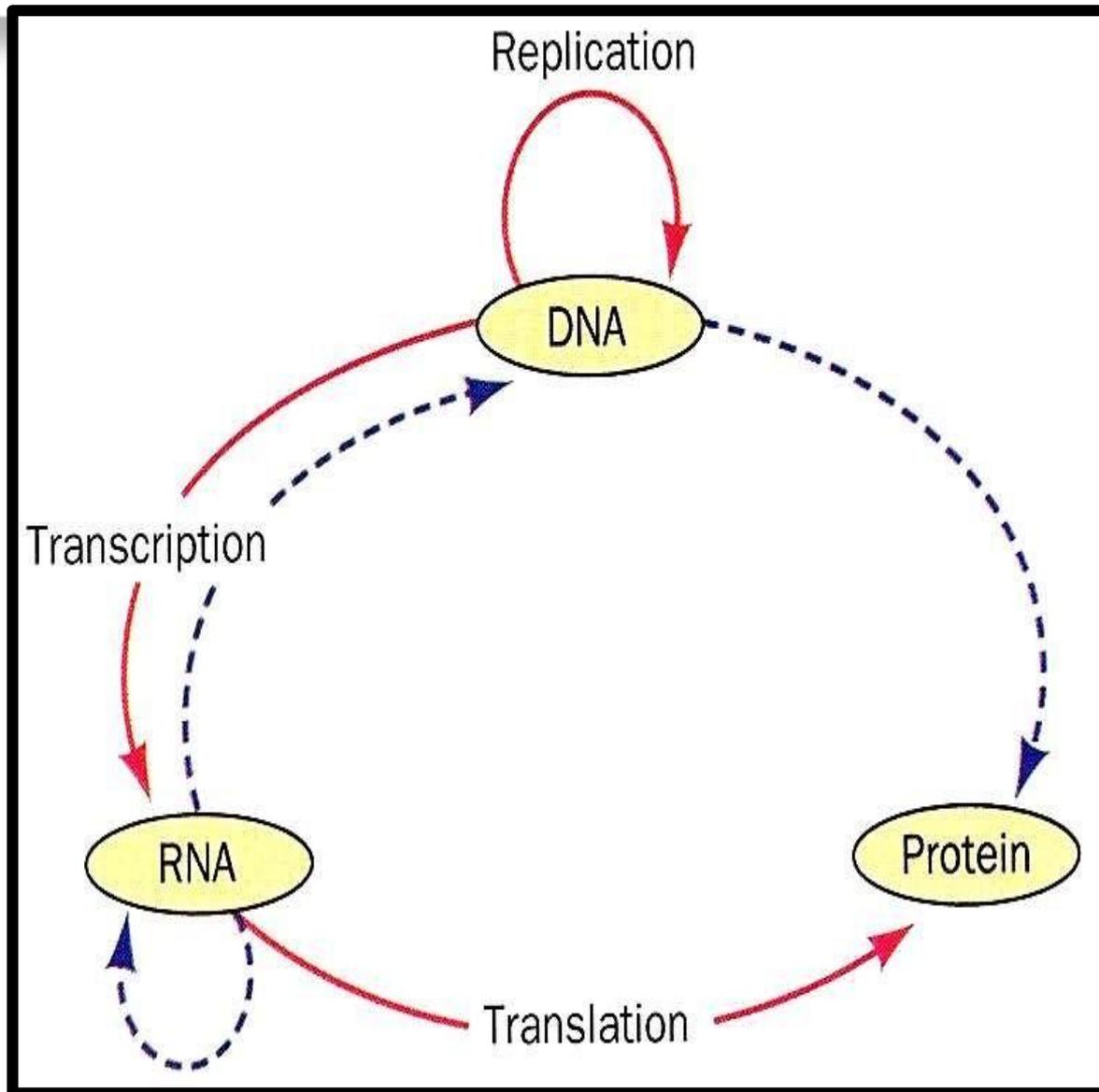


THE CENTRAL DOGMA

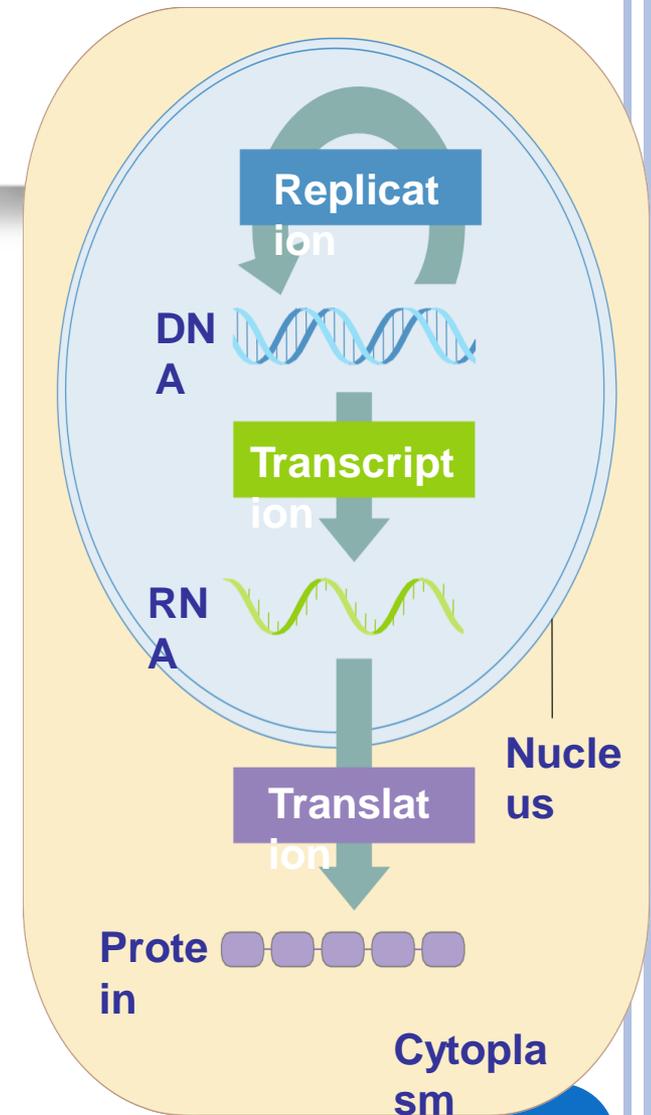
THE CENTRAL DOGMA



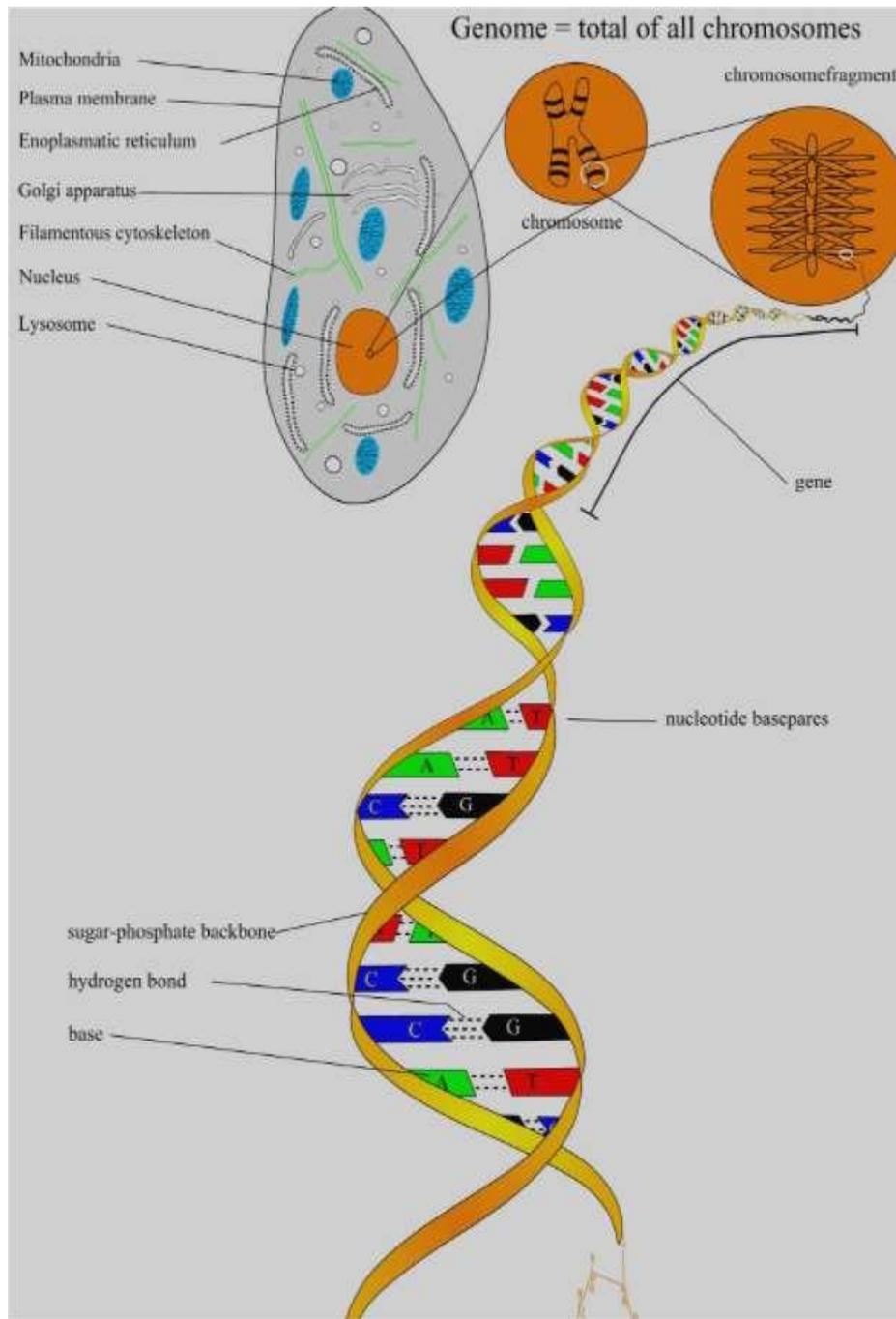
THE CENTRAL

DOGMA is the genetic material within the nucleus.

- **Replication** creates new copies of DNA.
- **Transcription** creates an RNA using DNA information.
- **Translation** creates a



THE DNA



THE GENETIC CODE IS A TRIPLET CODE

Normal mRNA **AUG ACACAUAACGGCUUCGUAUGGUGUGAA**

Amino acids **Met Thr His Asn Gly Phe Val Trp Cys Glu**

3 + mutations

+U +C +A

mRNA **AUG AUC ACA UAC ACG GCA UUCGUAUGGUGUGAA**

Amino acids **Met Ile Thr Tyr Thr Ala Phe Val Trp Cys Glu**

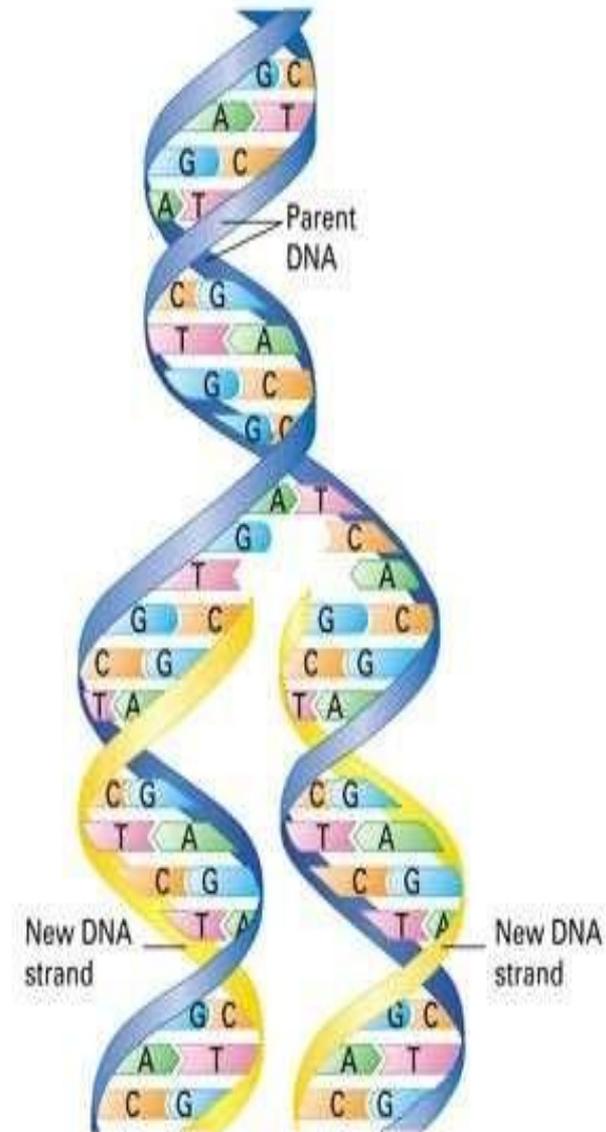
Incorrect amino acids
in polypeptide

PEARSON
Benjamin
Cummings



REPLICATION

- DNA Replication is semi-conservative.
- Each newly synthesized molecule contains 1 “parent template” strand and 1 new “daughter” strand.



TRANSCRIPTION: RNA SYNTHESIS

- RNA is an important type of nucleic acid that plays several roles in the production of protein
- RNA is necessary to carry the instructions of the DNA out of the nucleus and to the ribosomes.



TWO TYPES OF

NUCLEIC ACIDS

A DNA



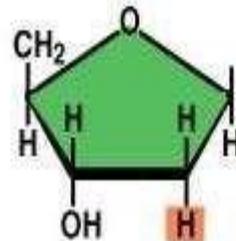
Double-stranded

RNA

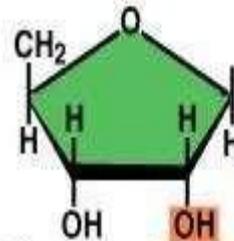


Generally single-stranded

B

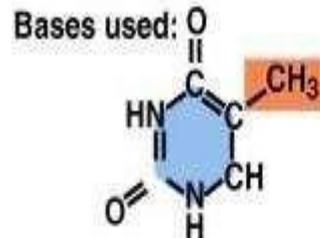


Deoxyribose as the sugar

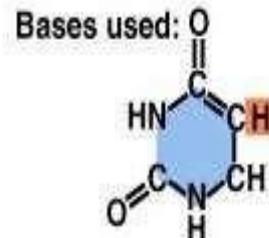


Ribose as the sugar

C



Thymine (T)
Cytosine (C)
Adenine (A)
Guanine (G)

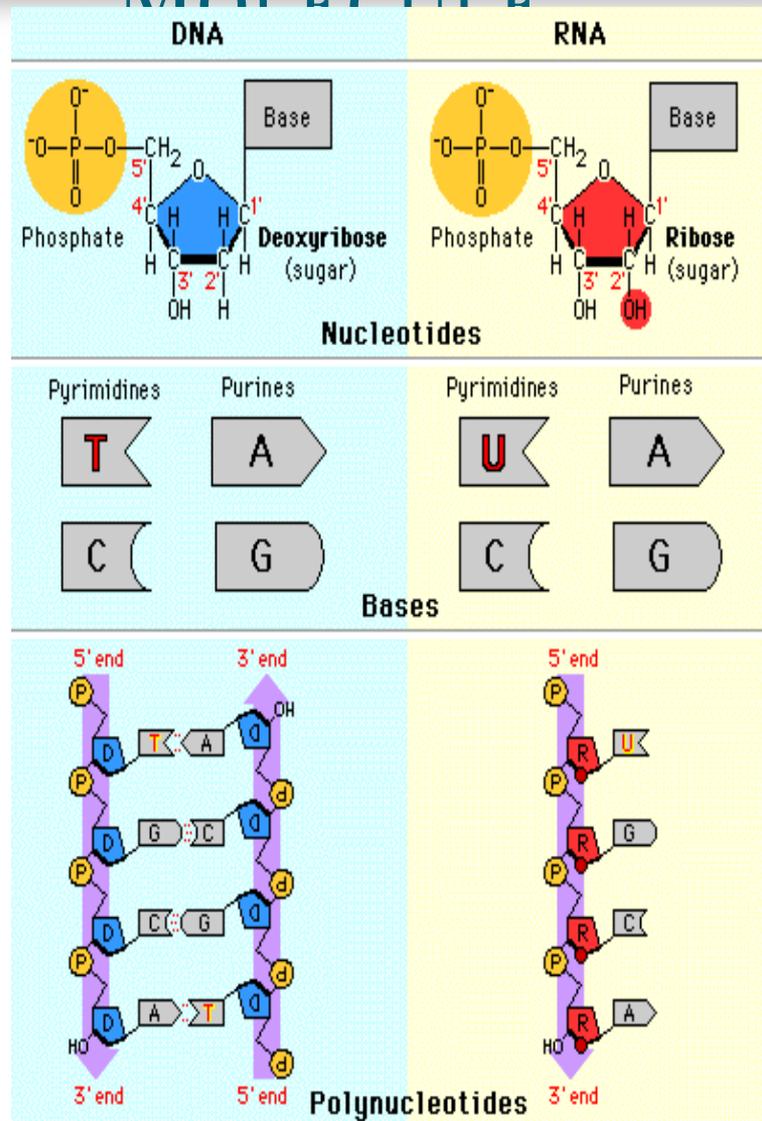


Uracil (U)
Cytosine (C)
Adenine (A)
Guanine (G)

D



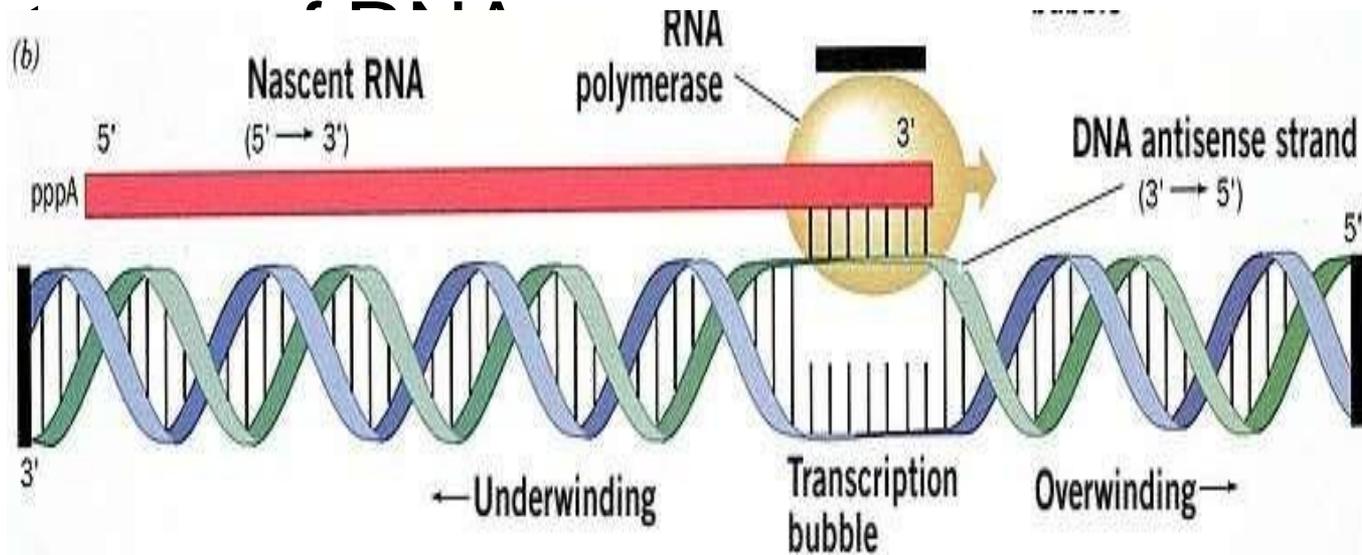
THE RNA MOLECULE



TRANSCRIP

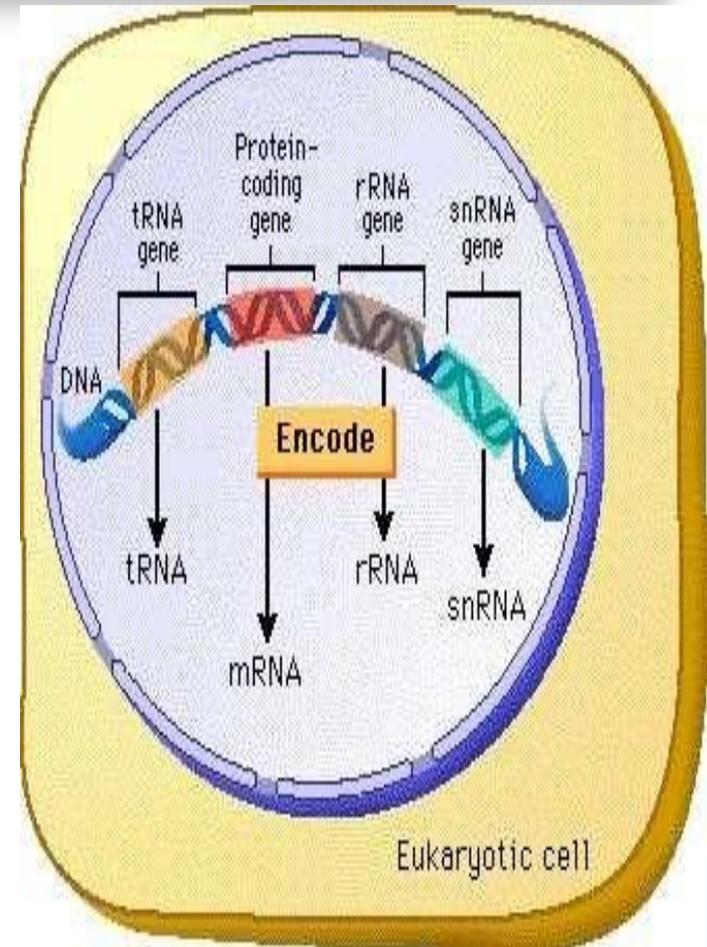
TION

- It is the mechanism by which a template strand of DNA is utilized by specific **RNA polymerases** to generate one of the 4 different



TYPES OF RNA

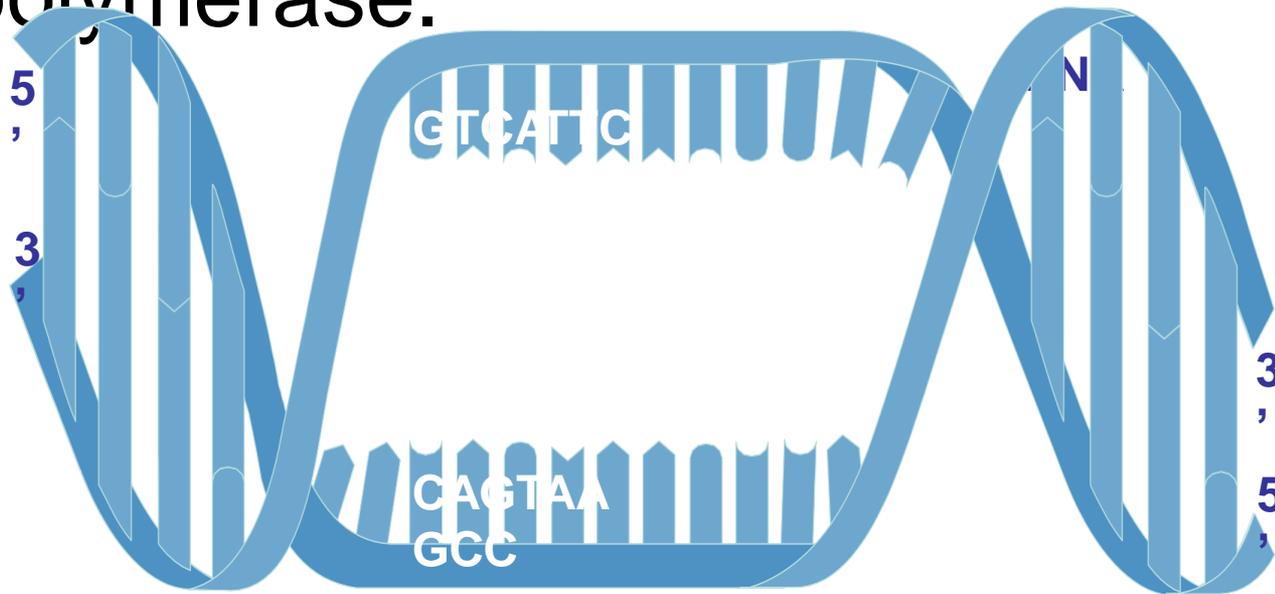
1. mRNA (messenger RNA)
2. tRNA (transfer RNA)
3. rRNA (ribosomal RNA)
4. snRNA (small nuclear RNA)



TRANSCRIP

TION

- DNA is used as a template for creation of RNA using the RNA polymerase.

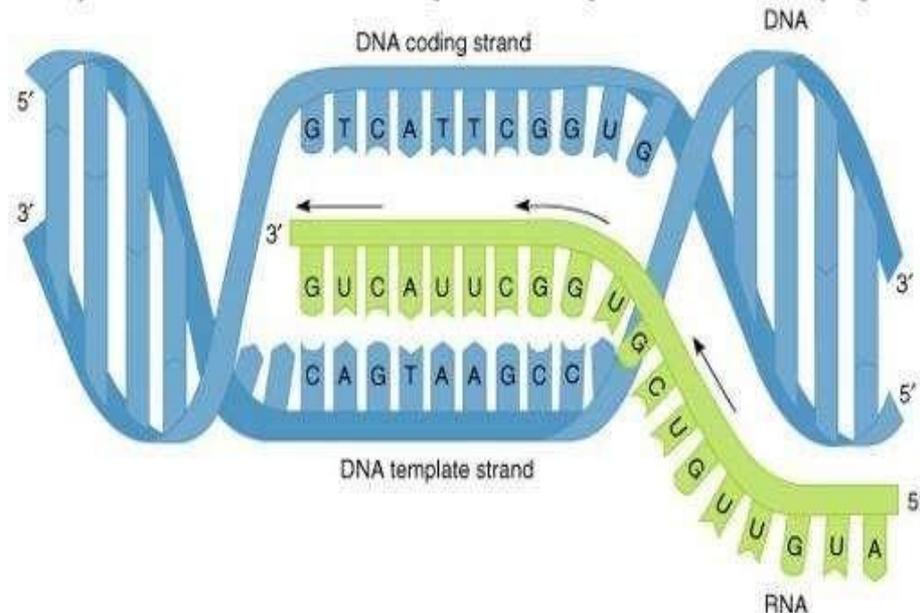
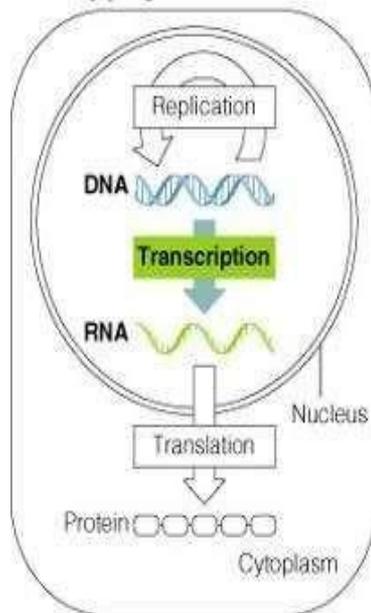


TRANSCRIP

TION

- RNA polymerase reads the nucleotides on the template strand from 3' to 5' and creates an RNA molecule in a 5' to 3'

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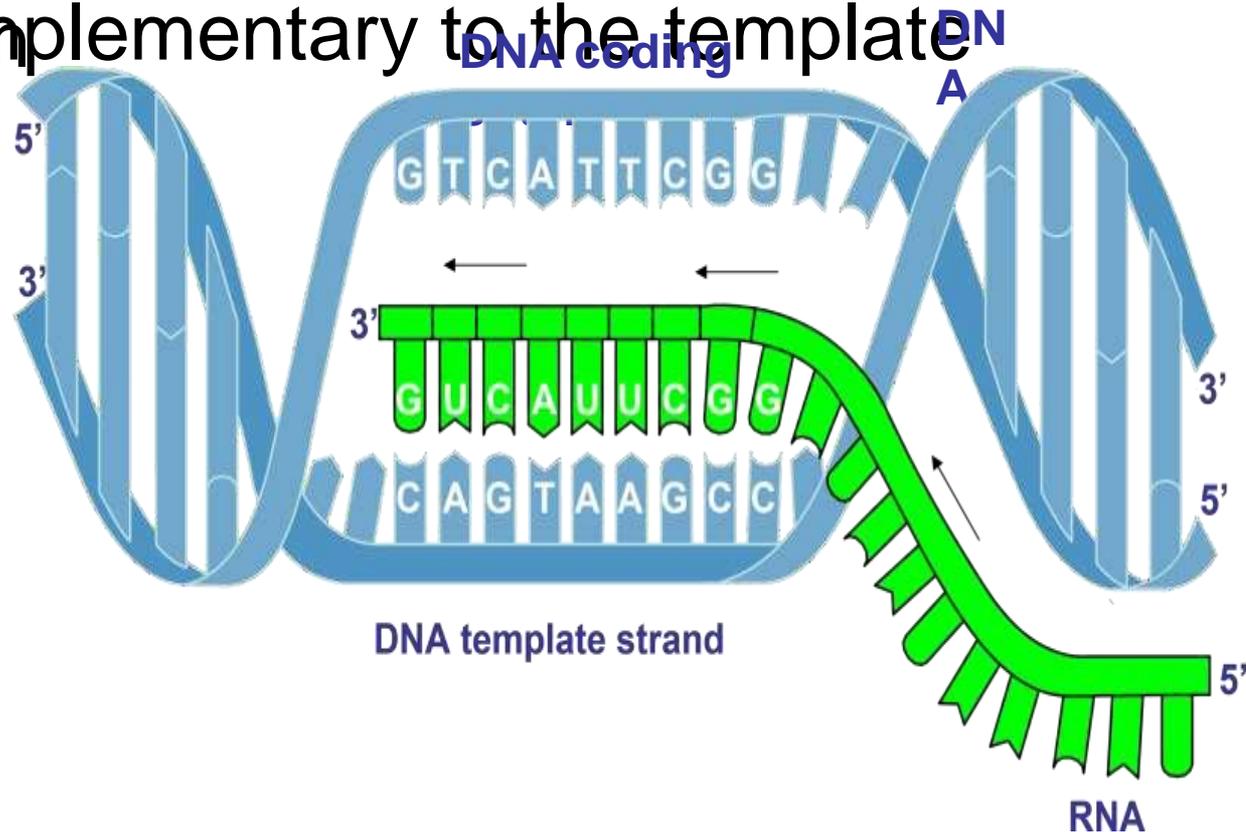


TRANSCRIP

TION

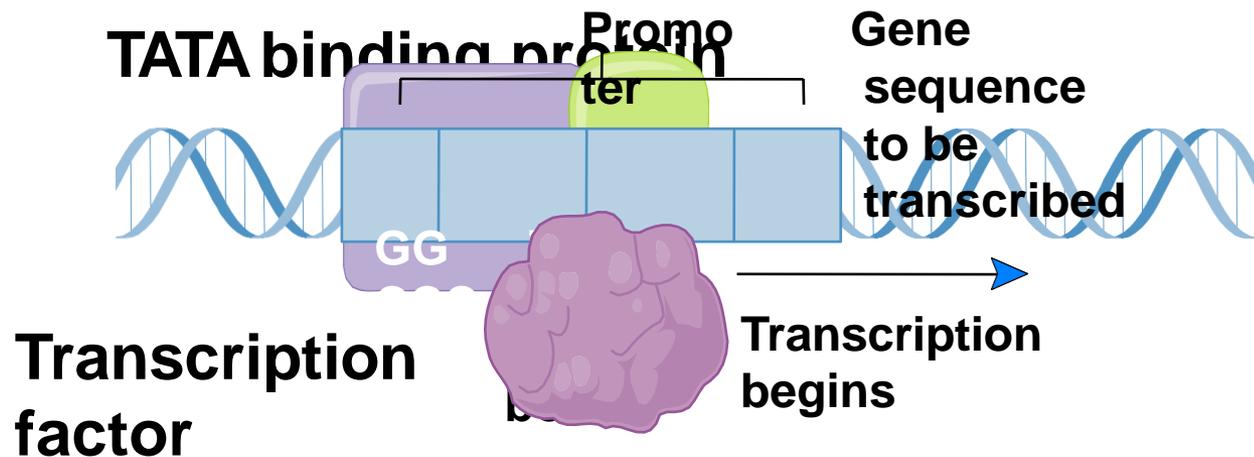
- The new RNA molecule is formed by incorporating nucleotides that are complementary to the template strand.

d.



INITIATION OF

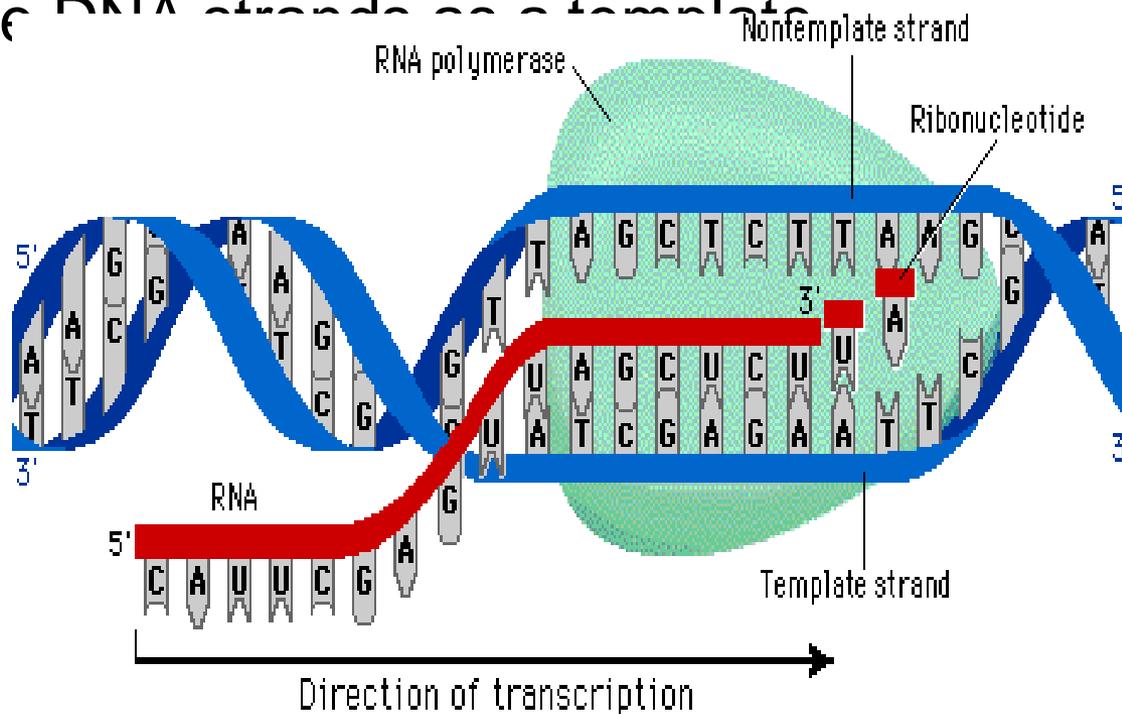
- **TRANSCRIPTION** begins at the 3' end of the gene in a region called the promoter.
- The promoter recruits TATA protein, a DNA binding protein, which in turn recruits other proteins.



THE TRANSCRIPTION

PROCESS

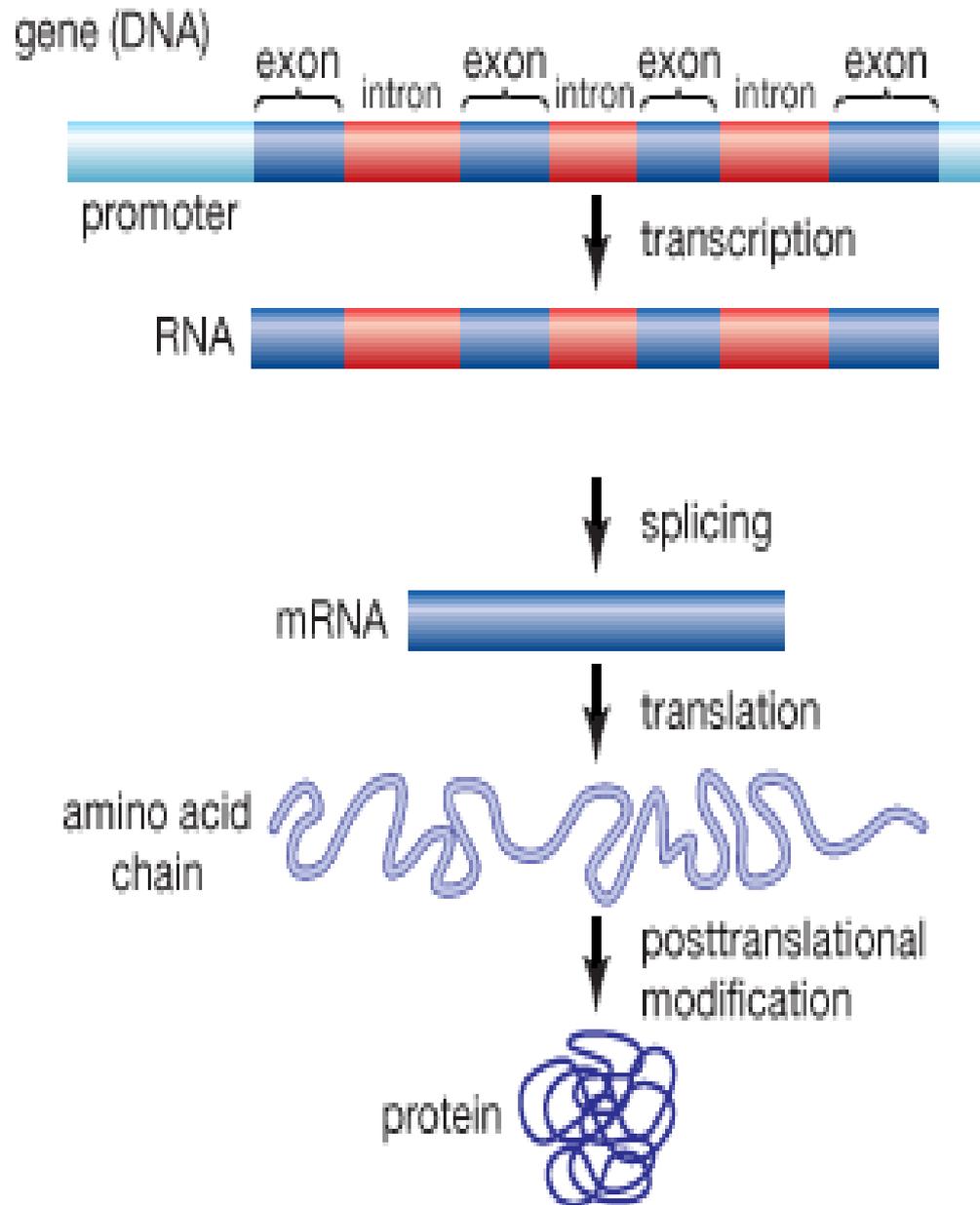
RNA synthesis involves separation of the DNA strands and synthesis of an RNA molecule in the 5' to 3' direction by RNA polymerase, using one of the DNA strands as a template.



COMPLETE TRANSCRIPTION OF AN RNA MOLECULE

- Transcription begins at the promoter, proceeds through the coding region, and ends at the terminator.





COD

ON

- A triplet of adjacent nucleotides in the messenger RNA chain that codes for a specific amino acid in the synthesis of a protein molecule.
- Each codon corresponds to a single amino acid (or stop signal), and the full set of codons is called the genetic code.



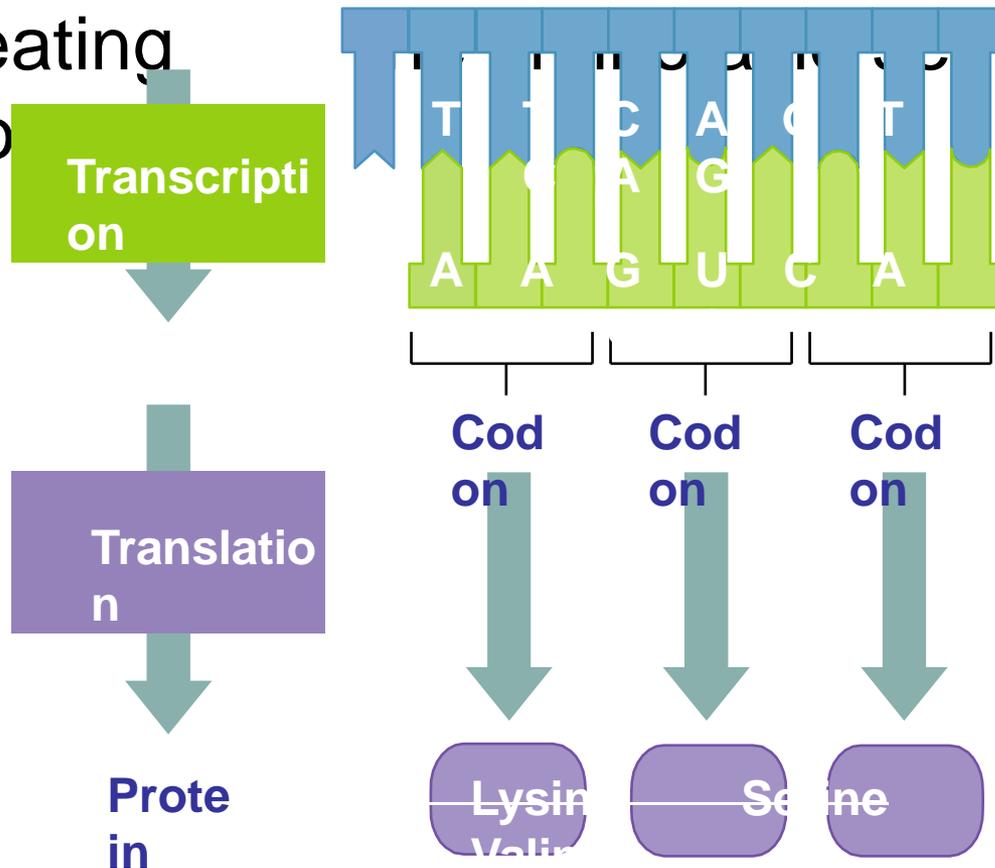
THE GENETIC CODE

- All organisms use the same 20 aa
- Each codon specifies a particular aa

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

TRANSLATION: PROTEIN SYNTHESIS

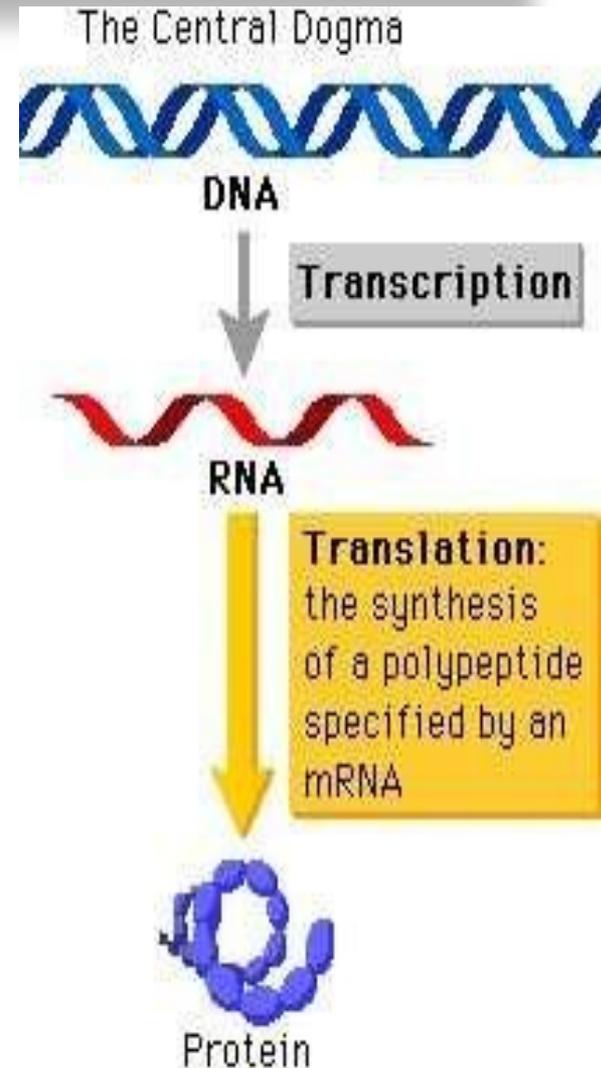
- The process of reading the RNA sequence of an mRNA and creating a polypeptide sequence of a protein



TRANSLA

TION

- The language of nucleic acids is translated into the language of proteins
- Nucleic acids have a 4 letter language
- Proteins have a 20 letter language



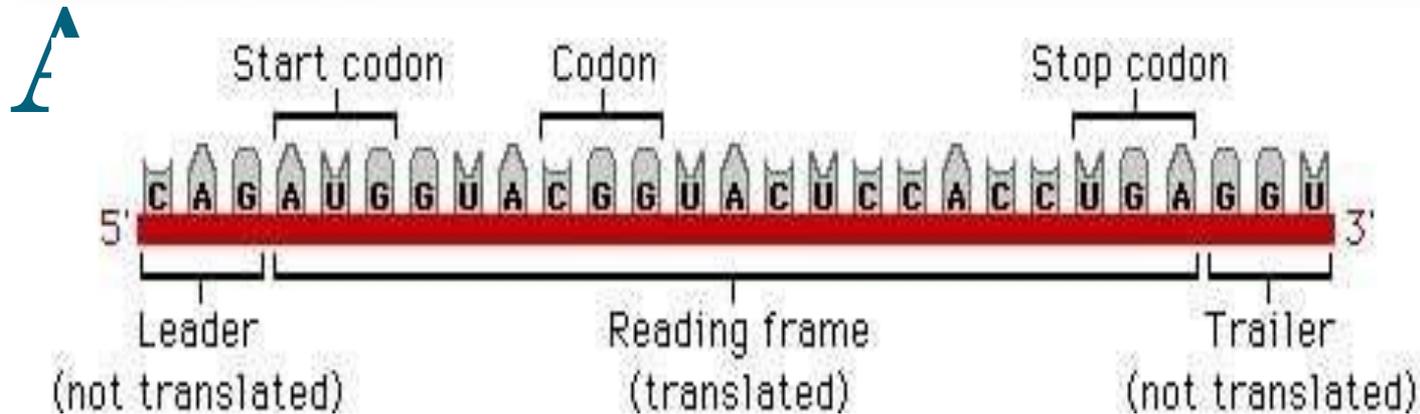
TRANSLA TION

The “Players”

- Messenger RNA (mRNA)
- Ribosomes
- Transfer RNA (tRNA)
- Amino Acids



mRNA



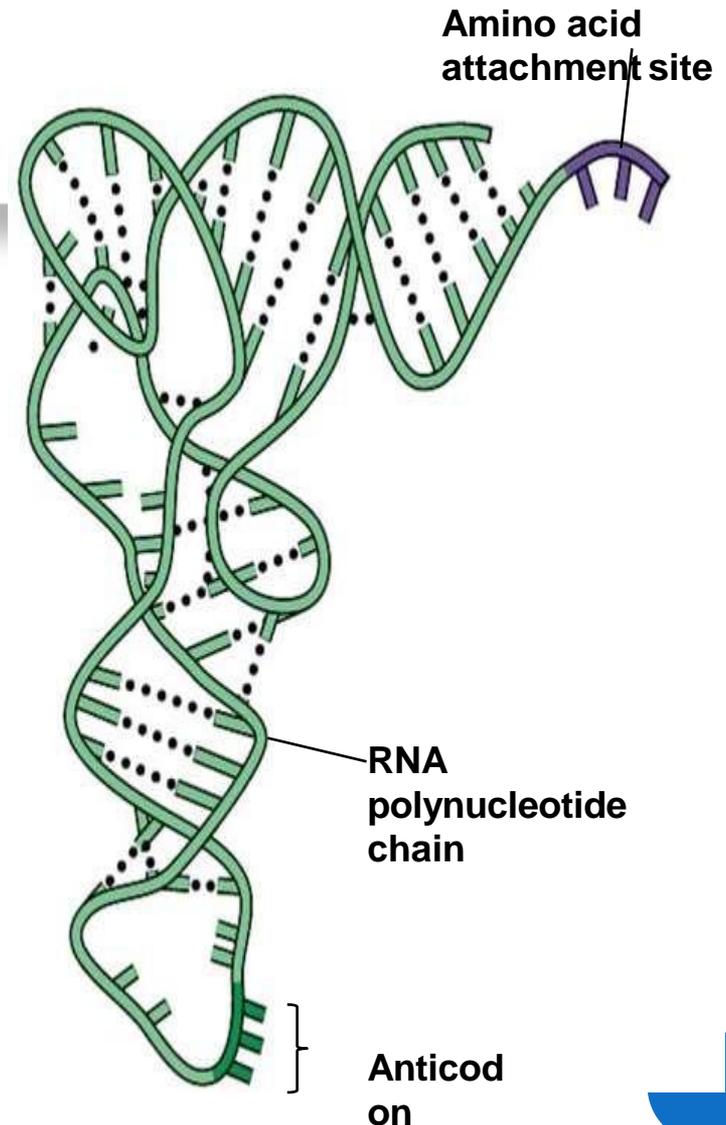
- Synthesized in transcription
- Composed of Codons
- Codons are 3-base sequences of mRNA



TRANSFER

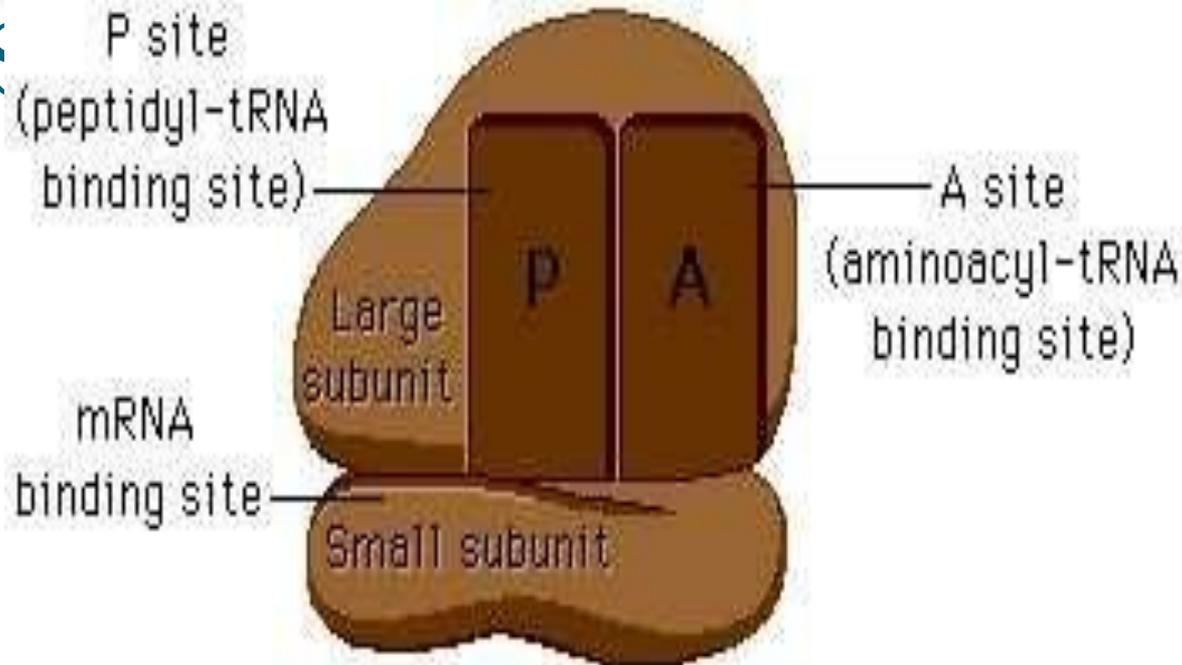
RNA

- In the cytoplasm, a ribosome attaches to the mRNA and translates its message into a polypeptide.
- The process is aided by transfer RNAs.



RIBOSO

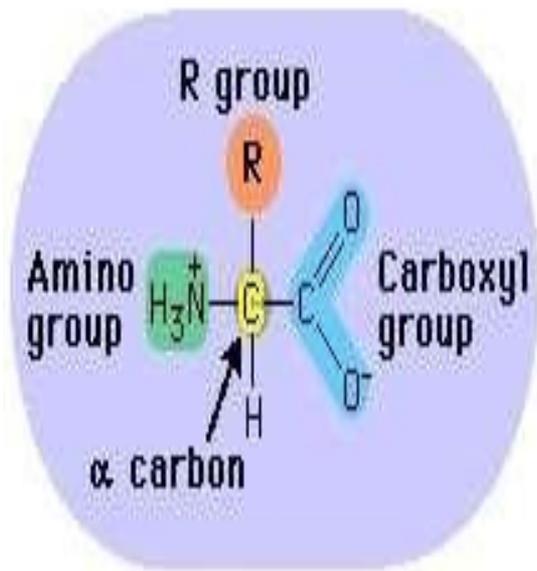
MES



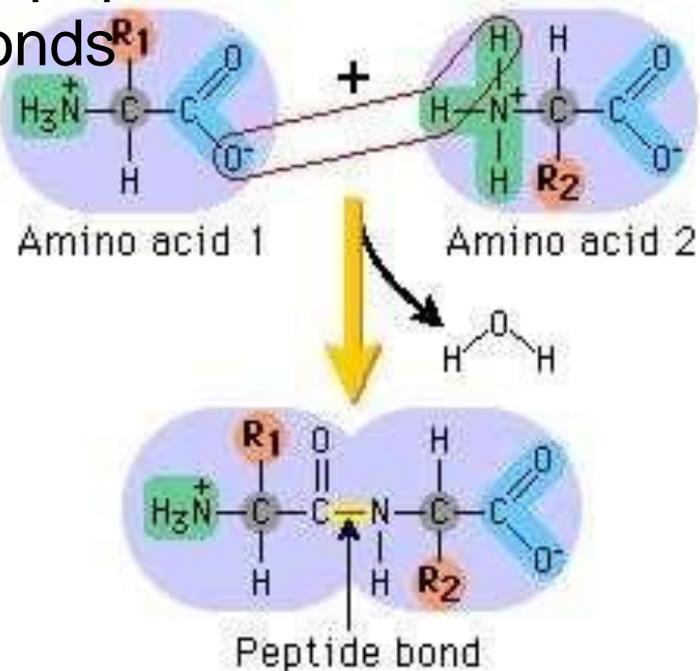
- Made of rRNA and protein
- 2 subunits (large and small) form a 3D groove



AMINO



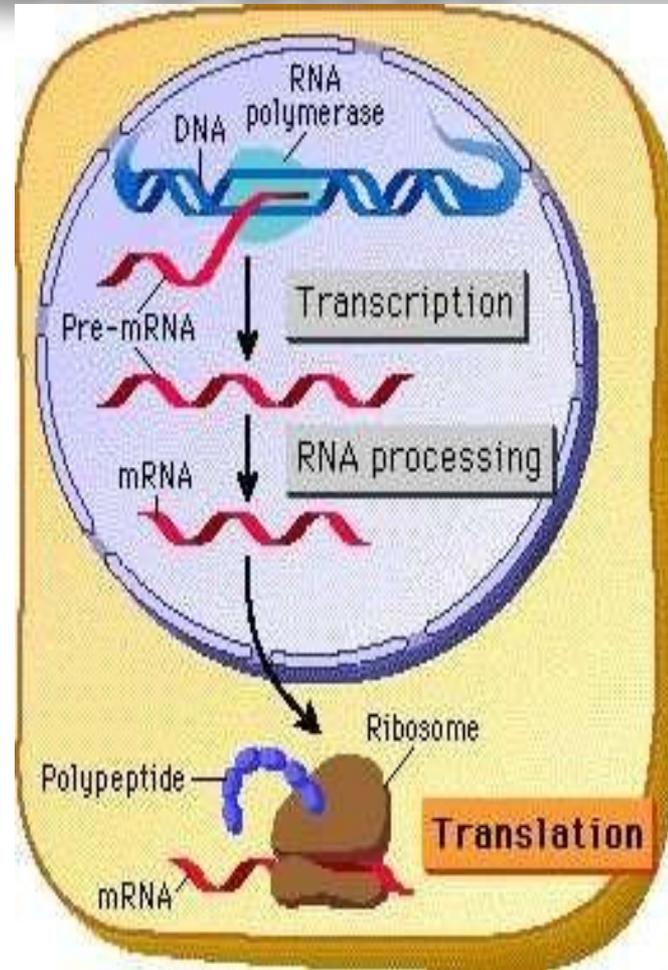
- There are 20 amino acids, each with a basic structure
- Amino acids are held together by peptide bonds



TRANSLATION HAS

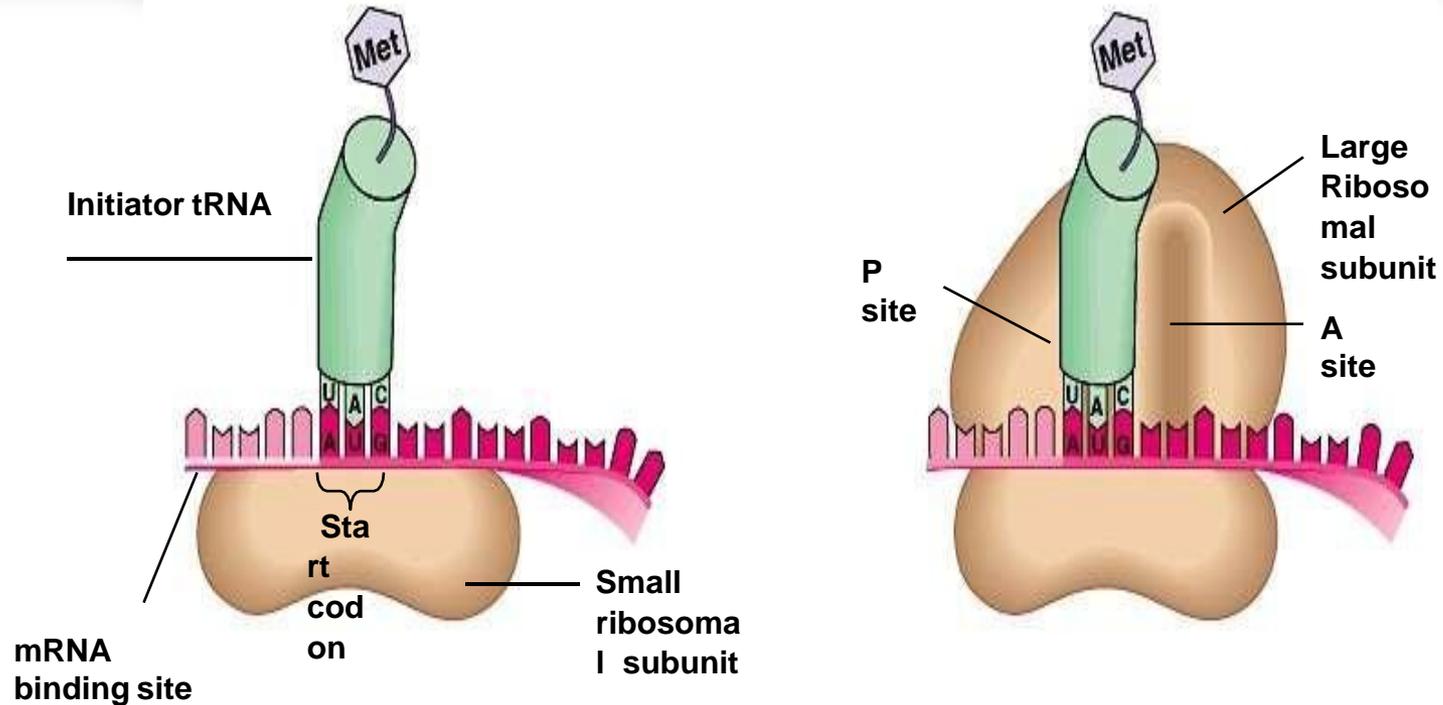
3 STEPS

1. Initiation
2. Elongation
3. Termination



STEP 1.

INITIATION



1

**mRNA, a specific tRNA, and the ribosome subunits assemble during initiation



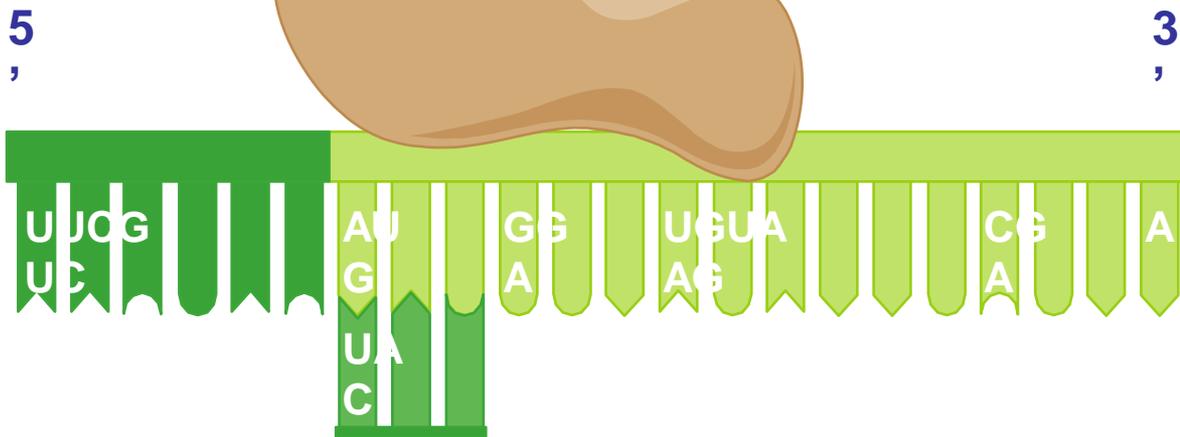
INITIATION

Leader
sequence

Small ribosomal
subunit

mRNA

mRNA



Assembling
to begin
translation

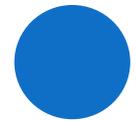
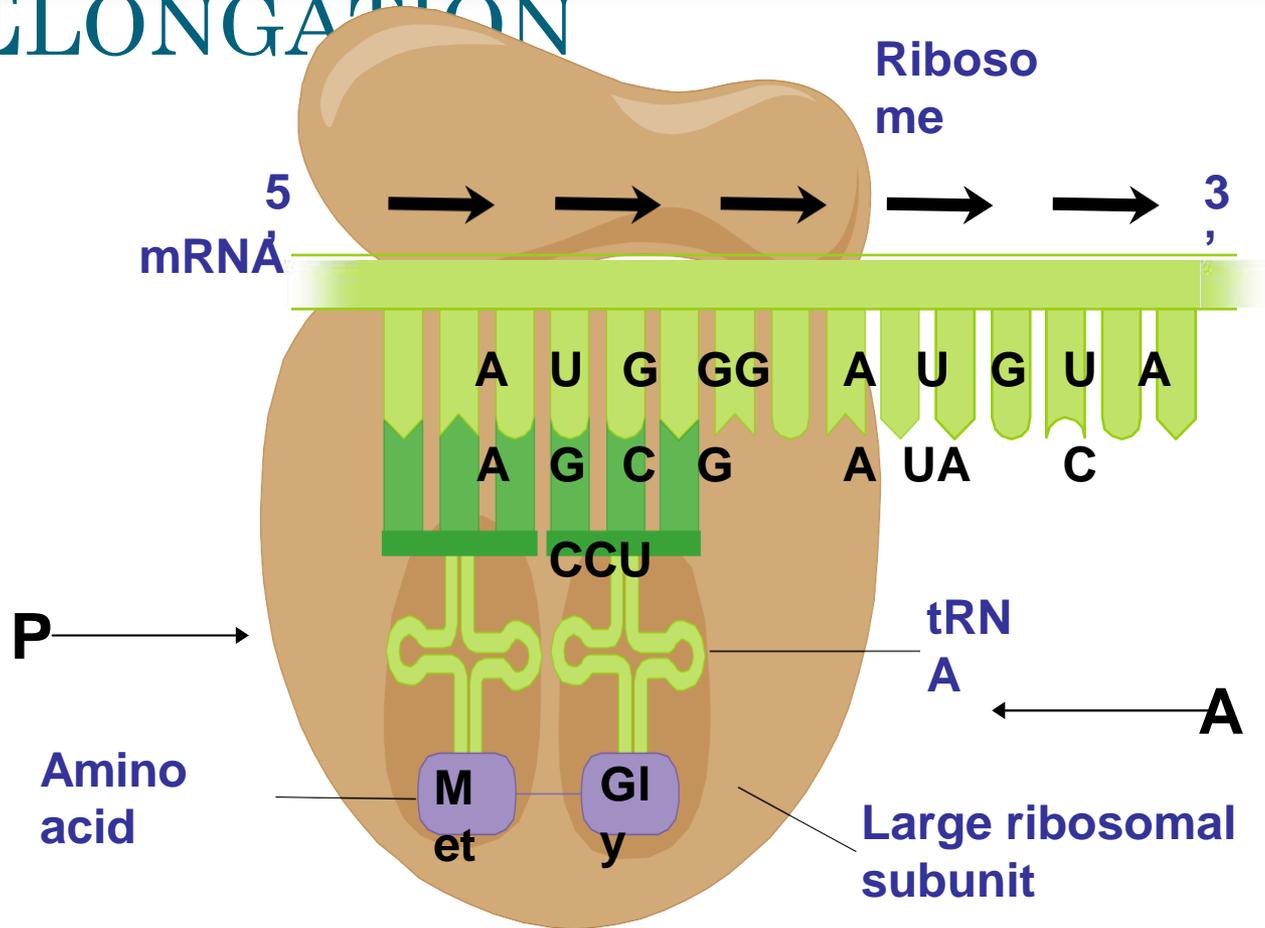
Initiator
tRNA

Met

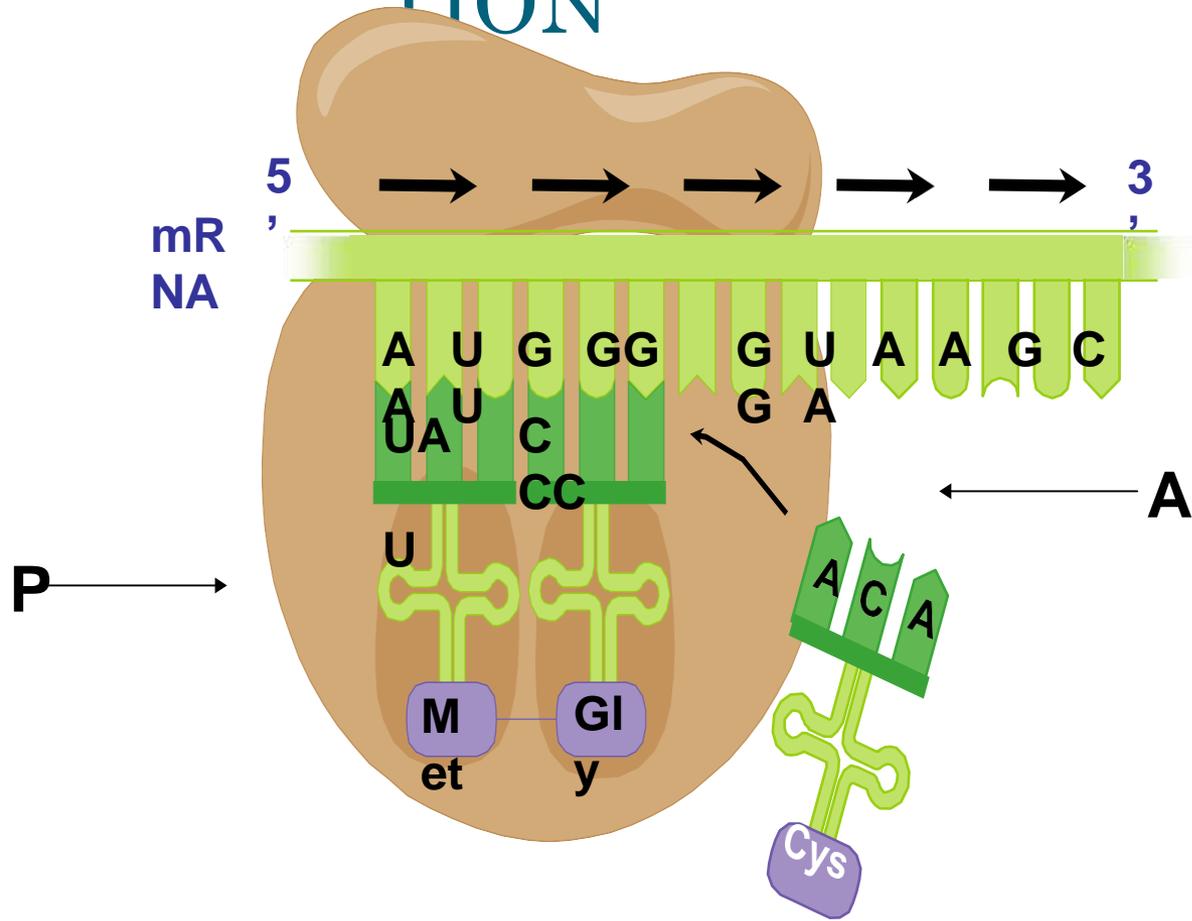


STEP 2.

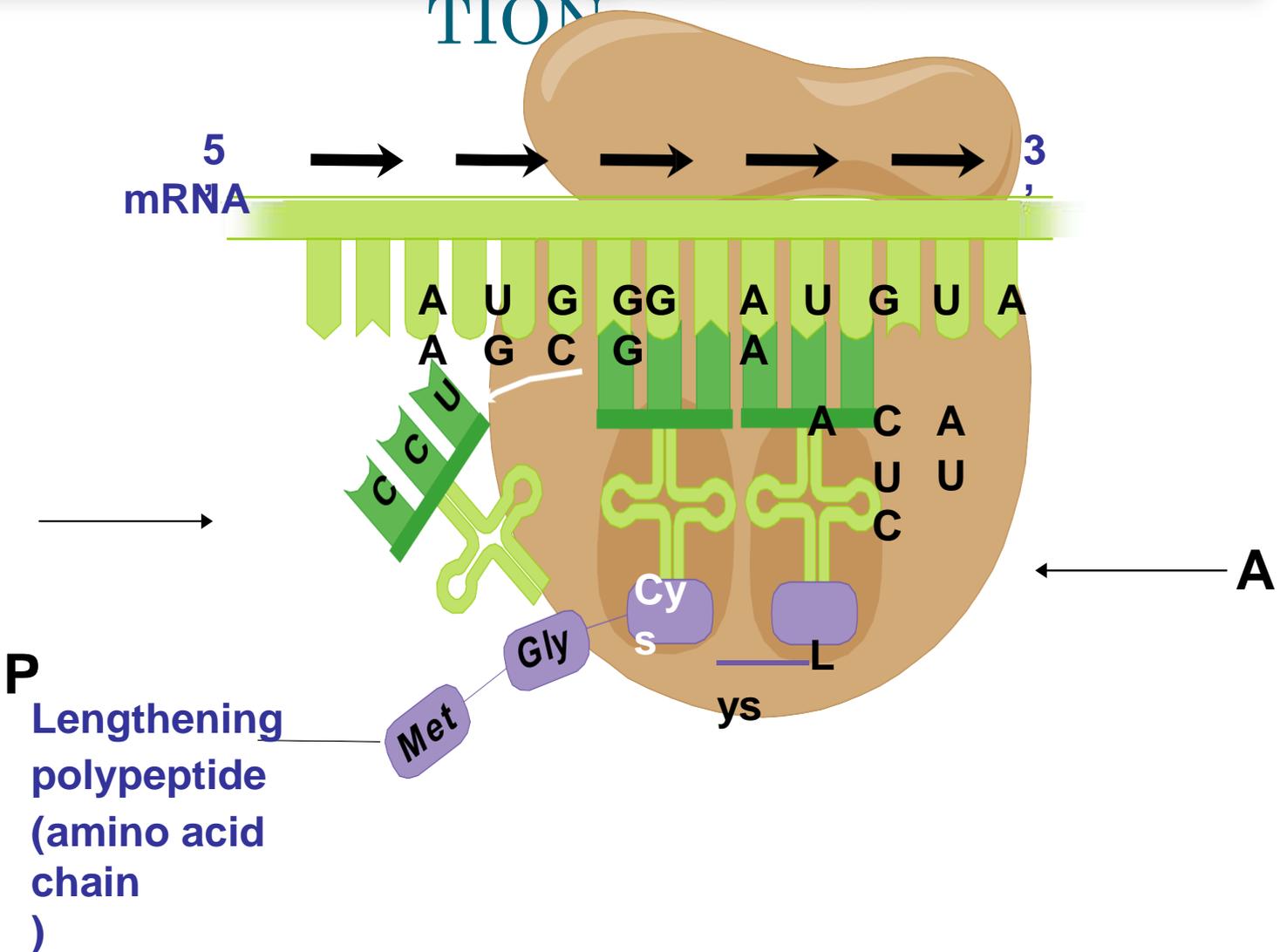
ELONGATION



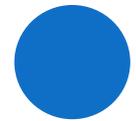
ELONGATION



ELONGATION

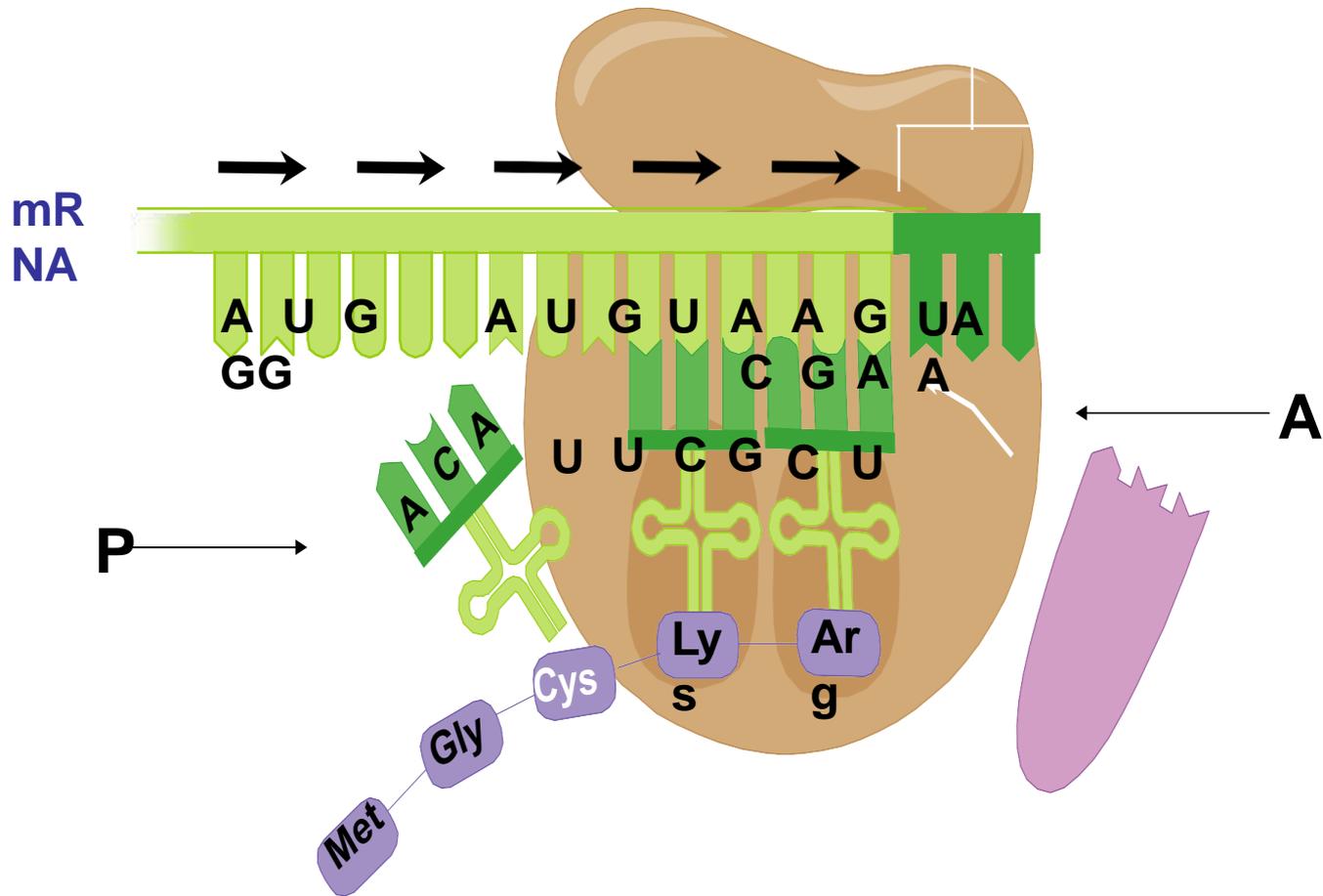


P
 Lengthening
 polypeptide
 (amino acid
 chain
)



ELONGATION

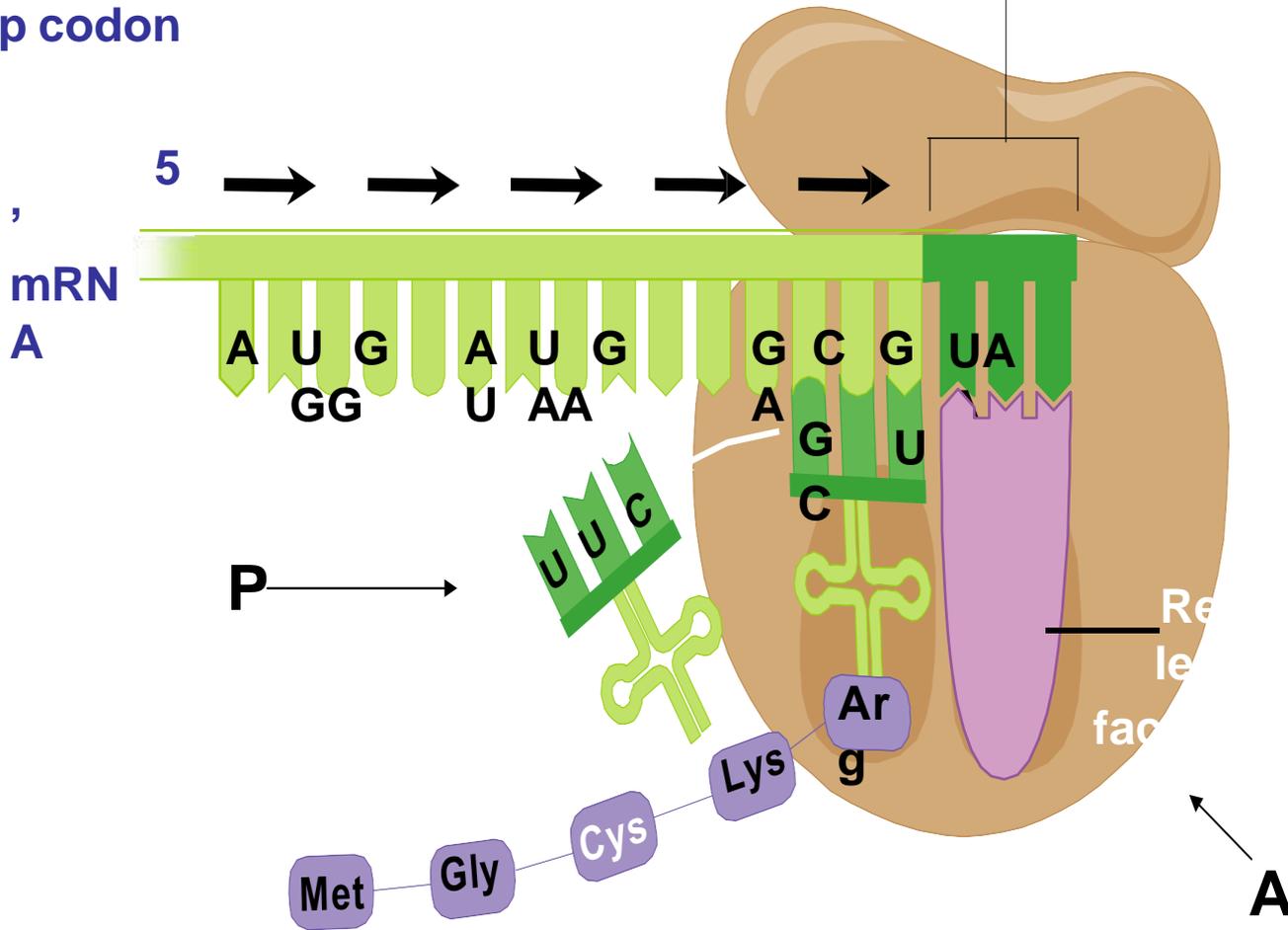
Stop
codon



TERMINATION

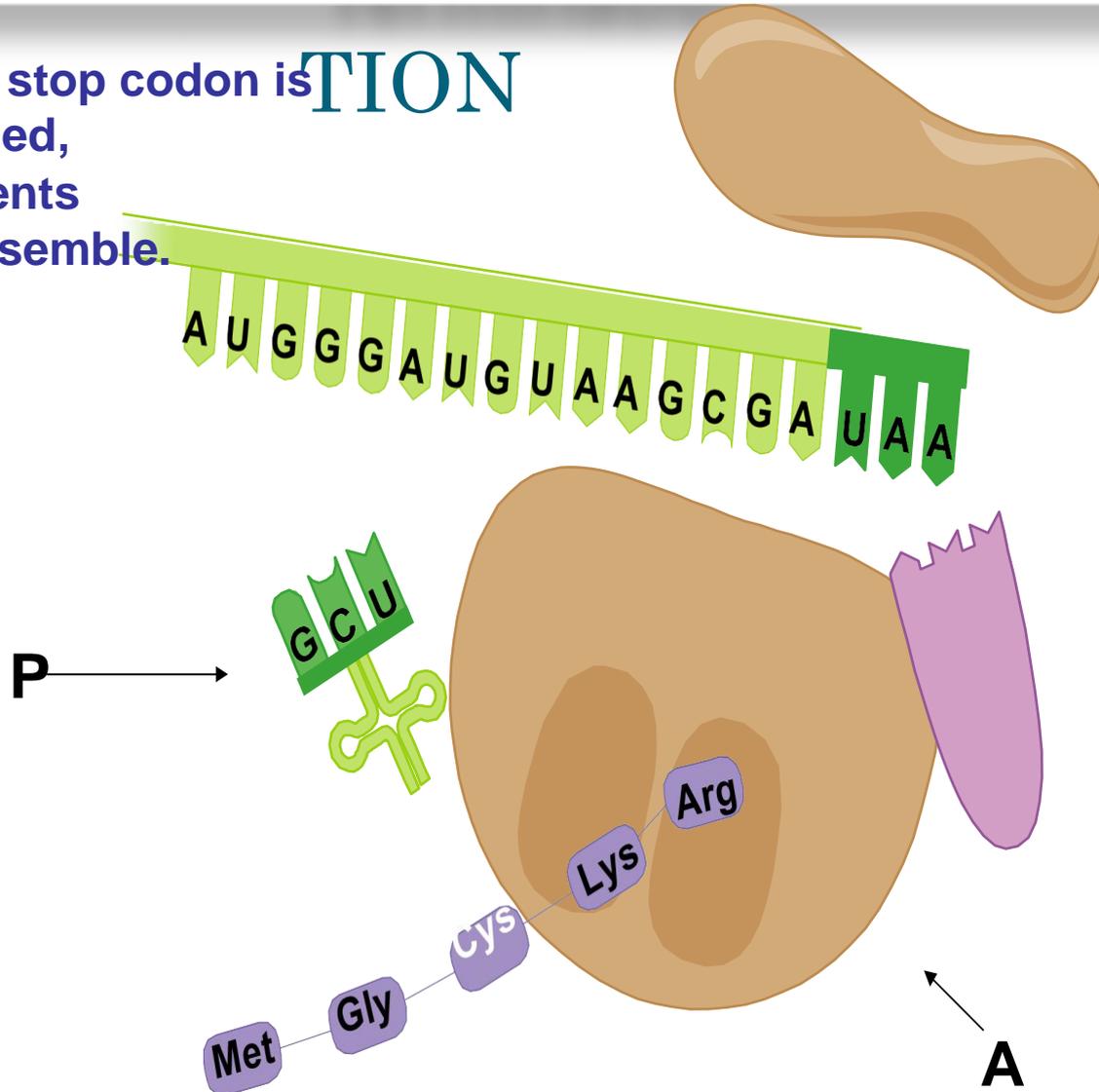
Ribosome reaches stop codon

Stop codon



TERMINA

Once stop codon is reached,
elements
disassemble.



THE GENETIC CODE

- All organisms use the same 20 aa
- Each codon specifies a particular aa

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

MUTAT

- Normally, the genetic code is translated and the correct protein is formed from a long chain of amino acids.
- Translation of codons is dependent on the **reading**

frame, a grouping of codons in
or a gene

transcri
pt.

GCG	GAC	UAC	GGC
	AAC	GCC	

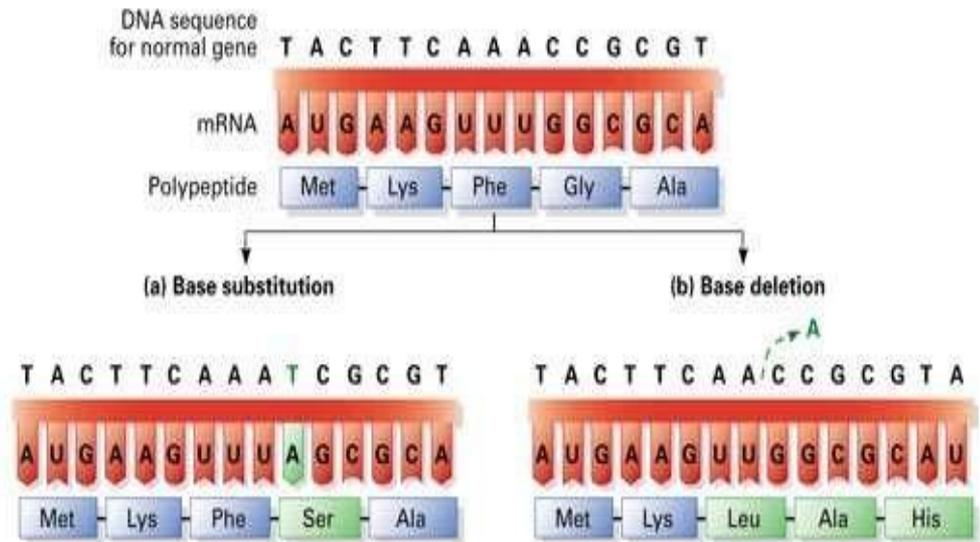
A



MUTA

TION

- Any change in the nucleotide sequence of DNA
- It may involve large sections of chromosomes or single base pairs
- Mutations can change the reading frame of a gene



MUTA

TION

Normal

Sickle Cell

Hemoglobin DNA

Hemoglobin

GGA CTT

GGA CAT GCA

GCA

CCU GUA

mRNA CCU GAA

CGU

Changes in one or a few bases is called a Point Mutation
2 Types: Substitution or Insertion/Deletion



MUTAT

ION

- **Deletion or insertion mutations** are most disruptive because they change the reading frame, causing a frame shift.
- **Substitution mutations** have varied impact on amino acid sequences.



Size of a genetic code word (codon)

Original sequence

GAC GAC GAC GAC GAC GAC GAC ...

One base added

Sequence disrupted

GAC **UGA** CGA CGA CGA CGA ...

Two bases added

Sequence disrupted

GAC **UUG** ACG ACG ACG ACG ...

Three bases added

Sequence restored

GAC **UUU** GAC GAC GAC GAC ...

 = Wrong triplet



WHAT CAUSES

MUTATIONS?

- Errors in DNA Replication
- Errors in chromosome crossover in meiosis

- **Mutagens**

Mutagens are physical or chemical factors that cause mutations

- UV Radiation and X-Rays
- Chemicals like DDT

