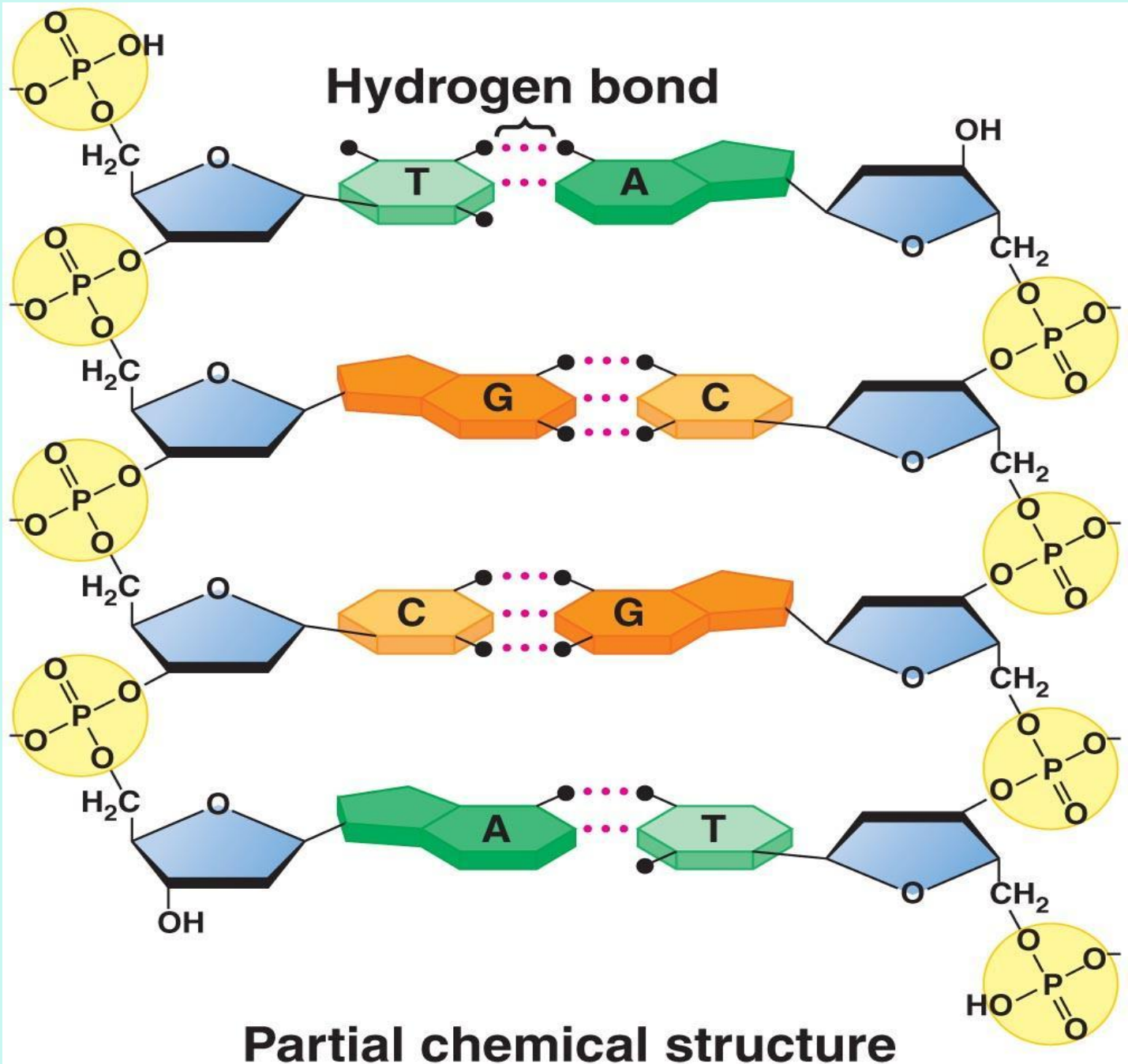
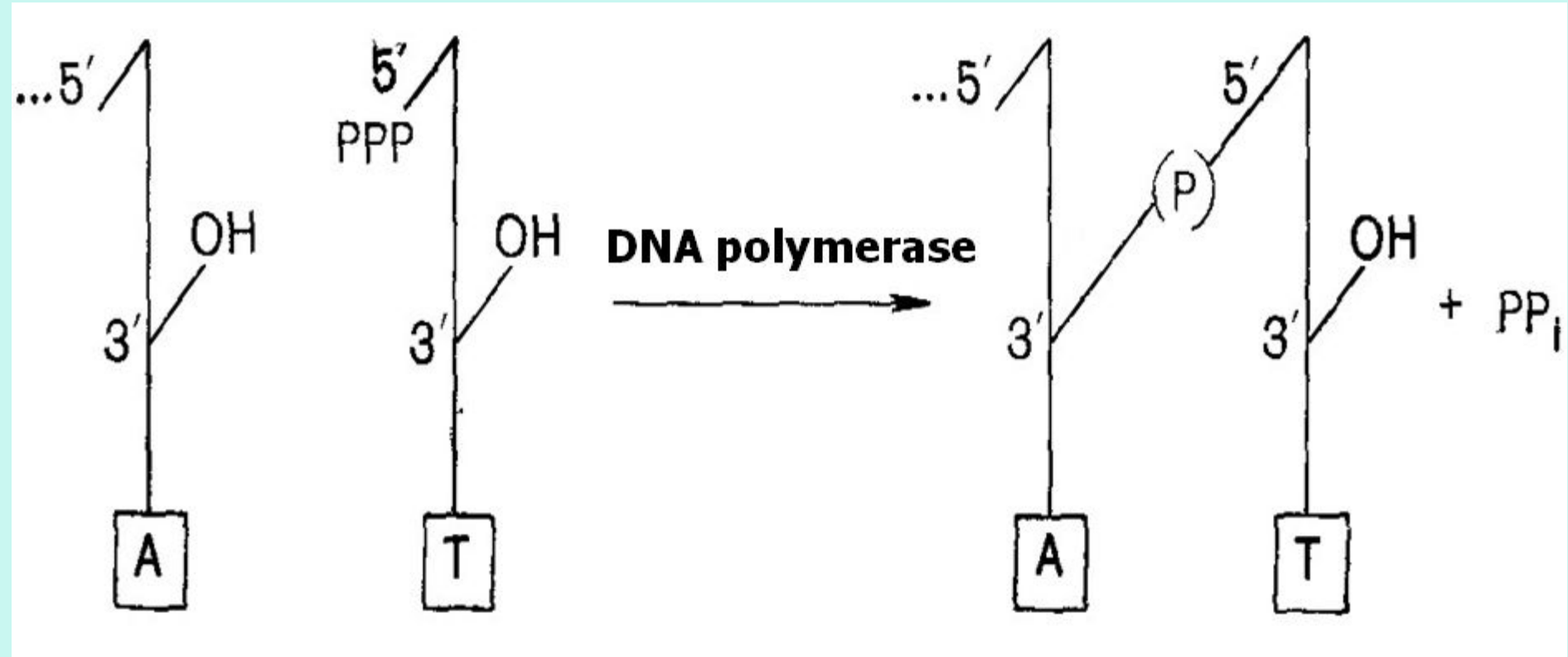


***TEMPLATE  
BIOSYNTHESIS***

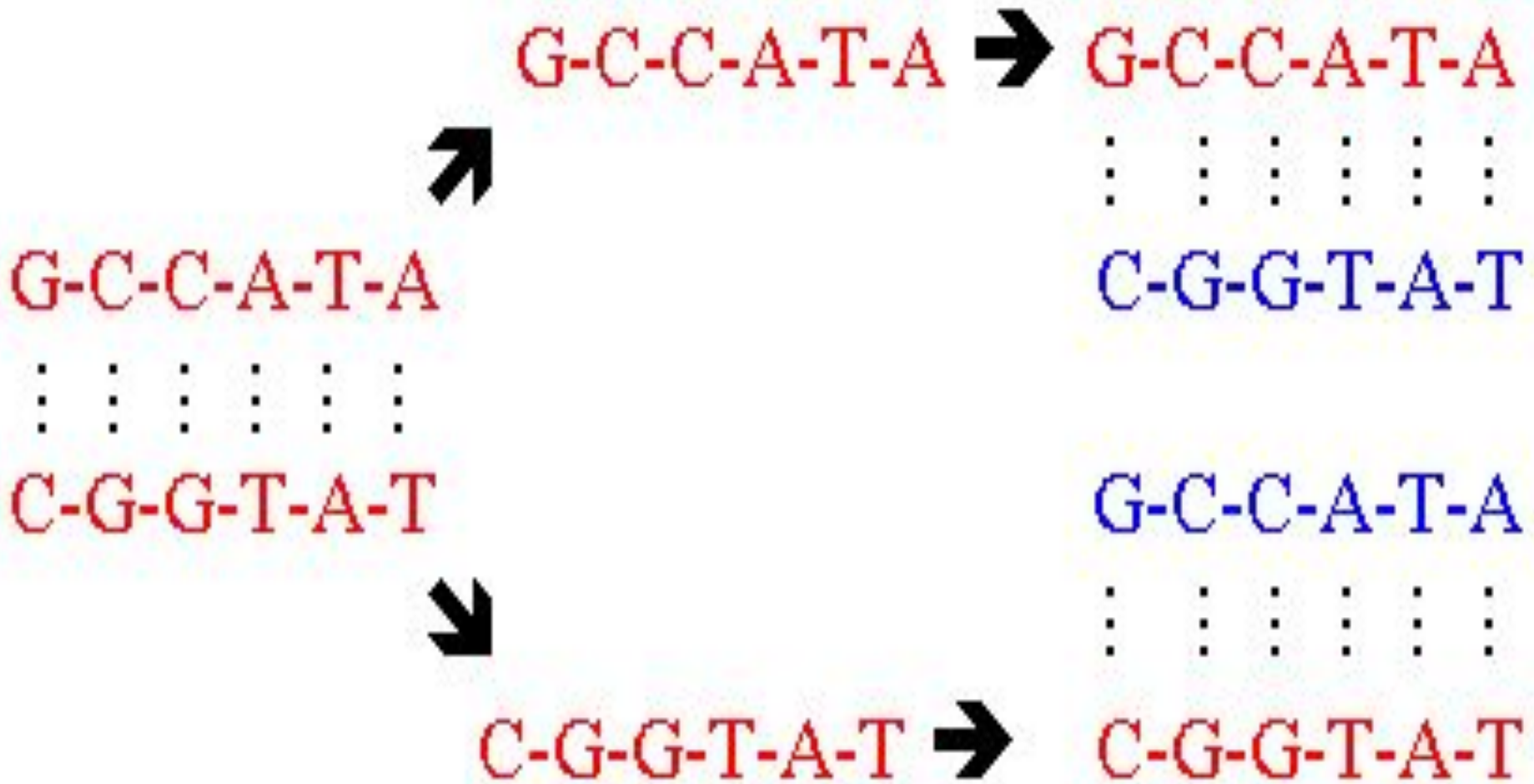


Partial chemical structure

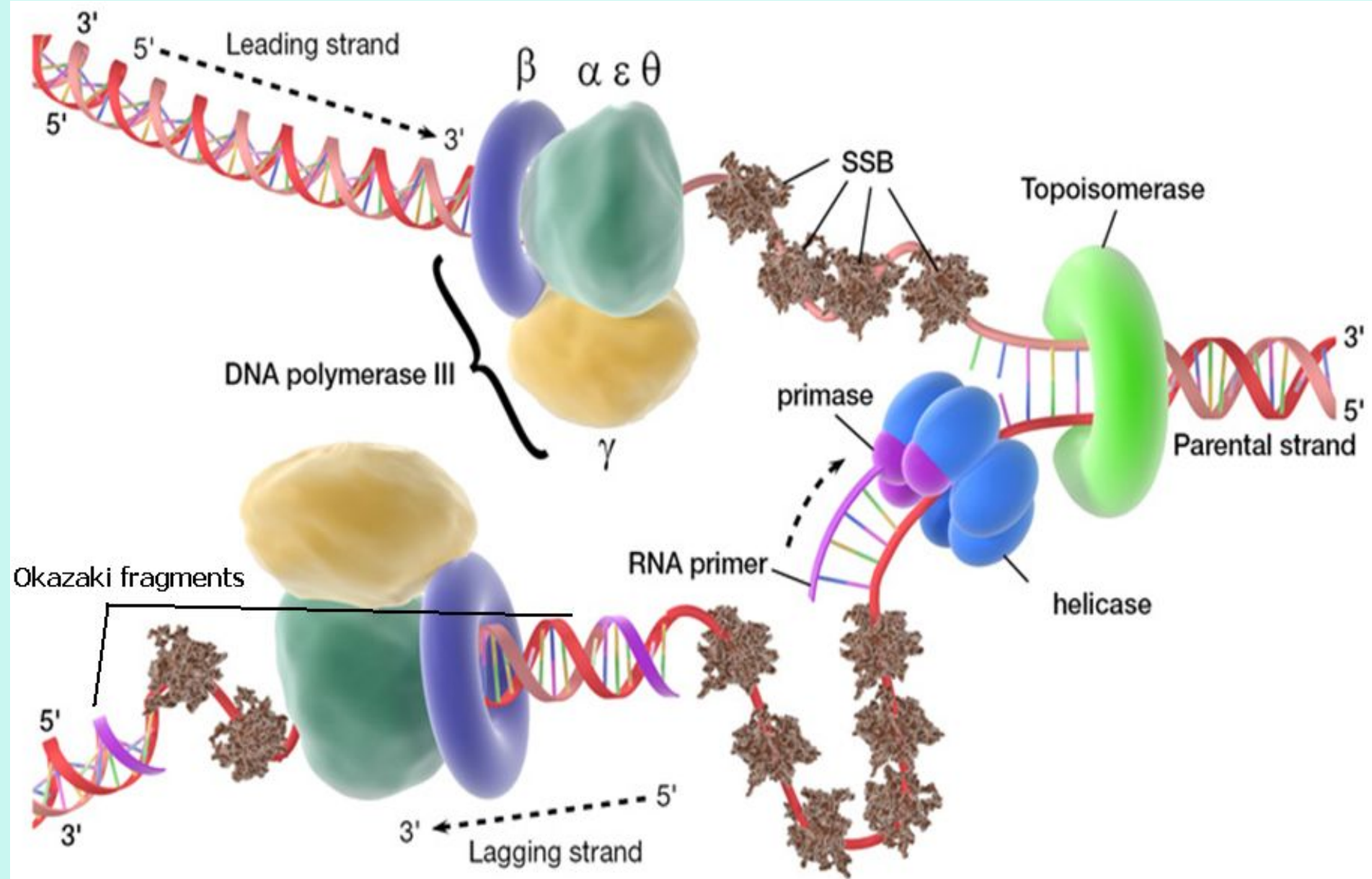
# 3'-5'-phosphodiester bond formation



# DNA biosynthesis (homologous replication)

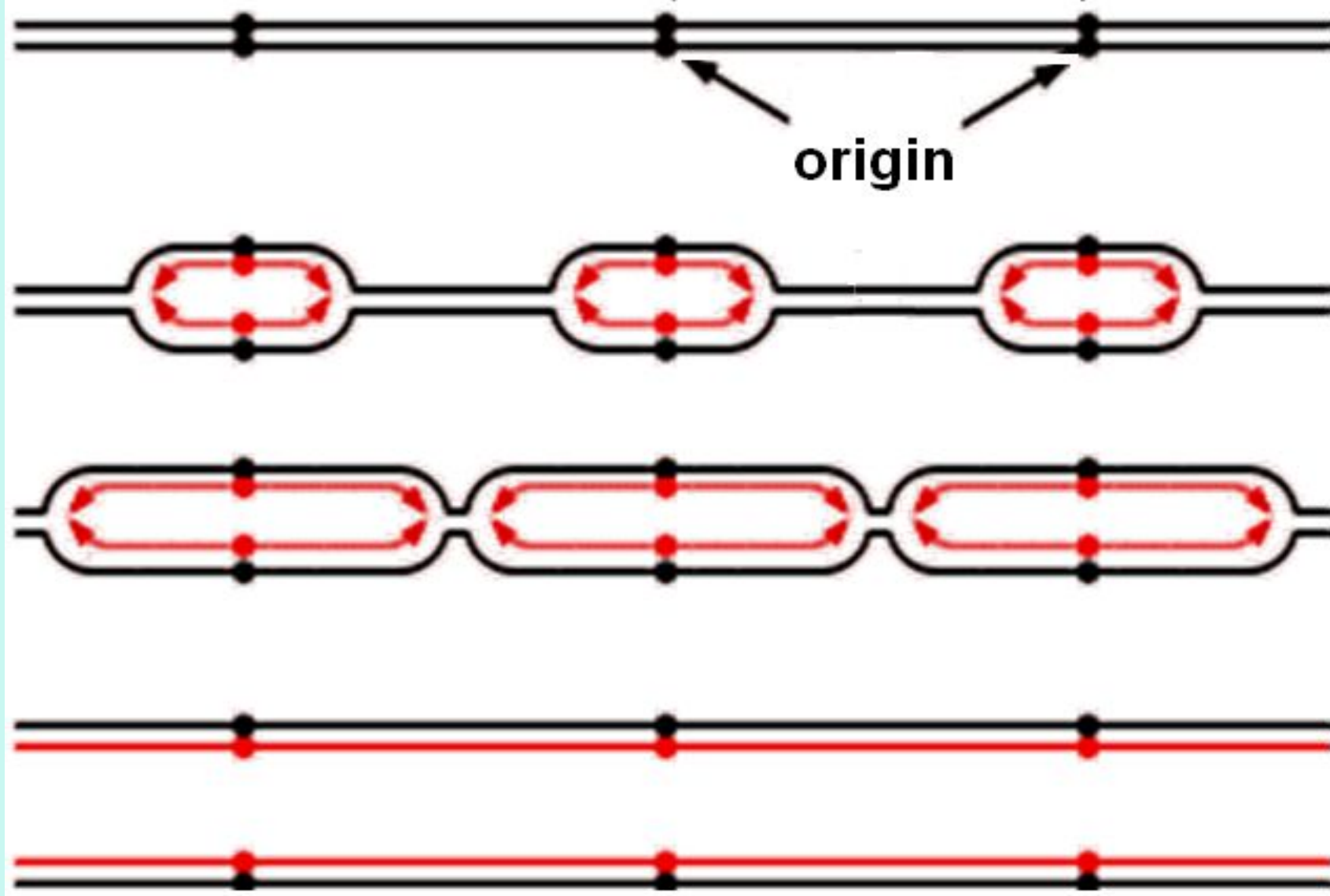


# Replicative fork



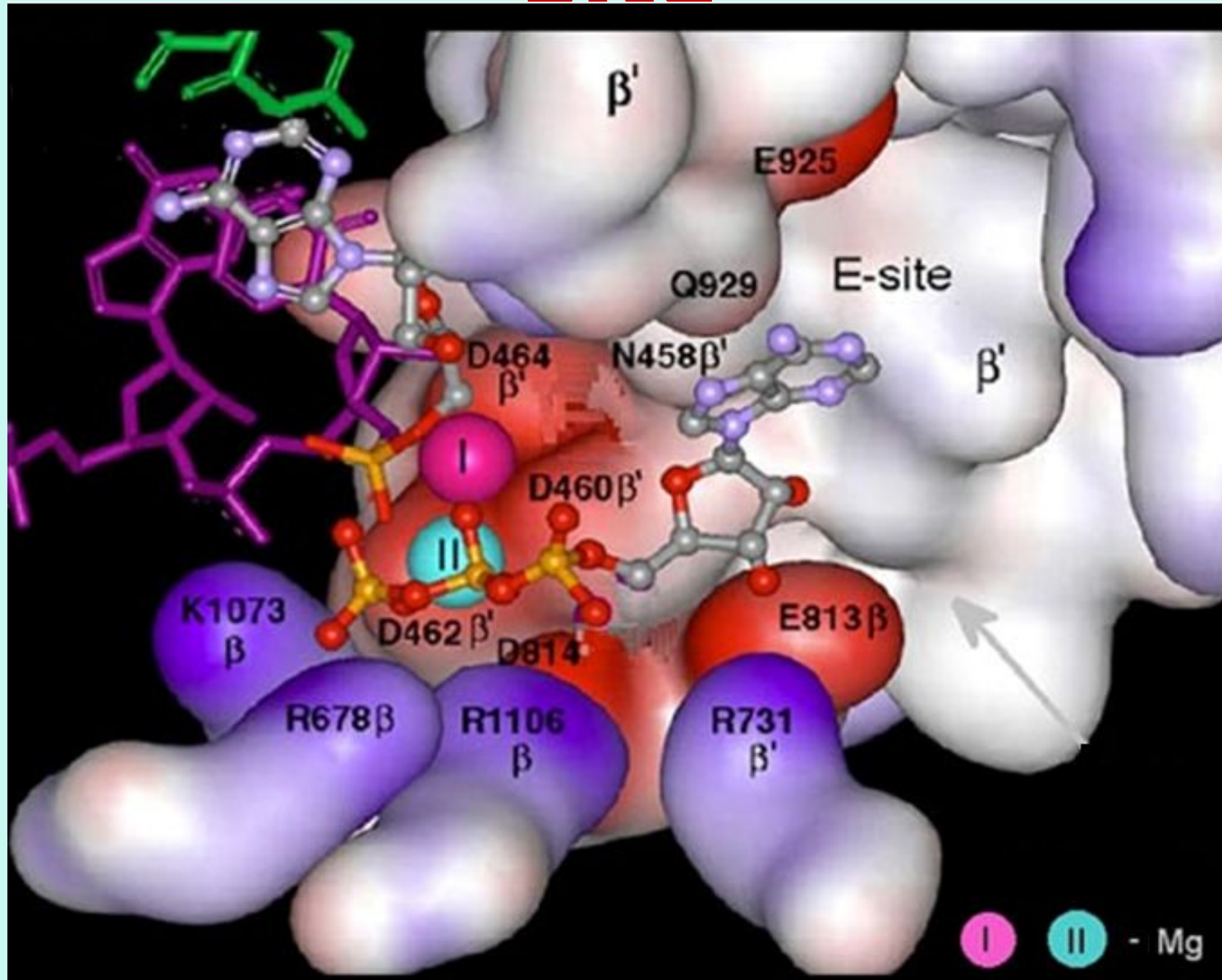
replicon

origin

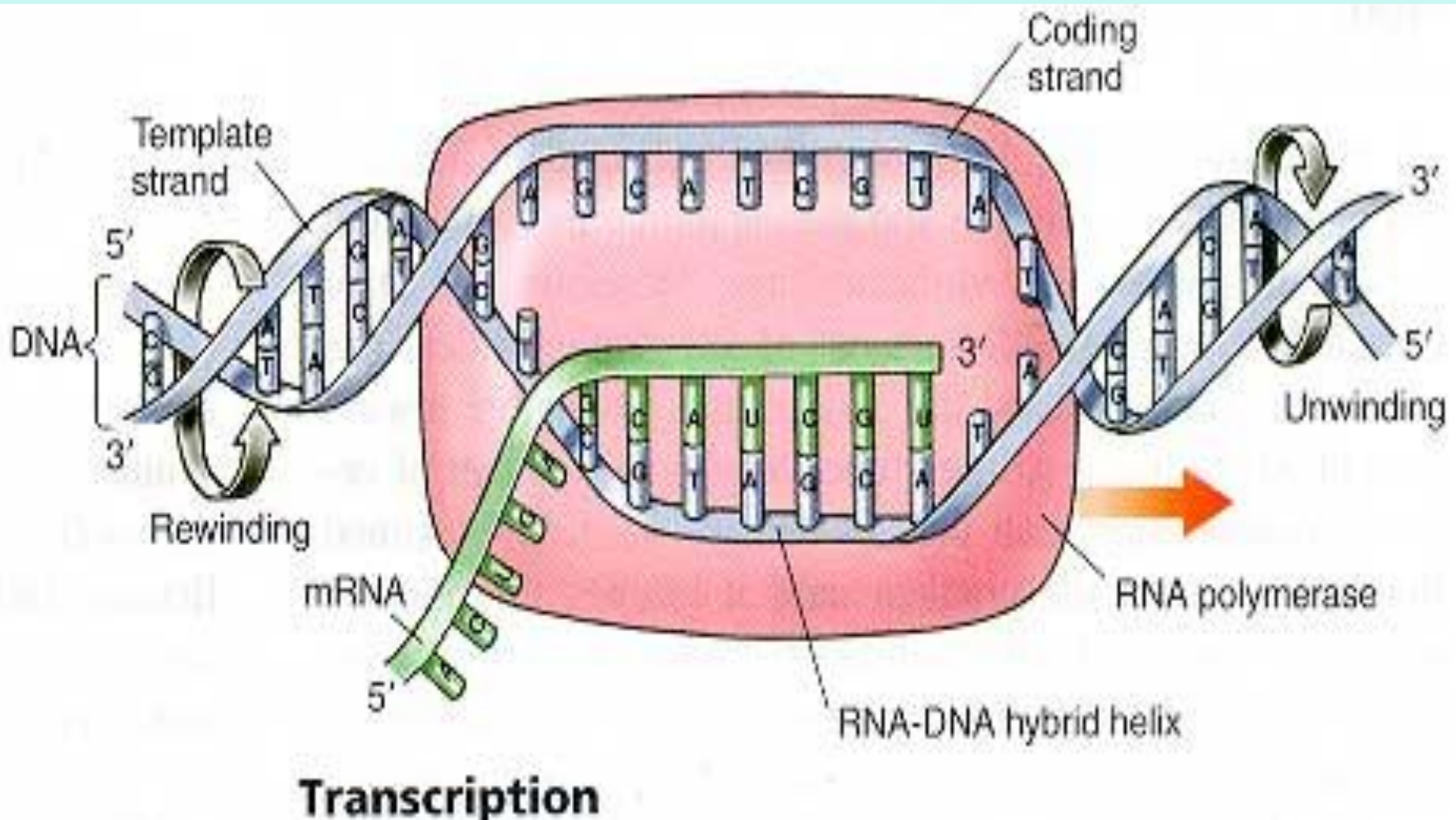




# RNA polymerase active site

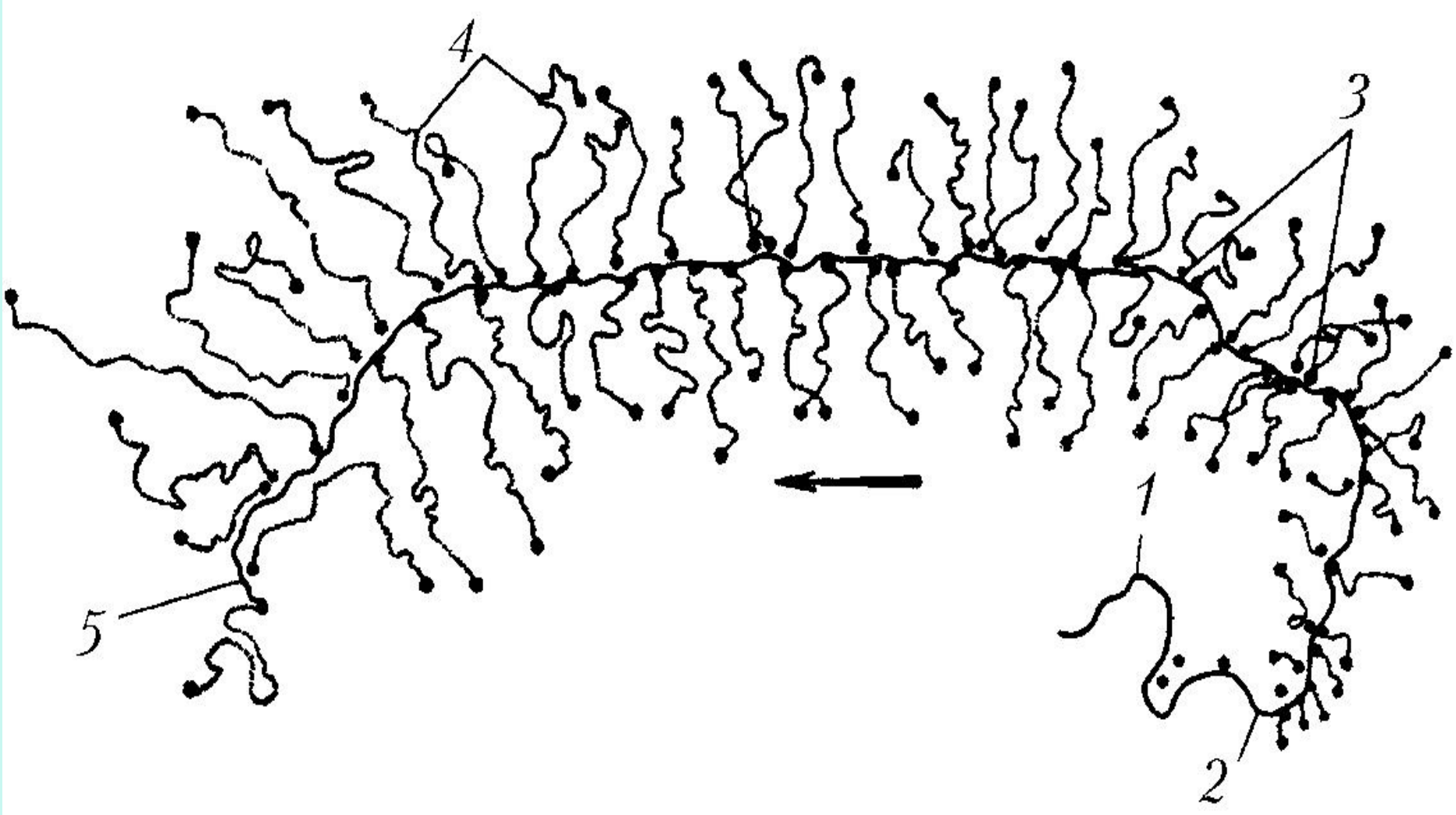


# RNA synthesis on DNA template

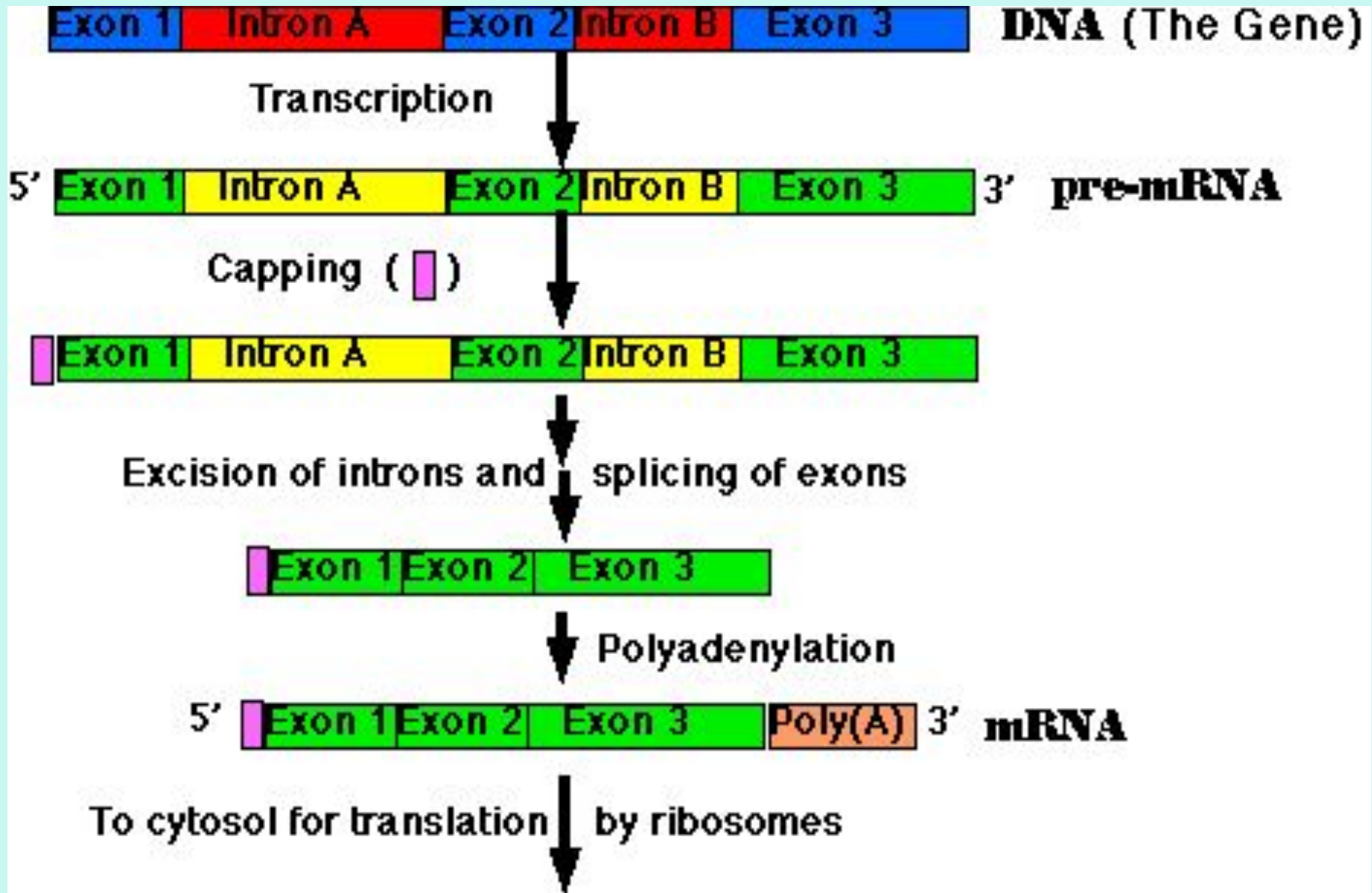




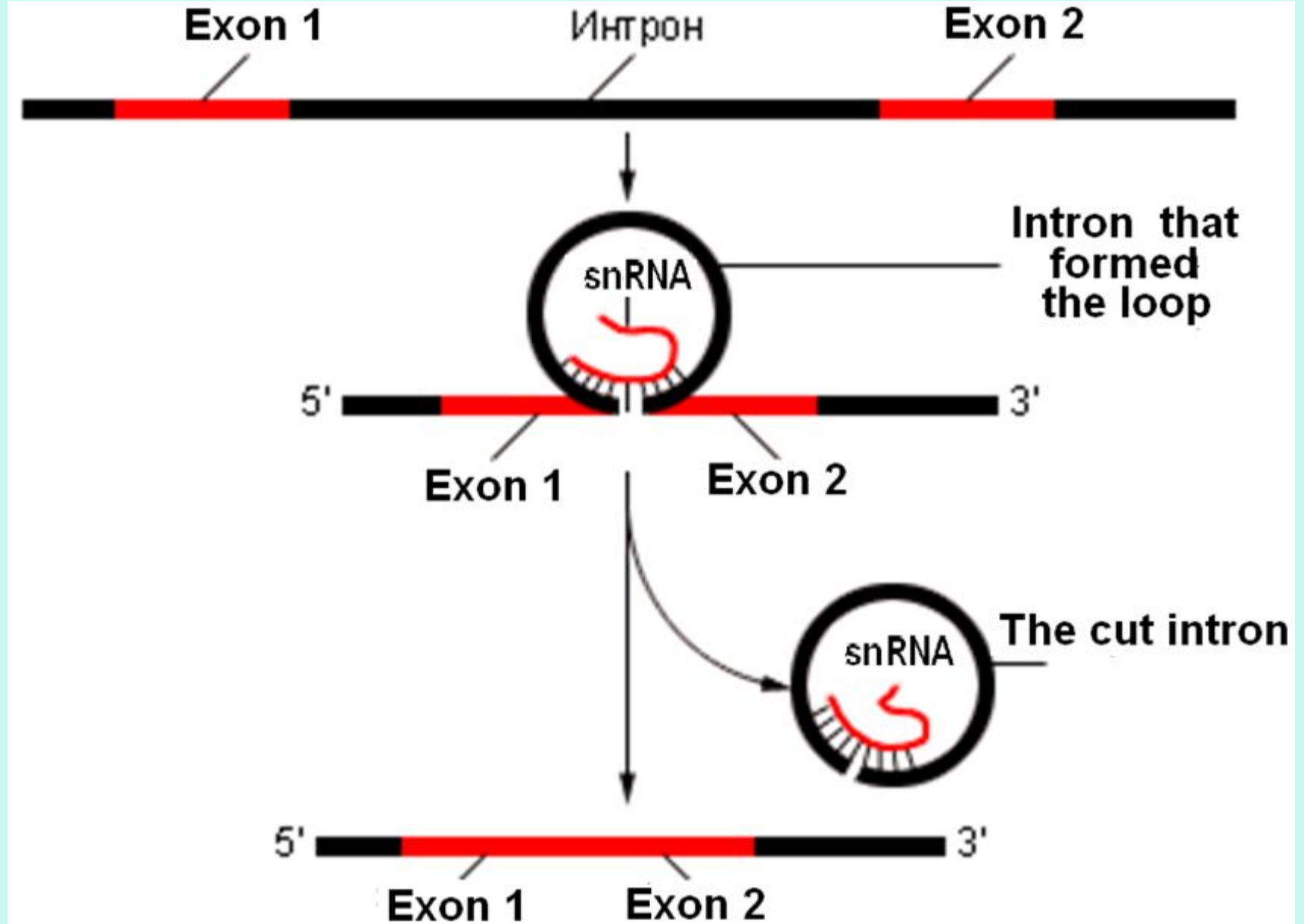
**polymerase;**  
**4 - growing RNA chain; 5 - area**  
**of termination.**  
**Arrow: direction of RNA polymerase**



# Processing of mRNA

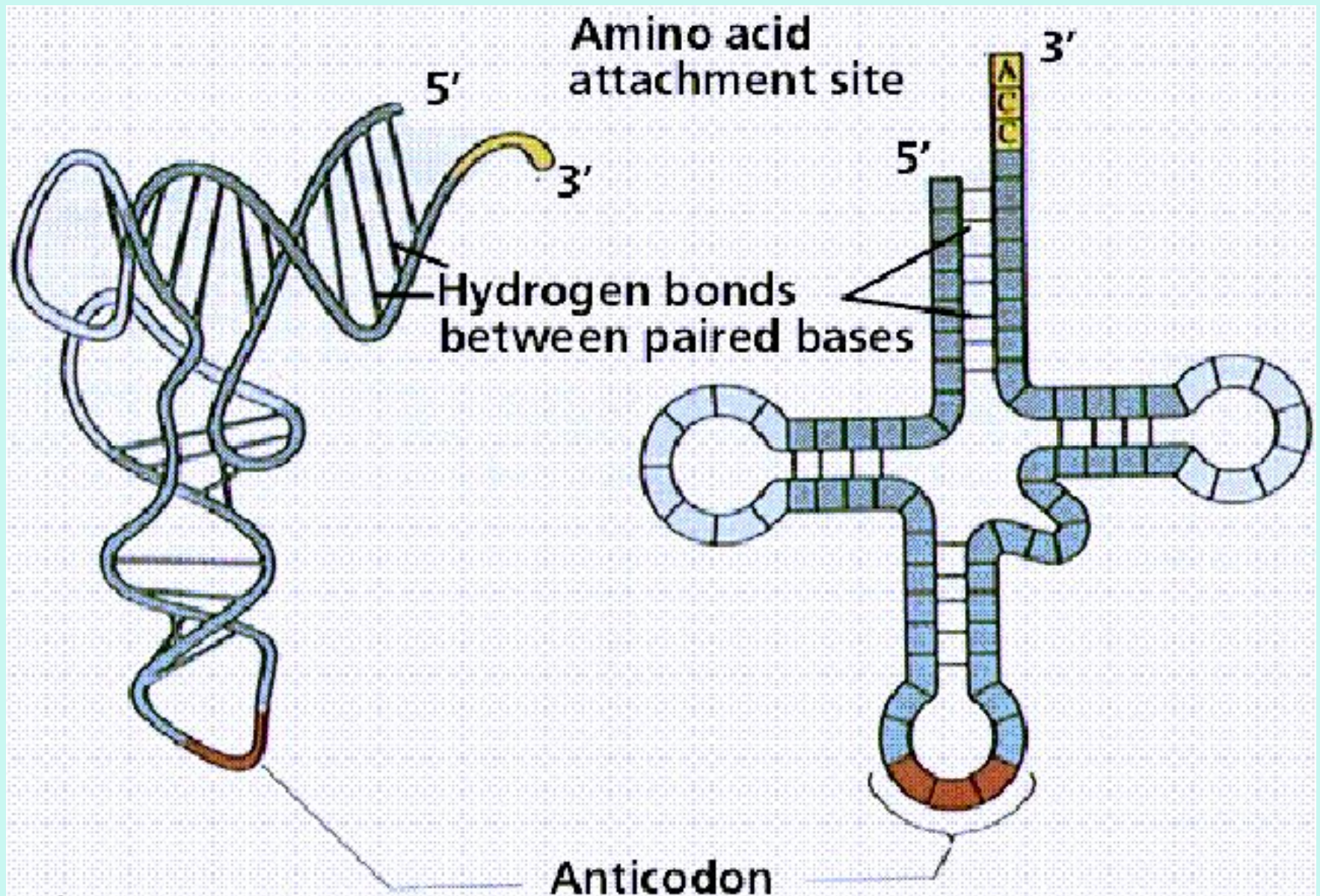


# Splicing

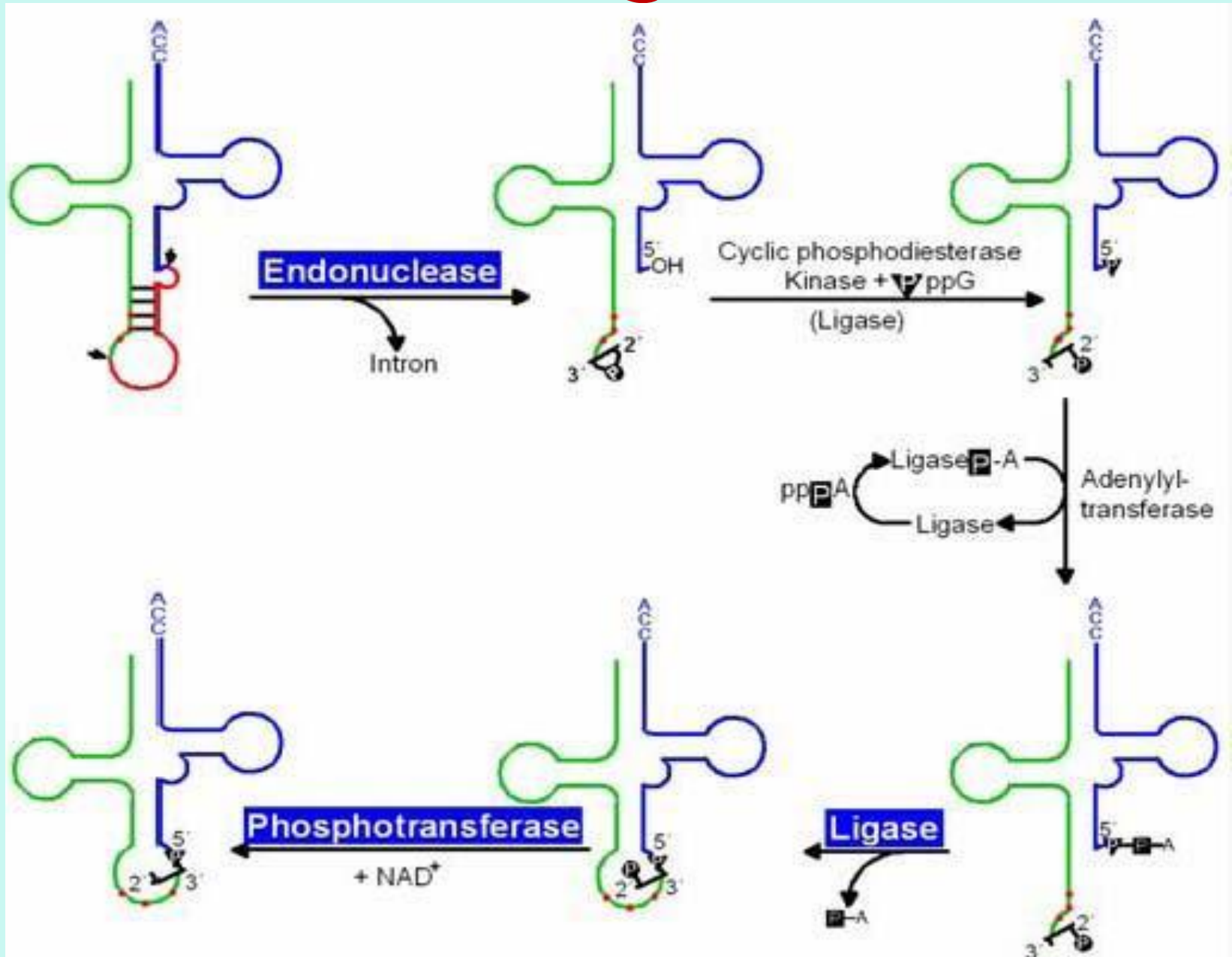




# tRNA



# Processing of tRNA





***PROTEIN  
SYNTHESIS***

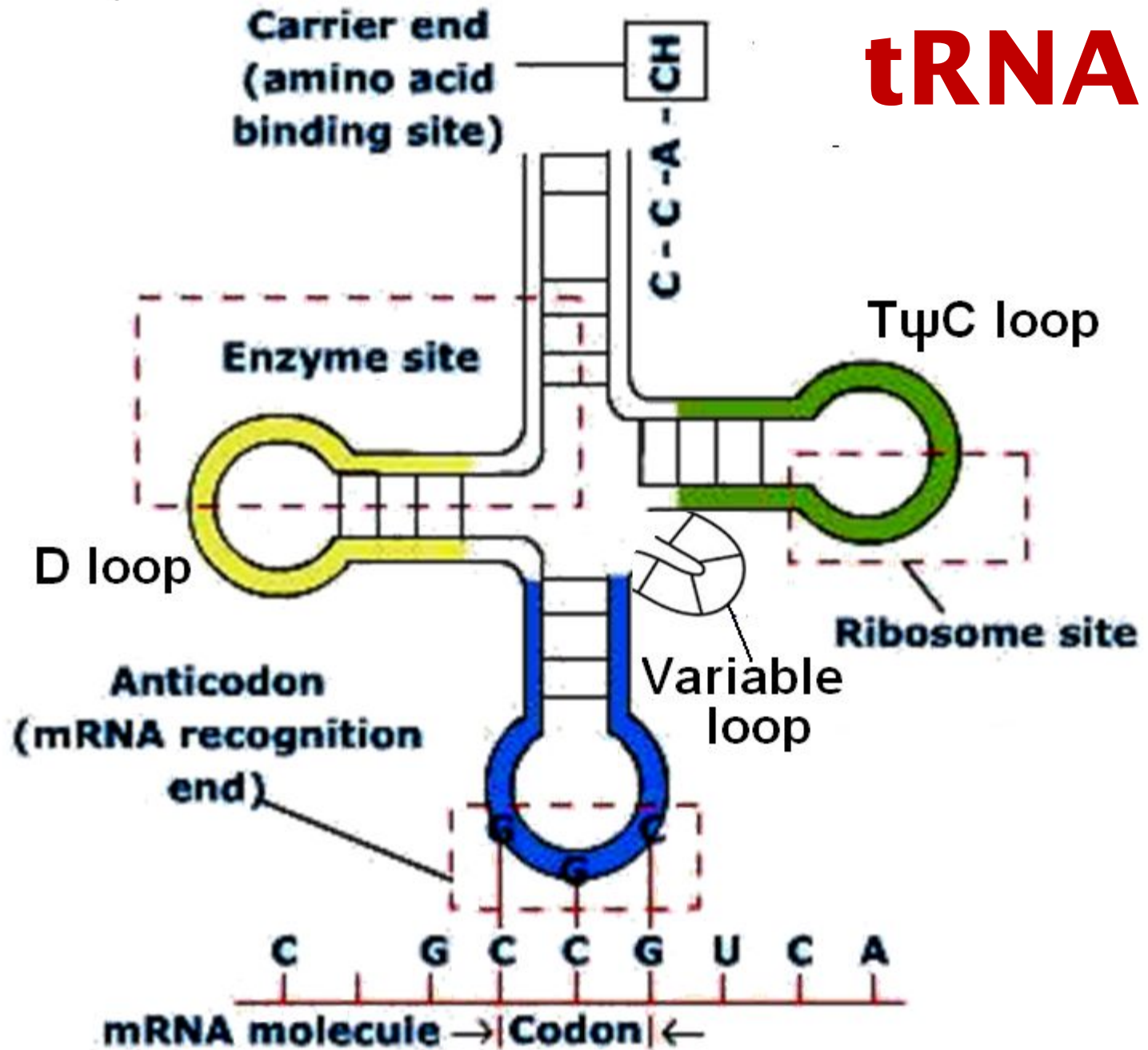
# Genetic code

Second letter

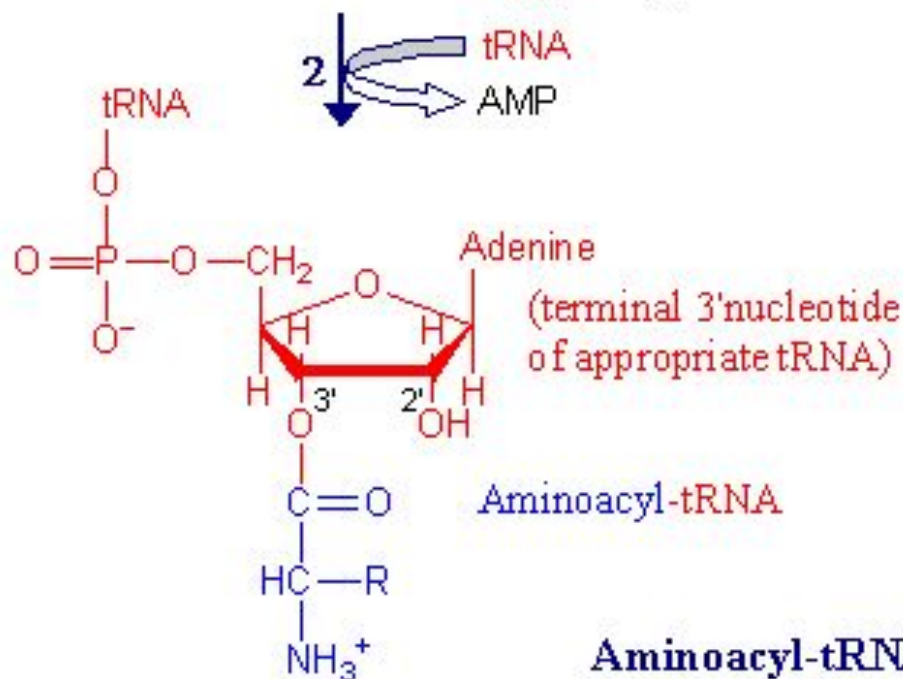
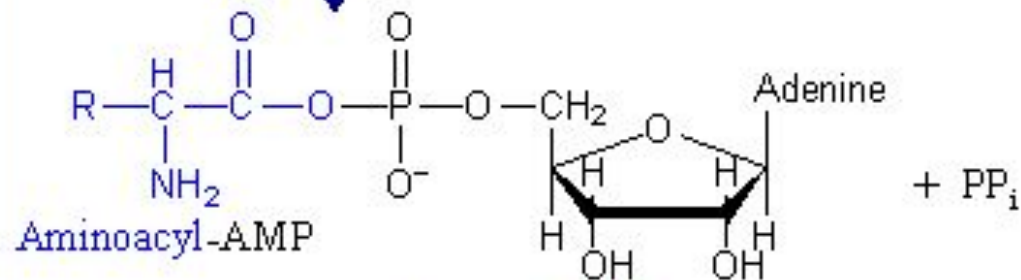
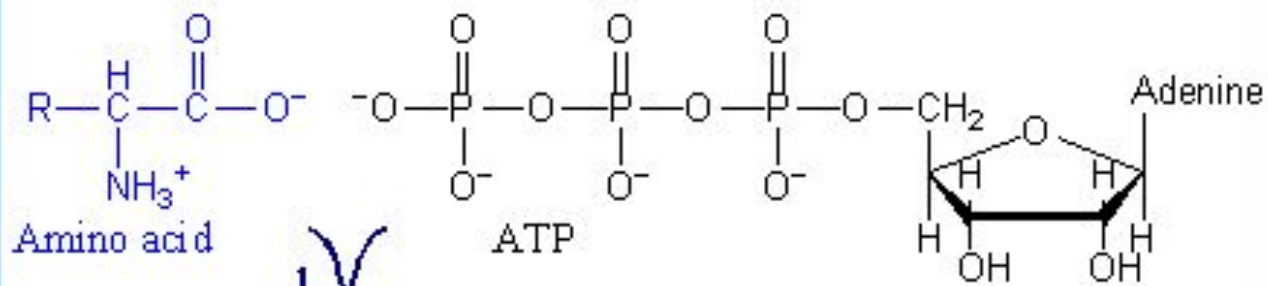
First letter

	U	C	A	G	
U	<div style="border: 1px solid black; padding: 2px; display: inline-block;">UUU</div> Phenyl- <div style="border: 1px solid black; padding: 2px; display: inline-block;">UUC</div> alanine <div style="border: 1px solid black; padding: 2px; display: inline-block;">UUA</div> Leucine <div style="border: 1px solid black; padding: 2px; display: inline-block;">UUG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">UCU</div> Serine <div style="border: 1px solid black; padding: 2px; display: inline-block;">UCC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">UCA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">UCG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">UAU</div> Tyrosine <div style="border: 1px solid black; padding: 2px; display: inline-block;">UAC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">UAA</div> Stop codon <div style="border: 1px solid black; padding: 2px; display: inline-block;">UAG</div> Stop codon	<div style="border: 1px solid black; padding: 2px; display: inline-block;">UGU</div> Cysteine <div style="border: 1px solid black; padding: 2px; display: inline-block;">UGC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">UGA</div> Stop codon <div style="border: 1px solid black; padding: 2px; display: inline-block;">UGG</div> Tryptophan	U C A G
C	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CUU</div> Leucine <div style="border: 1px solid black; padding: 2px; display: inline-block;">CUC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CUA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CUG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CCU</div> Proline <div style="border: 1px solid black; padding: 2px; display: inline-block;">CCC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CCA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CCG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CAU</div> Histidine <div style="border: 1px solid black; padding: 2px; display: inline-block;">CAC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CAA</div> Glutamine <div style="border: 1px solid black; padding: 2px; display: inline-block;">CAG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CGU</div> Arginine <div style="border: 1px solid black; padding: 2px; display: inline-block;">CGC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CGA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">CGG</div>	U C A G
A	<div style="border: 1px solid black; padding: 2px; display: inline-block;">AUU</div> Isoleucine <div style="border: 1px solid black; padding: 2px; display: inline-block;">AUC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">AUA</div> Methionine; <div style="border: 1px solid black; padding: 2px; display: inline-block;">AUG</div> initiation codon	<div style="border: 1px solid black; padding: 2px; display: inline-block;">ACU</div> Threonine <div style="border: 1px solid black; padding: 2px; display: inline-block;">ACC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">ACA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">ACG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">AAU</div> Asparagine <div style="border: 1px solid black; padding: 2px; display: inline-block;">AAC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">AAA</div> Lysine <div style="border: 1px solid black; padding: 2px; display: inline-block;">AAG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">AGU</div> Serine <div style="border: 1px solid black; padding: 2px; display: inline-block;">AGC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">AGA</div> Arginine <div style="border: 1px solid black; padding: 2px; display: inline-block;">AGG</div>	U C A G
G	<div style="border: 1px solid black; padding: 2px; display: inline-block;">GUU</div> Valine <div style="border: 1px solid black; padding: 2px; display: inline-block;">GUC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GUA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GUG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">GCU</div> Alanine <div style="border: 1px solid black; padding: 2px; display: inline-block;">GCC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GCA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GCG</div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">GAU</div> Aspartic <div style="border: 1px solid black; padding: 2px; display: inline-block;">GAC</div> acid <div style="border: 1px solid black; padding: 2px; display: inline-block;">GAA</div> Glutamic <div style="border: 1px solid black; padding: 2px; display: inline-block;">GAG</div> acid	<div style="border: 1px solid black; padding: 2px; display: inline-block;">GGU</div> Glycine <div style="border: 1px solid black; padding: 2px; display: inline-block;">GGC</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GGA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">GGG</div>	U C A G

# tRNA

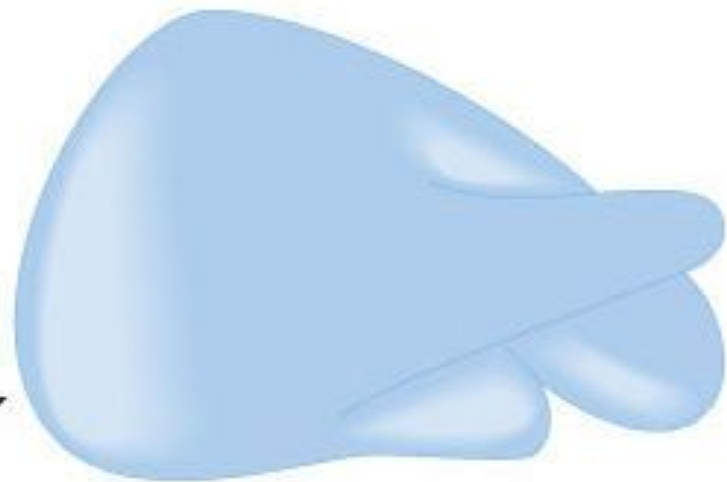
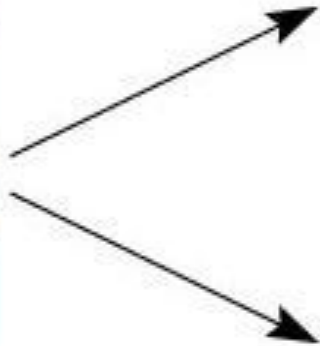






**Aminoacyl-tRNA Synthetase**

Mammalian  
ribosome (80S)  
( $4.2 \times 10^6$  daltons)



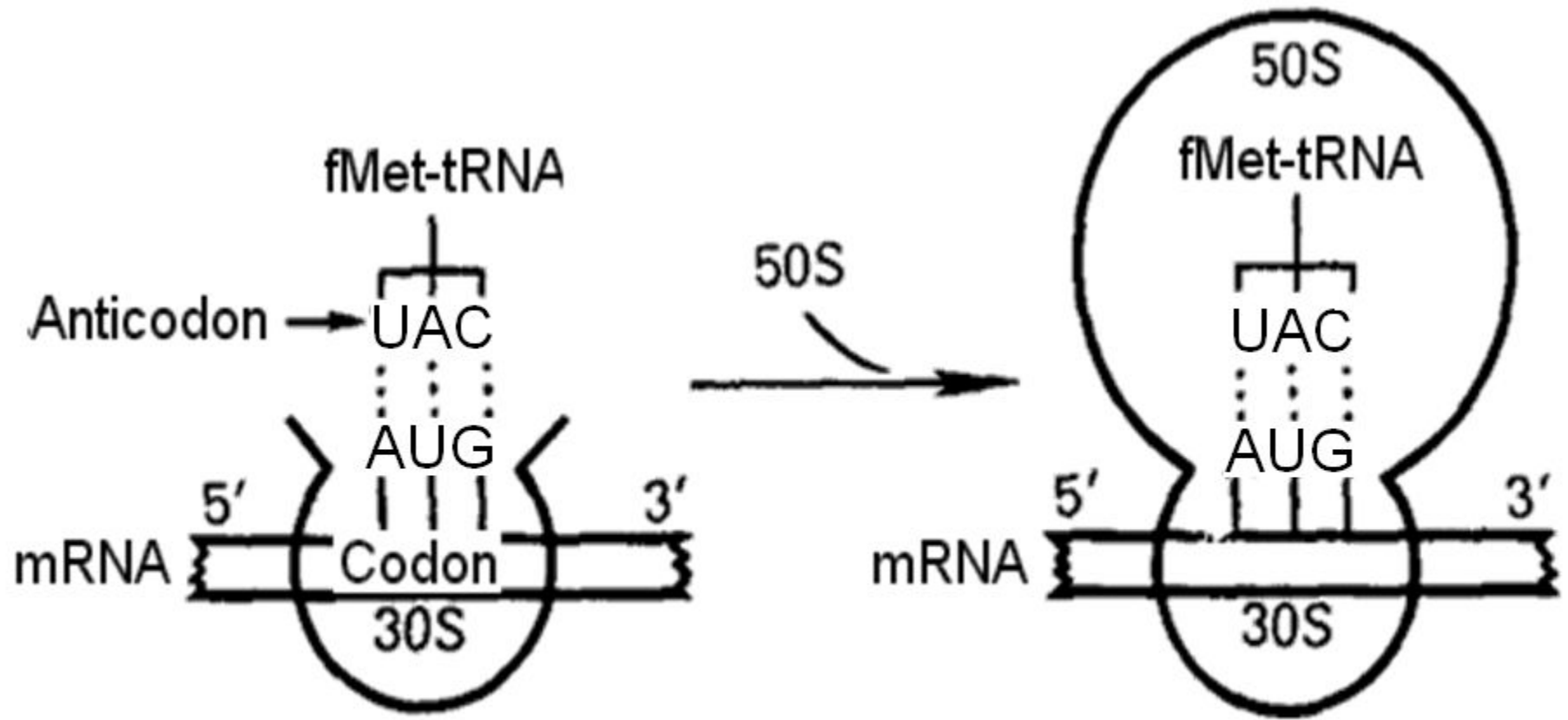
60S subunit



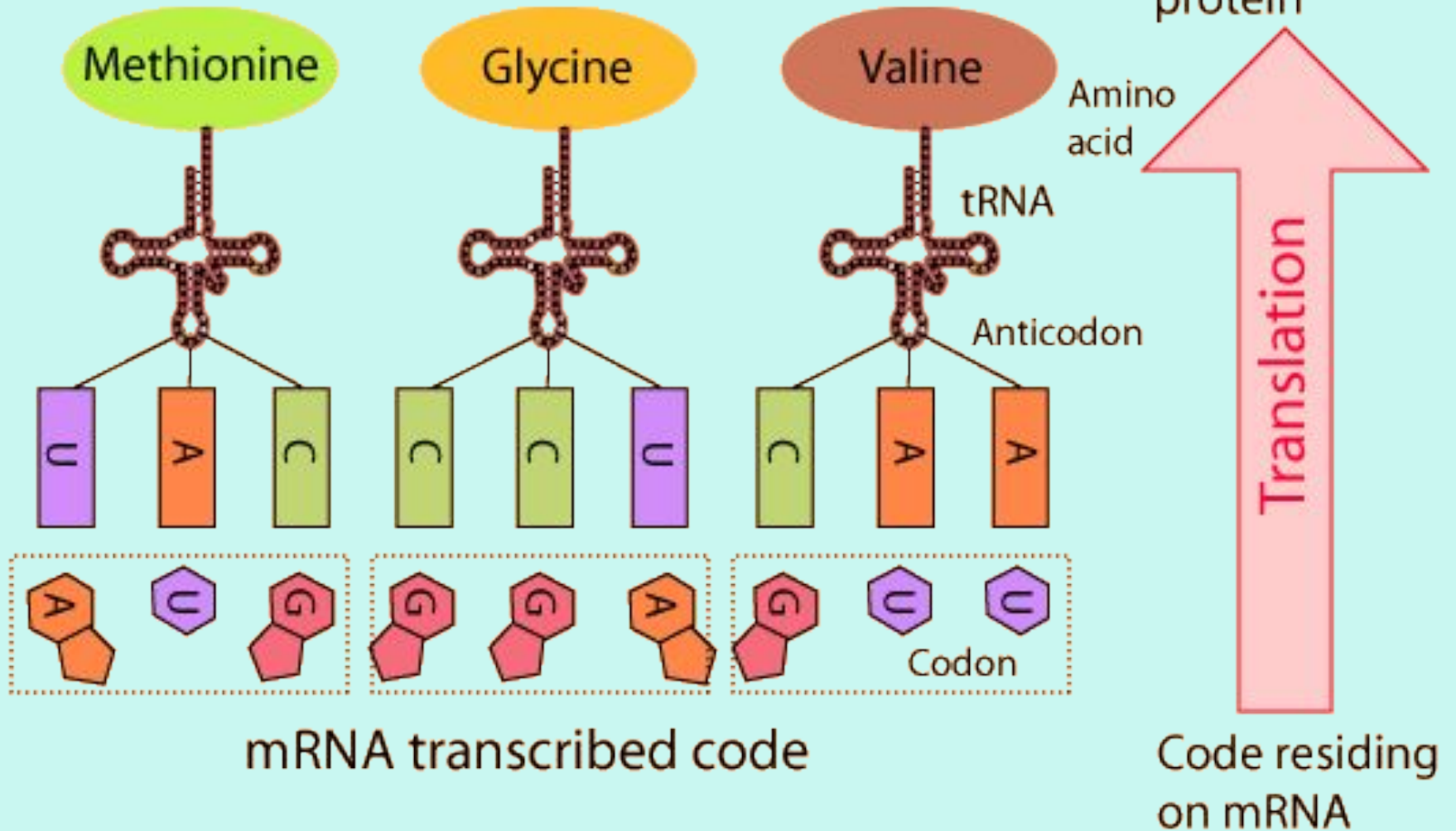
40S subunit

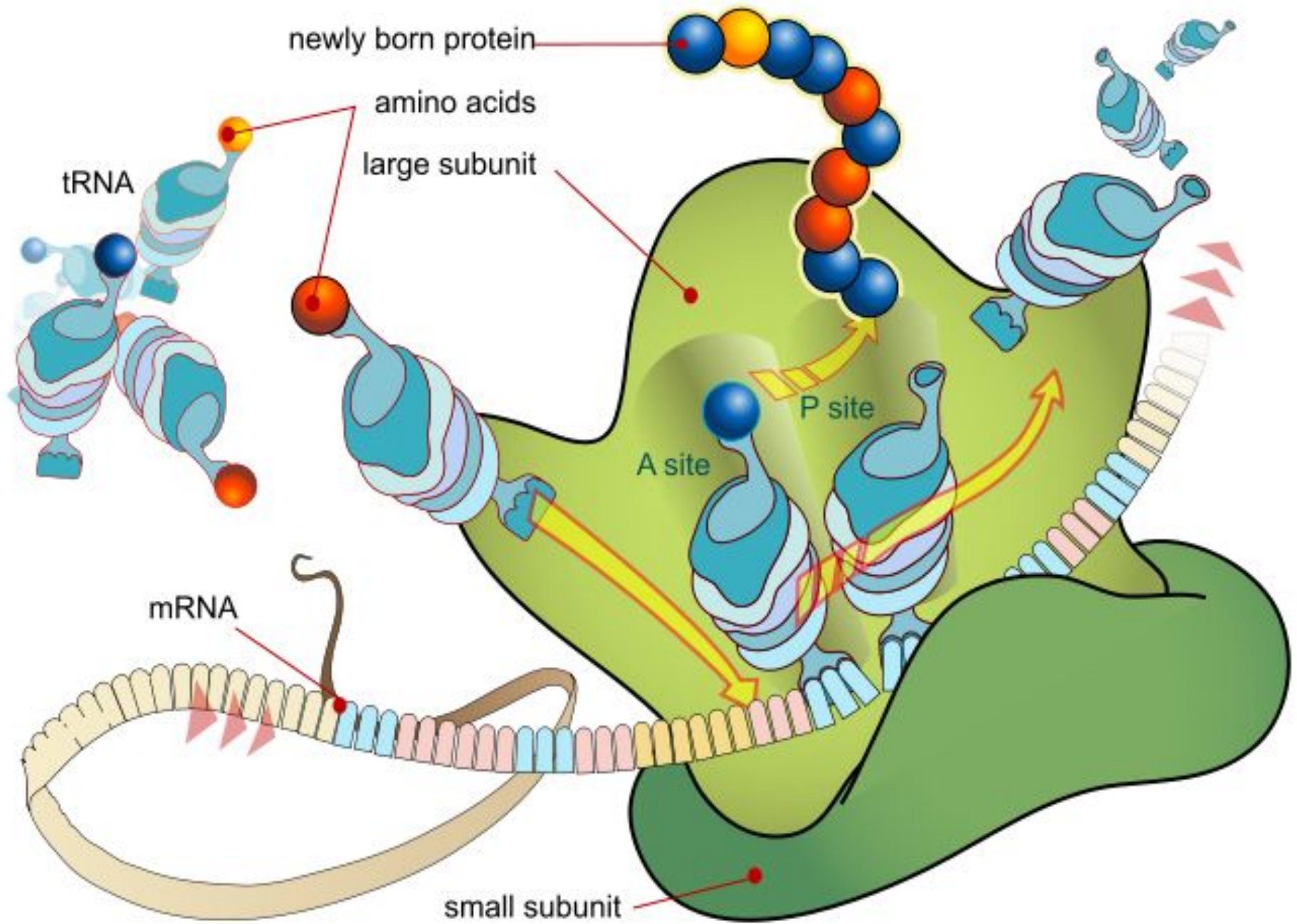
nt = nucleotides



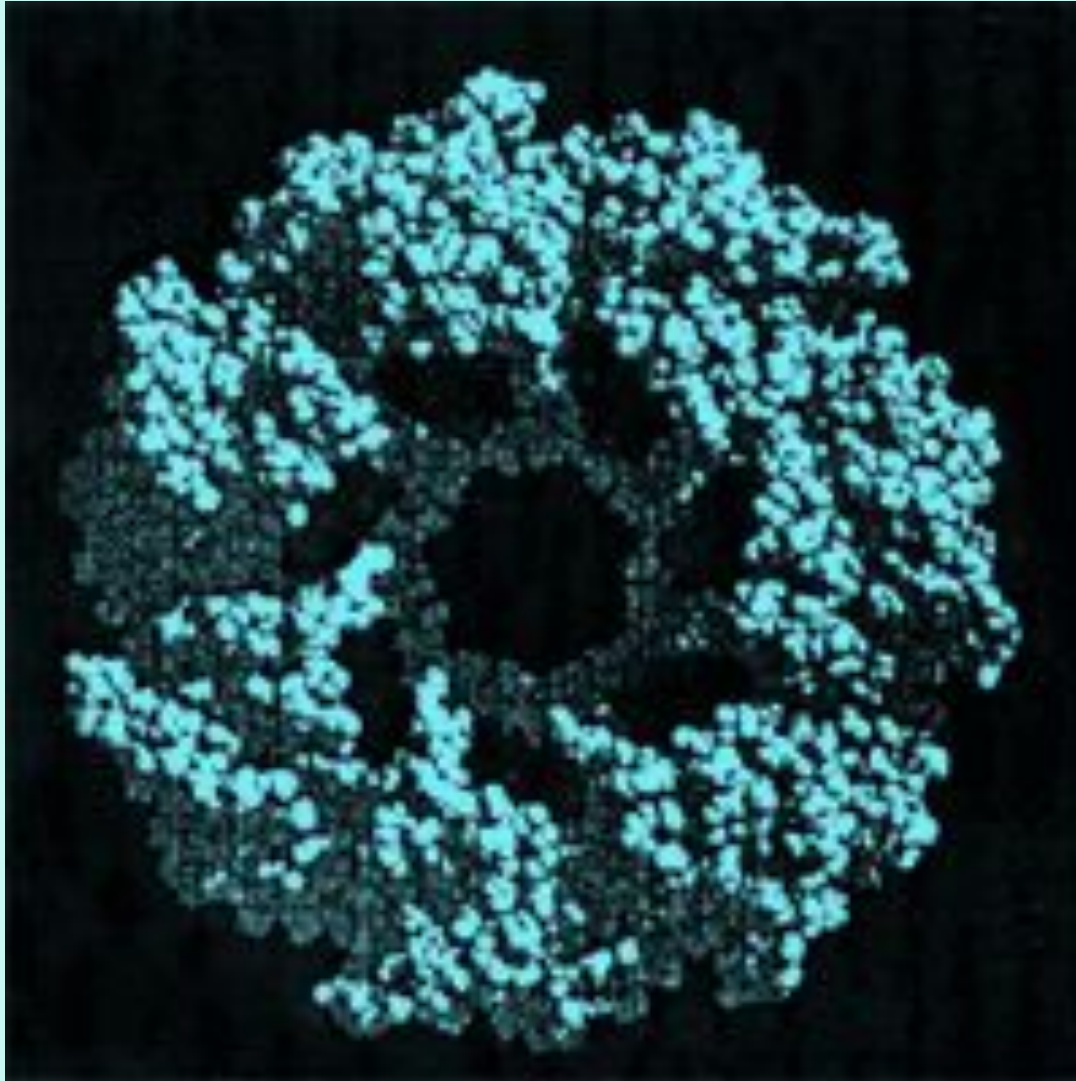


Amino acids corresponding to the codons are added to the growing protein chain.

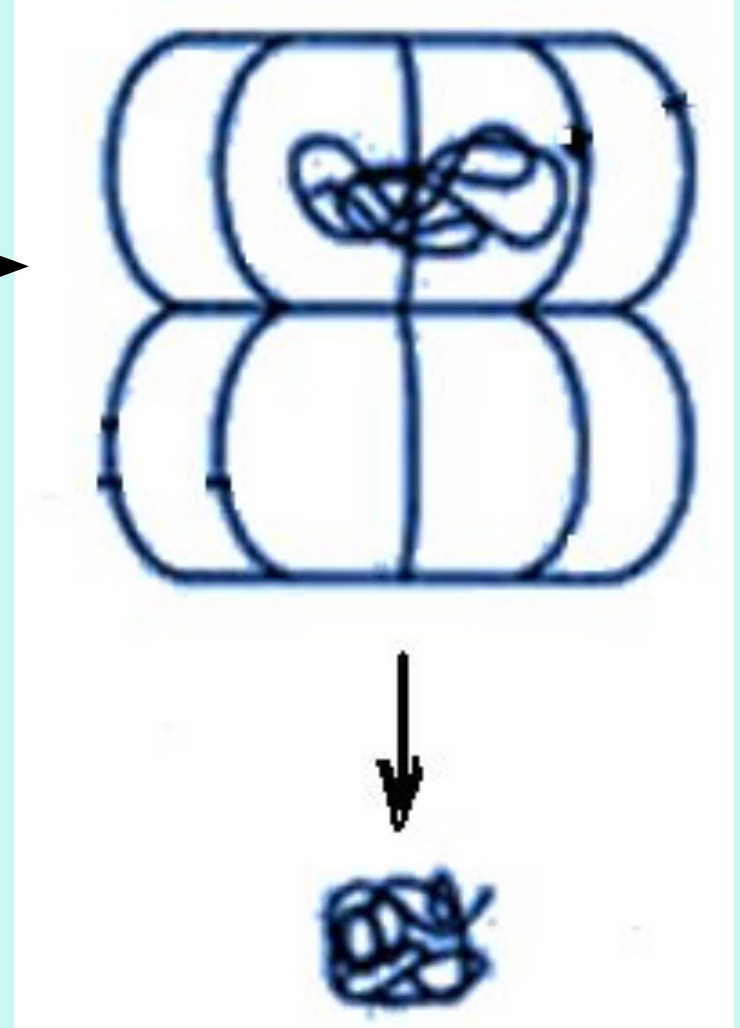
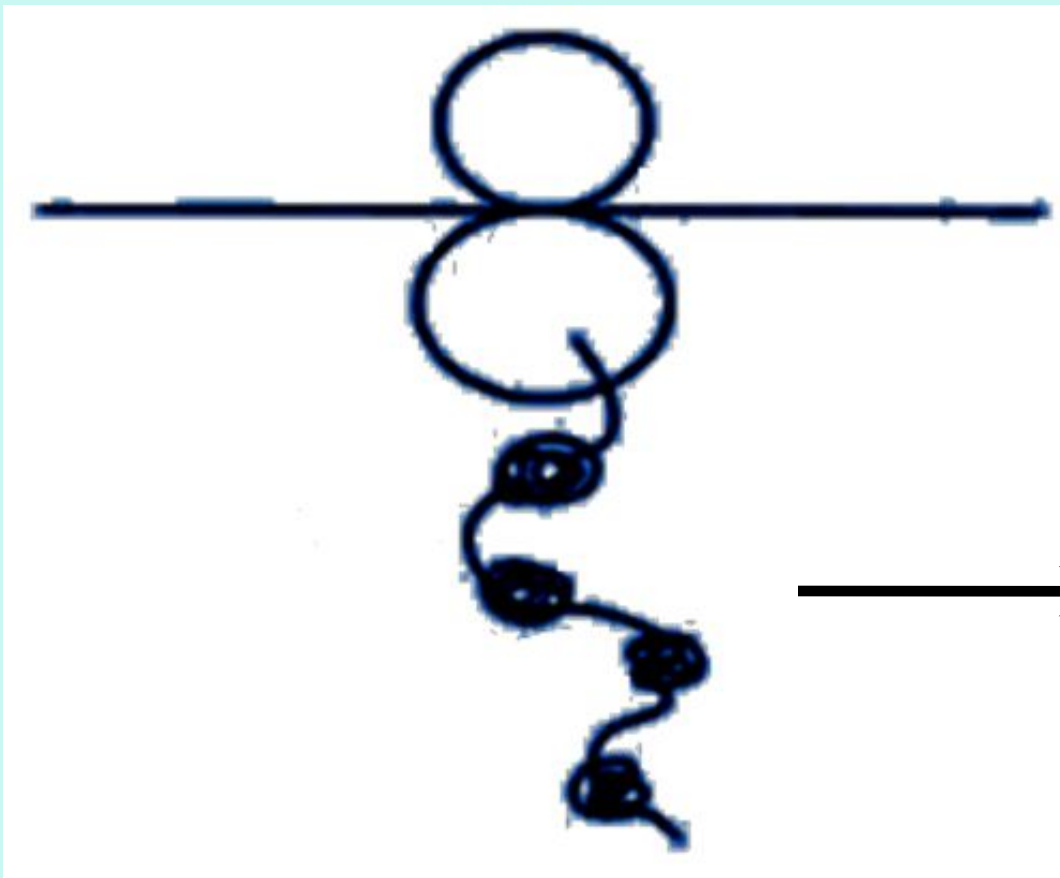




# Chaperone



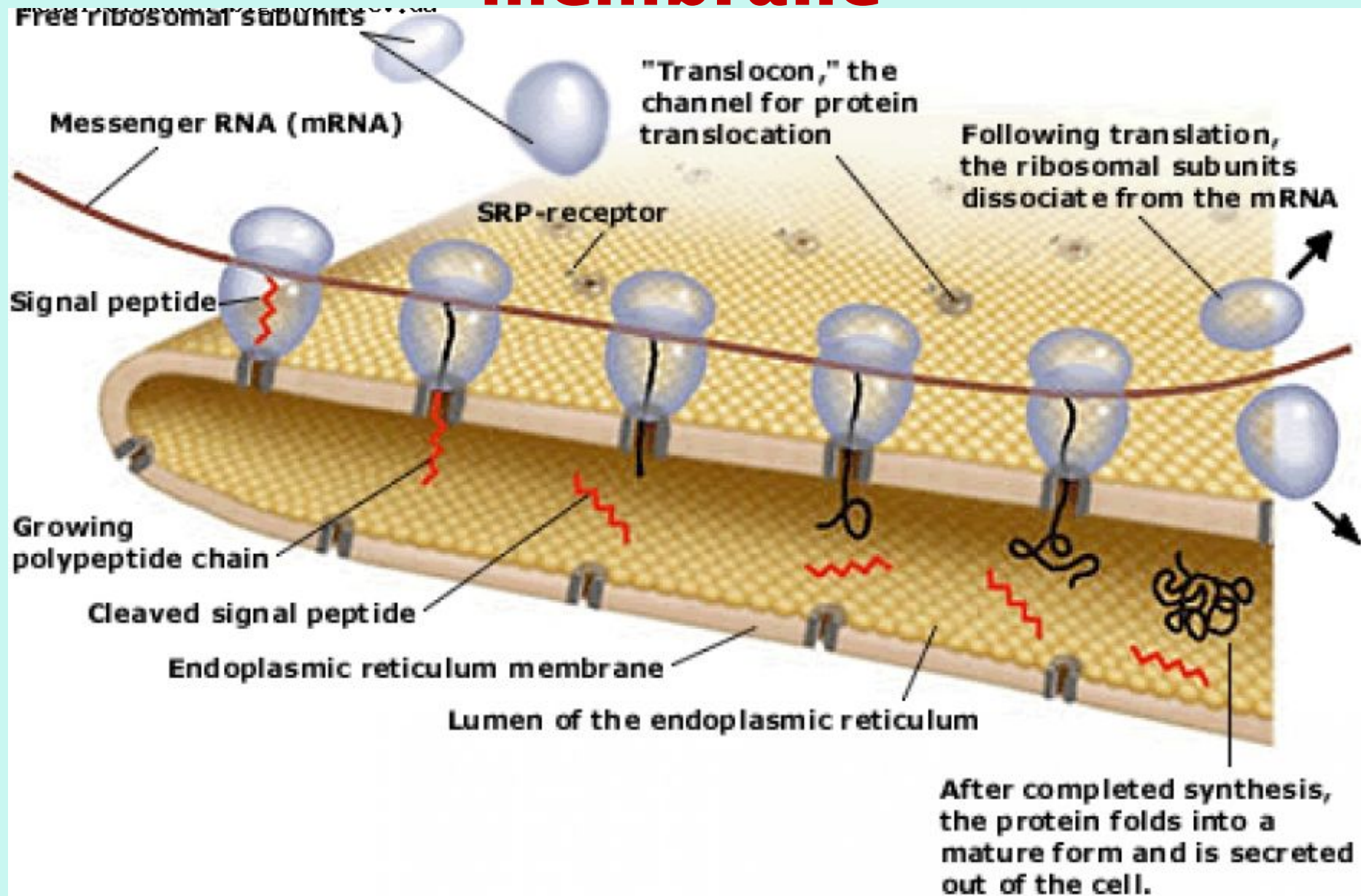




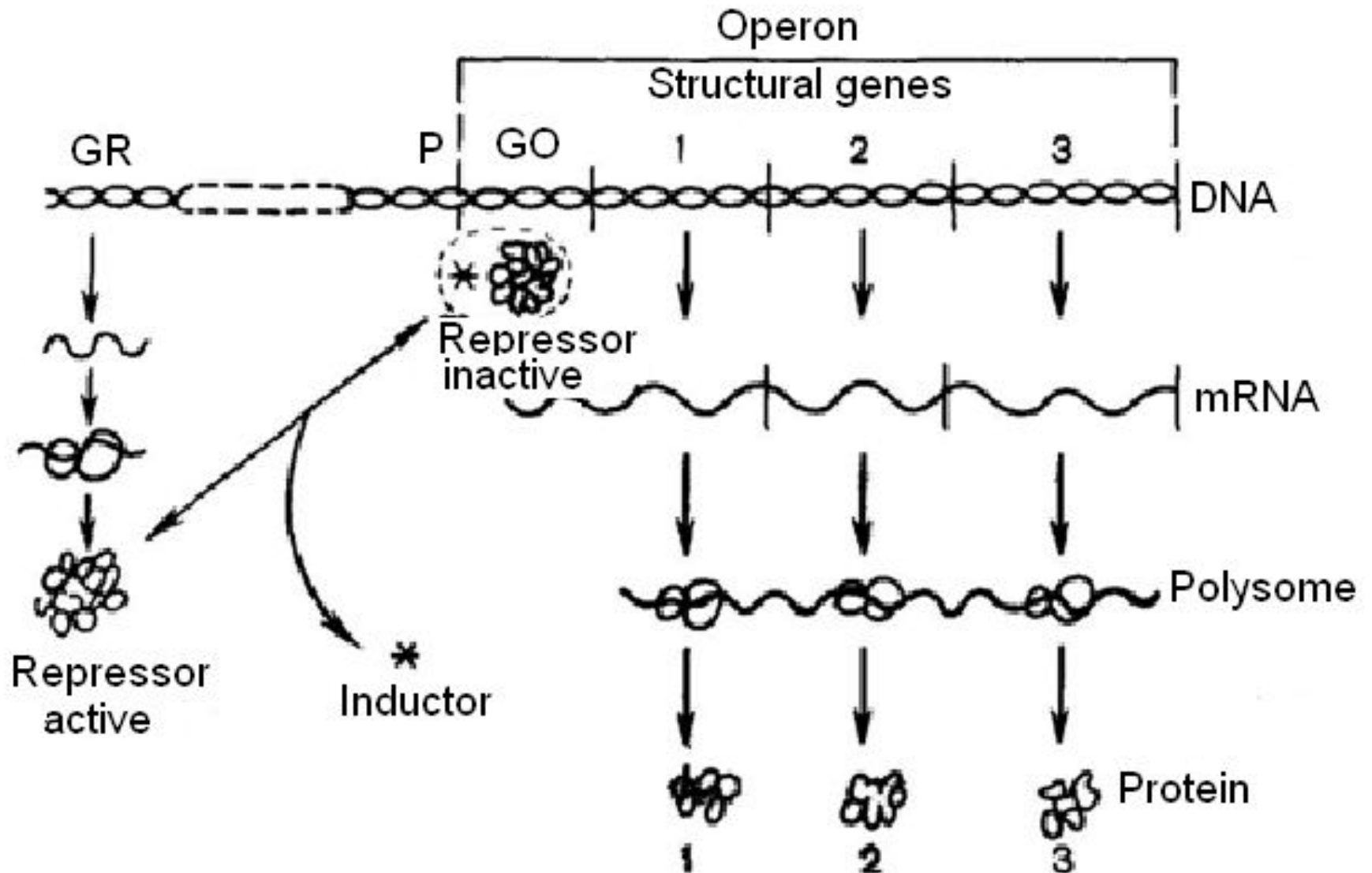
**Participation  
of chaperones  
in protein folding**



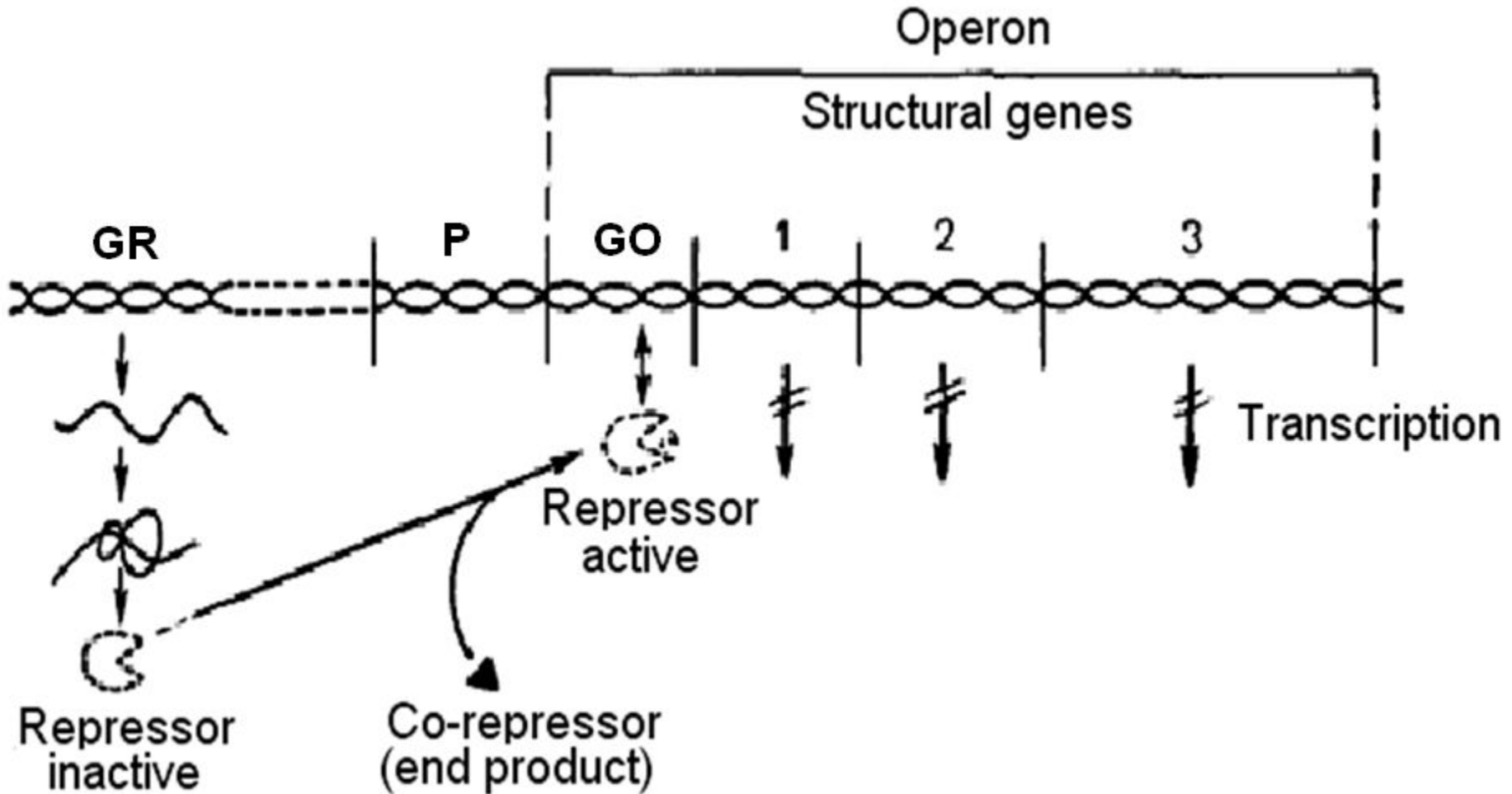
# Transport of protein across membrane



# Regulation of protein synthesis by induction



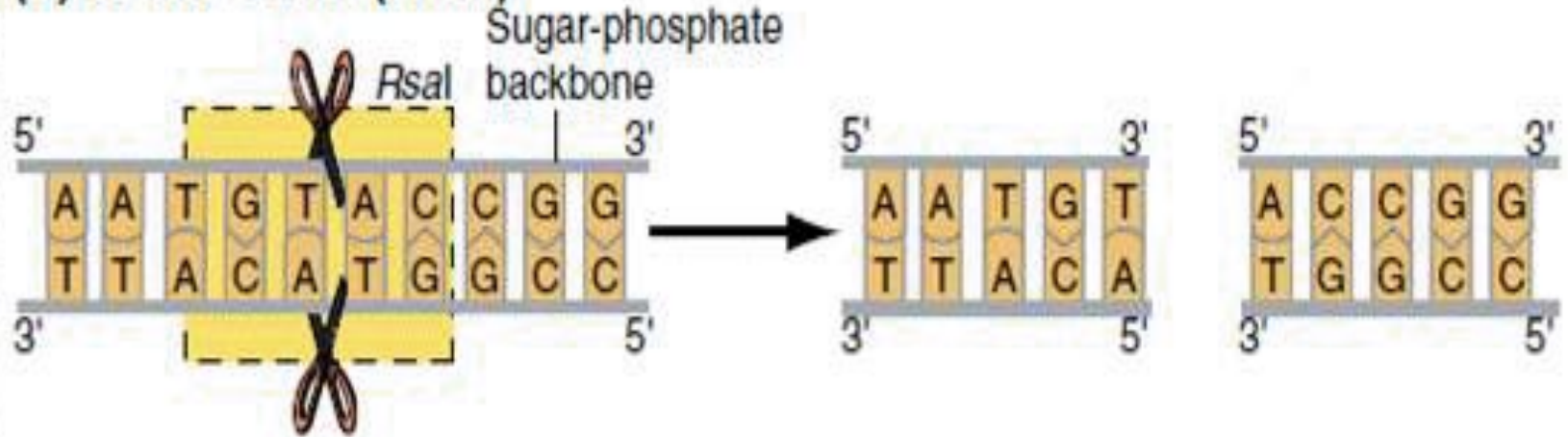
# Regulation of protein synthesis by repression



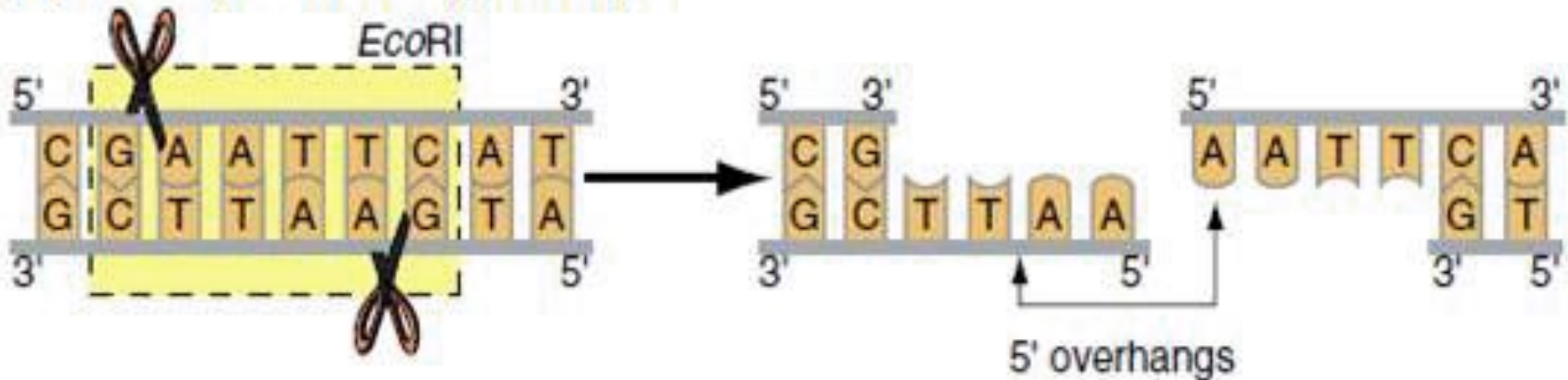
***GENETIC  
ENGINEERING***

# Cleavage of DNA with restriction enzymes

(a) Blunt ends (*RsaI*)

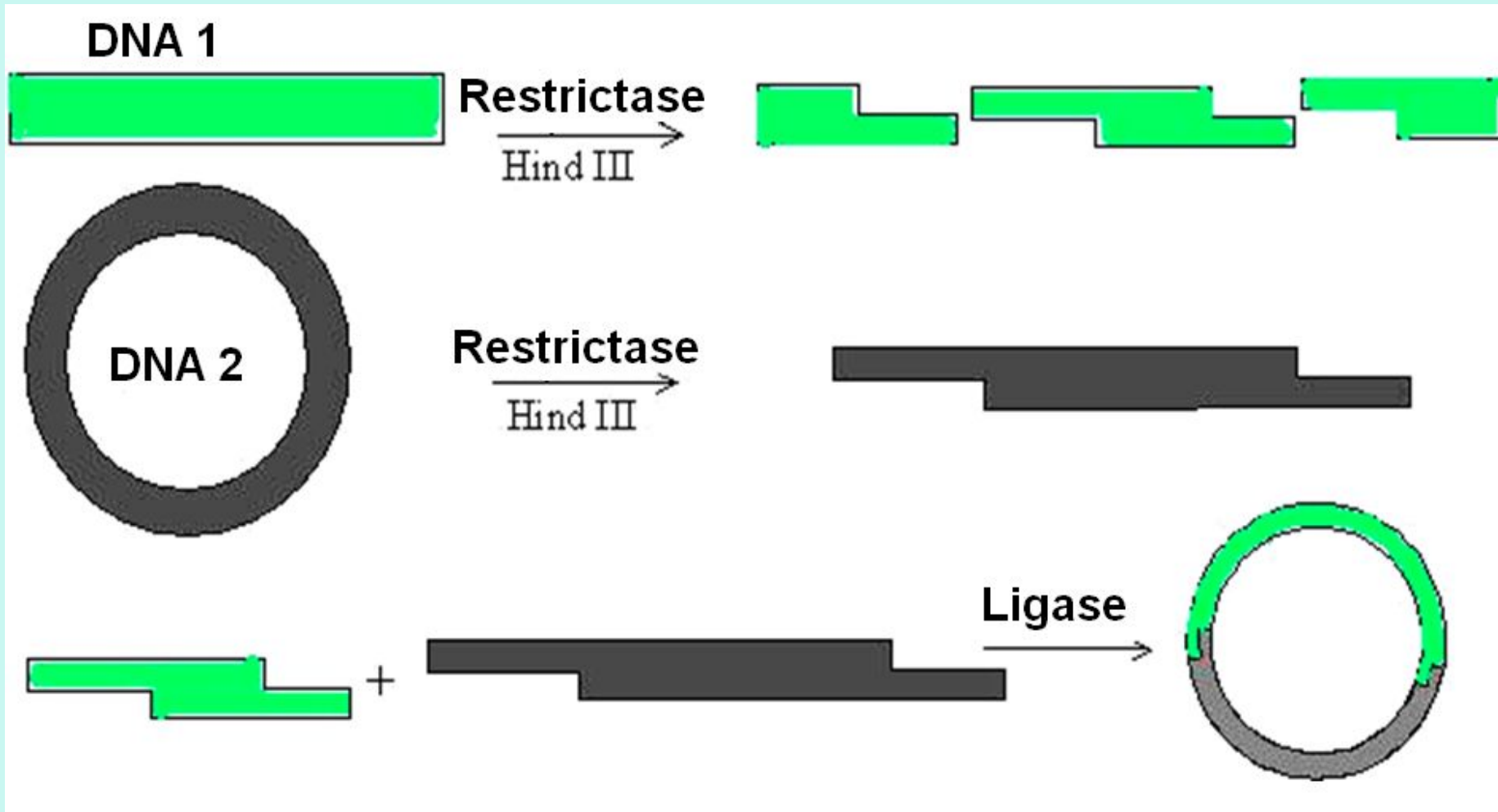


(b) Sticky 5' ends (*EcoRI*)

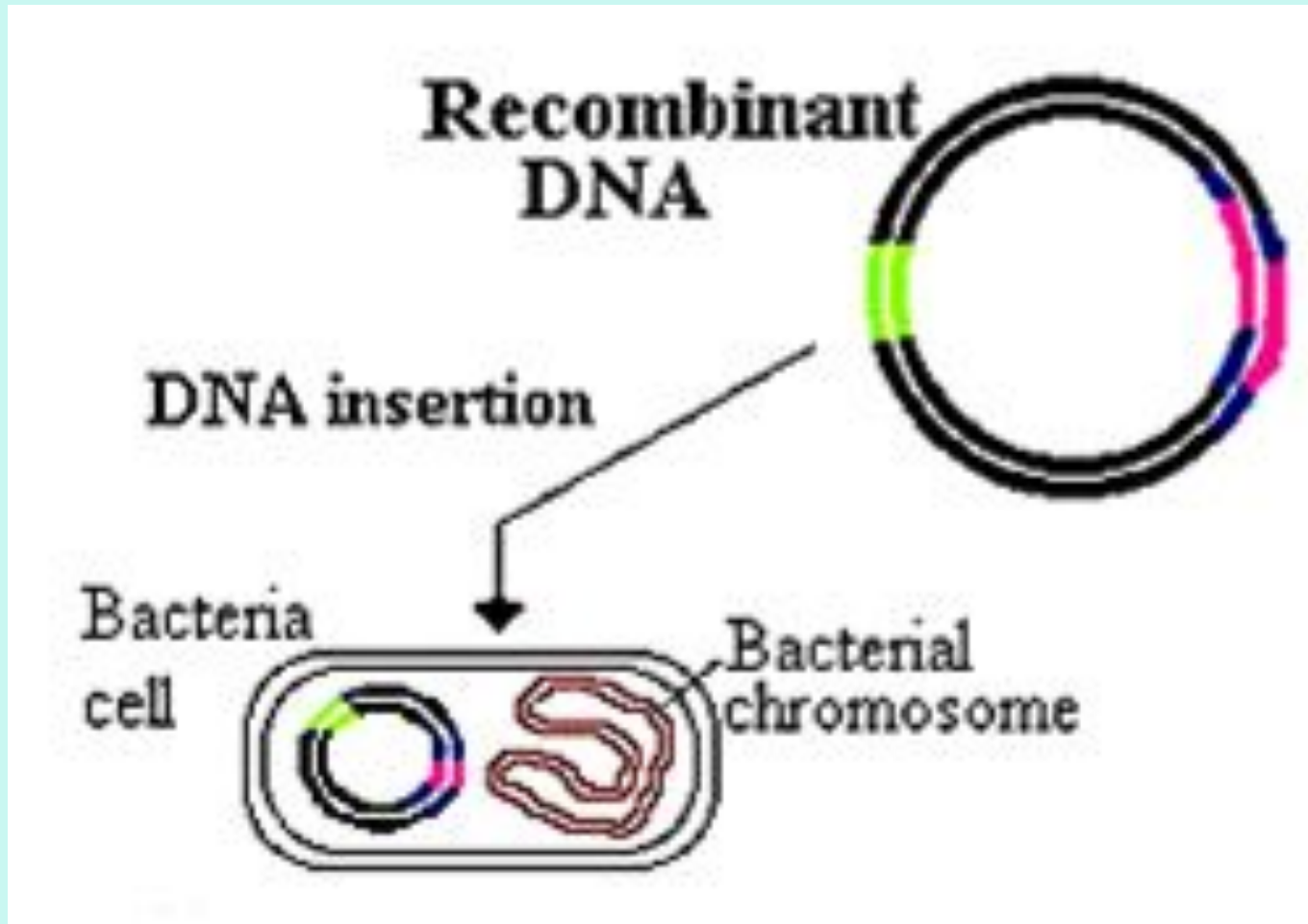


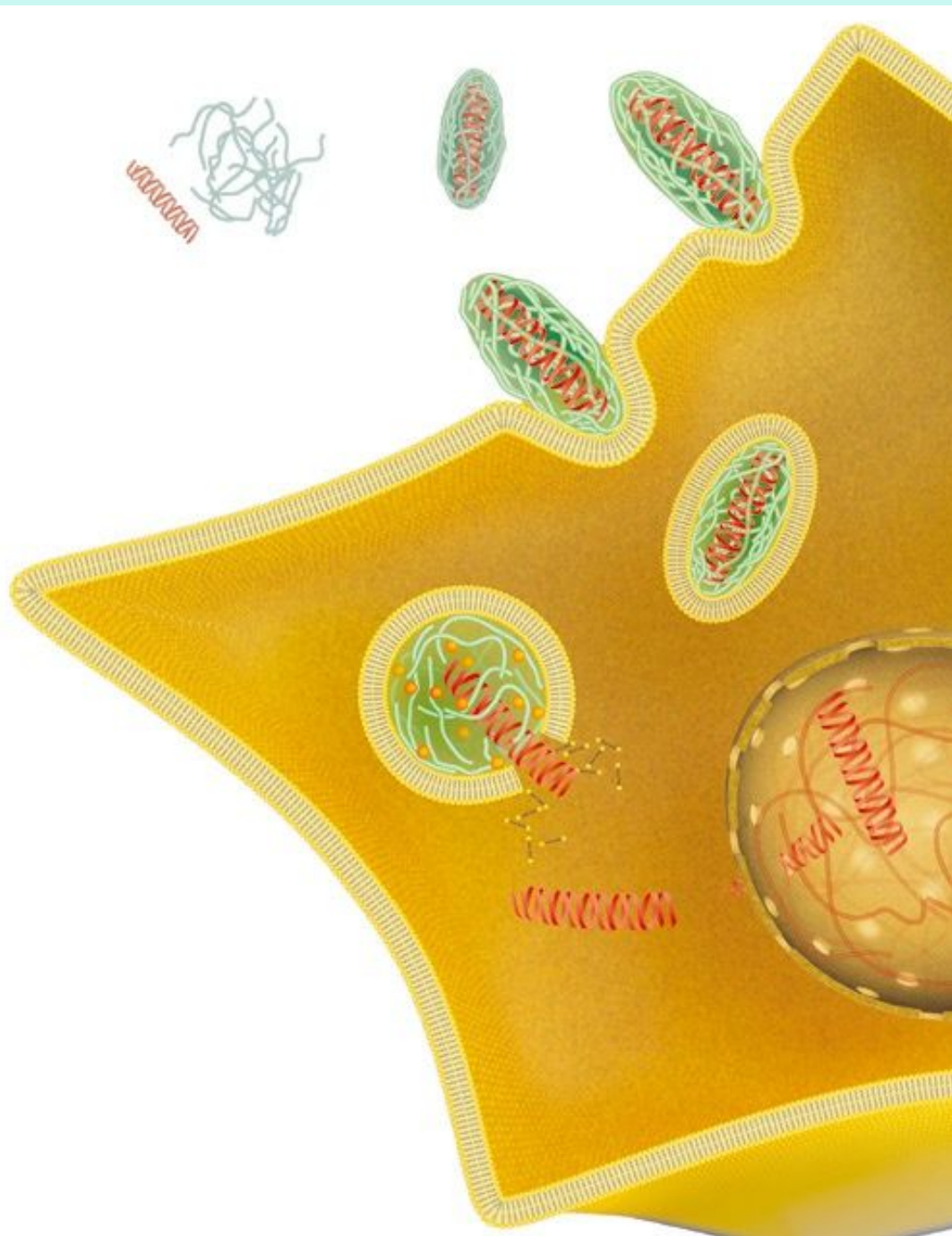


# Construction of recombinant DNA



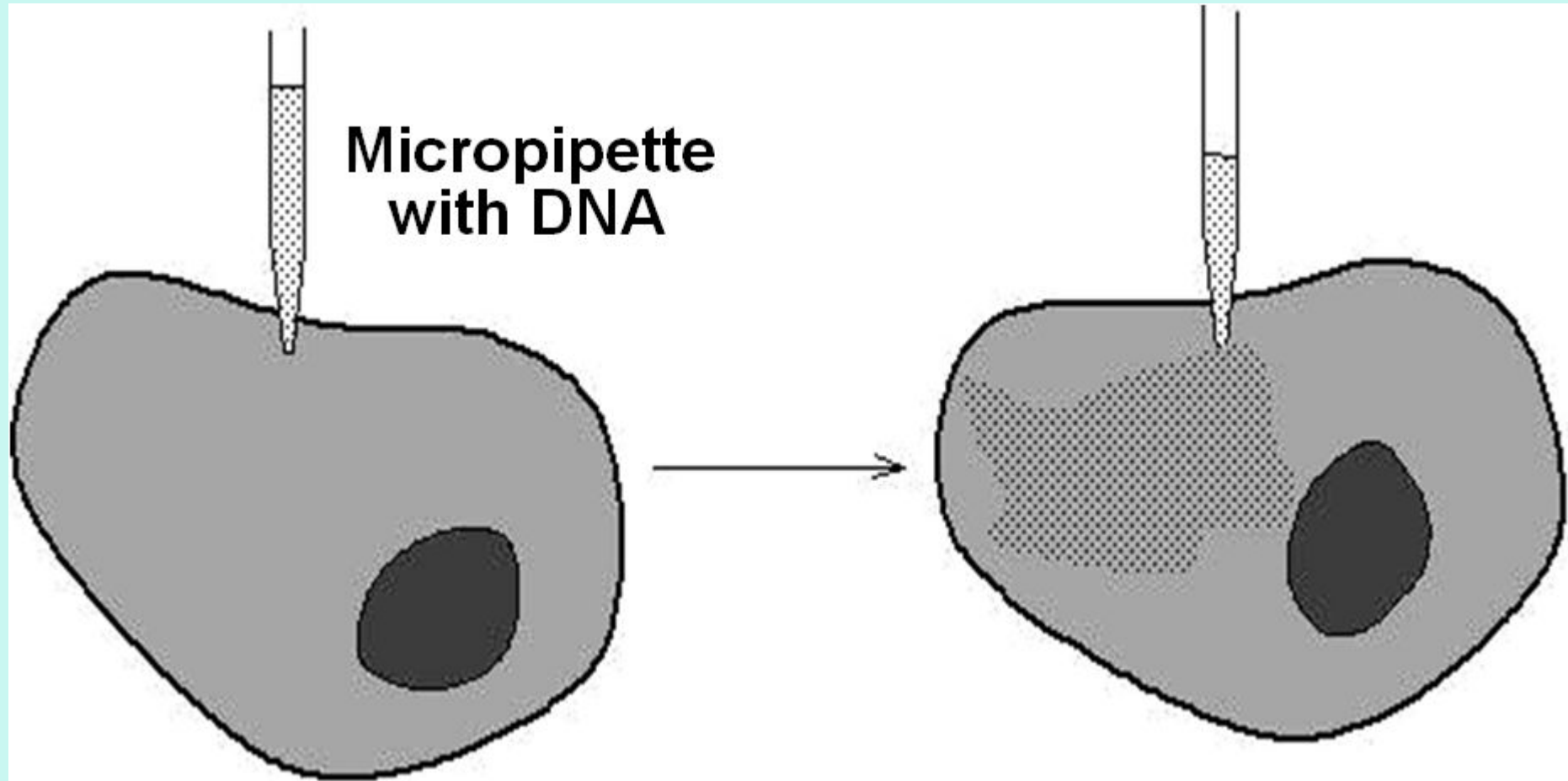
# Introduction of DNA into the cell with plasmids





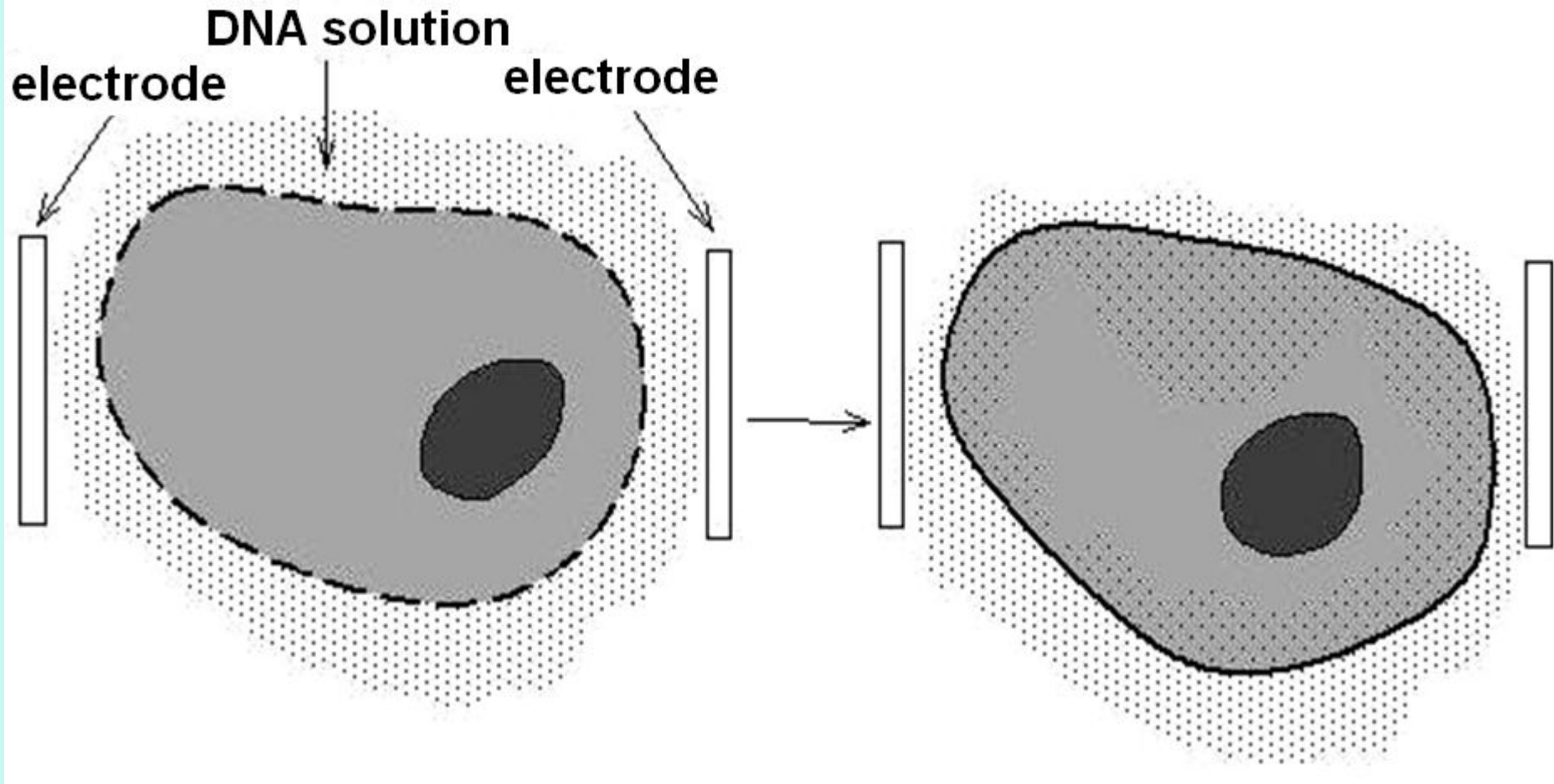
# Transfection on

# Microinjection of DNA

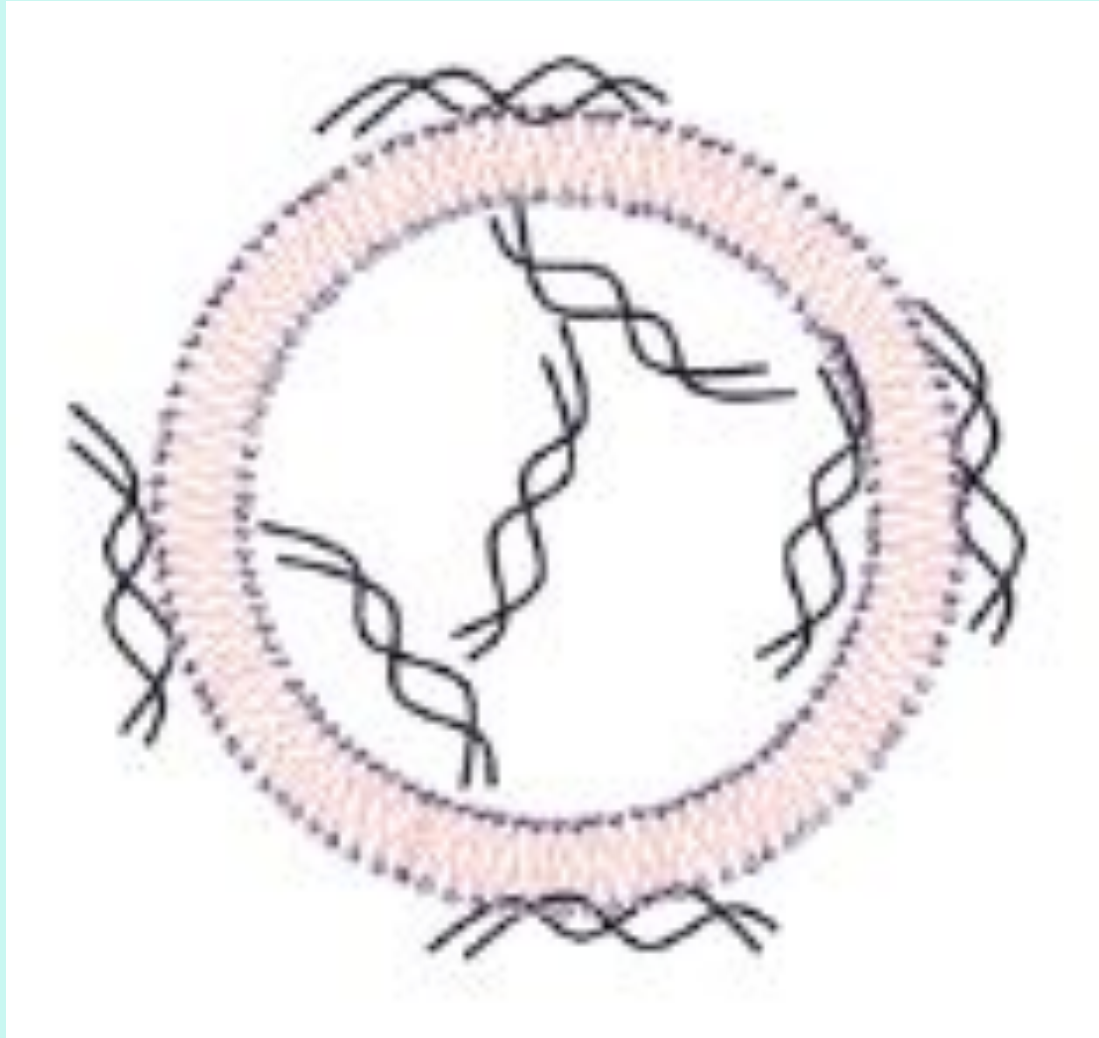




# Electroporation

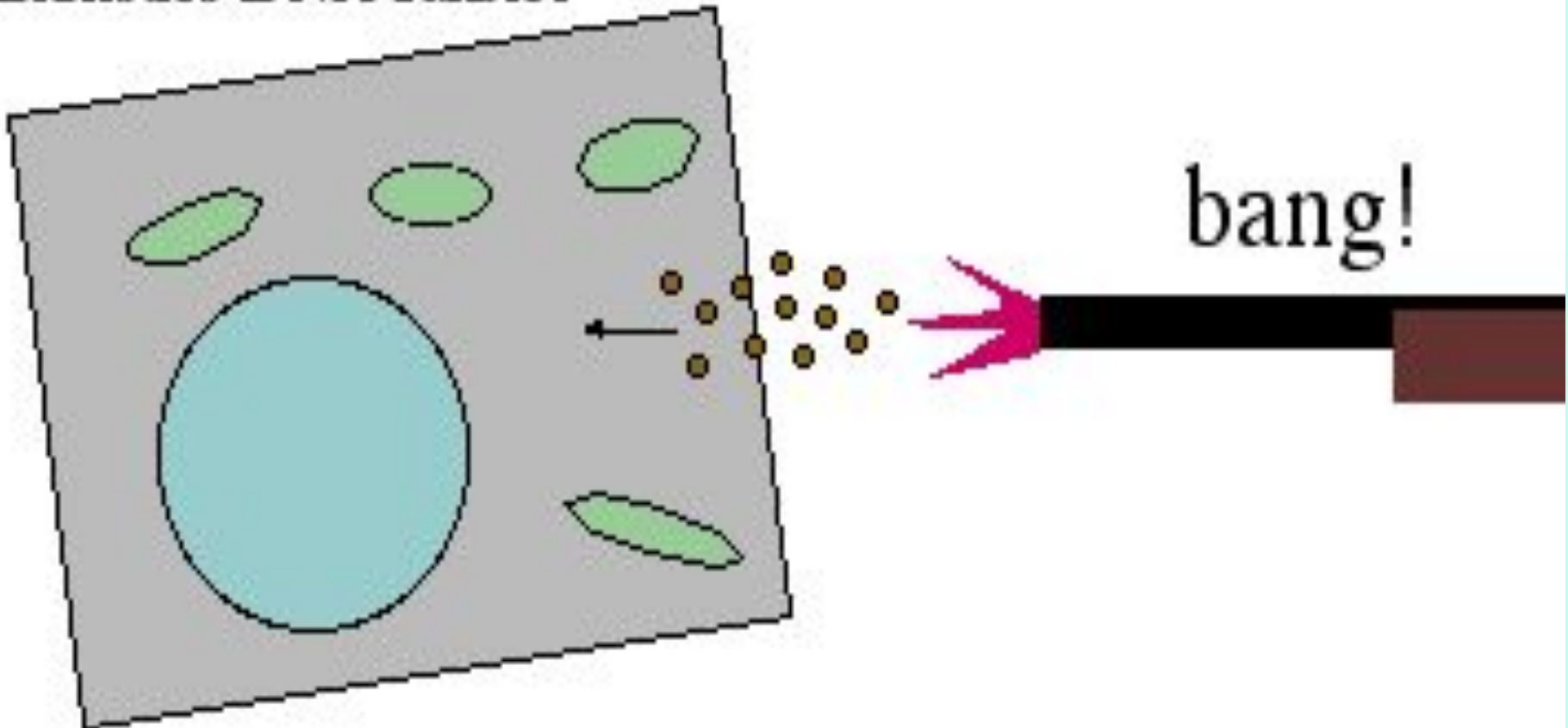


# Packing in liposomes



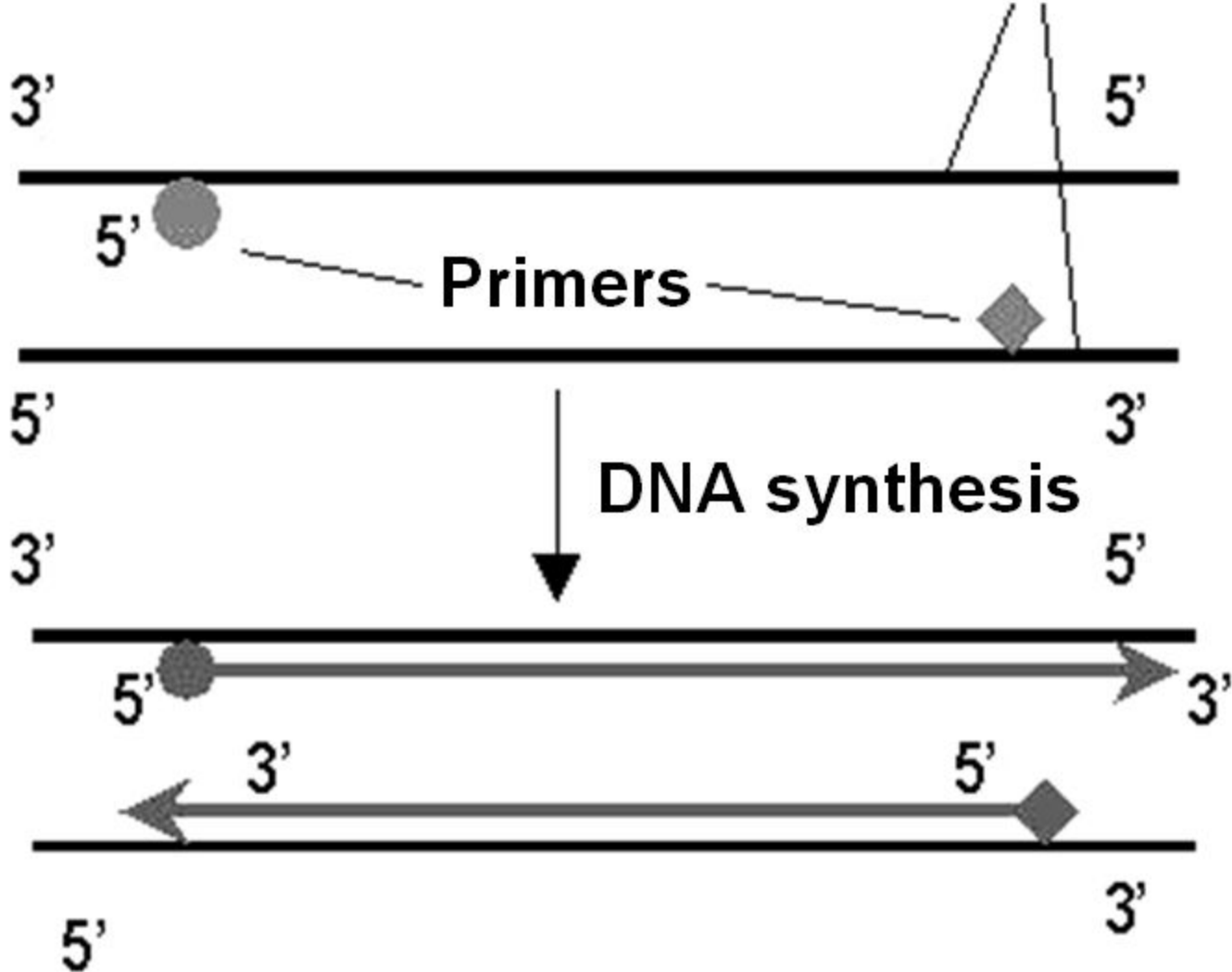
# The method of biological ballistics

Biolistics DNA transfer



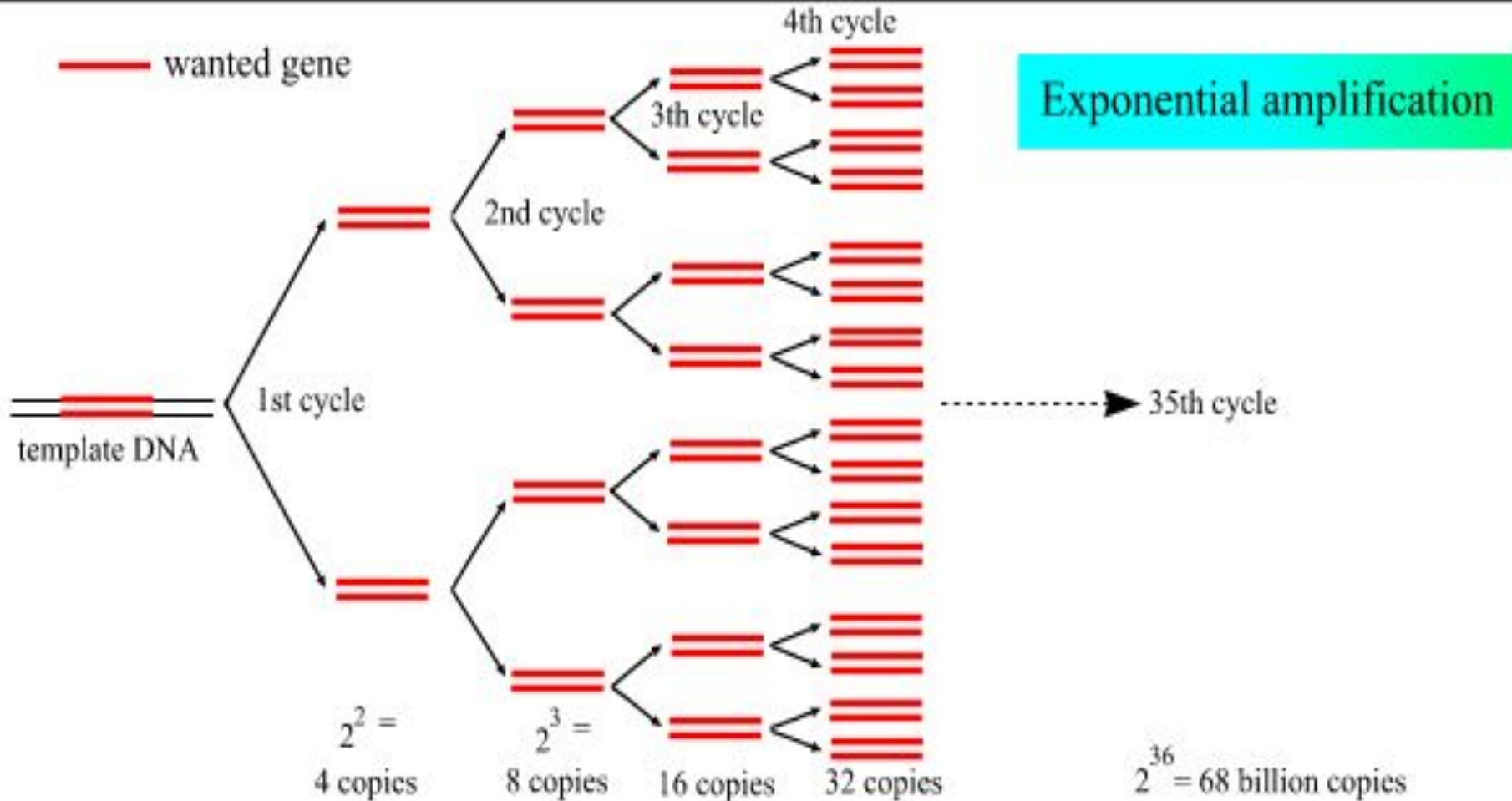
# Polymerase chain reaction (PCR)

Separated complementary DNA strands

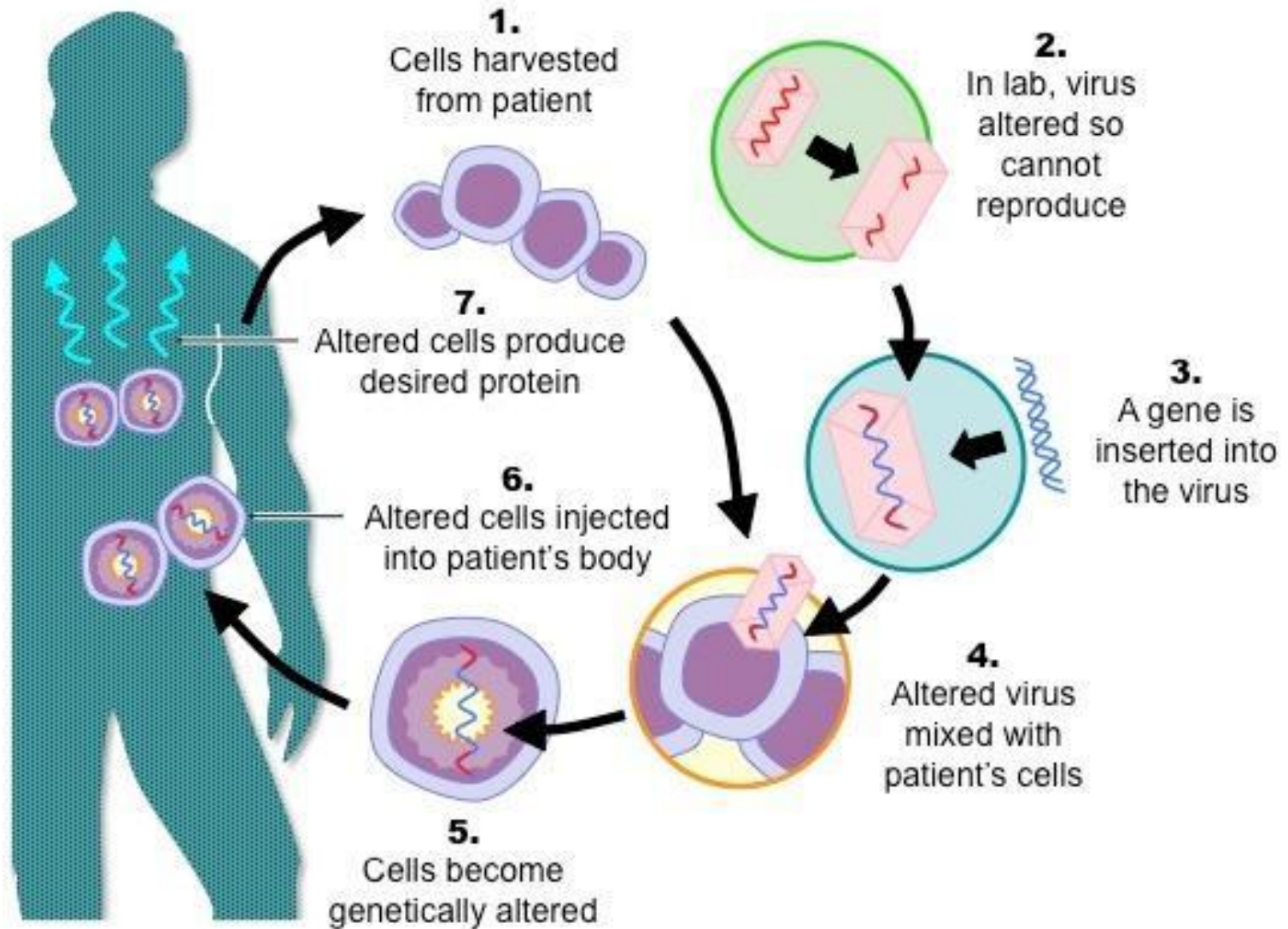




# Polymerase chain reaction DNA amplification



# Gene Therapy



# Treatment with Gene Therapy

