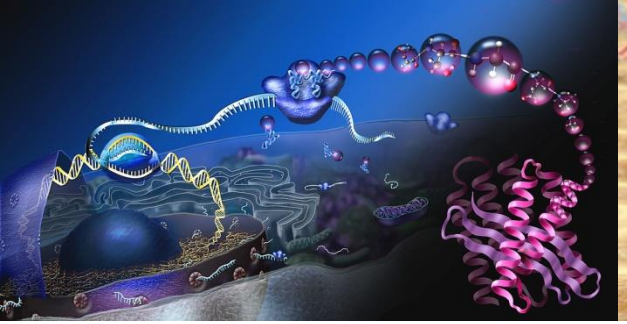
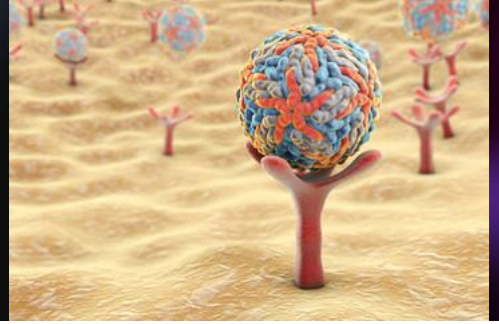
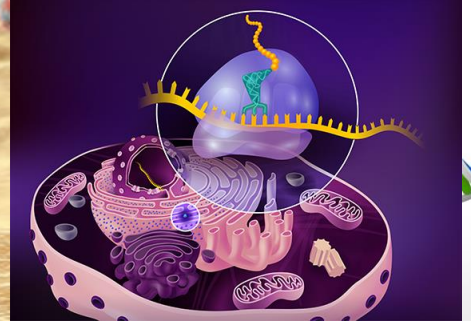

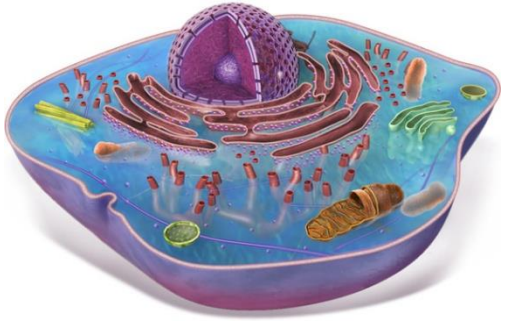

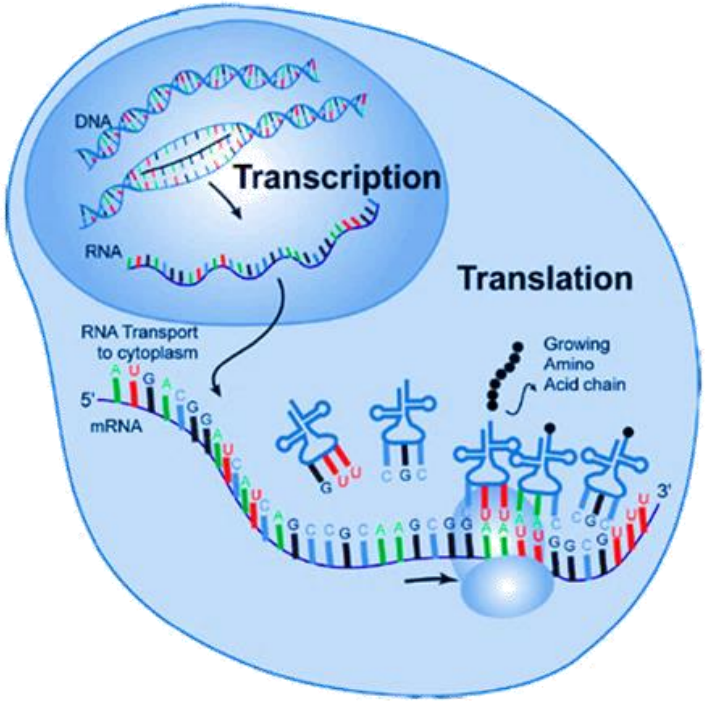

TRANSCRIPTION. TRANSLATION.

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23. 11. 2017

OUTLINE

- CELL NUCLEUS AND DNA
- CENTRAL DOGMA
- I. TRANSCRIPTION
  - PROCESS – KEY PLAYERS
  - REGULATION
  - POST-TRANSCRIPTIONAL REGULATION

BREAK

- II. TRANSLATION
  - PROCESS – KEY PLAYERS
  - REGULATION
- COMPARISION OF EUKARYOTIC VS. PROKARYOTIC CELLS

THE FIRST MAN WHO USED THE TERM “GENETICS” IN A SCIENCE PAPER

Count **Imre Festetics**

1764- 1847

Hungarian noble landowner and geneticist.

Festetics formulated a number of rules of heredity and was the first to refer to these as ‘‘genetic laws of nature”

He used the term *genetic* for the first time, 80 years before William Bateson

Festetics was the first to recognize empirically the segregation of characters in the second hybrid generation (Mendel’s II. law)

Publications:

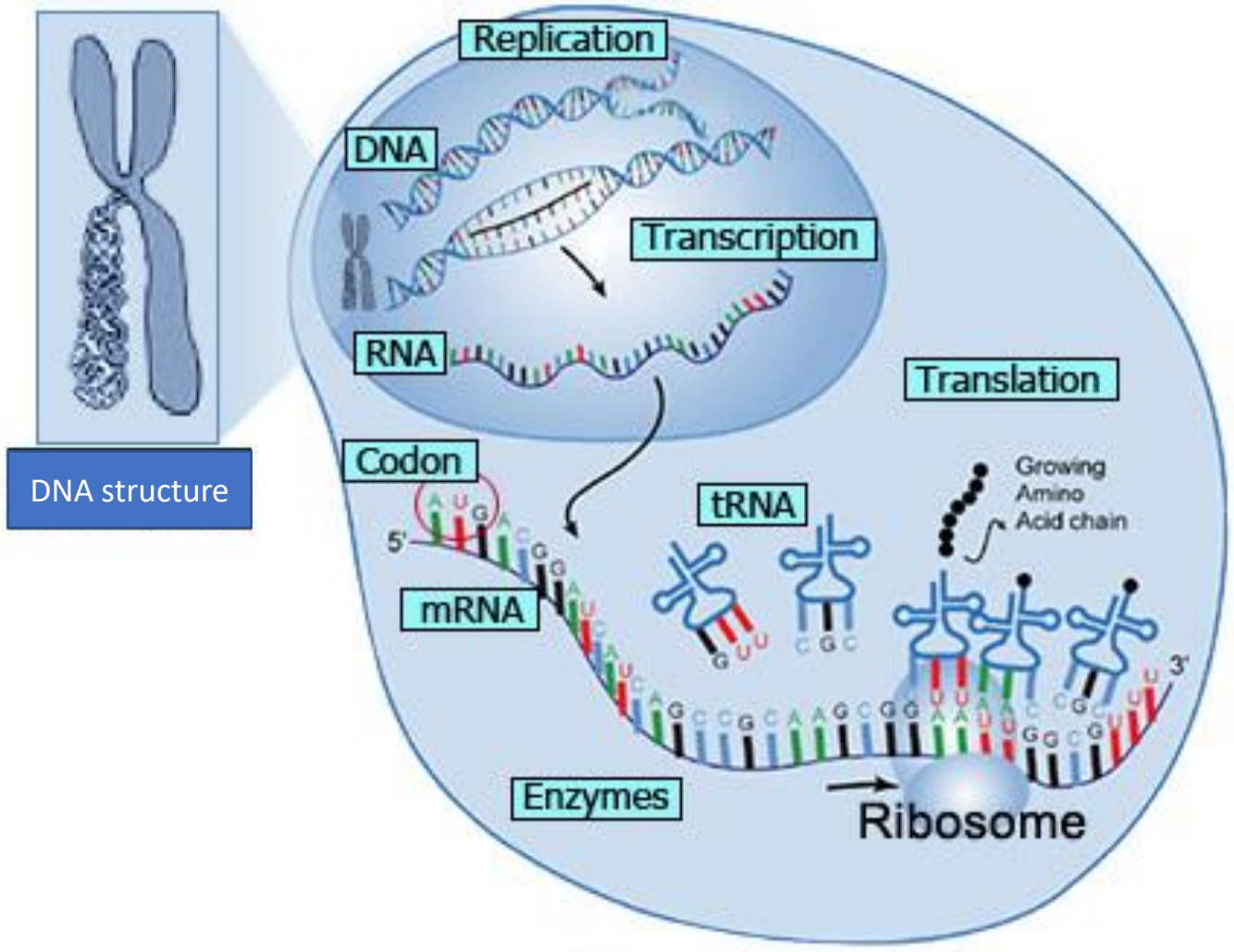
Die genetische Gesätze der Natur. *Oekonomische Neuigkeiten und Verhandlungen*, 1819.

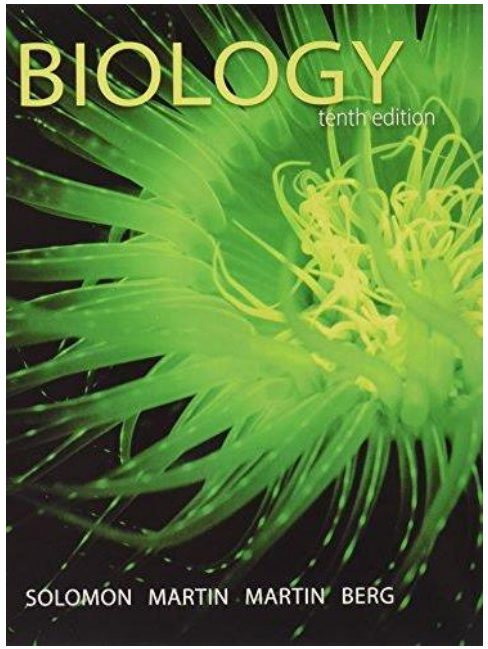
Festetics I (1815a) Híradás a juhtenyésztés jobbítását és pallérozását óhajtó hazafiakhoz. Nemzeti Gazda 10: 145–147

Festetics I (1820) Bericht des Herrn Grafen Emerich Festetics als Representanten des Schafzüchter-Vereins in Esenburgeer Comitat. Oekon Neuigk Vehandl 25–28

Festetics I (1819b) Weitere Erklärung des Herren Grafen Emmerich von Festetics. Oekon Neuigk Vehandl 169–70

BIG PICTURE – GENE EXPRESSION





(10th edition) Textbook (9th edition)

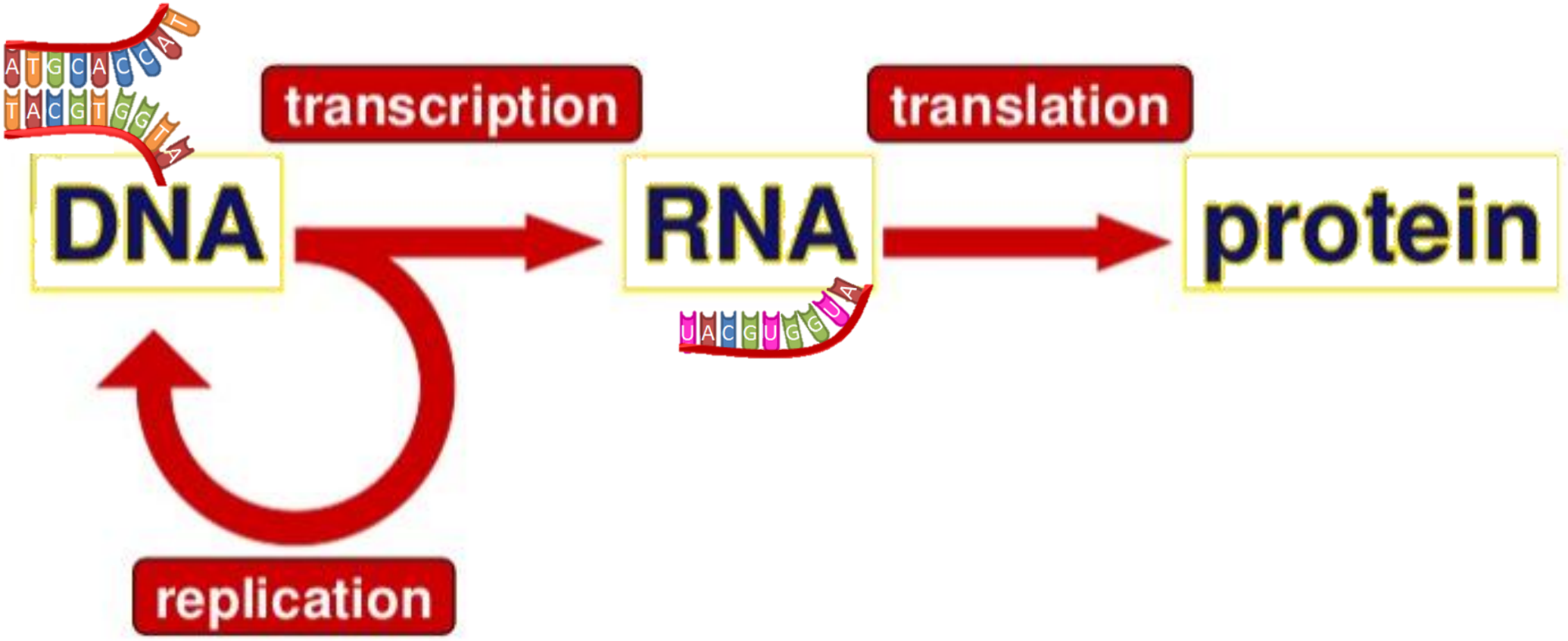
p 270 - 277 **Gene expression** p 282-288

p 277 – 282 **Transcription** p 288-293

p 282 - 288 **Translation** p 293-297

THE CENTRAL DOGMA

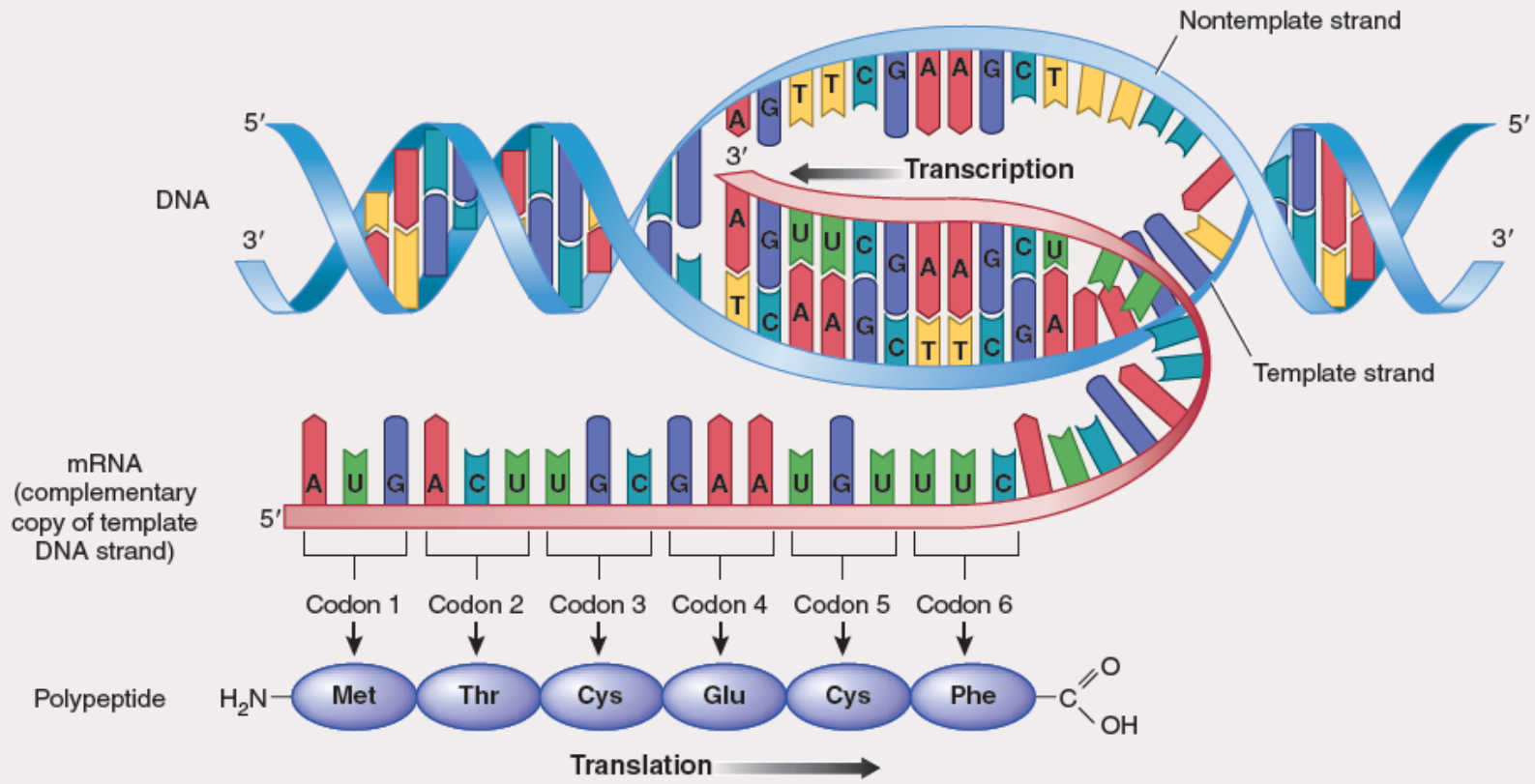
- Flow of the genetic information in a cell



OVERVIEW OF GENE EXPRESSION

KEY POINT

Protein synthesis requires two major steps: DNA $\xrightarrow{\text{transcription}}$ RNA $\xrightarrow{\text{translation}}$ protein



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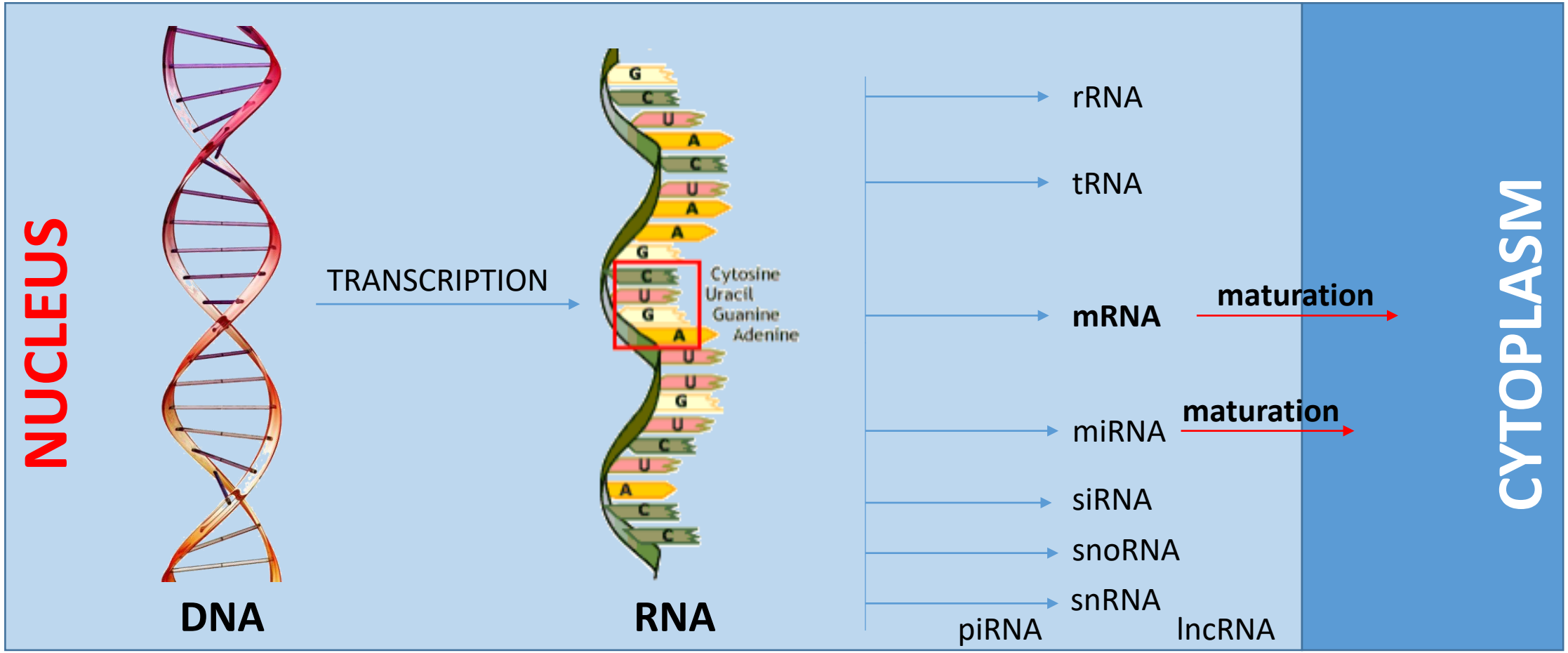
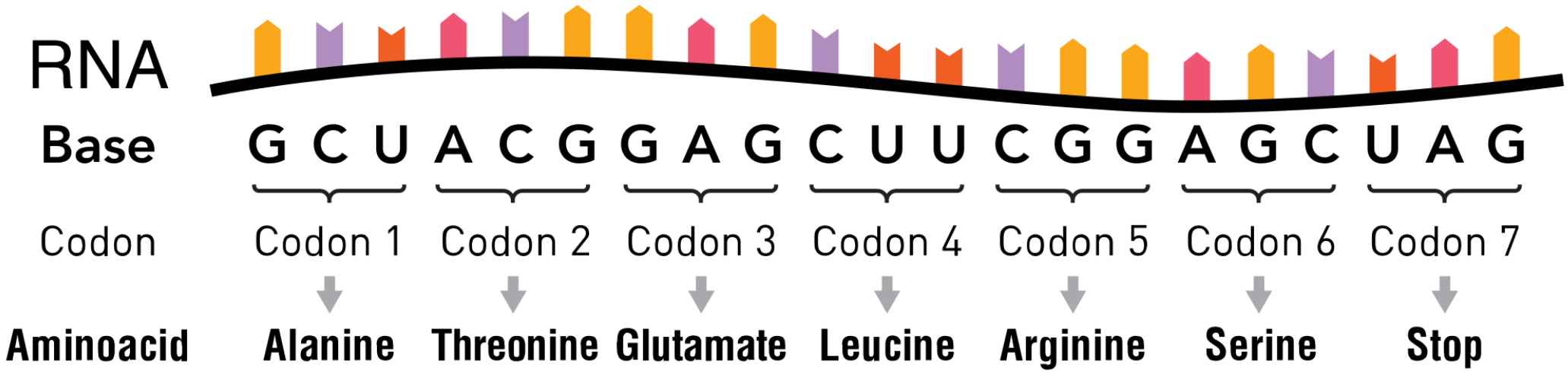
I. TRANSCRIPTION IN EUKARYOTIC CELL

- First stage in the flow of information from the DNA to polypeptide



I. TRANSCRIPTION (1)



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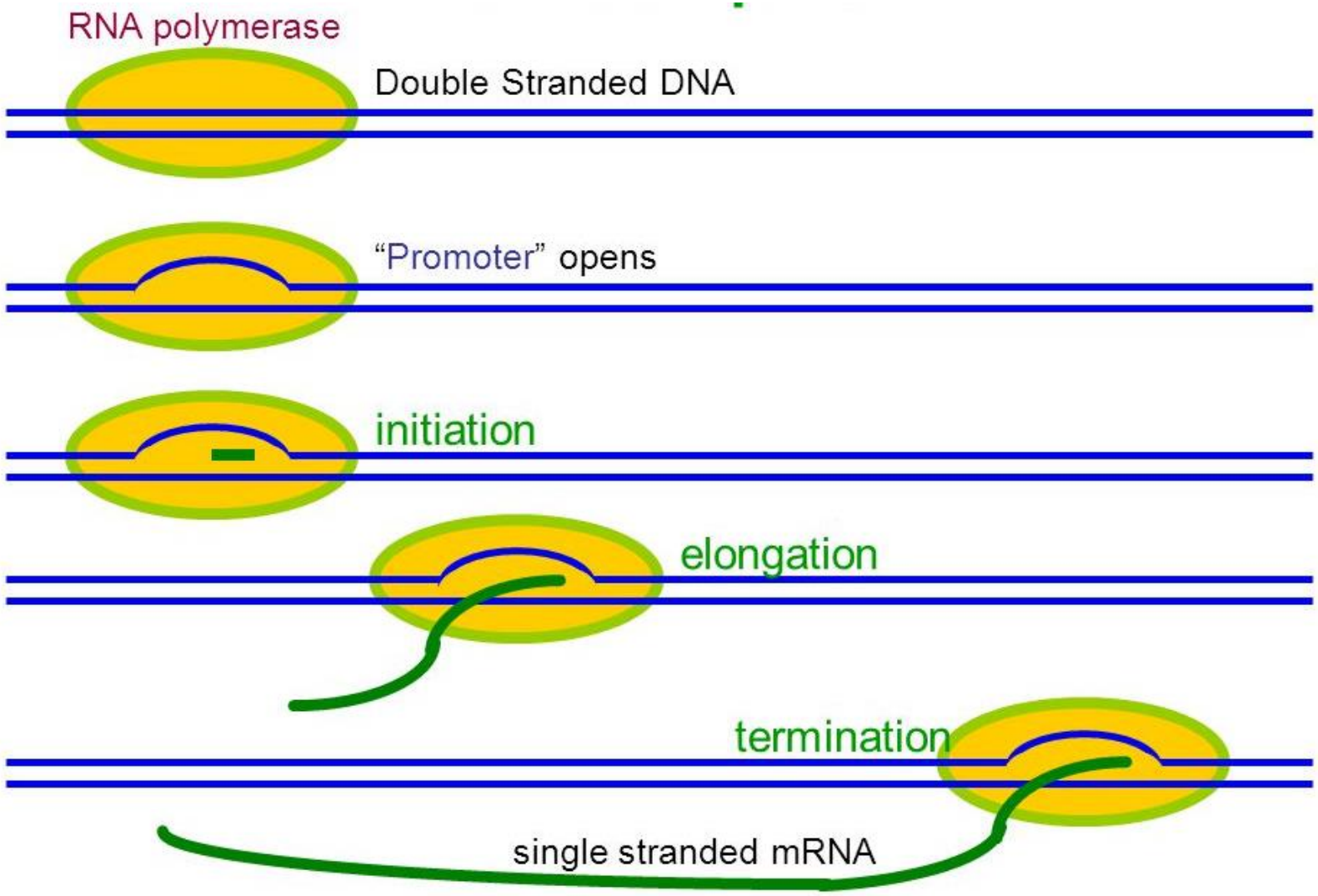

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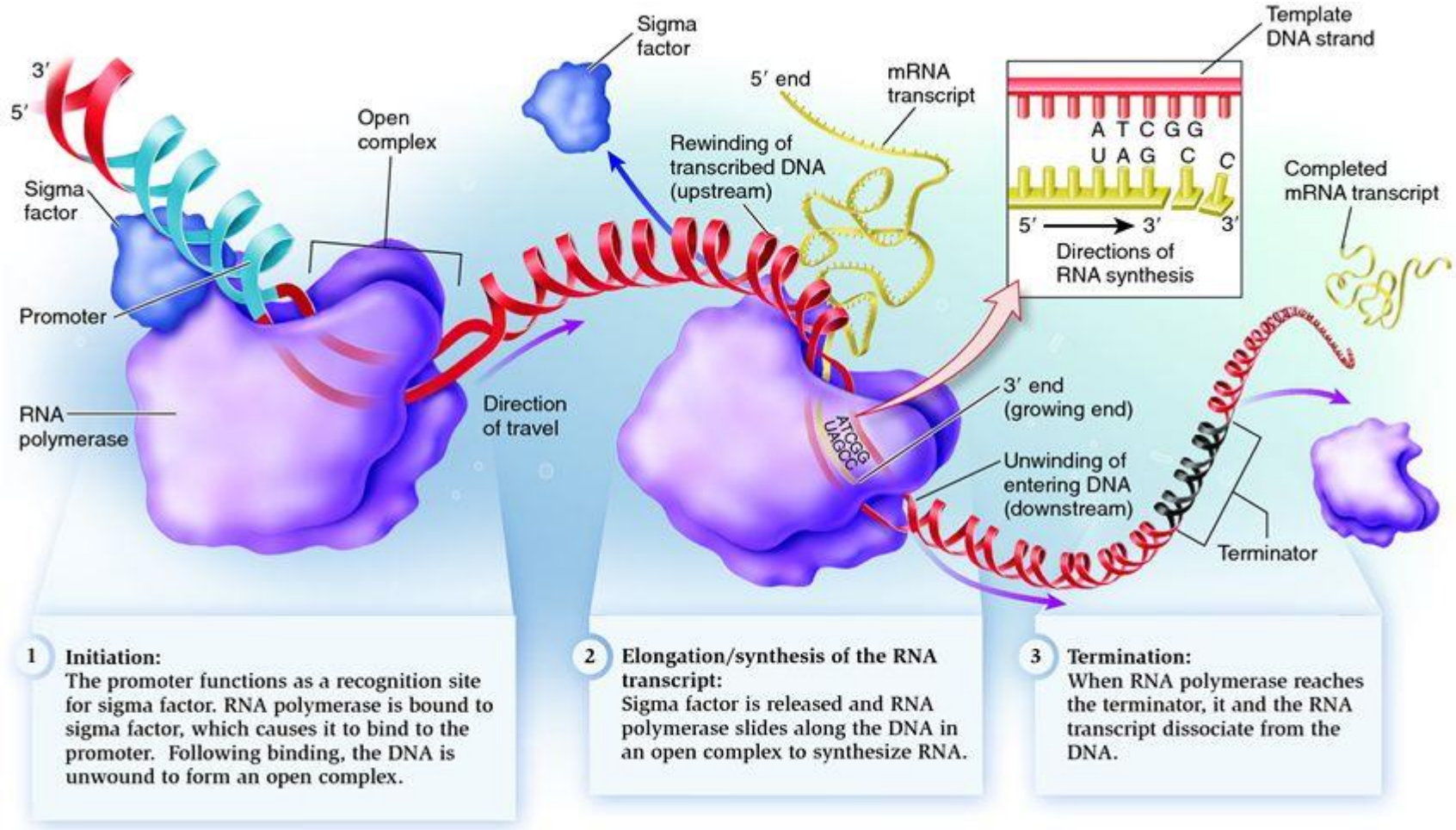
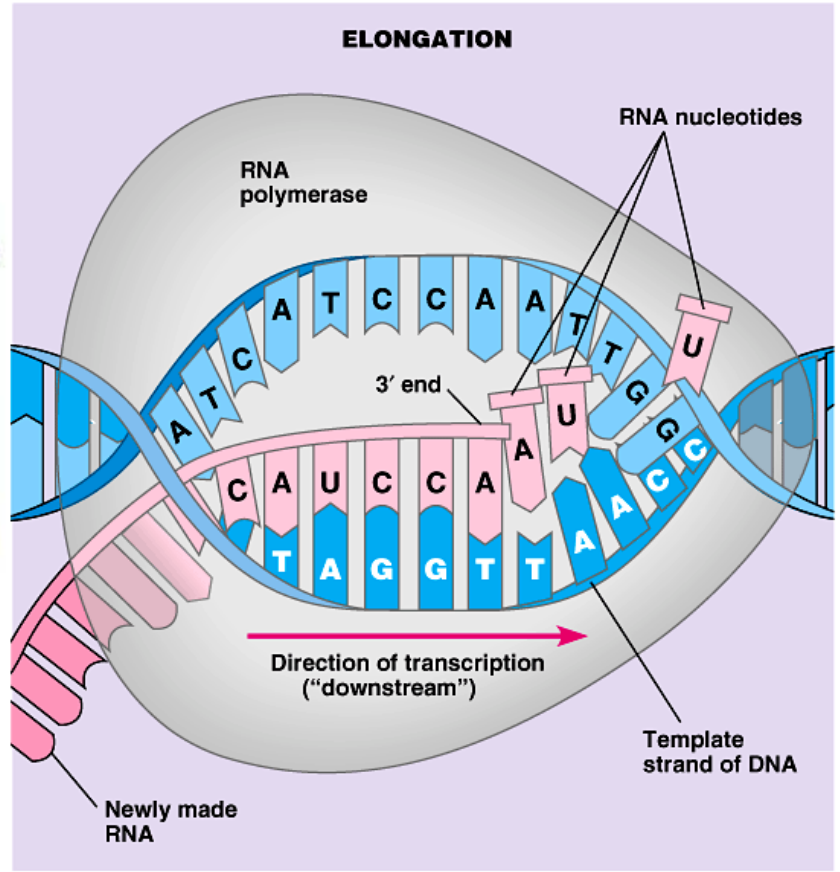
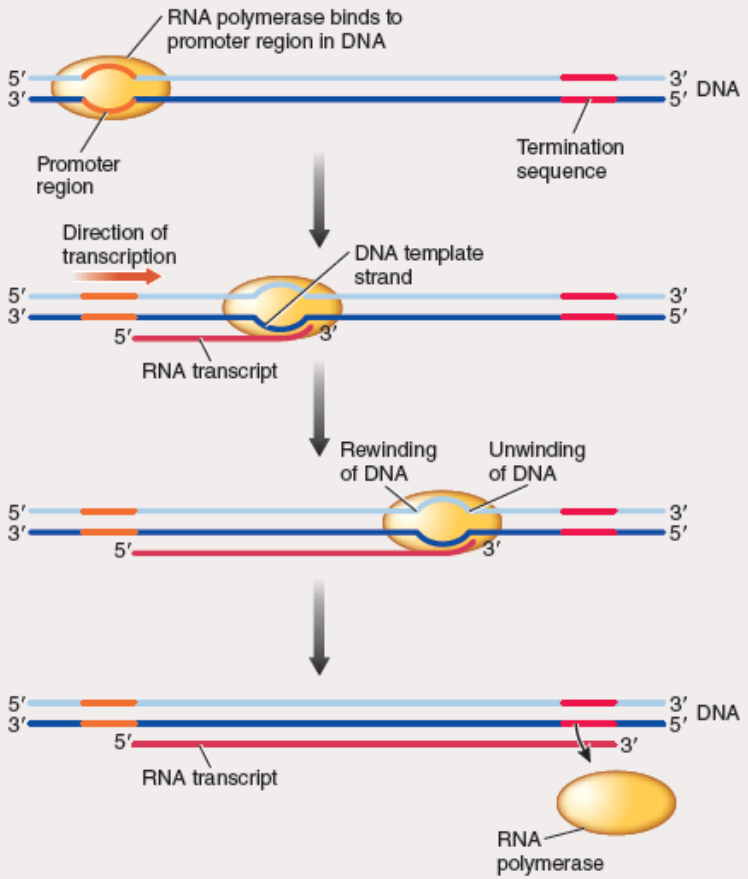




I. TRANSCRIPTION (3)

KEY POINT

The mRNA is synthesized in the 5′ to 3′ direction as the template strand of the DNA molecule is read in the 3′ to 5′ direction.



1. **Initiation.** RNA polymerase unwinds DNA double helix and initiates RNA synthesis.
2. **Elongation.** Additional nucleotides are added to the 3′ end of RNA molecule. DNA double helix re-forms following transcription.
3. **Elongation continues.**
4. **Termination.** RNA polymerase recognizes termination sequence. RNA transcript and RNA polymerase are released.

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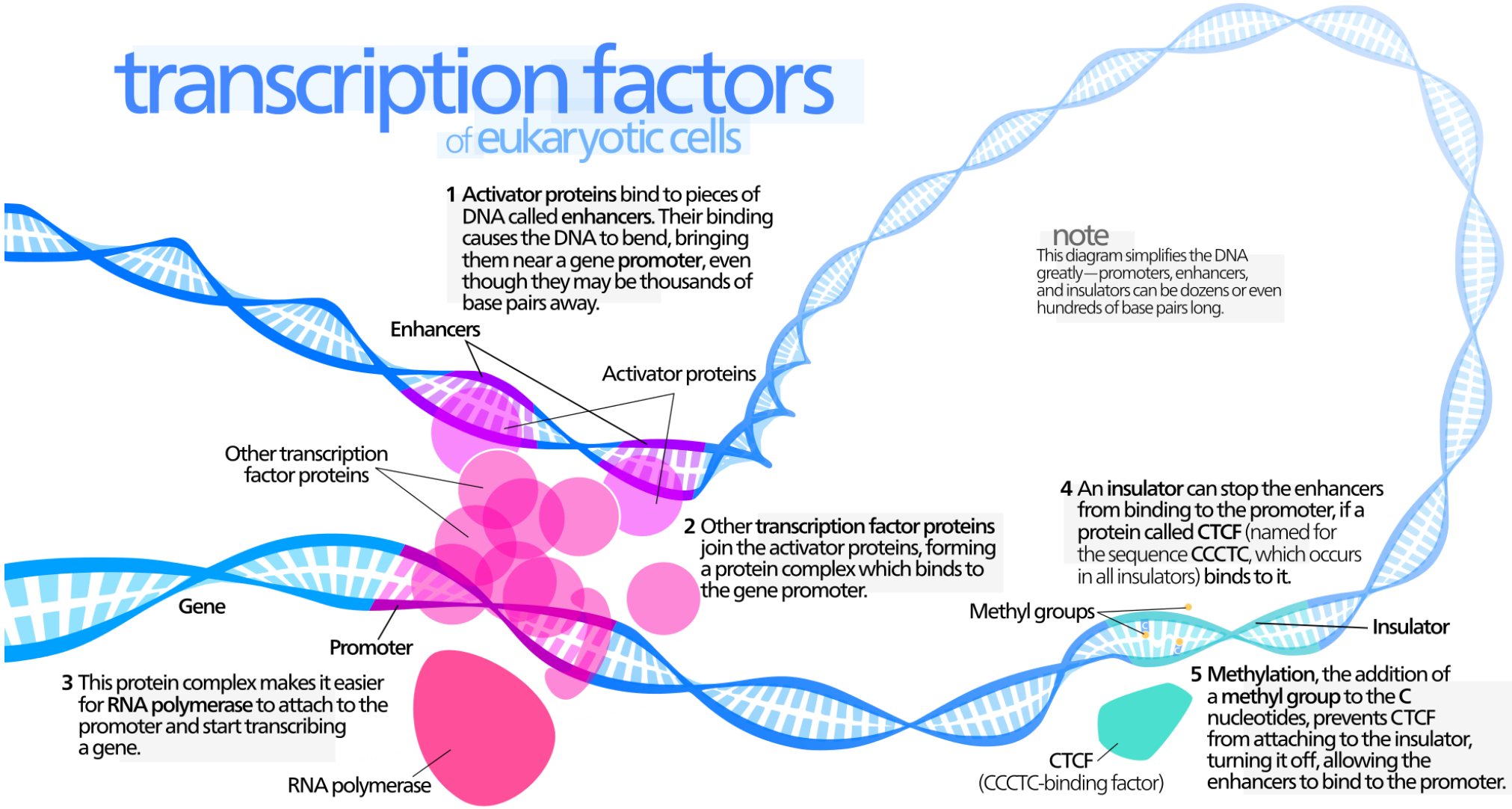
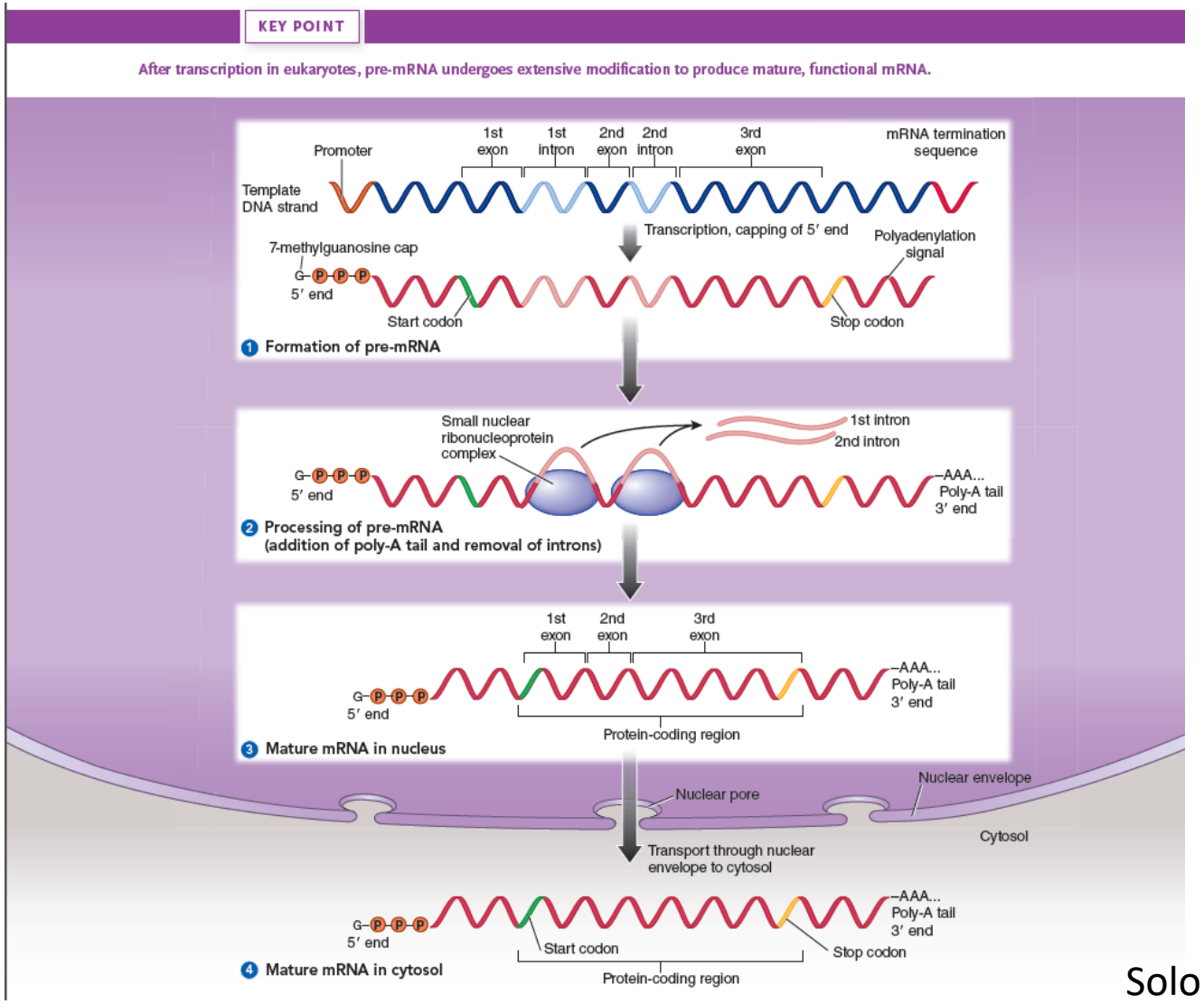
TRANSCRIPTION FACTORS



POSTTRANSCRIPTIONAL MODIFICATIONS



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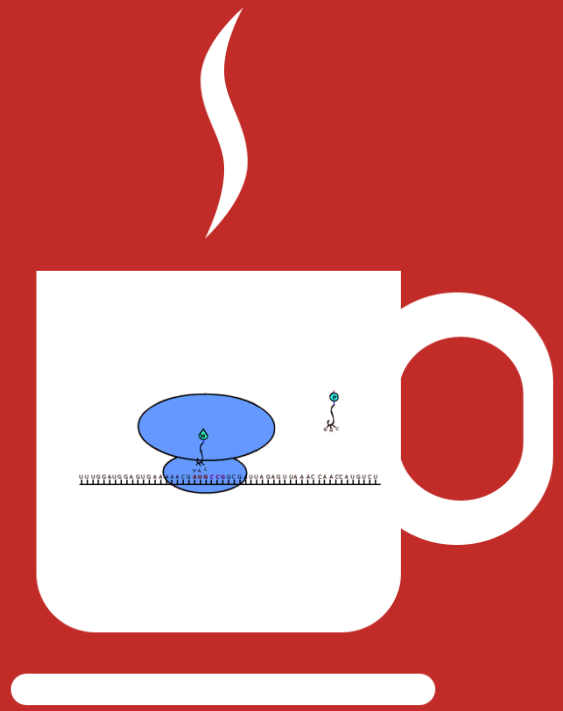
BREAKTIME!



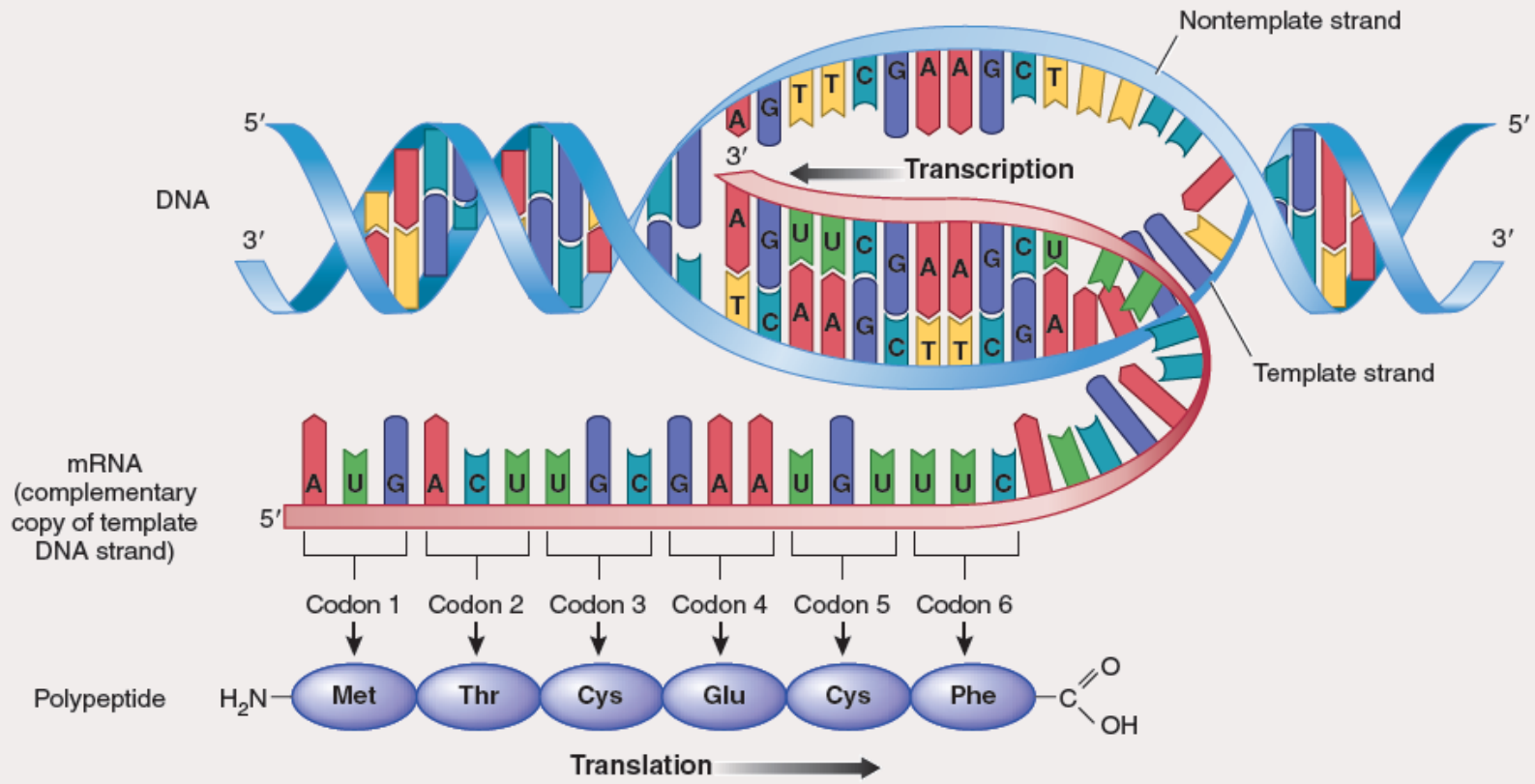
LET’S HAVE
A BREAK!

WE WILL
CONTINUE IN
20 MINUTES

OVERVIEW OF GENE EXPRESSION

KEY POINT

Protein synthesis requires two major steps: DNA $\xrightarrow{\text{transcription}}$ RNA $\xrightarrow{\text{translation}}$ protein



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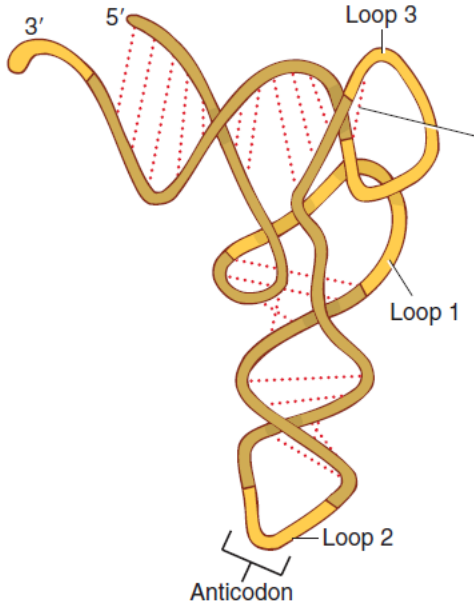
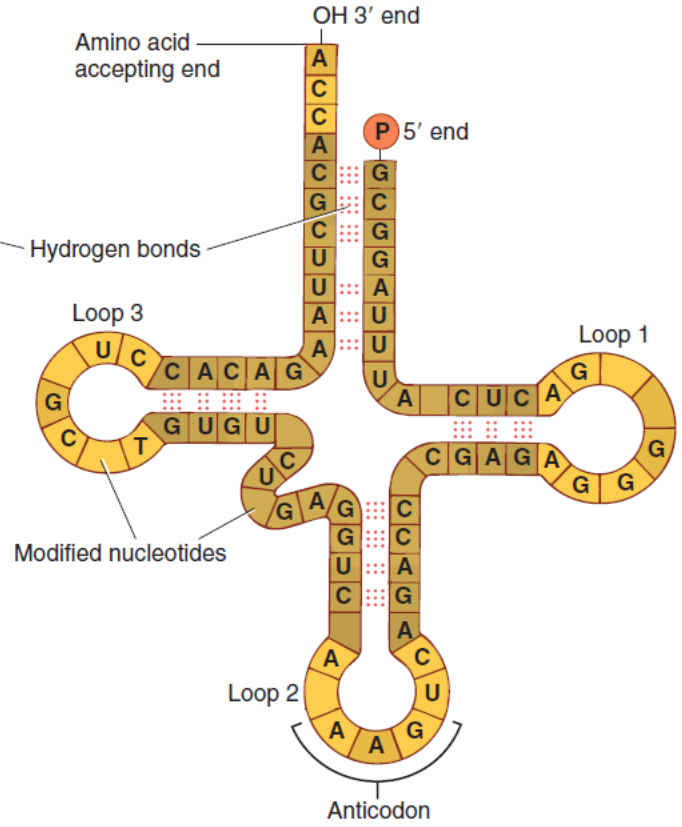
THE GENETIC CODE

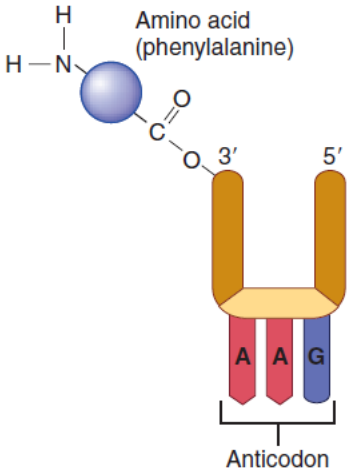
First letter (5′ end)	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter (3′ end)
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met or start	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

KEY

- Stop codon
- Start codon







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TRANSLATION (1)

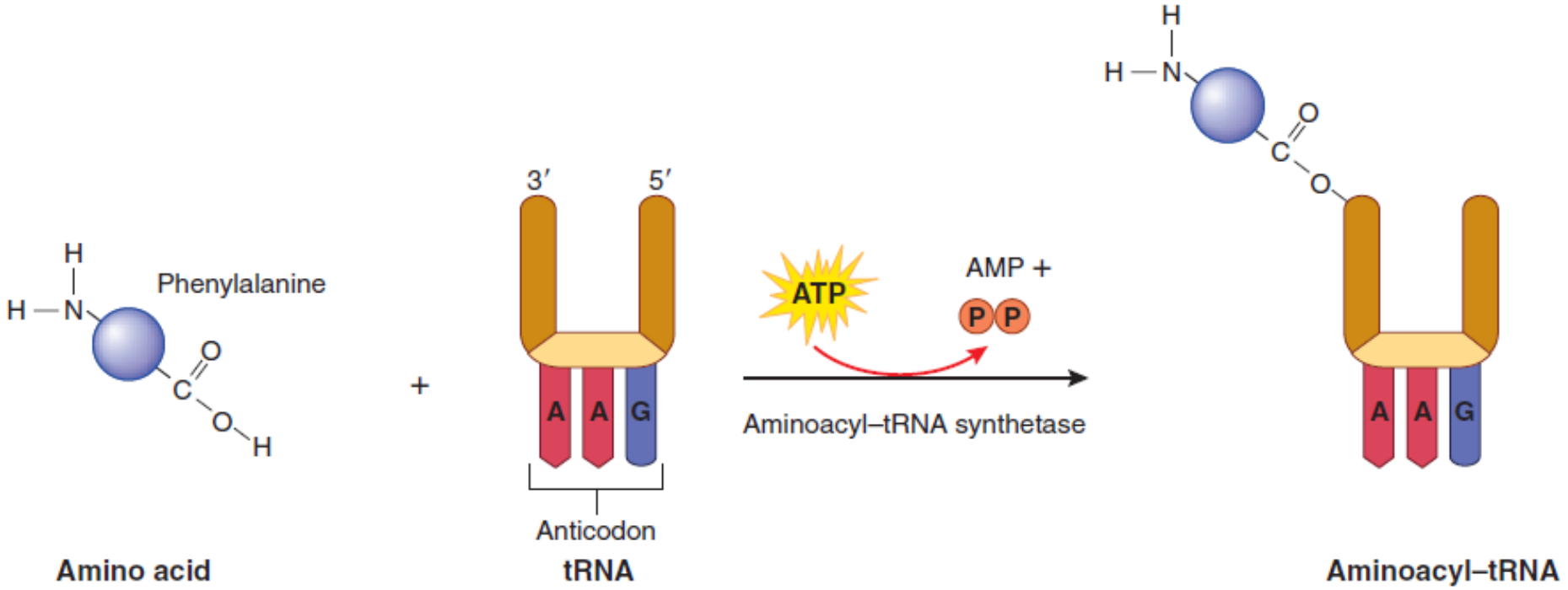
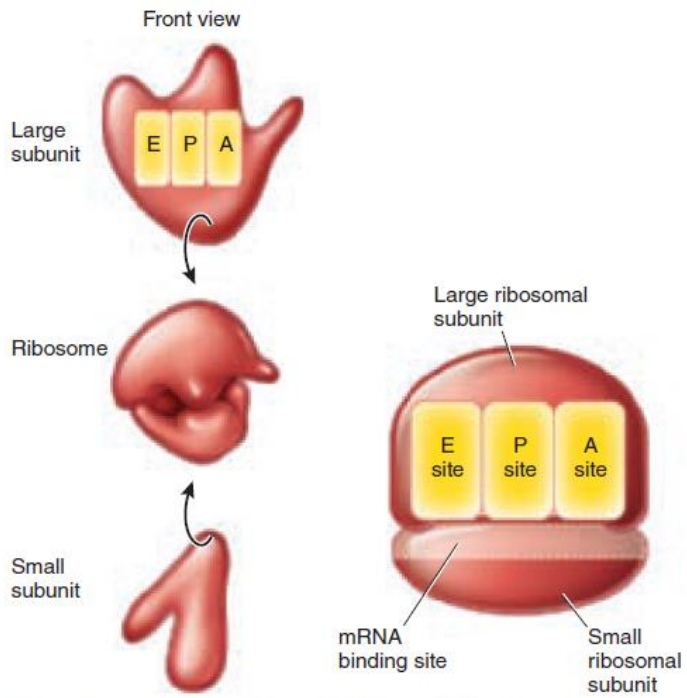


Figure 13-13 **Linkage of a specific amino acid to the appropriate tRNA**

Amino acids are covalently linked to their respective tRNA molecules by aminoacyl–tRNA synthetases, which use ATP as an energy source.

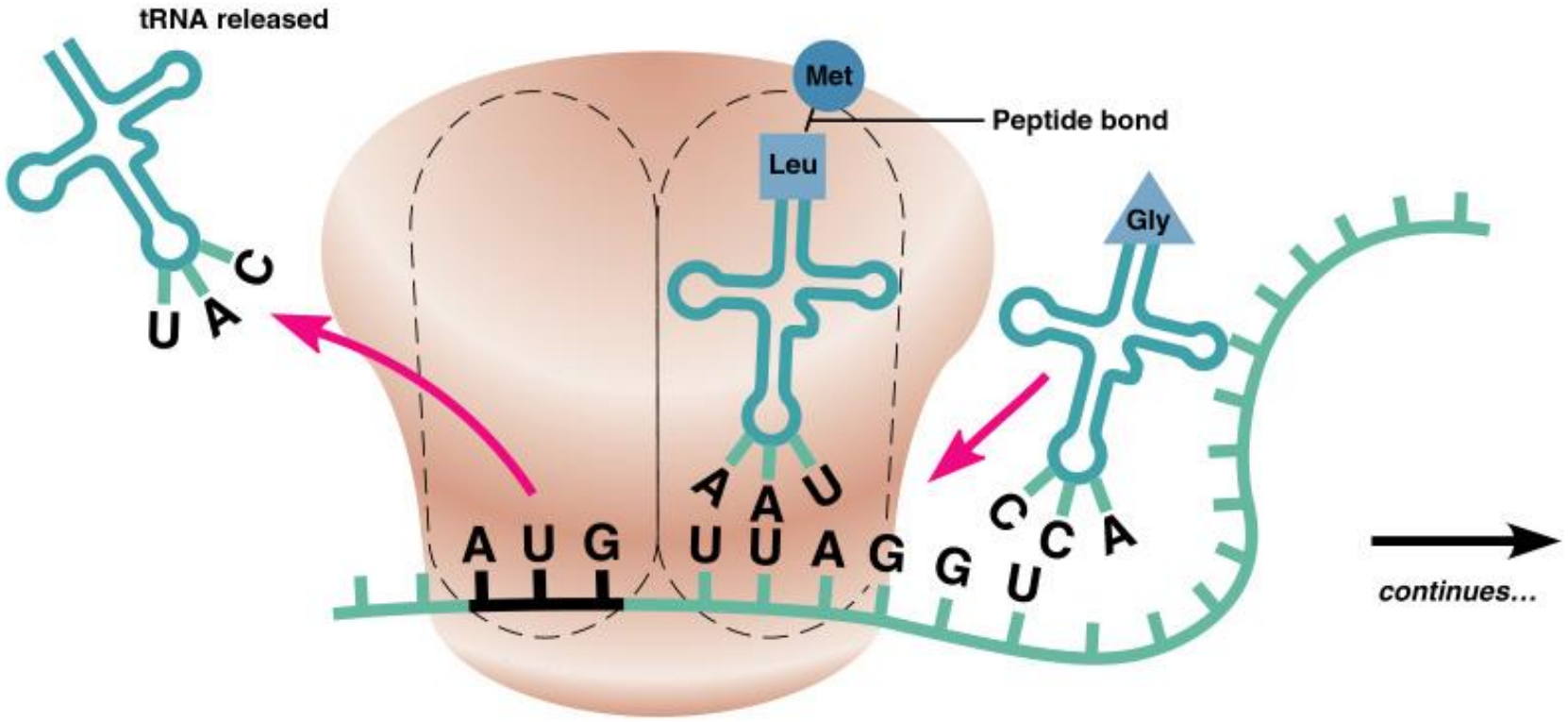
RIBOSOME



(a) A ribosome consists of two subunits, one large and one small. This model of a ribosome is based on a 3-D reconstruction of electron microscopic images.

(b) The mRNA passes through a groove between the two ribosomal subunits. Each ribosome contains three binding sites for tRNA molecules.

Figure 13-14 *Animation* **Ribosome structure**



4 **The first amino acid joins to the second by a peptide bond, and the first tRNA is released.**

TRANSLATION (2)

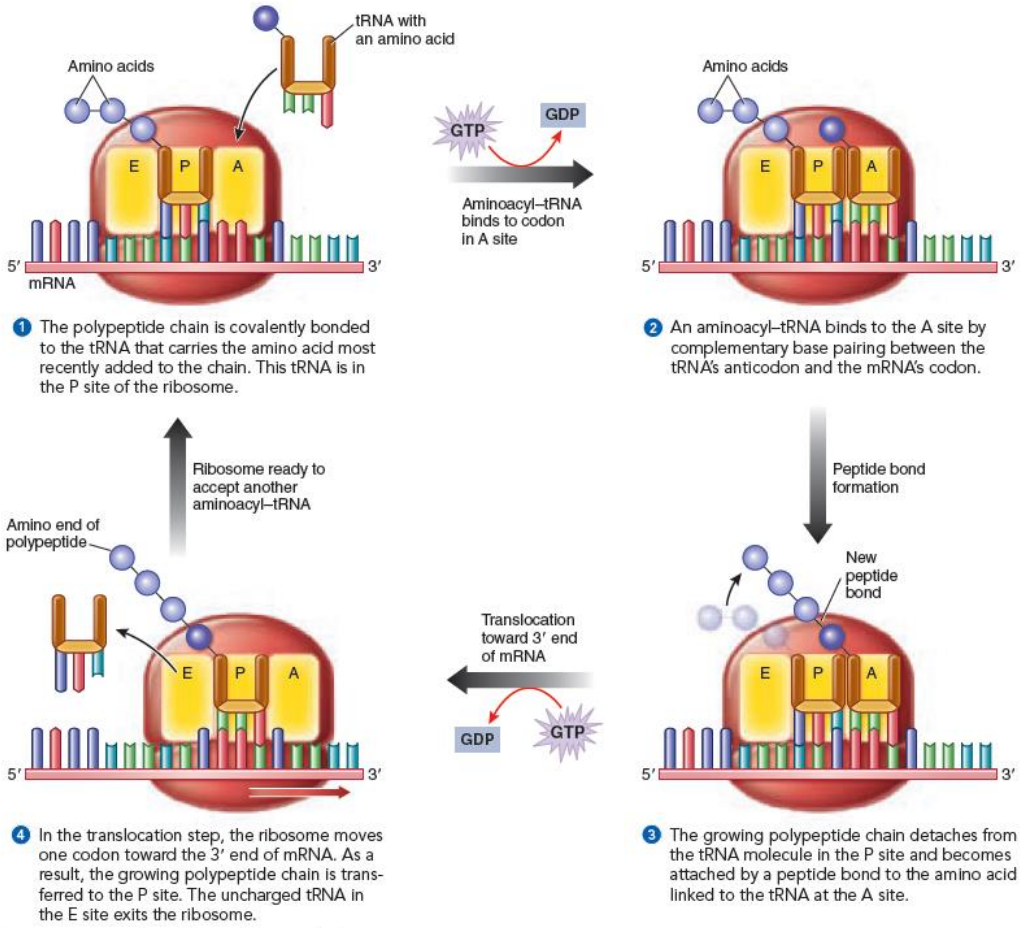
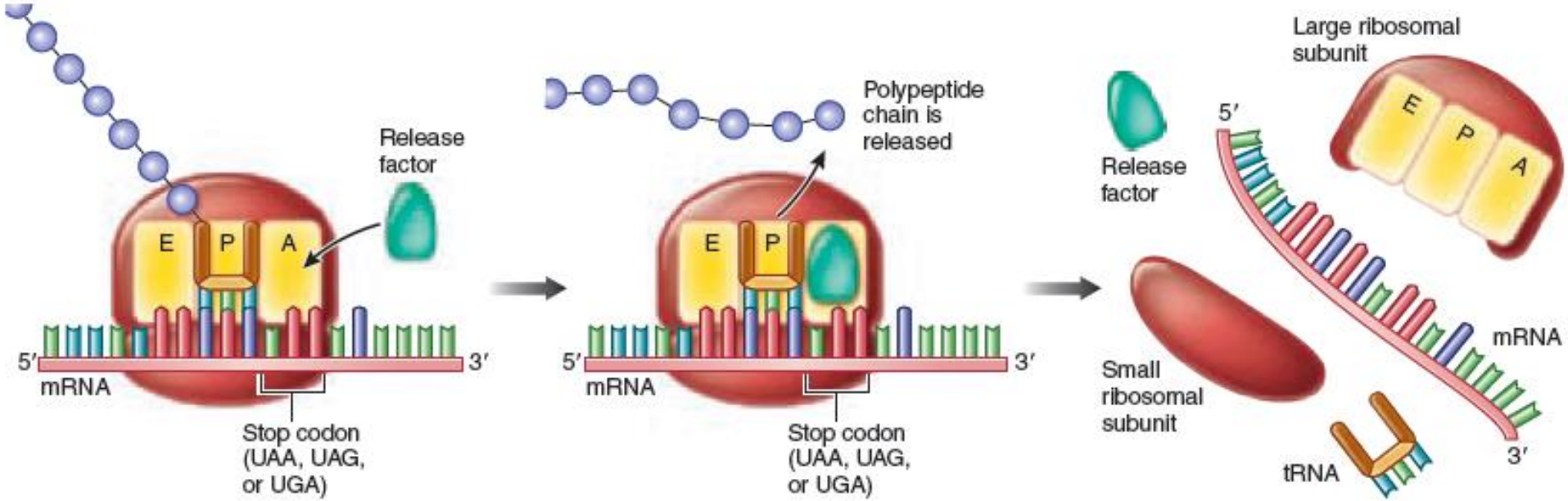


Figure 13-16 An elongation cycle in translation

This illustration begins after a short chain of amino acids has formed. Each repetition of the elongation process adds one amino acid to the growing polypeptide chain.

TRANSLATION (3)



1 When the ribosome reaches a stop codon, the A site binds to a protein release factor.

2 The release factor hydrolyzes the bond between the polypeptide chain and the tRNA, causing the release of the polypeptide chain from the tRNA molecule in the P site.

3 The remaining parts of the translation complex dissociate.

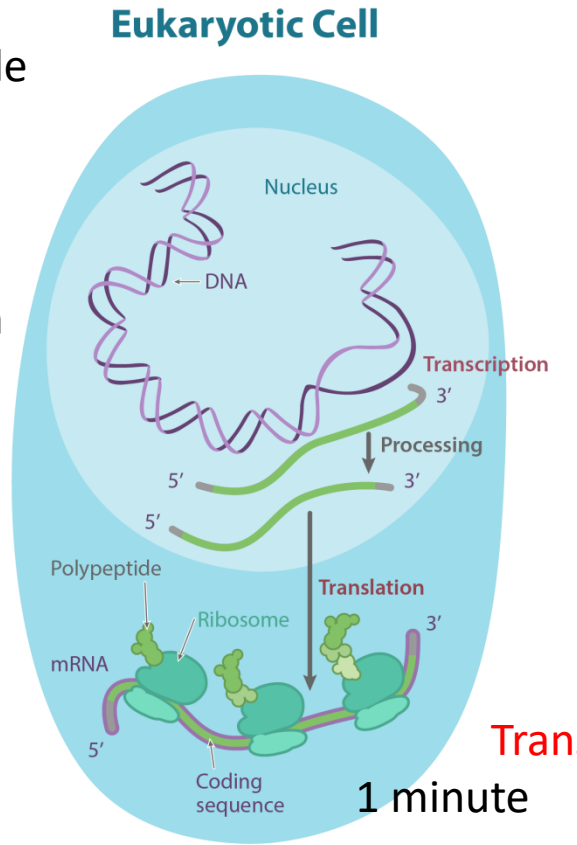
Figure 13-17 *Animation* **The termination of translation**

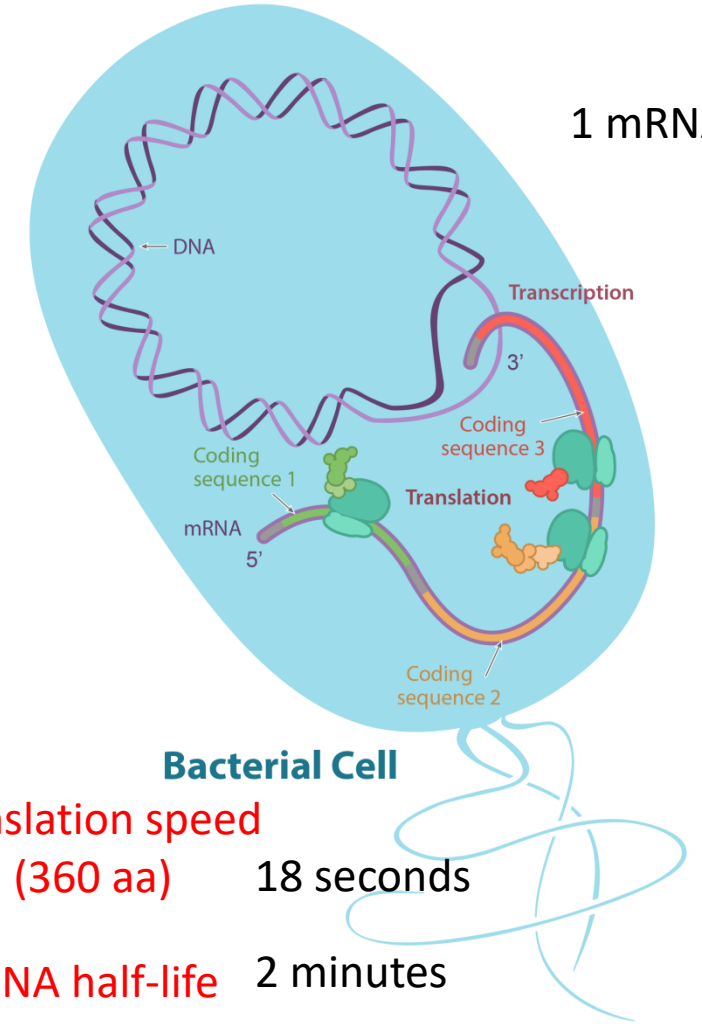
A stop signal terminates polypeptide synthesis because no tRNA molecules exist with an anticodon complementary to a stop codon.

EUKARYOTIC VS. BACTERIAL CELL

1 mRNA encode 1 polypeptide

Posttranscriptional regulation





1 mRNA encode >1 polypeptide

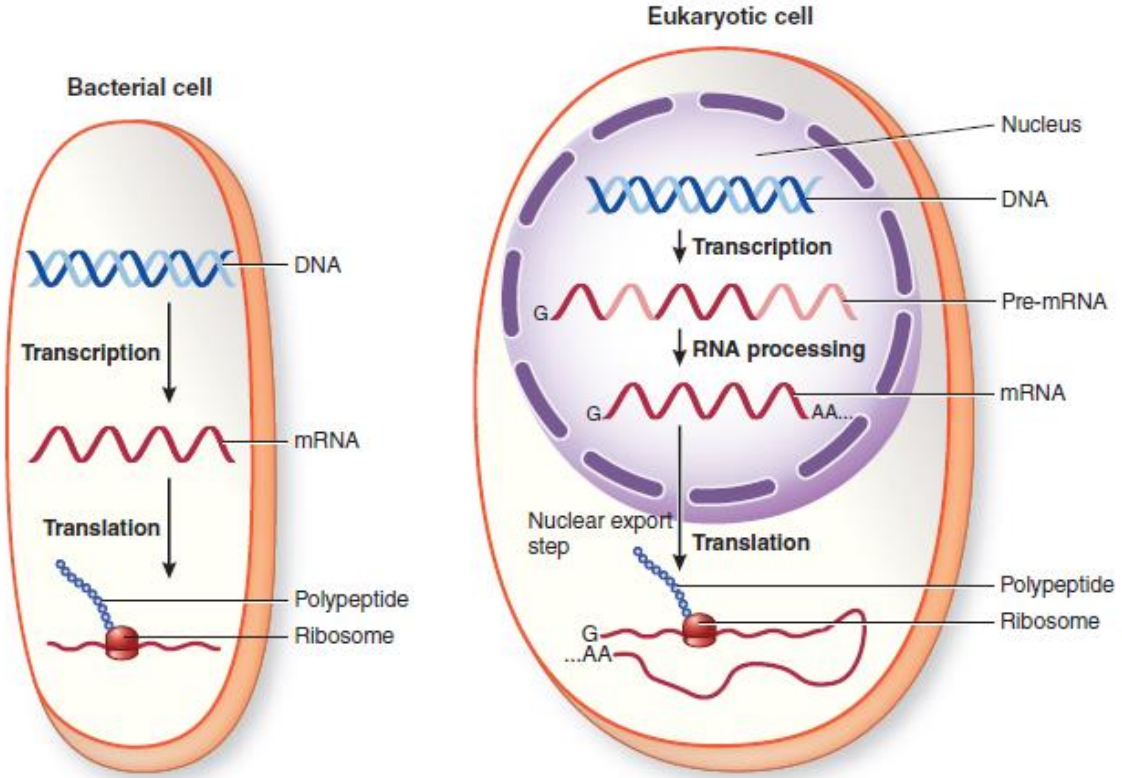
Translation begins before the 3’ end of the transcript is completed

Translation speed

1 minute (360 aa) 18 seconds

10 hours mRNA half-life 2 minutes

SUMMARY



(a) In a bacterial cell, mRNA is immediately ready for translation by ribosomes.

(b) In a eukaryotic cell, RNA processing occurs in the nucleus before the mRNA exits the nucleus for translation.

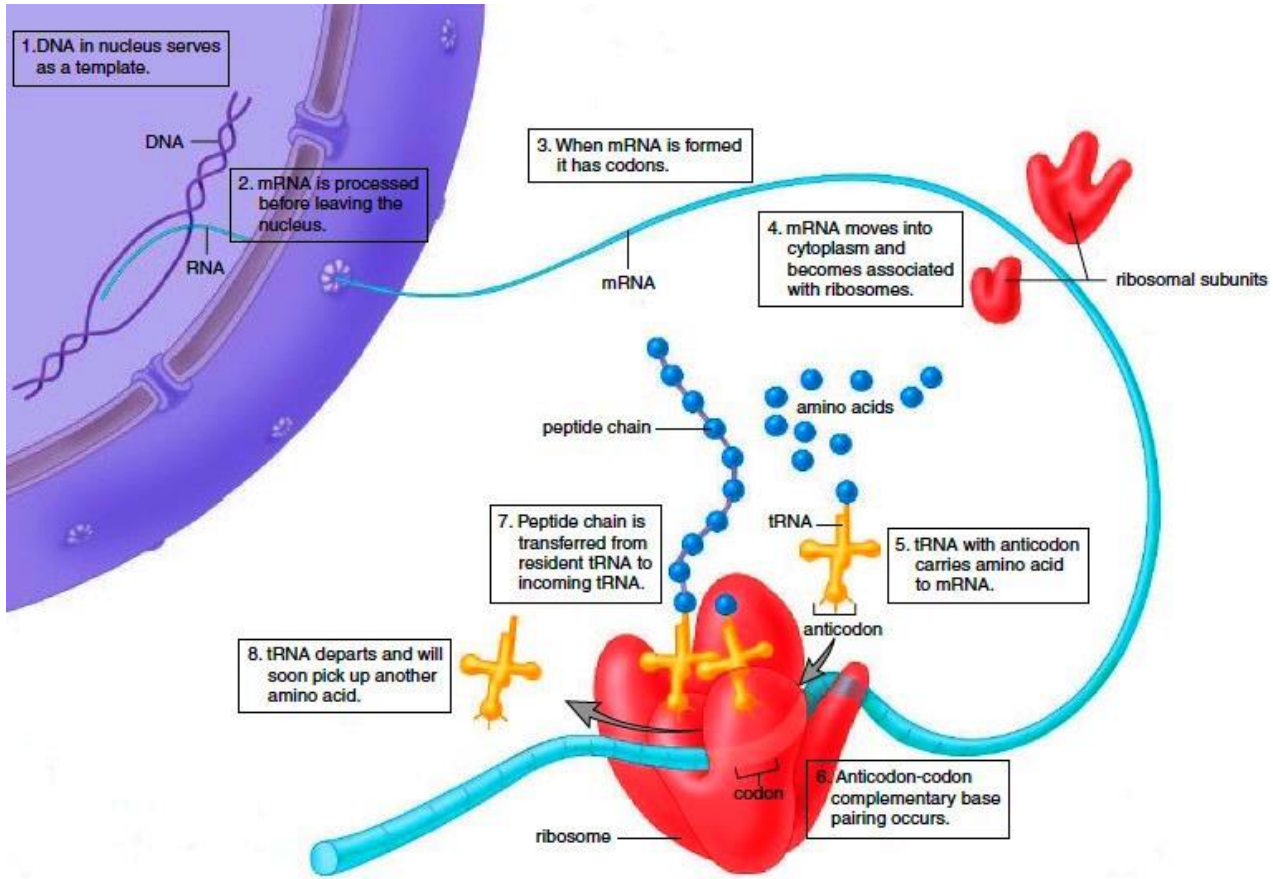
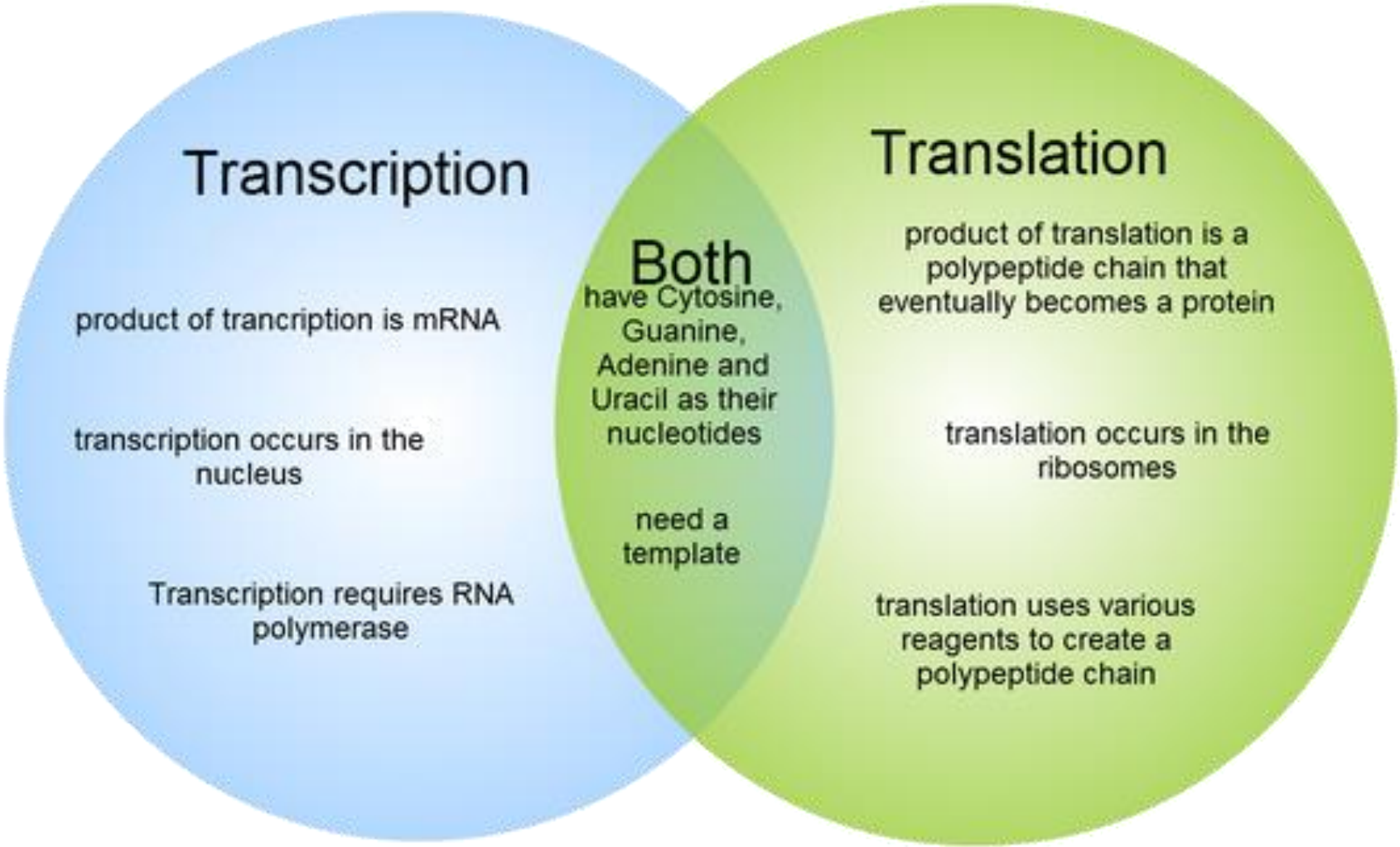


Figure 13-18 **Summary: the flow of genetic information in bacteria and eukaryotes**

TRANSCRIPTION VS. TRANSLATION



“For your own, work with tireless efforts if you want to understand what are the rules imposed by nature to itself.”

Imre Festetics

THANK YOU FOR YOUR ATTENTION!