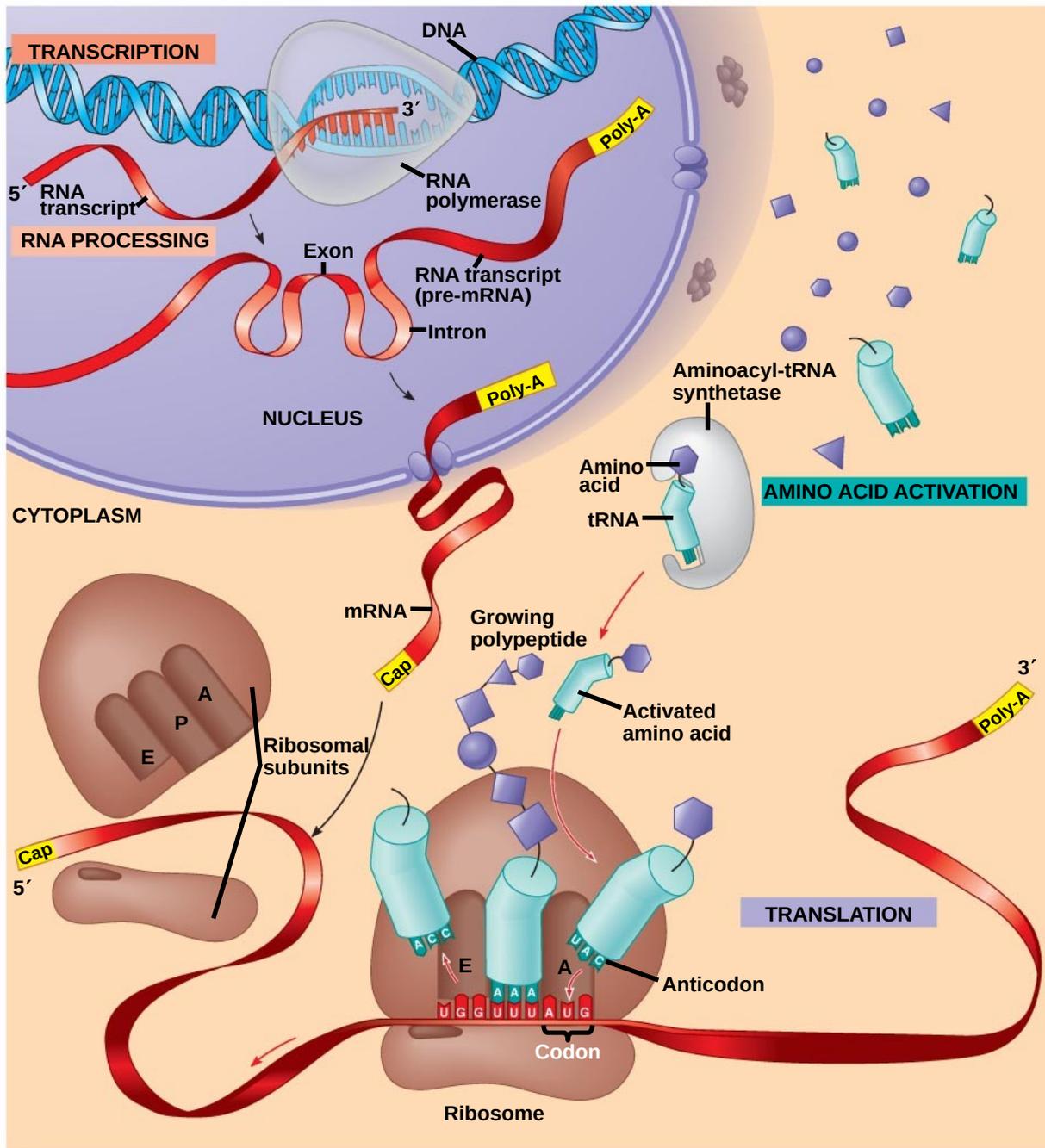
Wat zijn de meest invloedrijke mutaties?

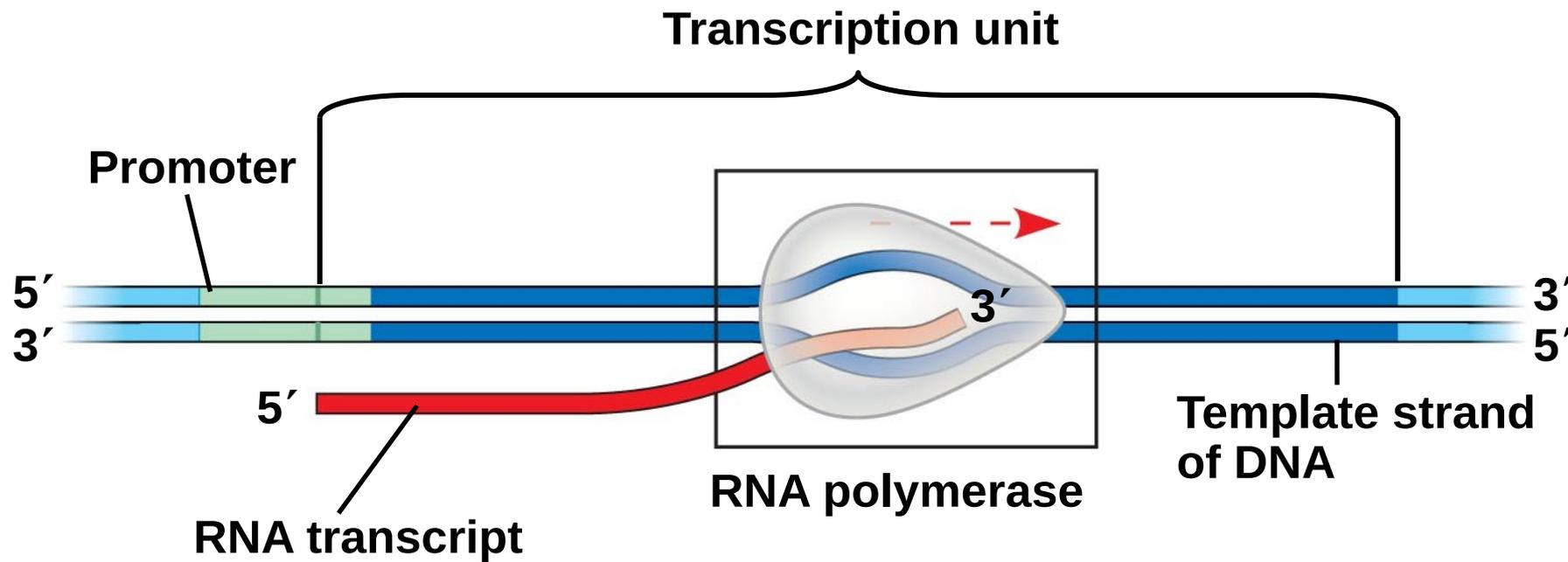
Wat zijn mogelijke oorzaken van deze mutaties?

# Samengevat

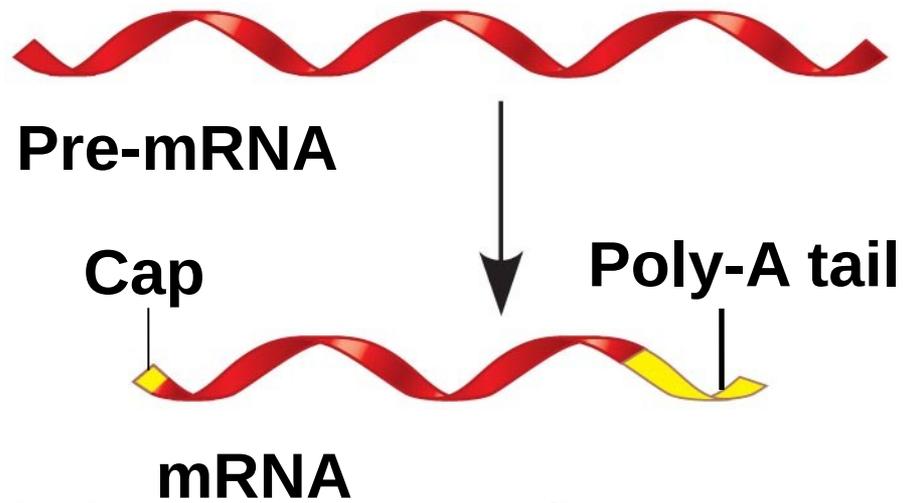
Middels transcriptie wordt mRNA gevormd  
Het mRNA bevat codons bestaande uit steeds 3 nucleotiden  
Ieder codon codeert voor een aminozuur  
Alle aminozuren samen vormen polypeptiden

Fig. 17-25

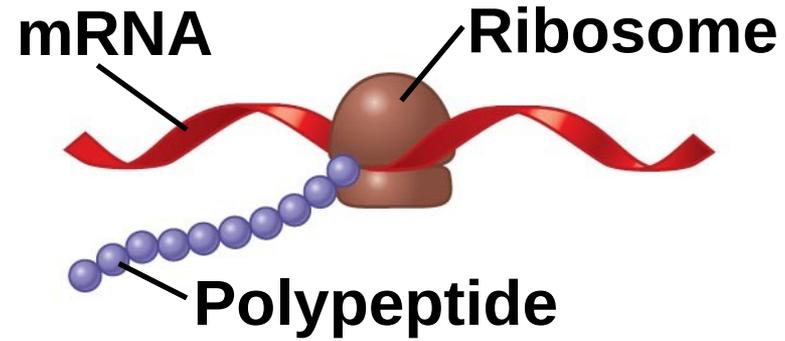




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# Bronnen

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