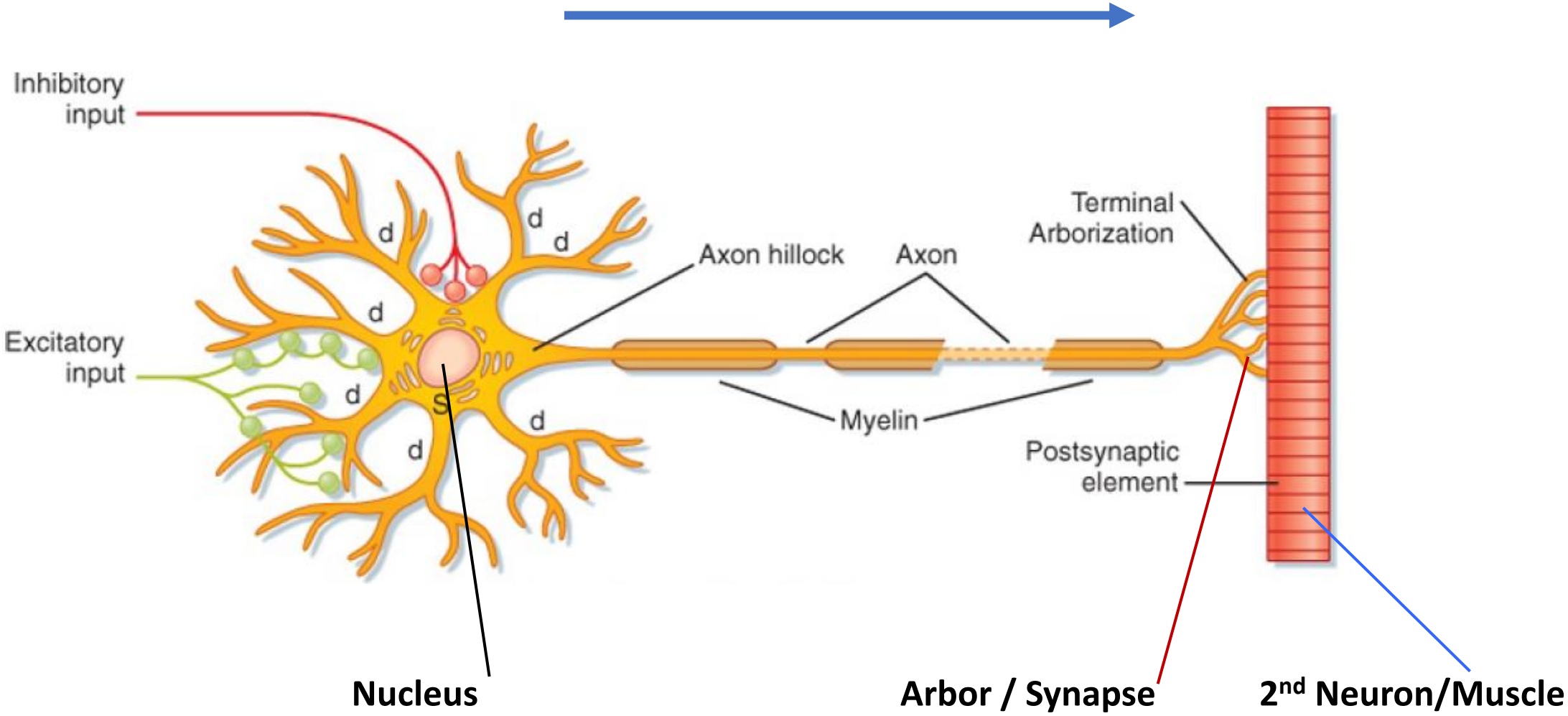
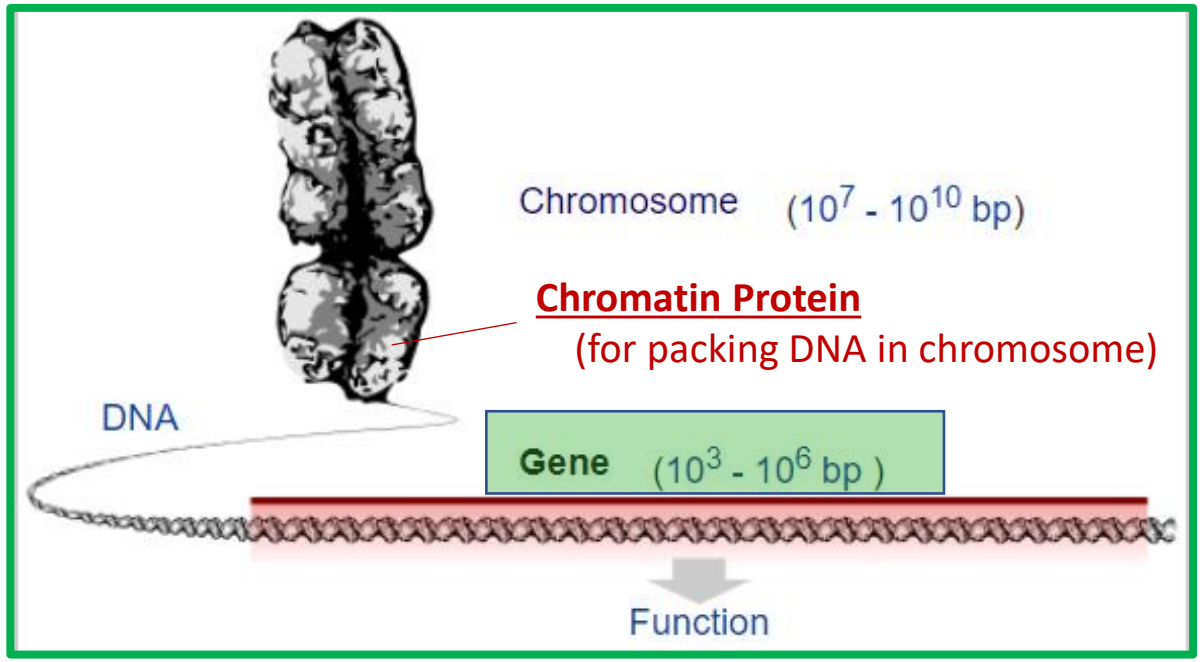
Neuron:
Its Nucleus

Neuron: Nucleus & Synapse



Chromosome → Gene → DNA Nucleotide Radicals



A gene is a region of DNA that encodes function. A chromosome consists of a long strand of DNA containing many genes. A human chromosome can have up to 500 million base pairs of DNA with thousands of genes.

The Nobel Prize in Physiology or Medicine 1968

Robert W. Holley
Prize share: 1/3

Har Gobind Khorana
Prize share: 1/3

Marshall W. Nirenberg
Prize share: 1/3

H. Gobind Khorana

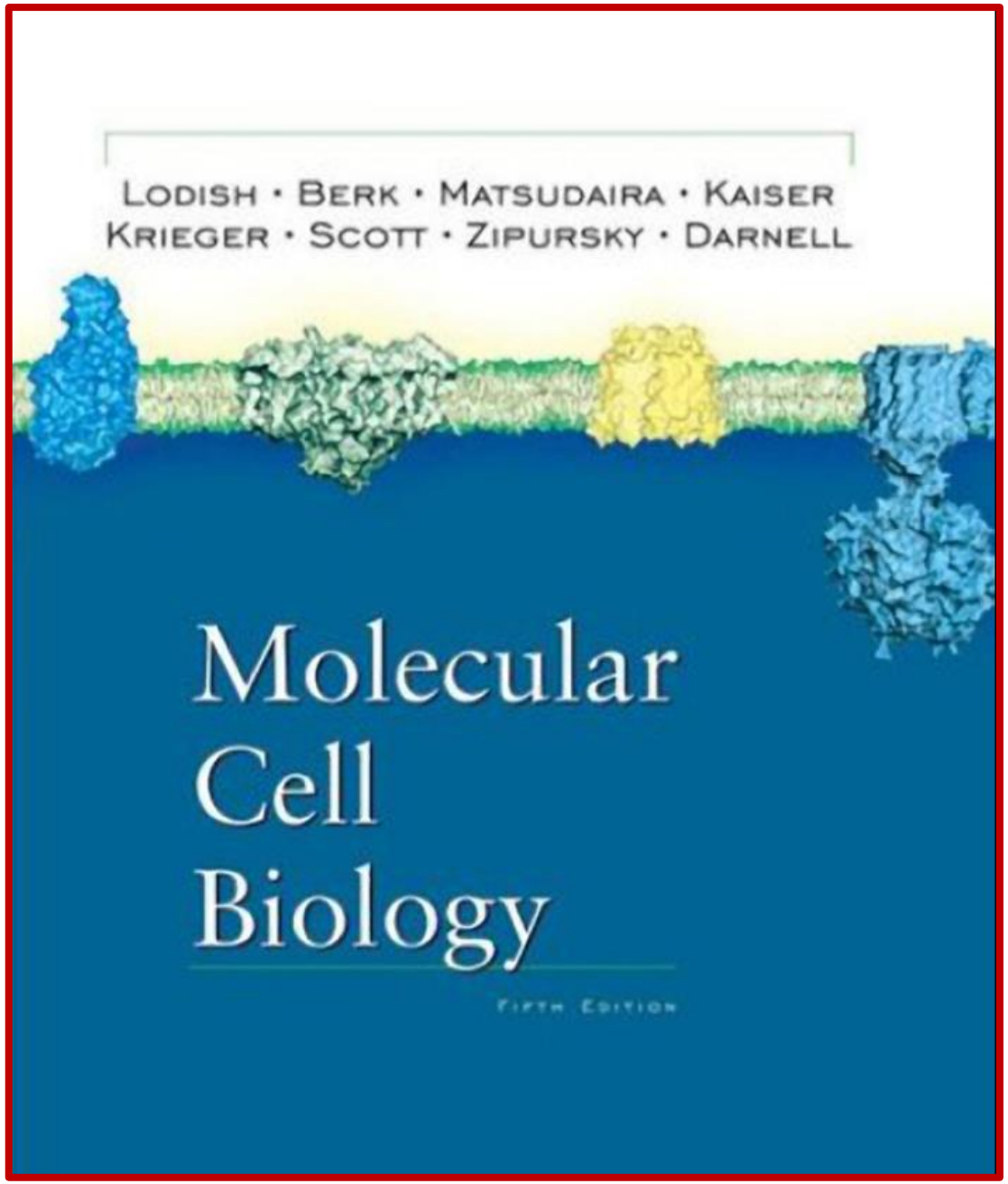
Nucleic acid synthesis in the study of the genetic code

Nobel Lecture, December 12, 1968

1. Introduction

Recent progress in the understanding of the genetic code is the result of the efforts of a large number of workers professing a variety of scientific disciplines. Therefore, I feel it to be appropriate that I attempt a brief review of the main steps in the development of the subject before discussing our own contribution which throughout has been very much a group effort. I should also like to recall that a review of the status of the problem of the genetic code up to 1962 was presented by Crick in his Nobel lecture[1].

While it is always difficult, perhaps impossible, to determine or clearly define the starting point in any area of science, the idea that genes make proteins was an important step and this concept was brought into sharp focus by the specific one gene-one enzyme hypothesis of Beadle and Tatum[2]. The field of biochemical genetics was thus born. The next step was taken when it was established that genes are nucleic acids. The transformation experiments of Avery and coworkers[3] followed by the bacteriophage experiments of Hershey and Chase[4] established this for DNA and the work with TMV-RNA a few years later established the same for RNA[5,6]. By the early 1950's it was, therefore, clear that genes are nucleic acids and that nucleic acids direct protein synthesis, the direct involvement of RNA in this process being suggested by


Lodish • Berk • Matsudaira • Kaiser
Krieger • Scott • Zipursky • Darnell
Molecular
Cell
Biology
Fifth Edition

DNA

BASES (2-Ring Purines)

BASES (1-Ring Pyrimidines)

Thymine

Adenine

5' end

3' end

Nucleo-side

Sugar (Ribose)

Phosphate

Phosphate-deoxyribose backbone

Nucleo-tide

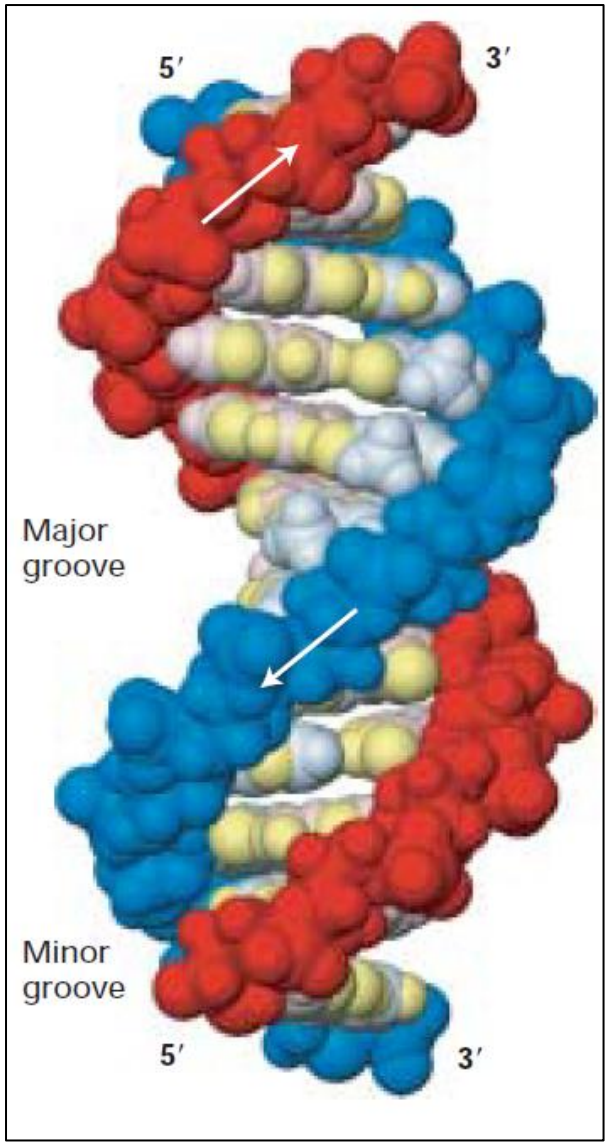
3' end

Cytosine

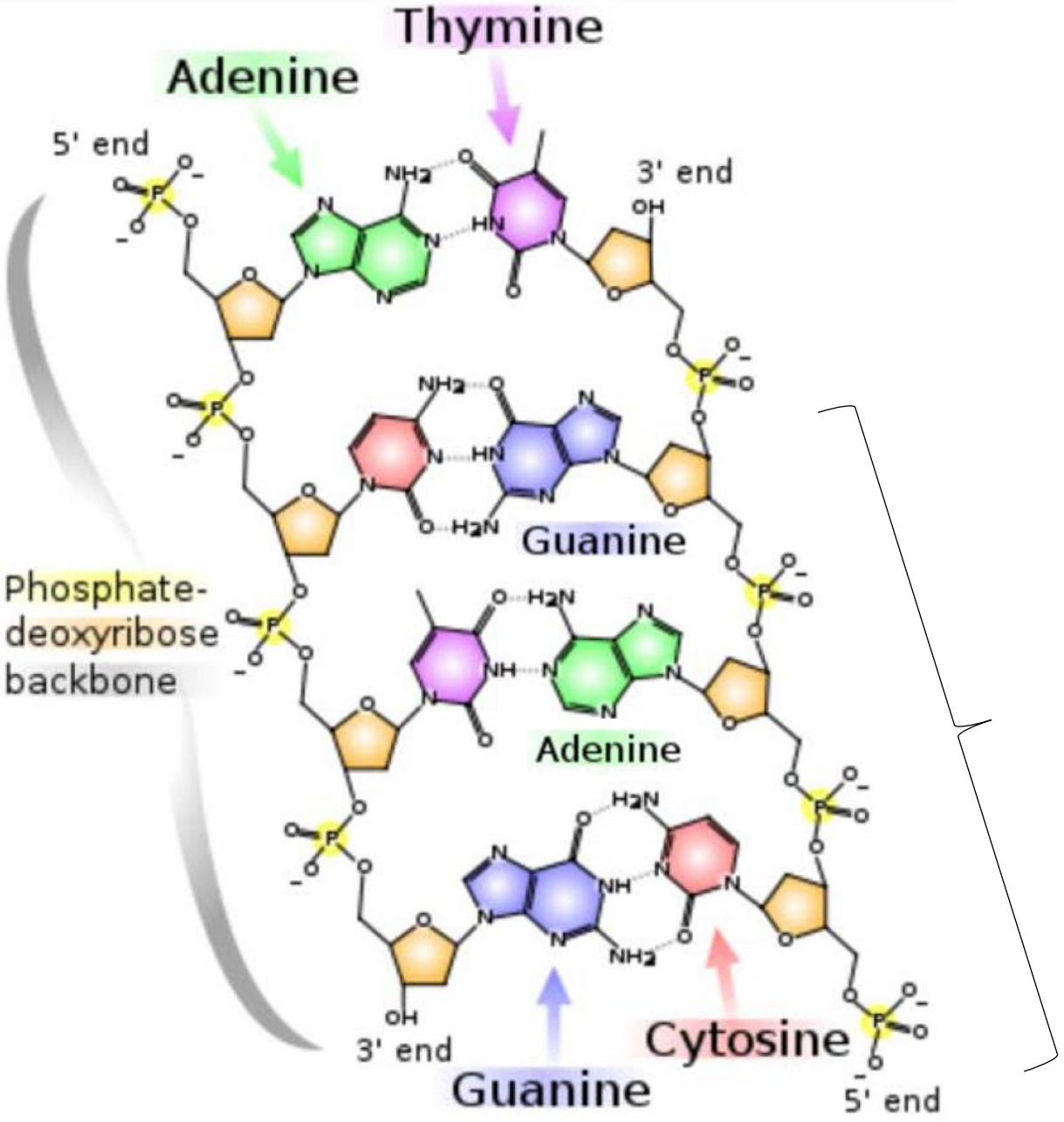
Guanine

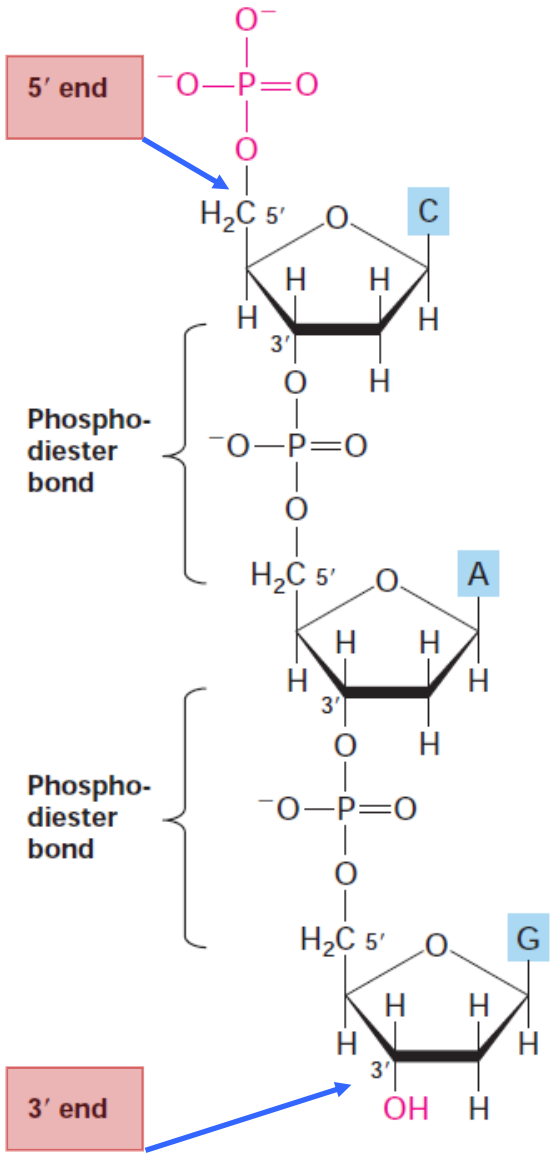
5' end

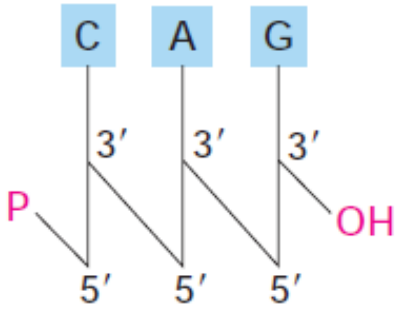
BASES



4 Types of DNA Nomenclatures

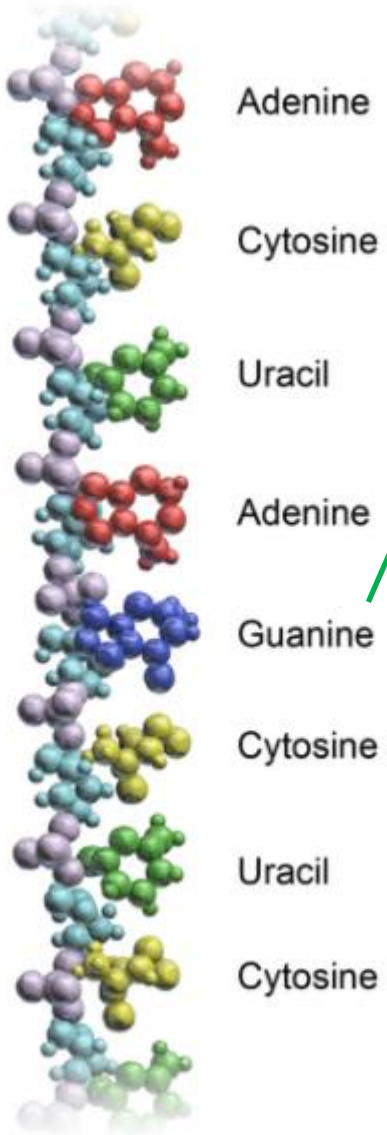


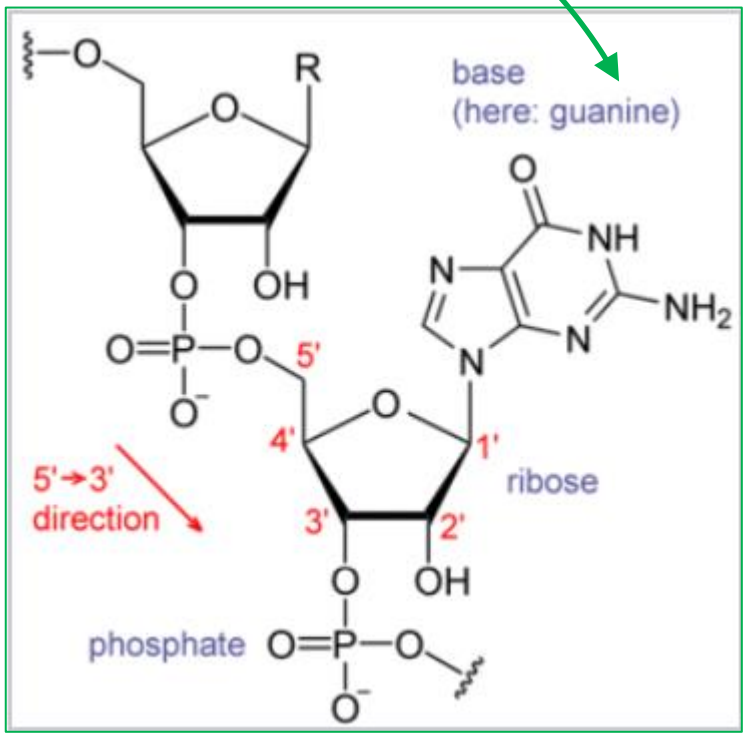




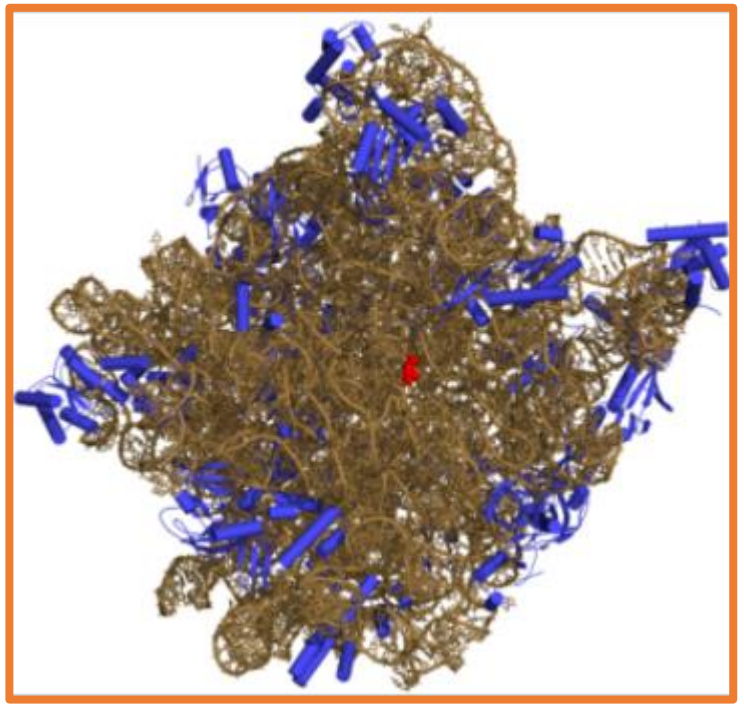
5′ C-A-G 3′

RNA Molecule





RNA coils → Ribosome (Cell's powerhouse)



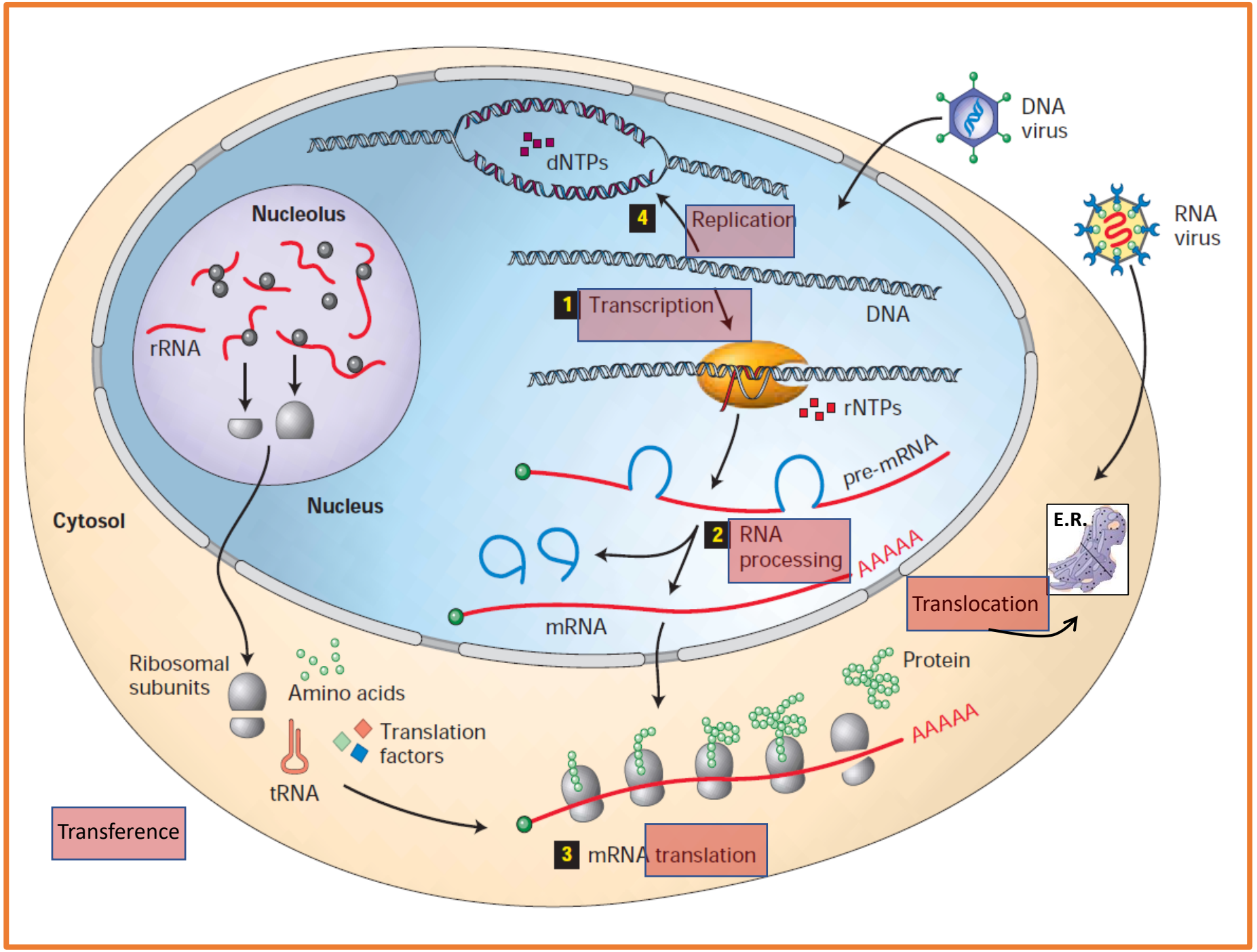
Basic Genetic Processes:

$R^2 T^5$

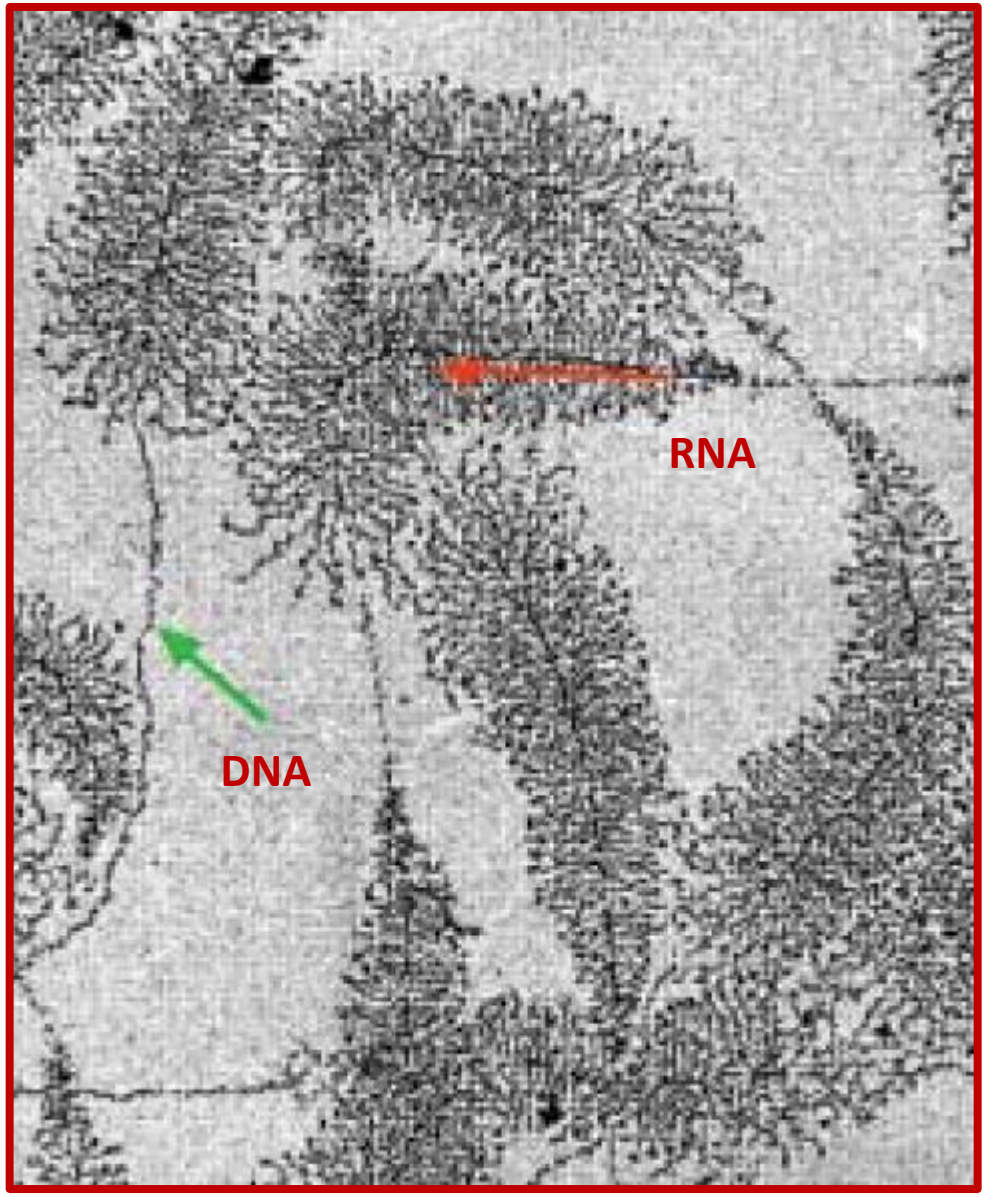
Replication of DNA
(during Cell Division)

Protein Formation Steps:

- Transcription,
- RNA processing,
- Transference,
- Translation
- Translocation

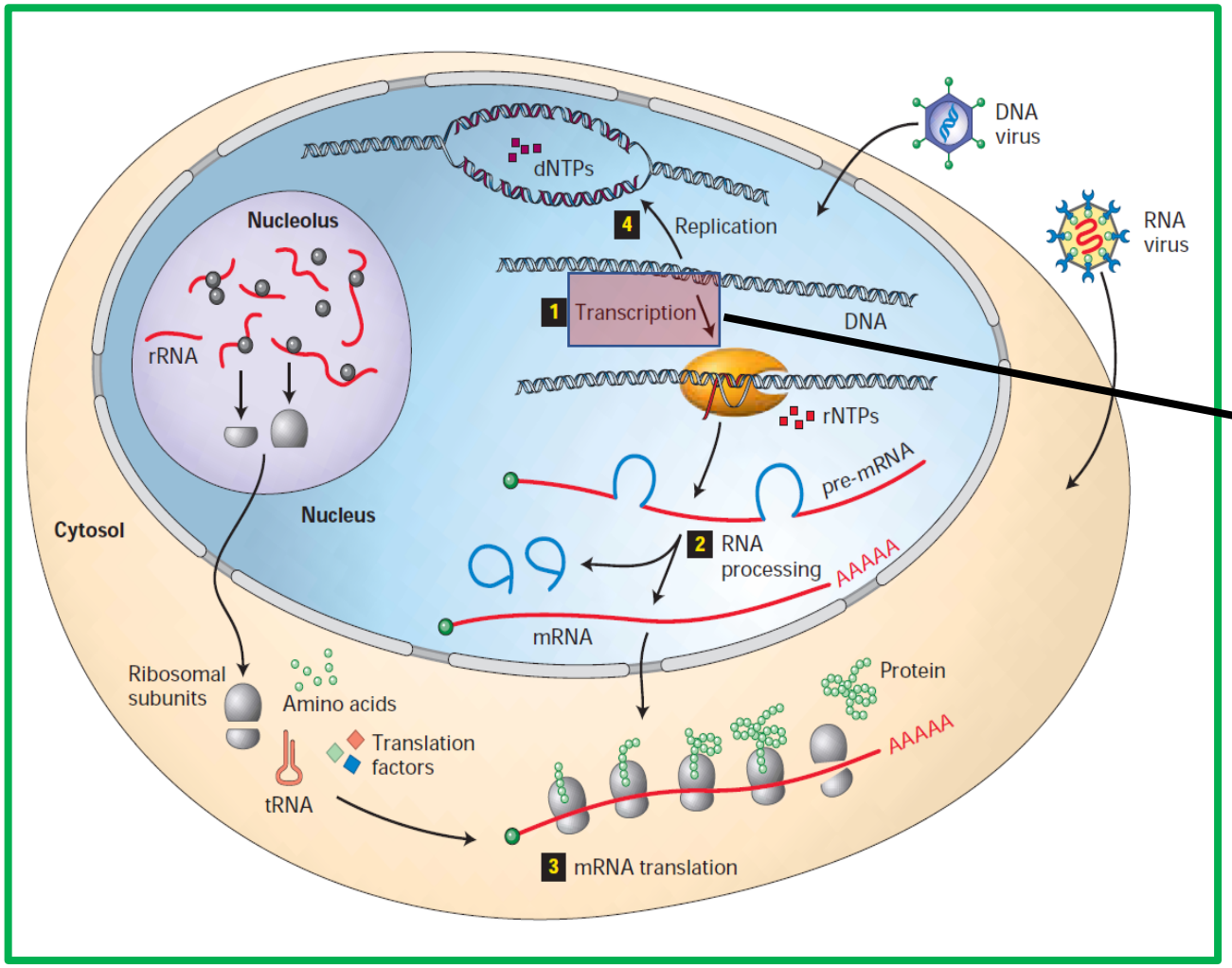


Electron Microscopy of Transcription



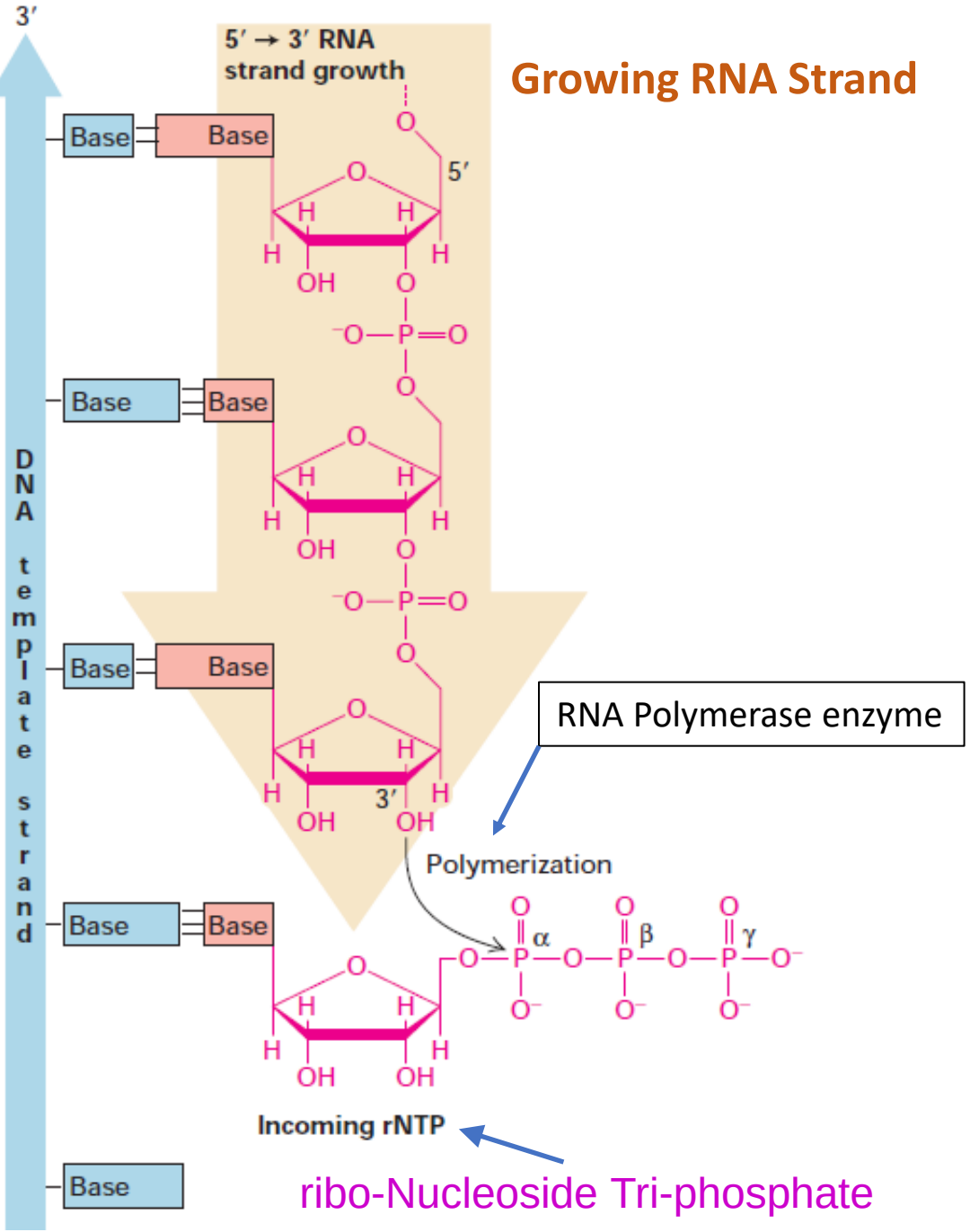
Stage 1: Translation

Forming pre- mRNA

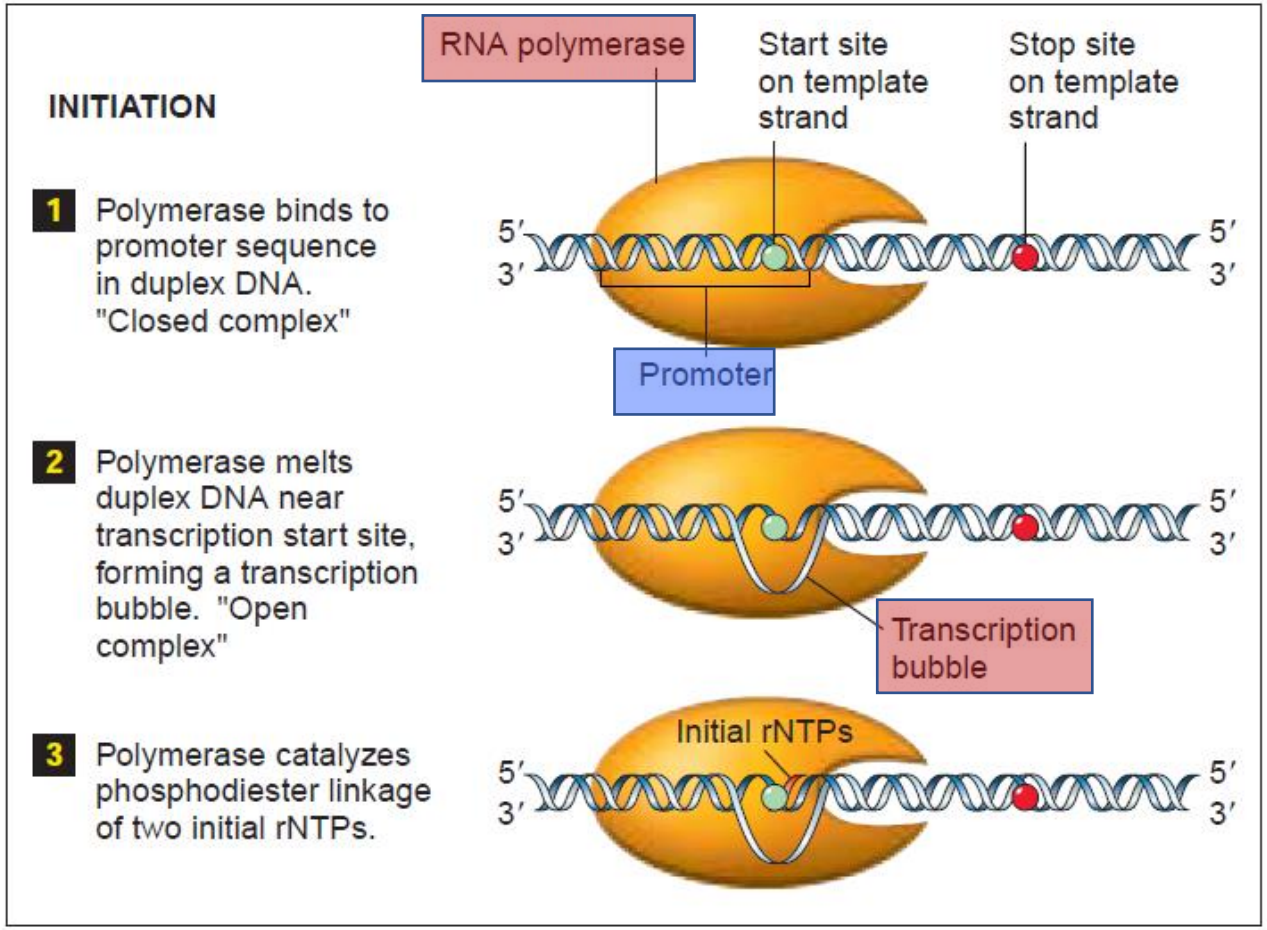


DNA Template Strand

Growing RNA Strand

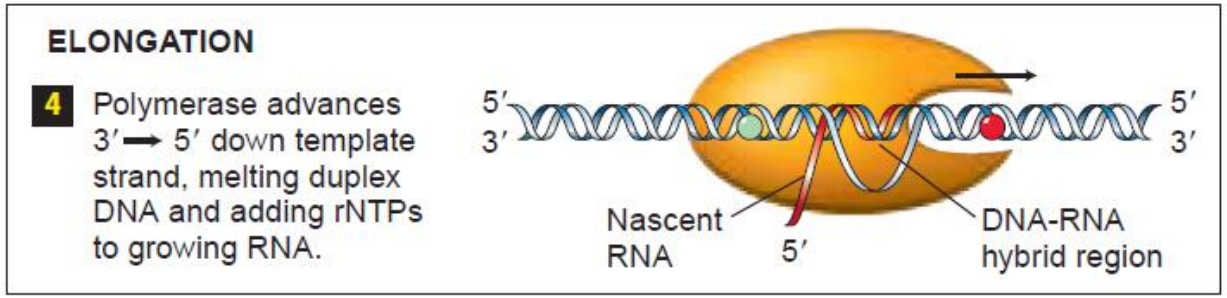


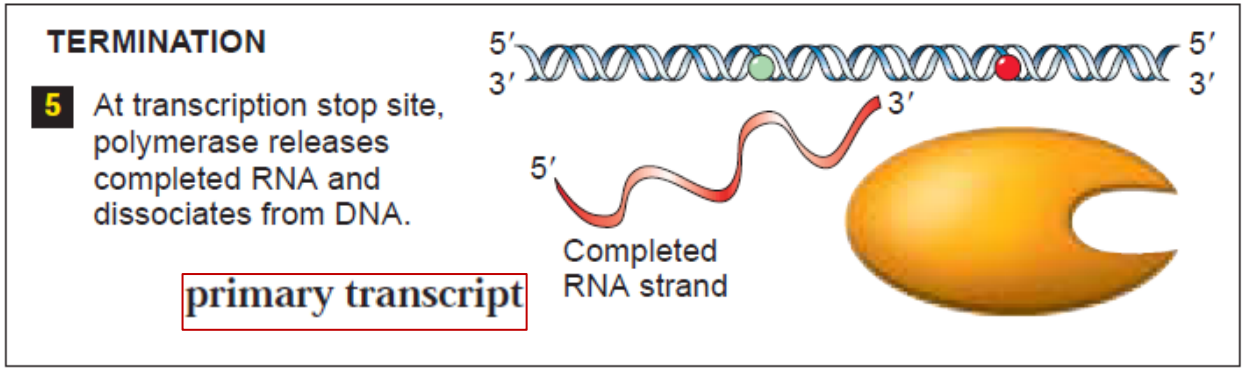
Three Stages of Transcription



14 base pairs

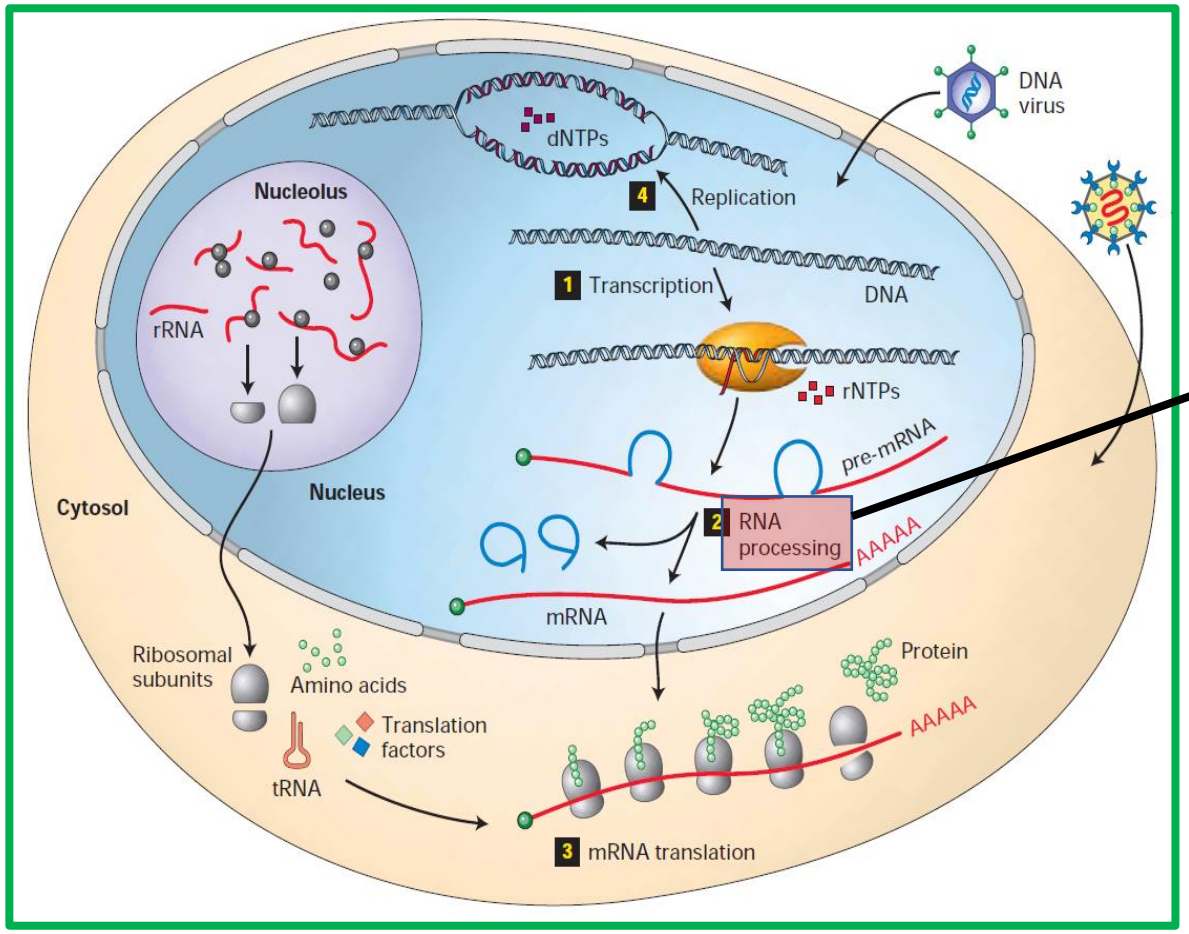
1000 nucleotides per minute

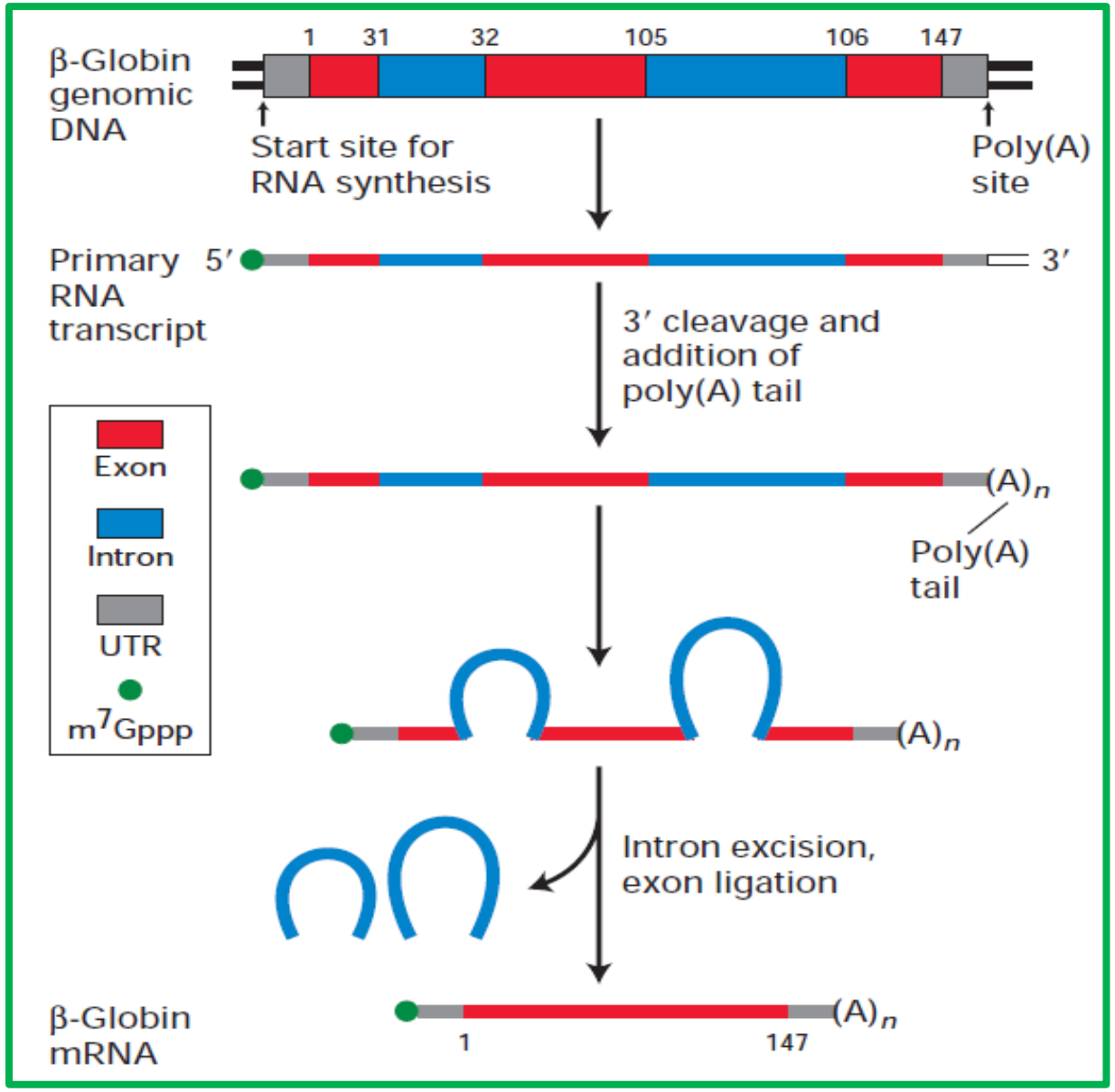




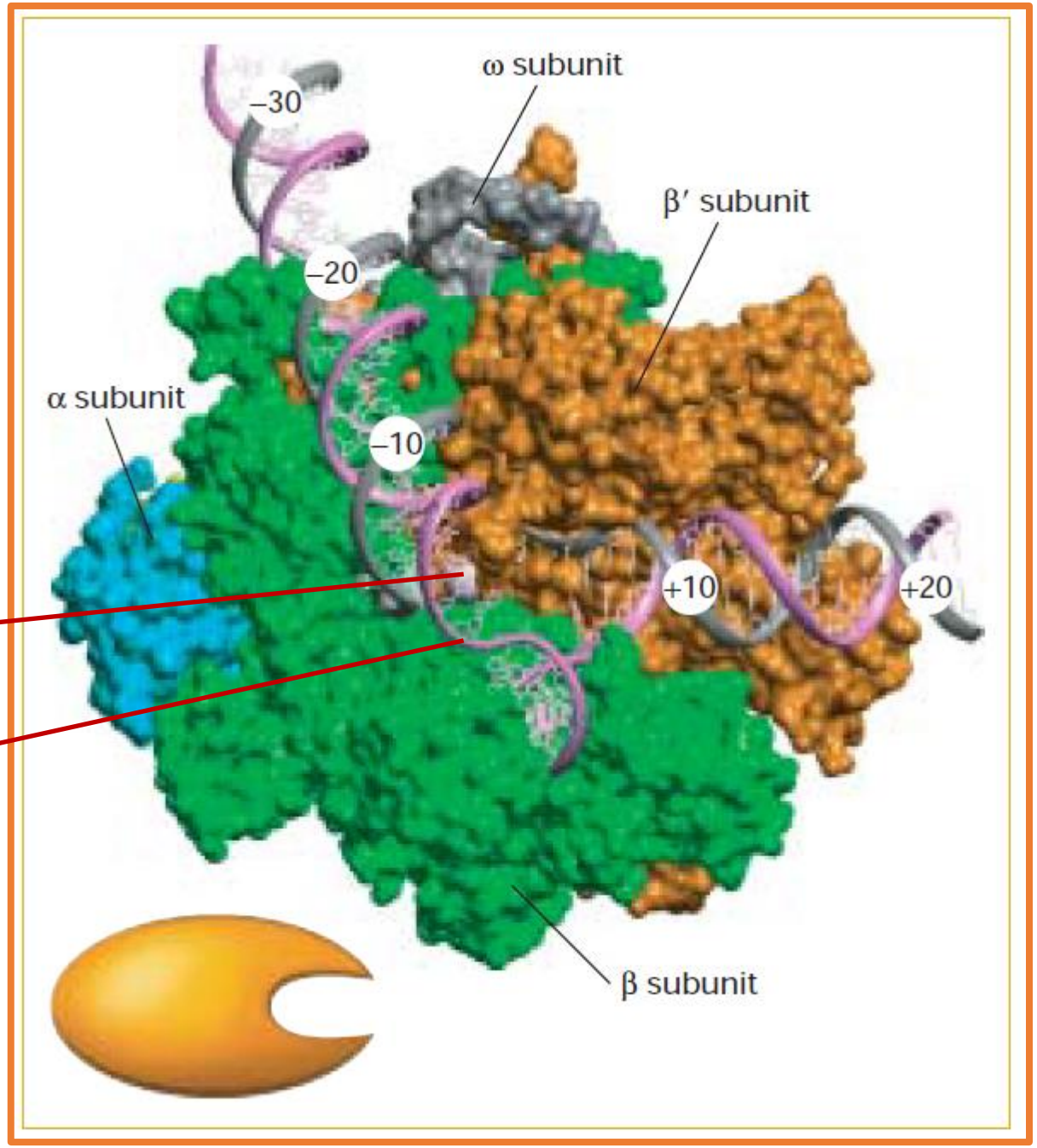
Stage 2: RNA Processing

Forming mRNA





Electron Microscopy-based Structure of RNA Polymerase



Mg ++ ion

Transcription Bubble
(Separating DNA strands)

Genetic Code (RNA to Amino Acids)*

Alanine (Ala or A)	Valine (Val or V)	Isoleucine (Ile or I)
Methionine (Met or M)	Phenylalanine (Phe or F)	Tyrosine (Tyr or Y)
Lysine (Lys or K)	Arginine (Arg or R)	Histidine (His or H)
Glutamate (Glu or E)	Asparagine (Asn or N)	Glutamine (Gln or Q)
Aspartate (Asp or D)	Serine (Ser or S)	Threonine (Thr or T)
Cysteine (Cys or C)	Glycine (Gly or G)	Proline (Pro or P)
Leucine (Leu or L)	Tryptophan (Trp or W)	

First Position (5′ end)	Second Position U	Second Position C	Second Position A	Second Position G	Third Position (3′ end)
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu (Met)*	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met (start)	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val (Met)*	Ala	Glu	Gly	G

*AUG is the most common initiator codon; GUG usually codes for valine, and CUG for leucine, but, rarely, these codons can also code for methionine to initiate a protein chain.