



Replication

DNA



Transcription

RNA



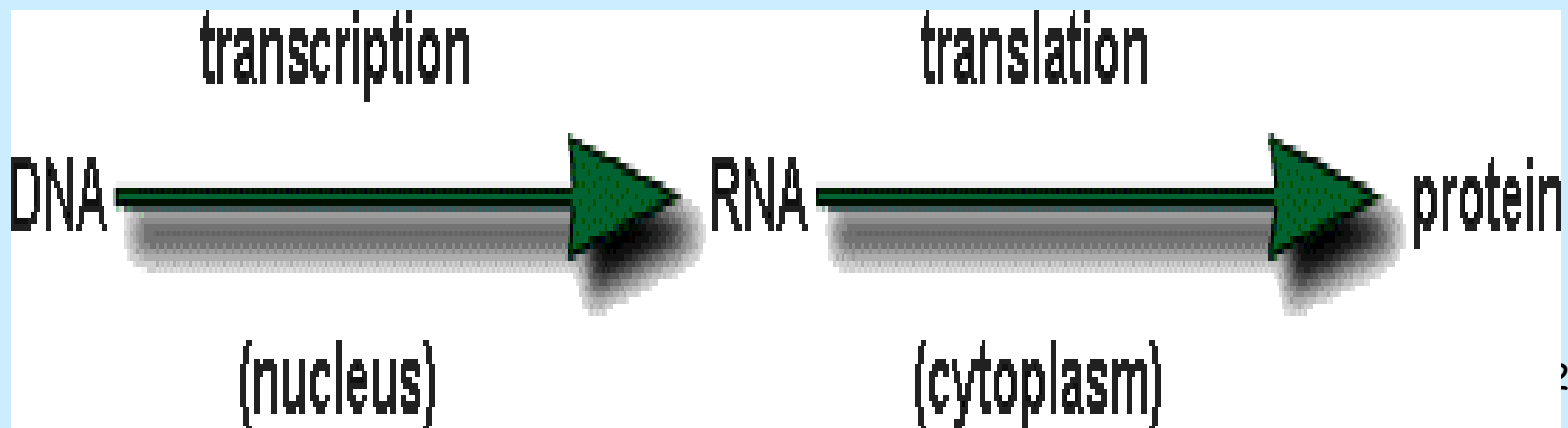
Translation

Protein

**The Central Dogma**

# DNA Replication--- transcription--- translation

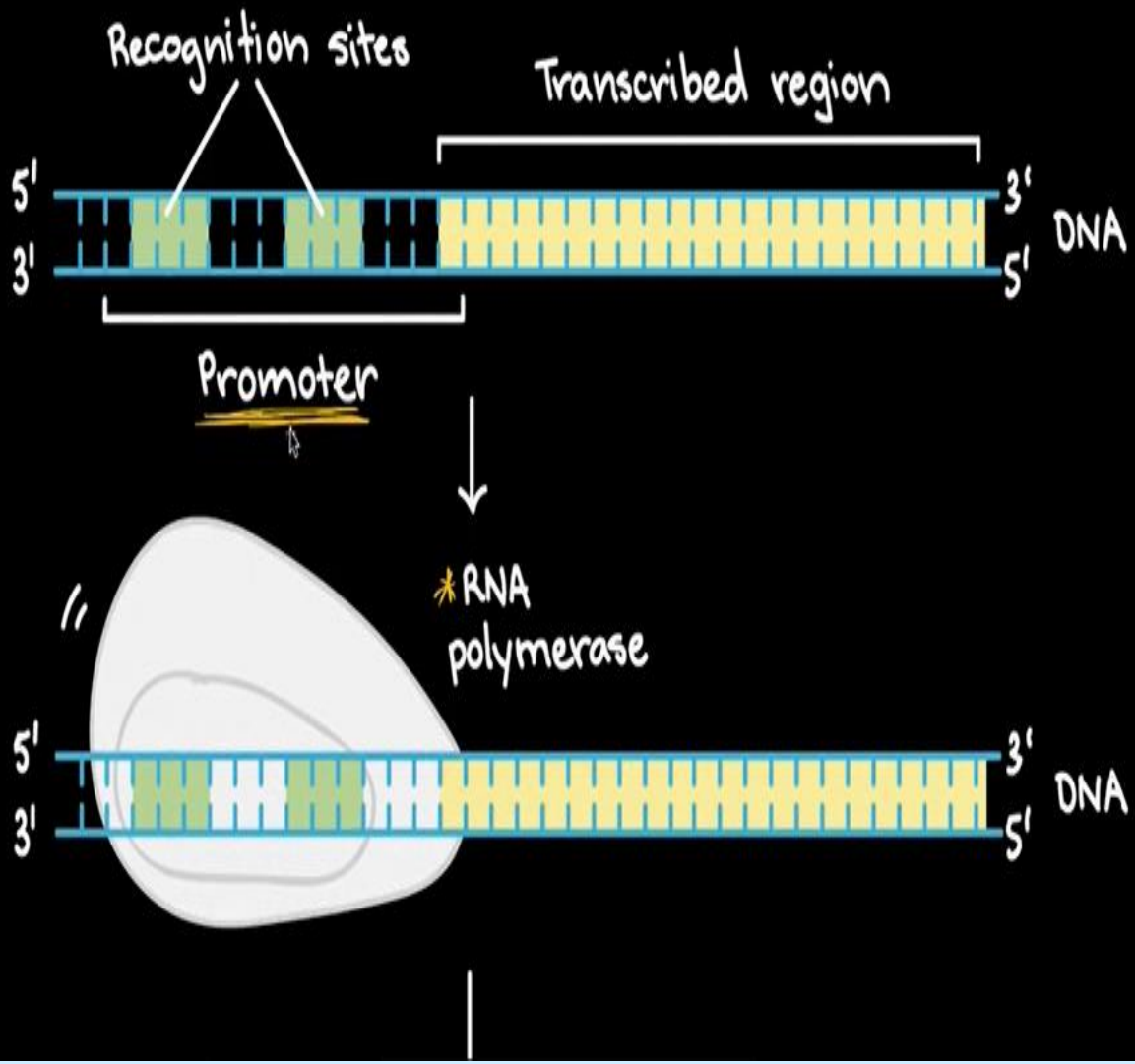
- DNA is replicated in the nucleus.
- DNA is transcribed into RNA in the nucleus
- RNA is translated to protein in the cytoplasm

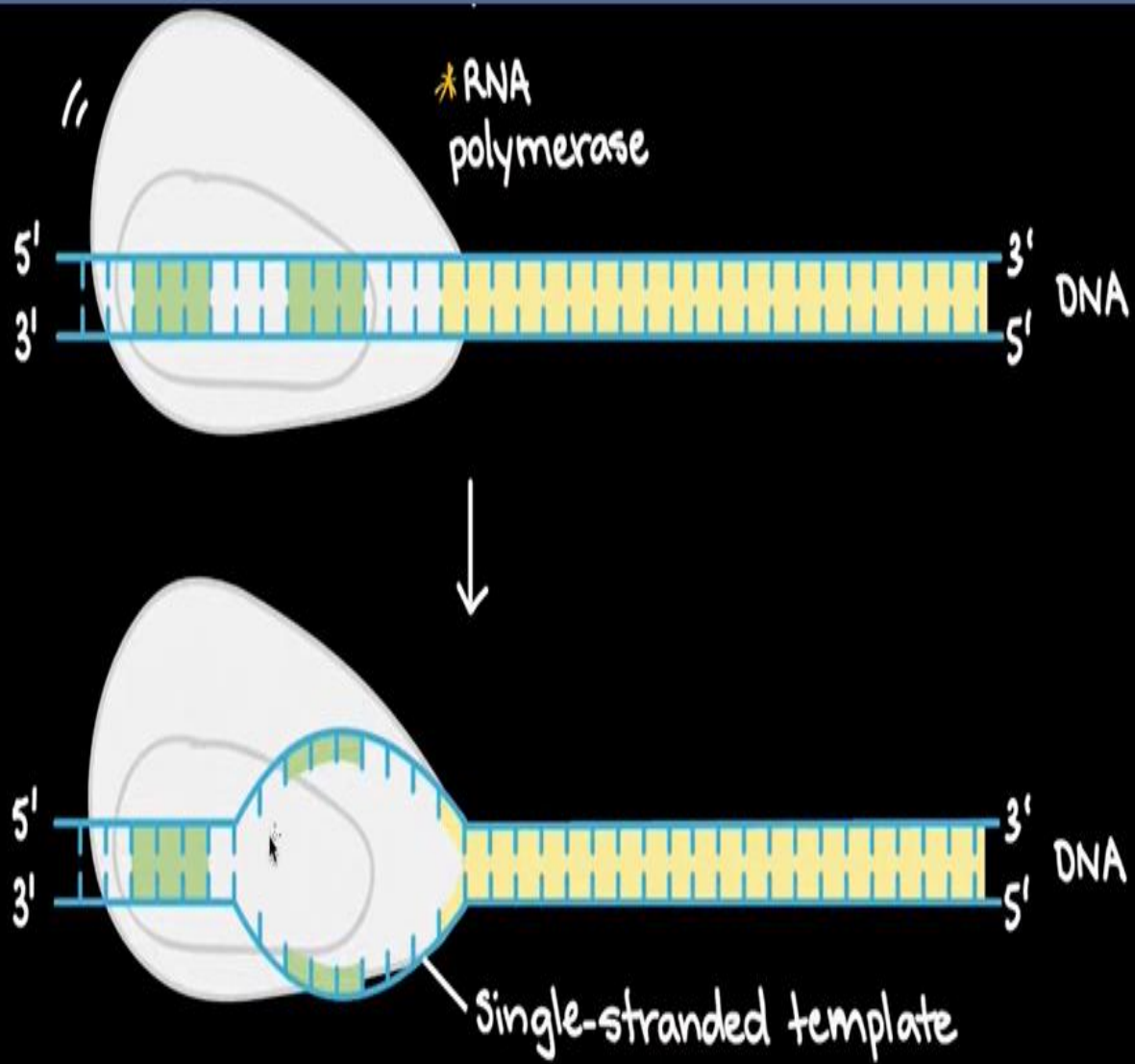


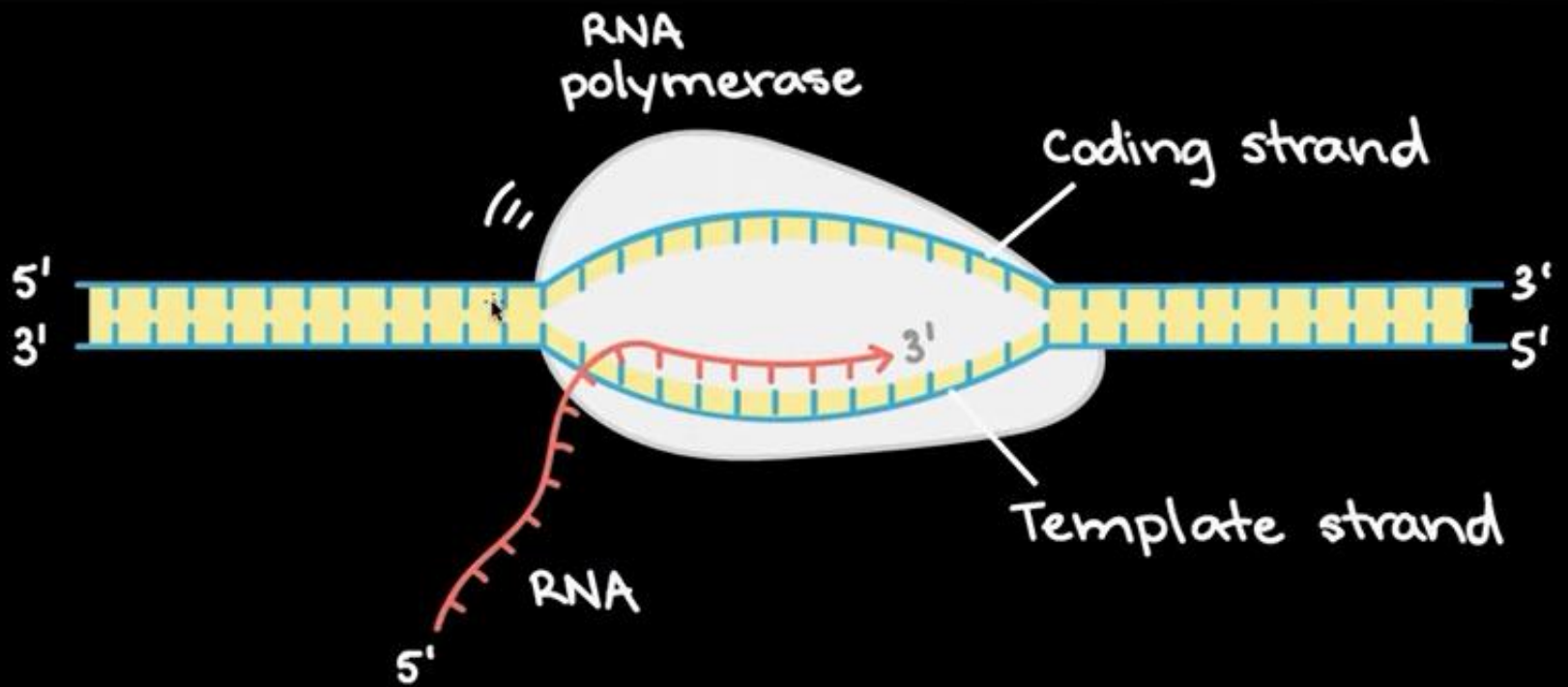
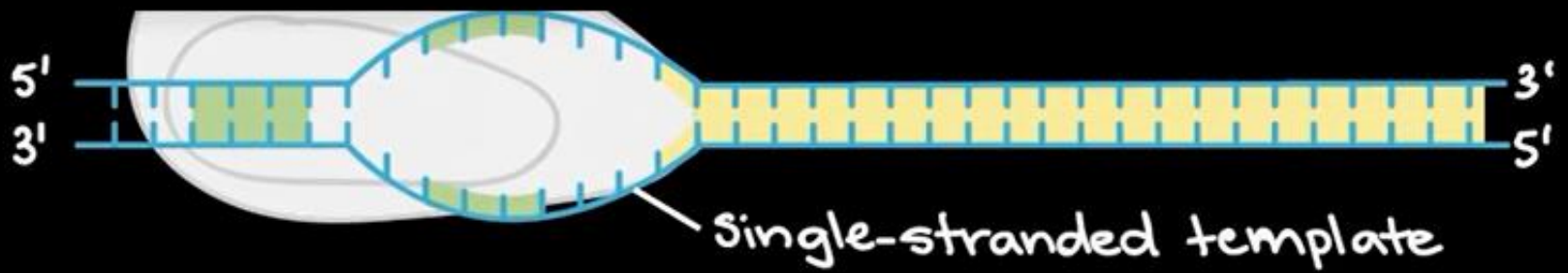
# Why are you different from other people?

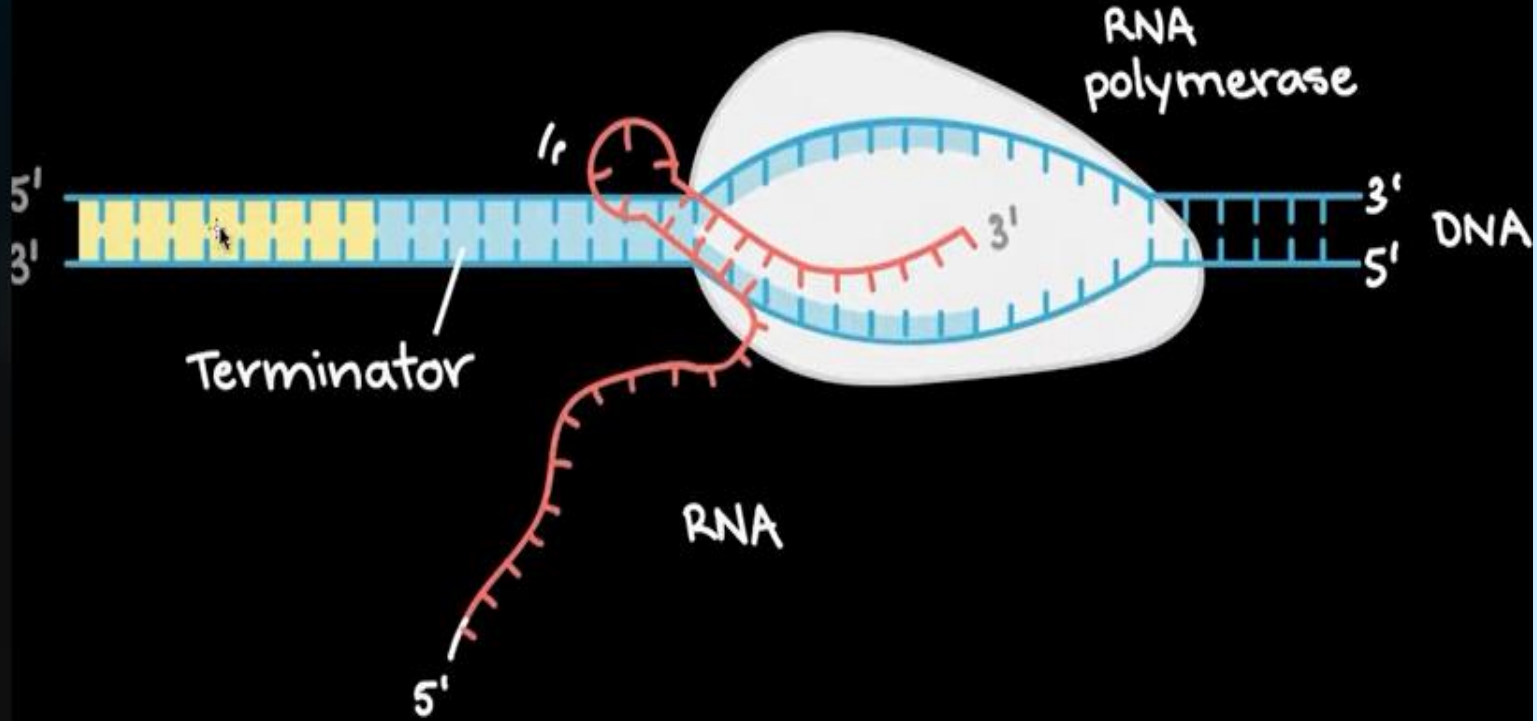
## Protein Synthesis

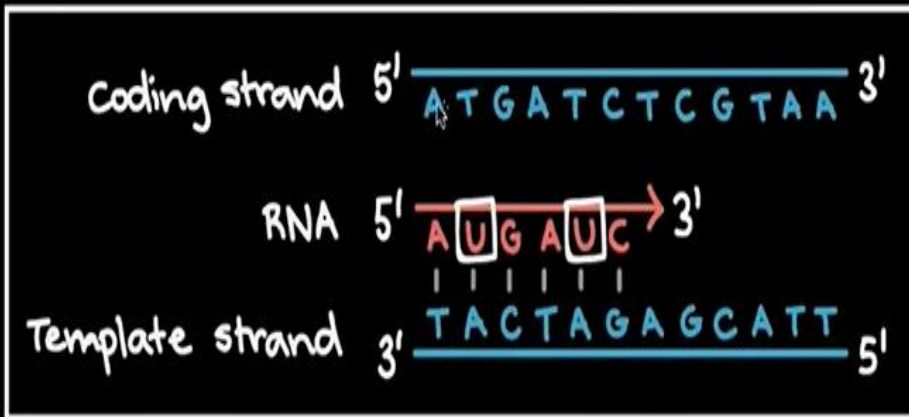
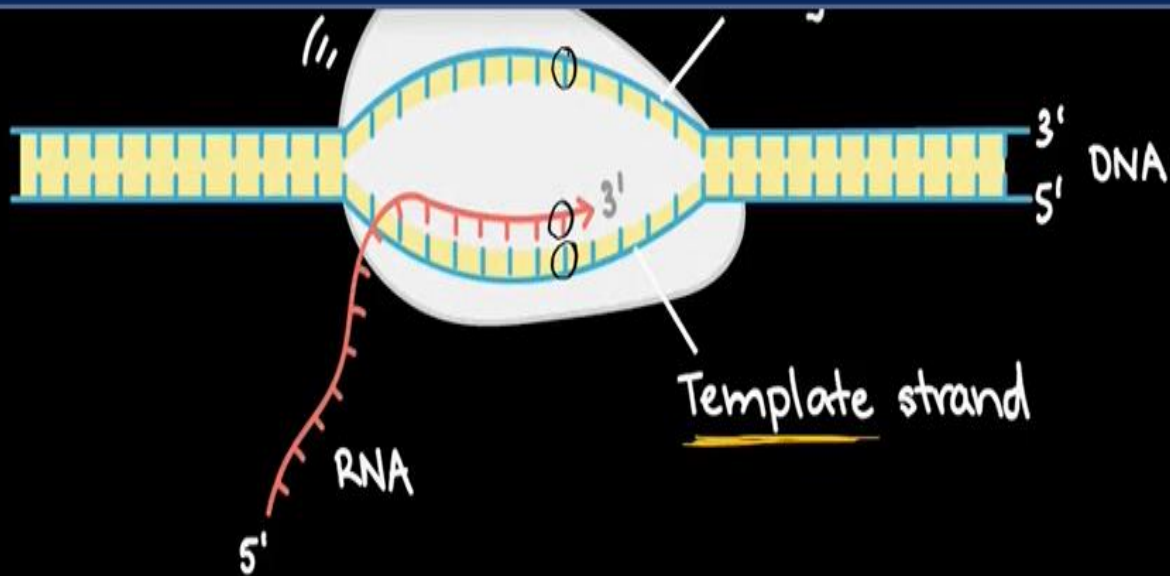




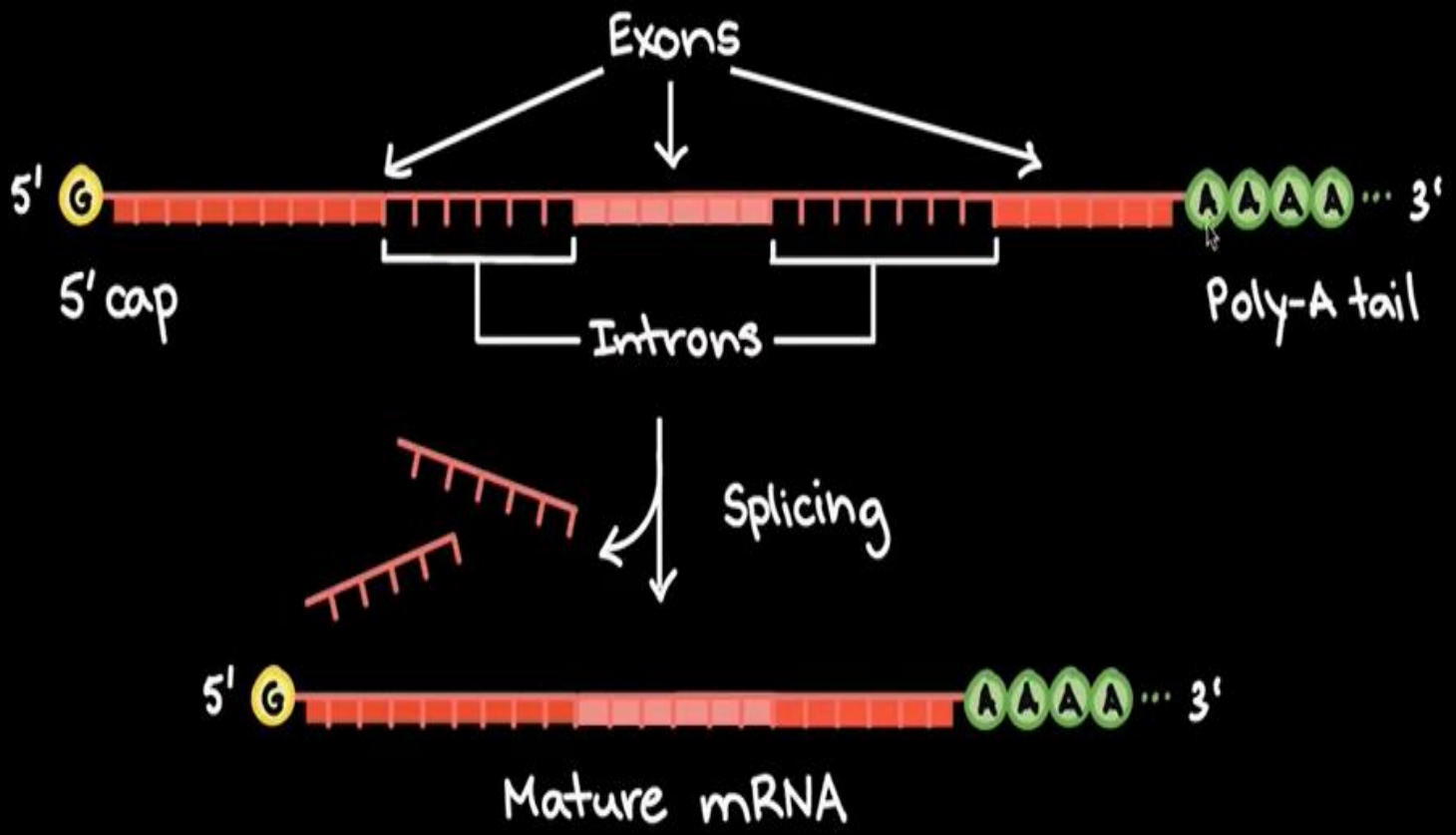










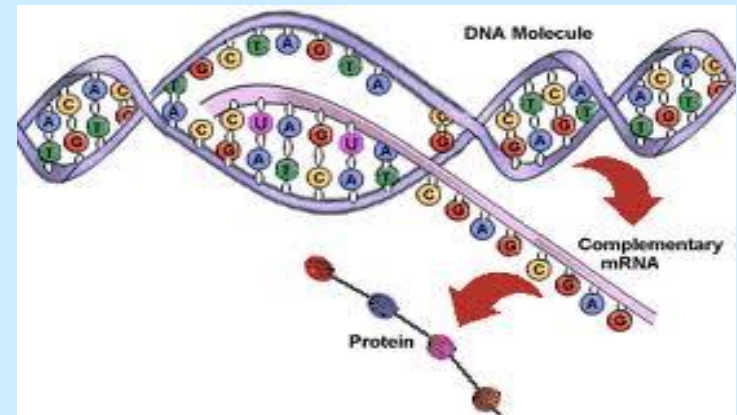
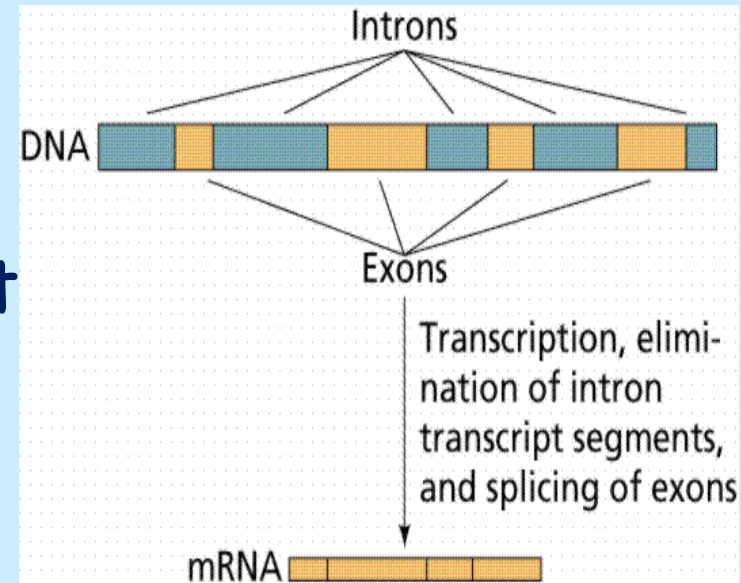


Eukaryotic Cell

\*Transcription - DNA → mRNA → protein

# Vocabulary Words

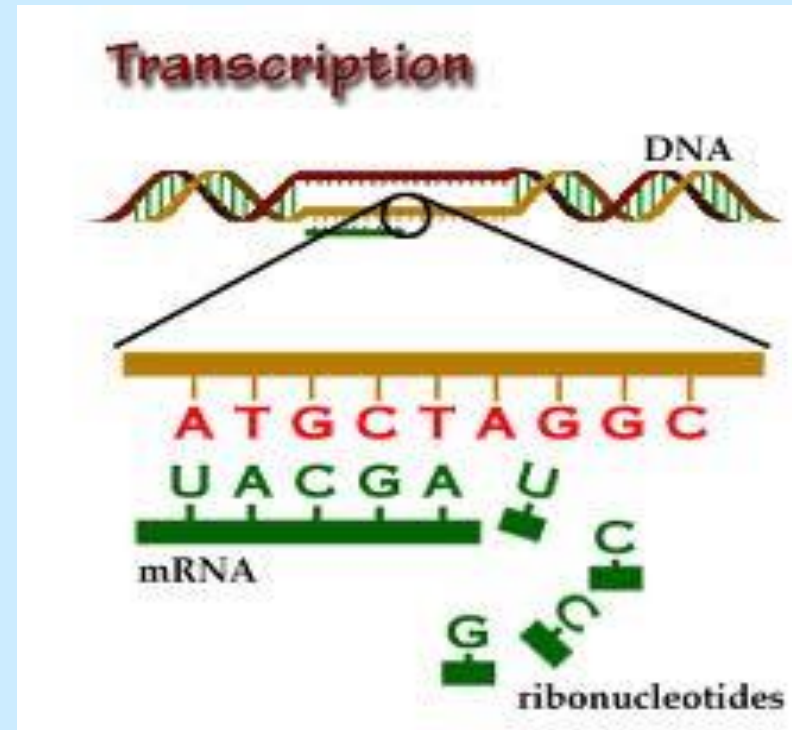
- ✓ **RNA polymerase** - enzyme that binds to DNA and separates the DNA strands during transcription.
- ✓ **Intron** - sequence of DNA that is **not** involved in coding for a protein.
- ✓ **Exon** - sequence of DNA that is involved in coding for a protein.



# DNA Replication--- transcription--- translation

## Transcription

- The process of making RNA molecules by copying part of a DNA nucleotide sequence.
- Production of mRNA copy of the DNA gene
- Uracil replaces Thymine.
- At the end of transcription: mRNA carries the genetic information out of the nucleus into the cytoplasm where it attaches to a ribosome and translation begins

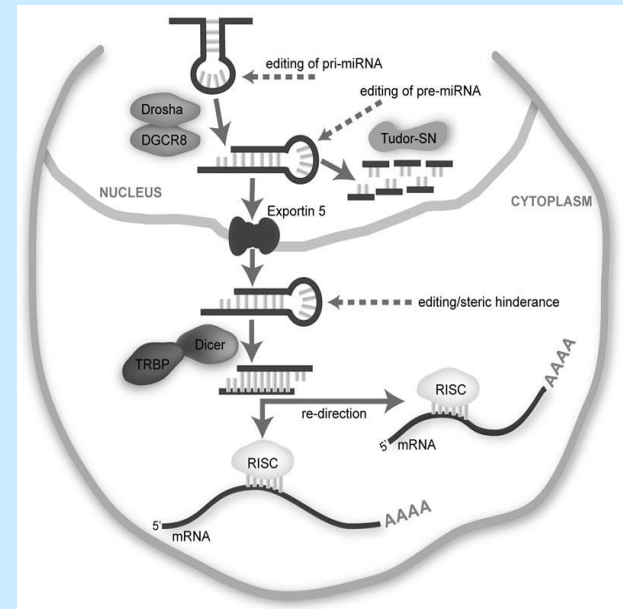


# Steps of Transcription

1. RNA polymerase separates the DNA strands.
2. Bases in RNA nucleotides pair up with corresponding DNA bases.
3. RNA is processed by removing introns and splicing exons back together to form the final mRNA.

# What is RNA editing?

- ❑ The DNA of eukaryotic genes contain sequences of nucleotides, called **introns**, that are not involved in coding proteins.
- ❑ The DNA sequences that code for proteins are called **exons**.
- ❑ When the RNA molecules are formed, both the introns and exons are copied from the DNA.
- ❑ However, introns are cut out of RNA molecules while they are still in the nucleus.
- ❑ The remaining exons are then spliced back together to form the final mRNA.

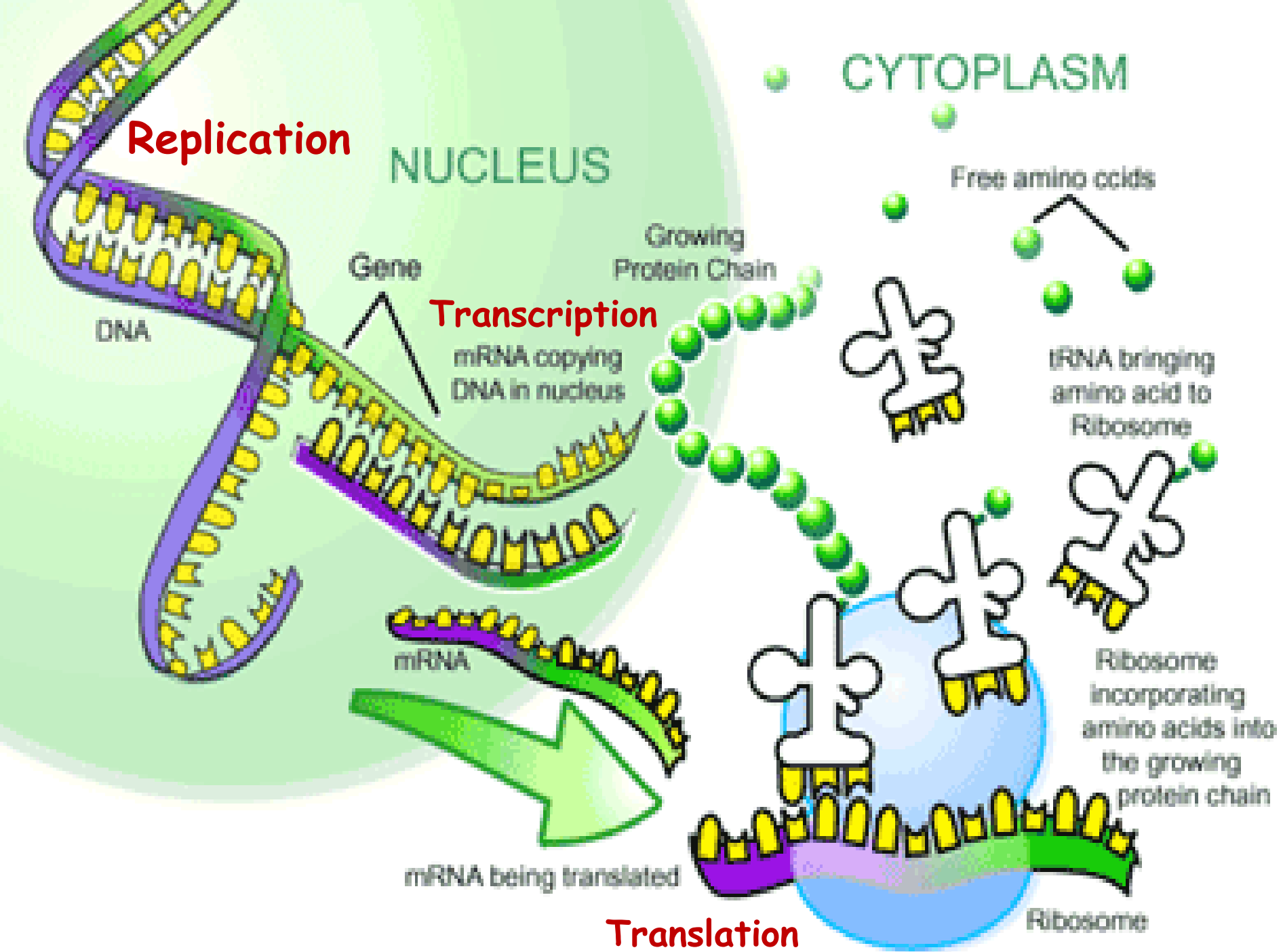


# How does transcription work?

A certain gene has the following sequence of nucleotides. From left to right, write the sequence of the mRNA molecule transcribed from this gene.

DNA      G A C A A G T C C A C A A T C

mRNA



**Replication**

NUCLEUS

CYTOPLASM

Free amino acids

Growing Protein Chain

Gene

**Transcription**

mRNA copying DNA in nucleus

DNA

tRNA bringing amino acid to Ribosome

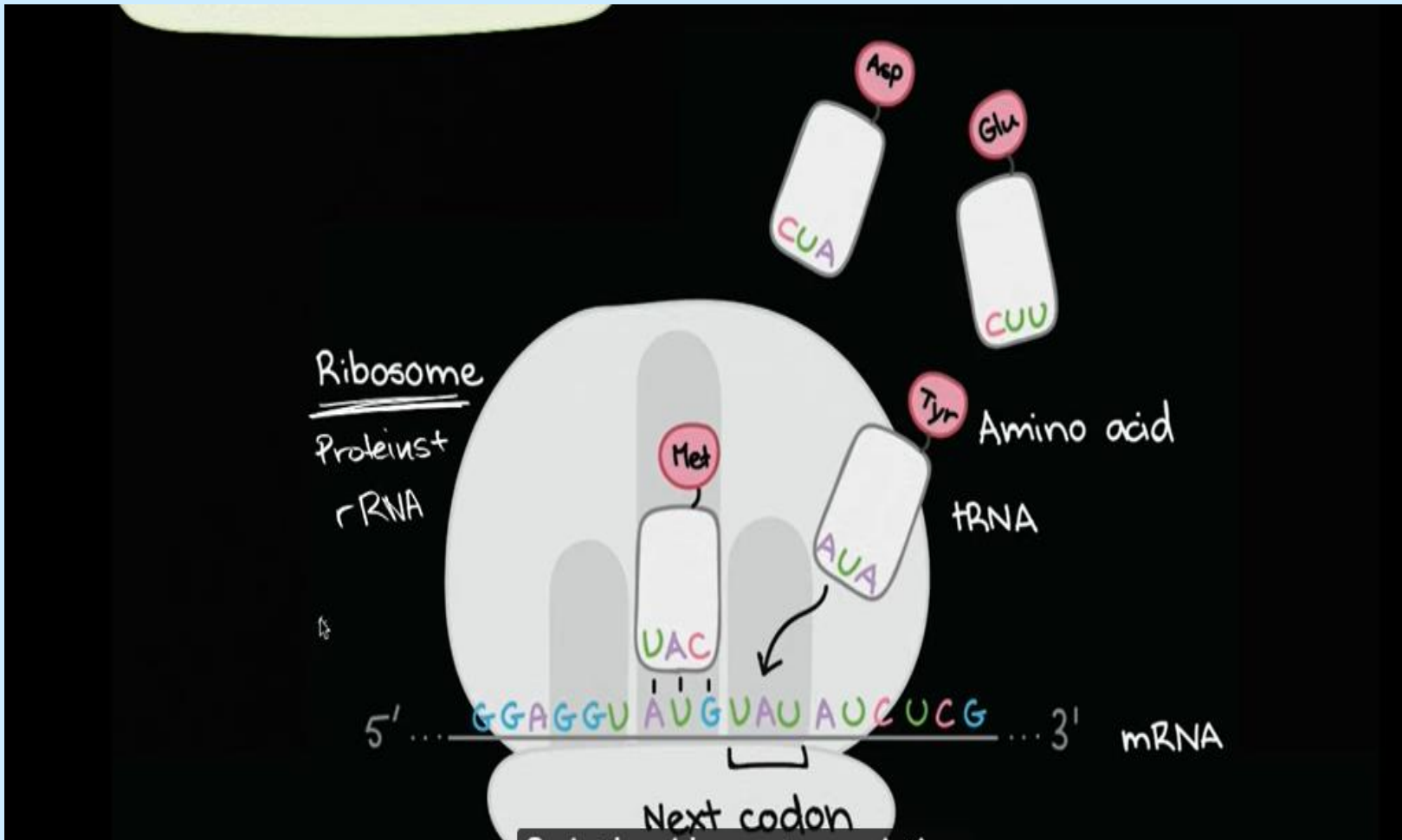
mRNA

Ribosome incorporating amino acids into the growing protein chain

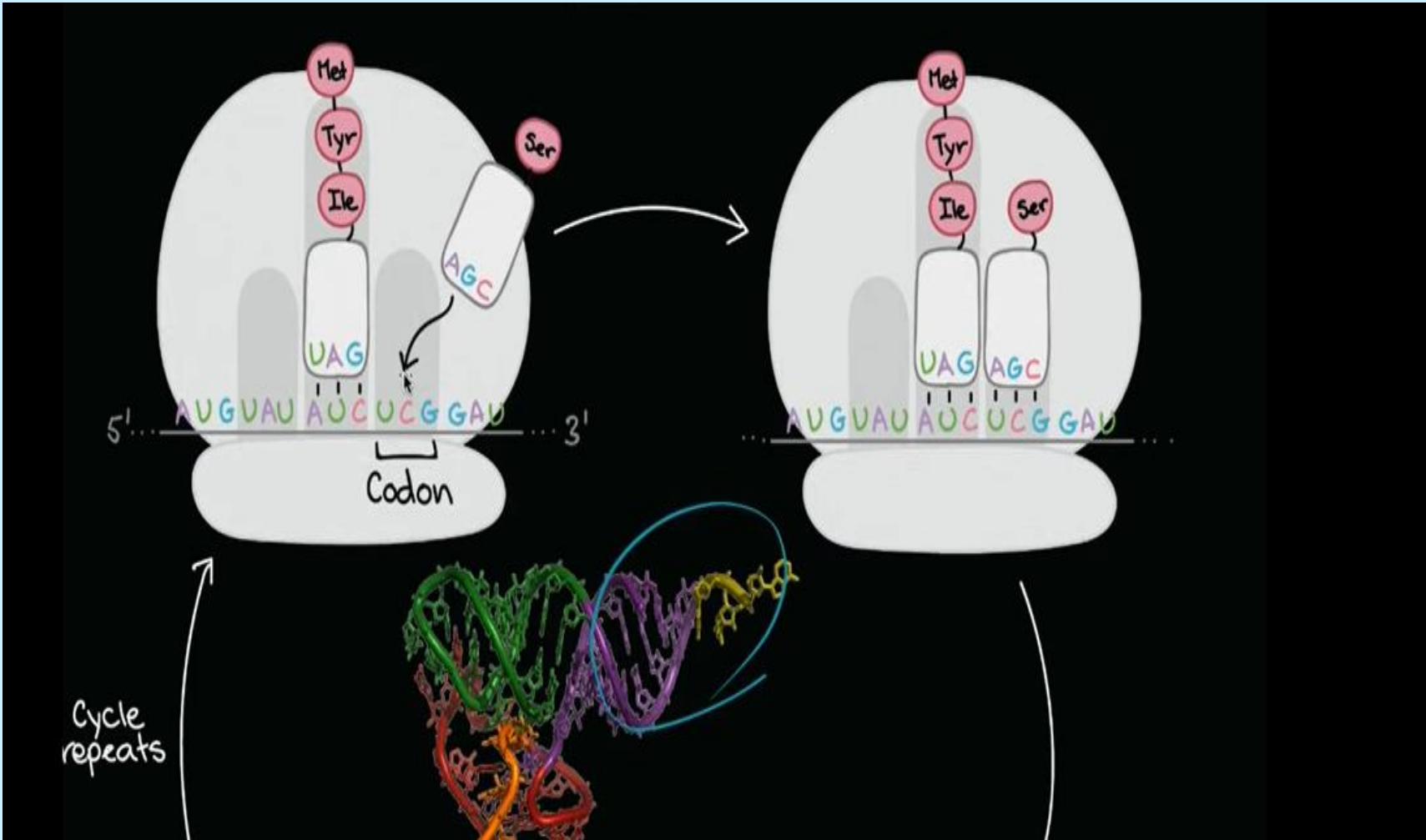
mRNA being translated

**Translation**

Ribosome



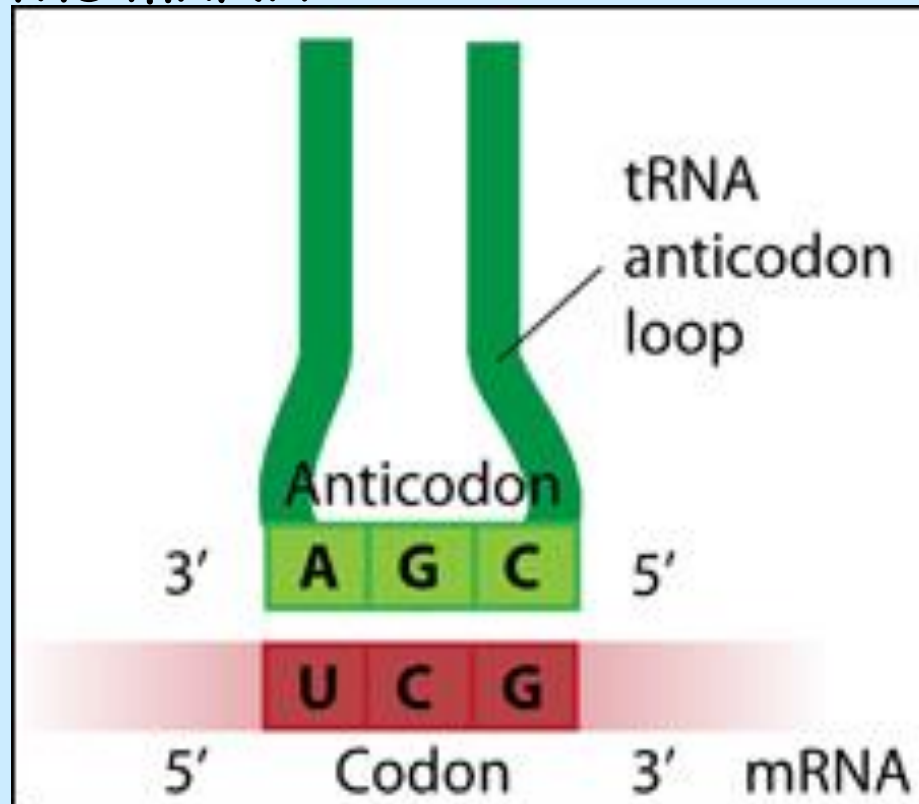




Genetic code: instructions need to convert DNA into proteins

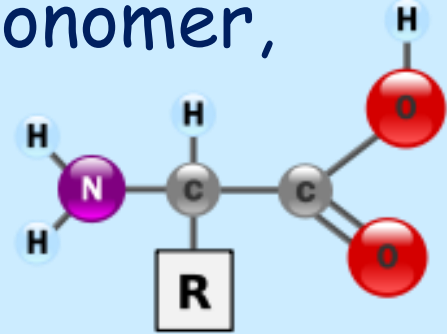
Codon- 3 consecutive mRNA nucleotides

Anticodon- unit made up of three nucleotides that correspond to the three bases of the codon on the mRNA



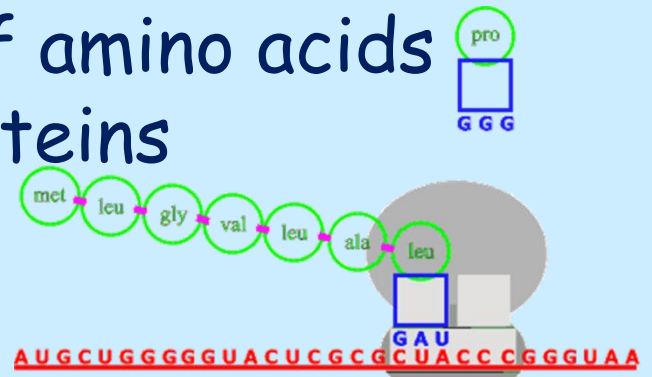
# Vocabulary Words

- ✓ **Amino acid** - building block, or monomer, of all proteins.



- ✓ **Ribosome** - organelle in the cell that is in charge of producing proteins

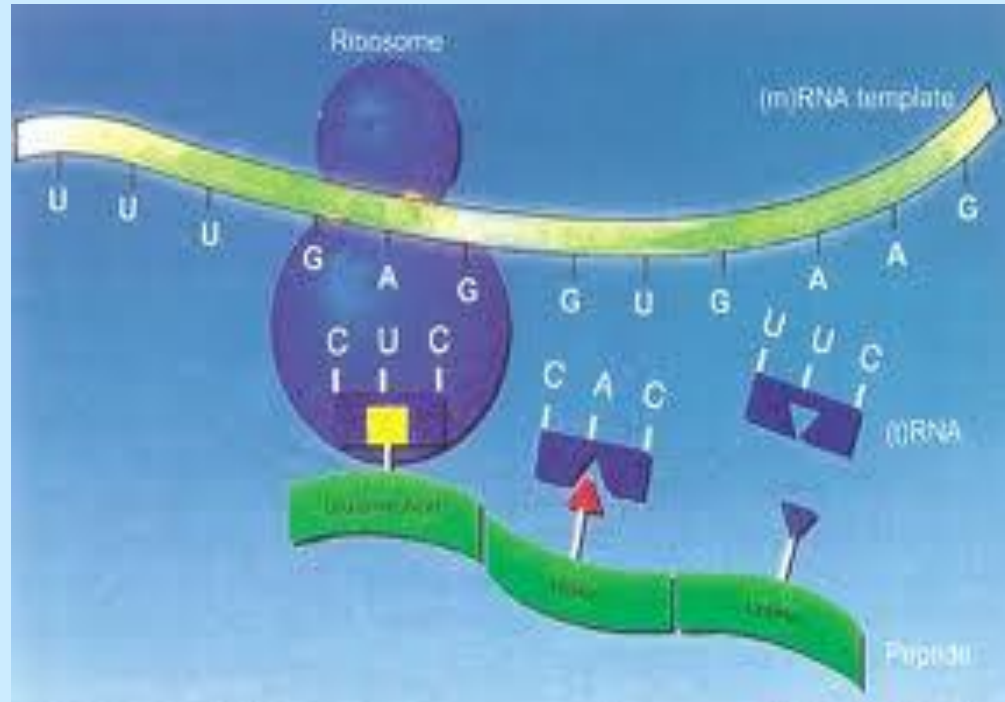
- ✓ **Polypeptide chain** - a group of amino acids joined together that form proteins



# DNA Replication--- transcription--- translation

## Translation-

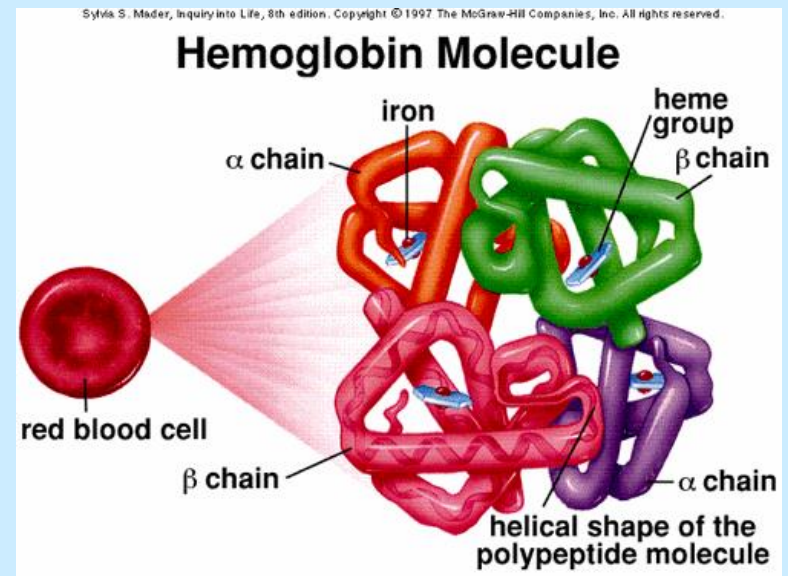
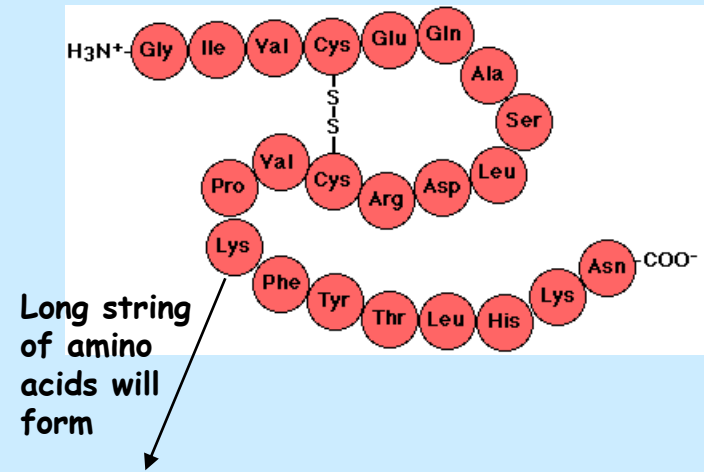
- base pair sequence and turning it into an amino acid sequence.
- Each 3 bases code for one amino acid (codon)
- The process building an amino acid by matching codons in mRNA to anticodons of tRNA
- Synthesis of protein by ribosomes



**At the end of translation:  
amino acid strand is released  
from the ribosome and  
folded into a protein**

# What do these codons have to do with proteins?

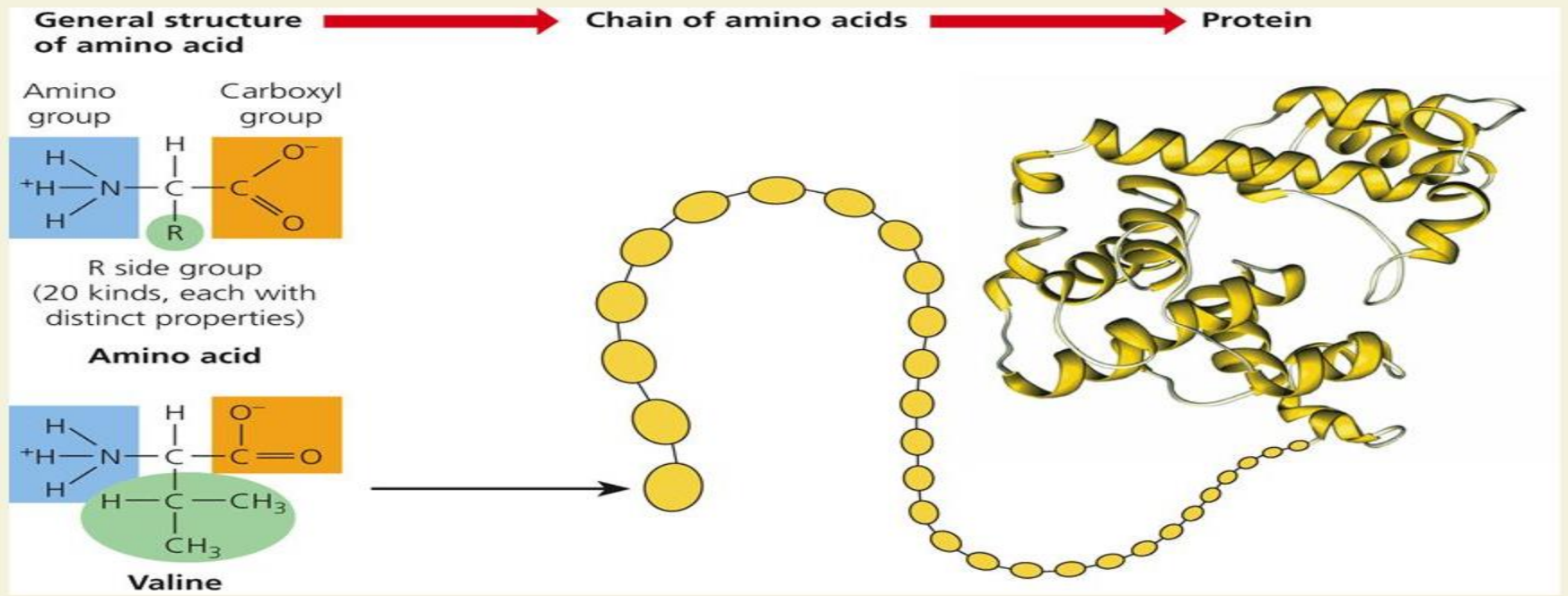
- Each codon represents an amino acid that will eventually form a protein that is used within a cell.
- Proteins are made up of hundreds of amino acids in a specific sequence.
- When they get out of order a mutation occurs.



# Proteins

- Protein: sequence of Amino acids put together
  - Molecules that runs life (Does all the work of life)

## Amino Acids and Proteins



# How are proteins made?

1. DNA serve as a template to RNA polymerase.
2. RNA polymerase creates a mRNA molecule.
3. mRNA enters cytoplasm and binds to a ribosome.
4. tRNA brings one amino acid at a time.
5. New amino acids are added to the polypeptide chain until stop codon.



# How does a cell interpret DNA?

- Consider the following RNA sequence:

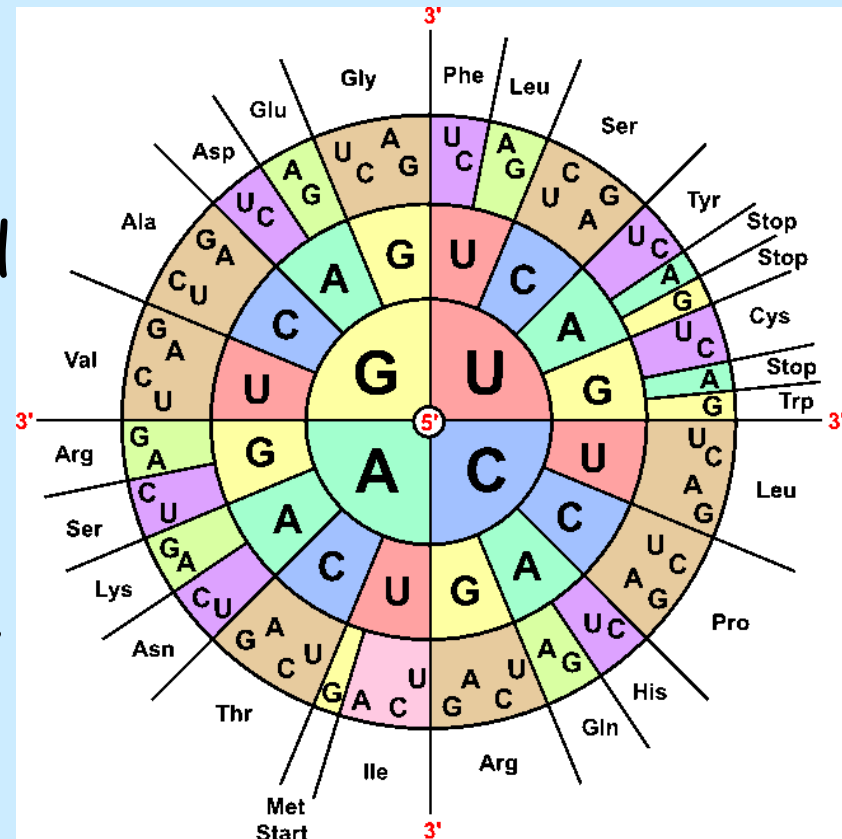
5' UCGCACGGU 3'

- This sequence will be read three bases at a time as:

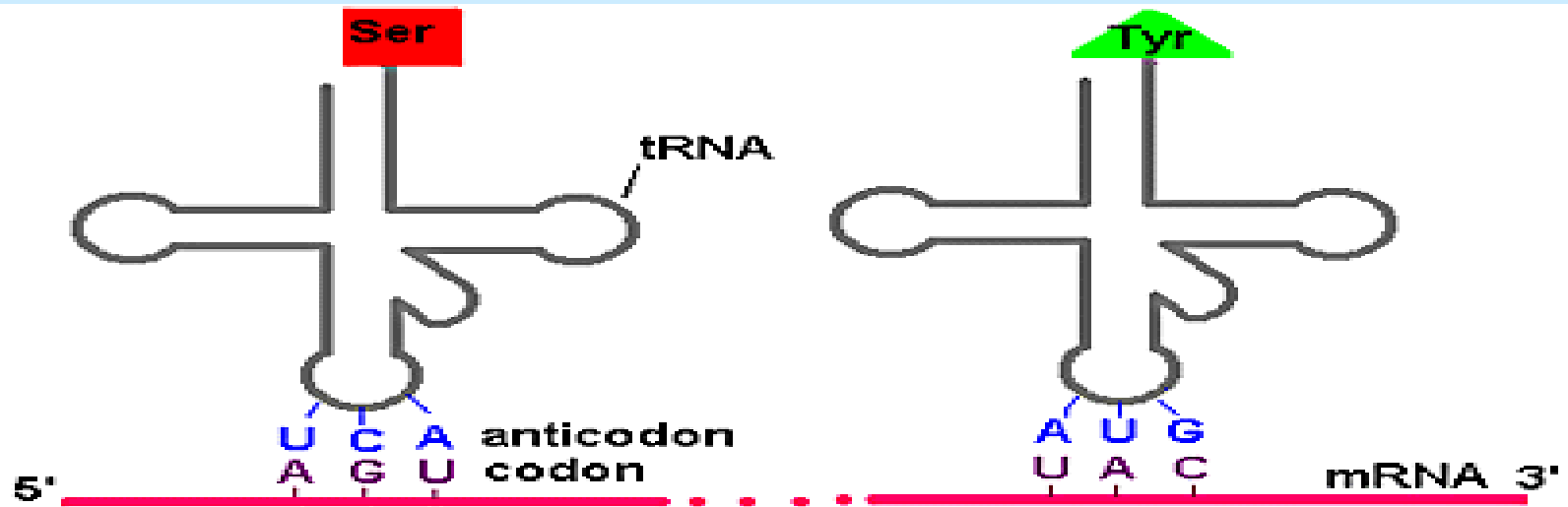
UCG - CAC - GGU

- The codons represent the following amino-acids.

Serine - Histidine - Glycine







2nd base in codon

		U	C	A	G	
1st base in codon	U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr <b>STOP</b> <b>STOP</b>	Cys Cys <b>STOP</b> Trp	3rd base in codon
	C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	
	A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	
	G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	
						U C A G U C A G U C A G

# The Genetic Code

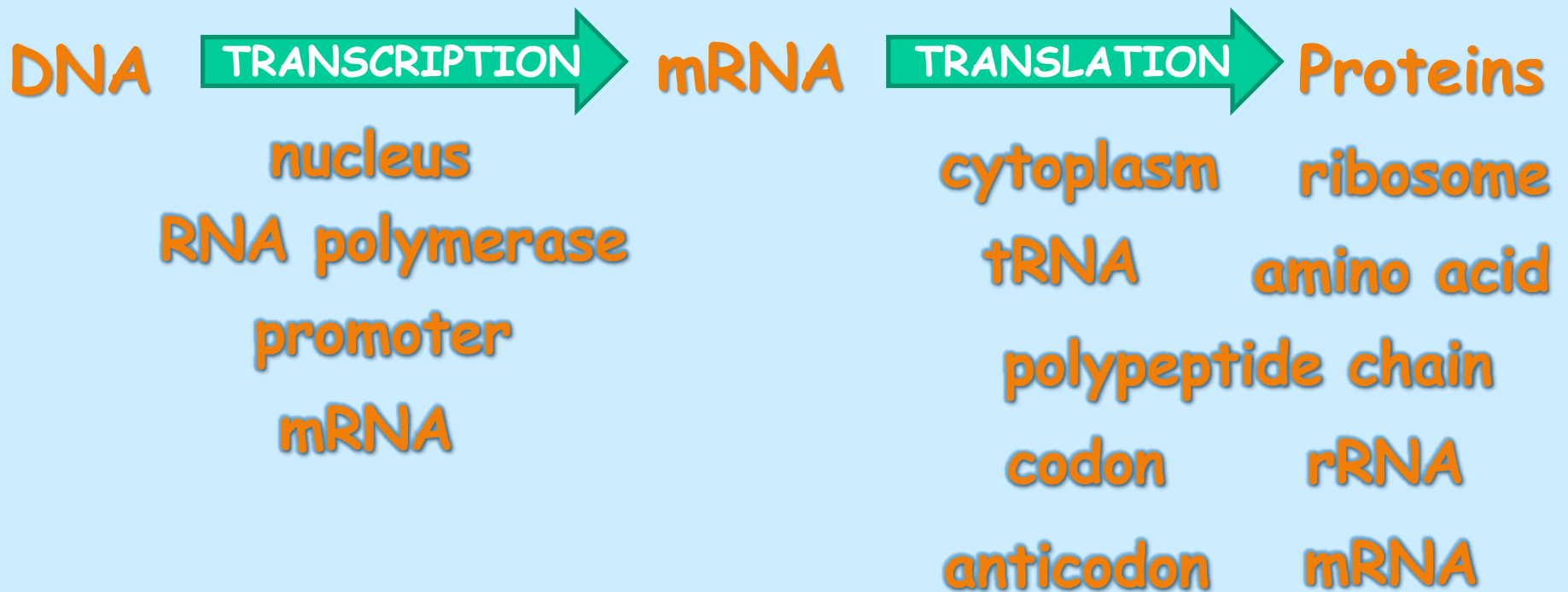
# How to read a codon table

Used in protein synthesis for translating the mRNA code into amino acid sequence.

		Second Position									
		U		C		A		G			
First Position	U	code	Amino Acid	code	Amino Acid	code	Amino Acid	code	Amino Acid	Third Position	
		UUU	phe	UCU	ser	UAU	tyr	UGU	cys		U
		UUC		UCC		UAC		UGC			C
		UUA	leu	UCA		UAA	STOP	UGA	STOP		A
	UUG	UCG		UAG		STOP	UGG	trp	G		
	C	CUU	leu	CCU	pro	CAU	his	CGU	arg		U
		CUC		CCC		CAC		CGC			C
		CUA		CCA		CAA	gln	CGA			A
		CUG		CCG		CAG		CGG			G
	A	AUU	ile	ACU	thr	AUU	asn	AGU	ser		U
		AUC		ACC		AUC		AGC			C
		AUA		ACA		AAA	lys	AGA	arg		A
		AUG		ACG		AAG		AGG			G
	G	GUU	val	GCU	ala	GAU	asp	GGU	gly		U
		GUC		GCC		GAC		GGC			C
		GUA		GCA		GAA	glu	GGA			A
GUG		GCG		GAG		GGG		G			

# DO NOW


1. Get a piece of notebook paper.
2. Explain the basic process of transcription and translation.





**1<sup>st</sup> Step - Copy**

DNA



**2<sup>nd</sup> Step - Rewrite**

RNA



**3<sup>rd</sup> Step - Change**

Protein

# Summary:

## DNA

### Replication:

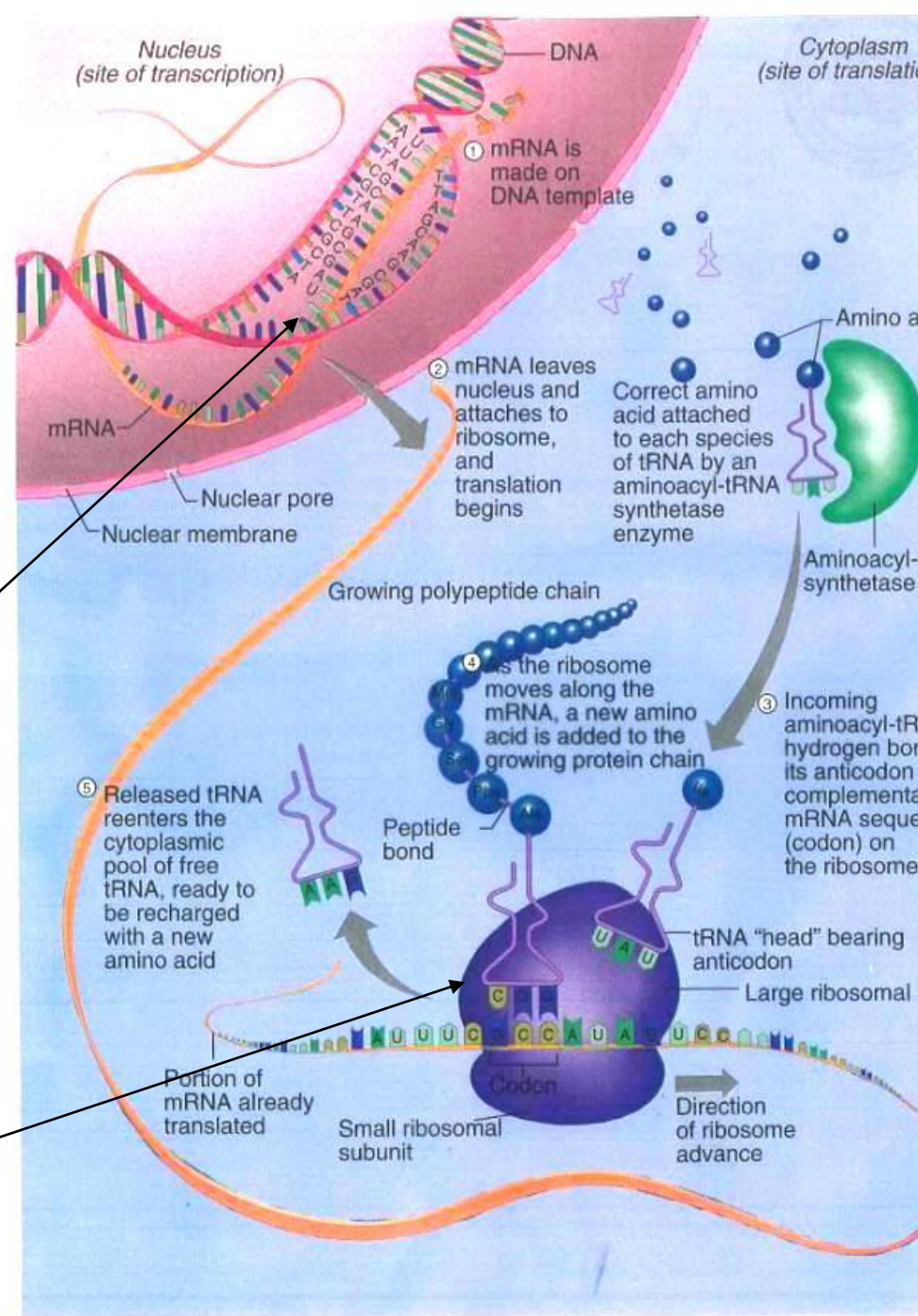
- Make duplicate DNA

### Transcription:

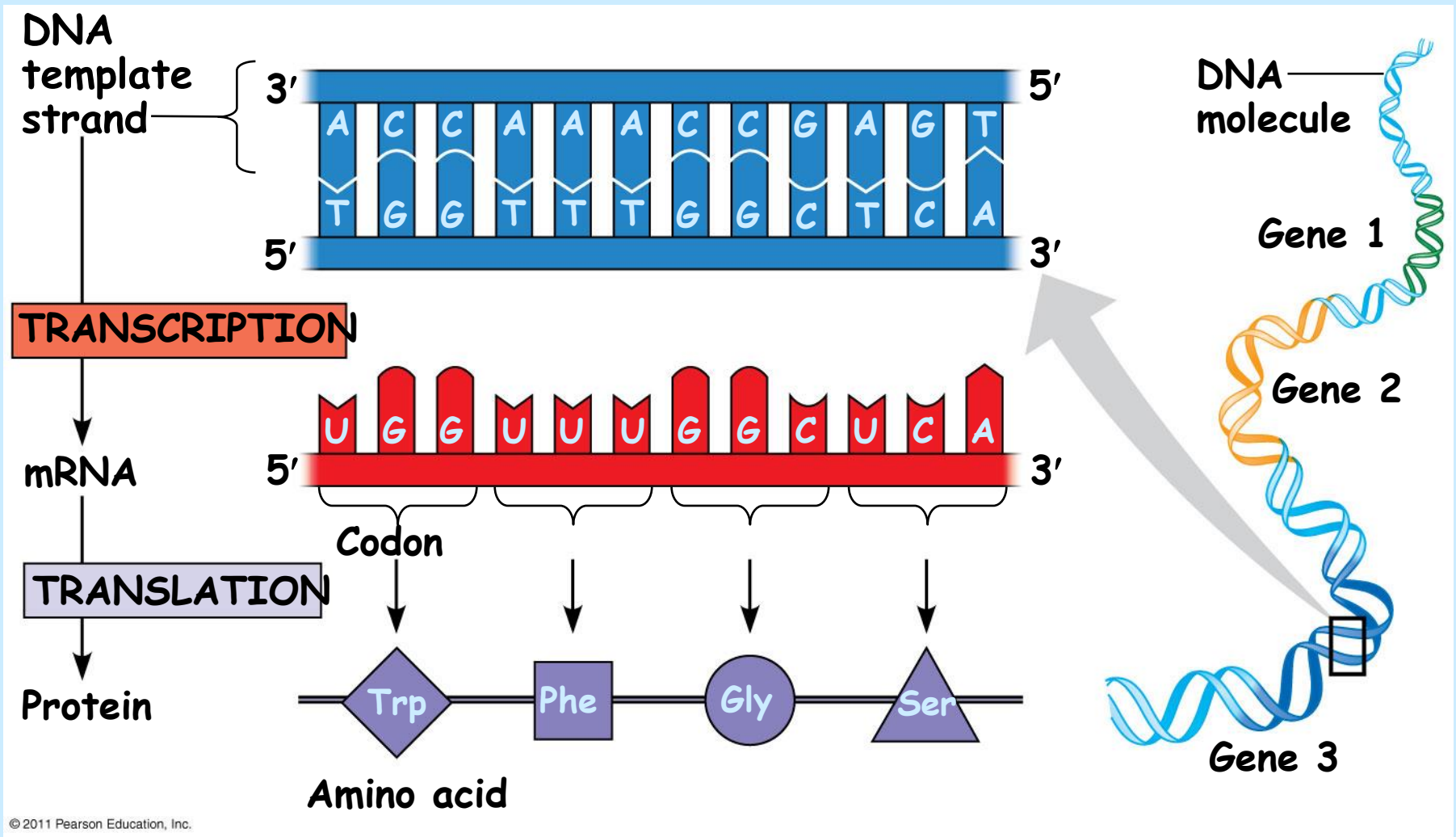
- Make mRNA from DNA

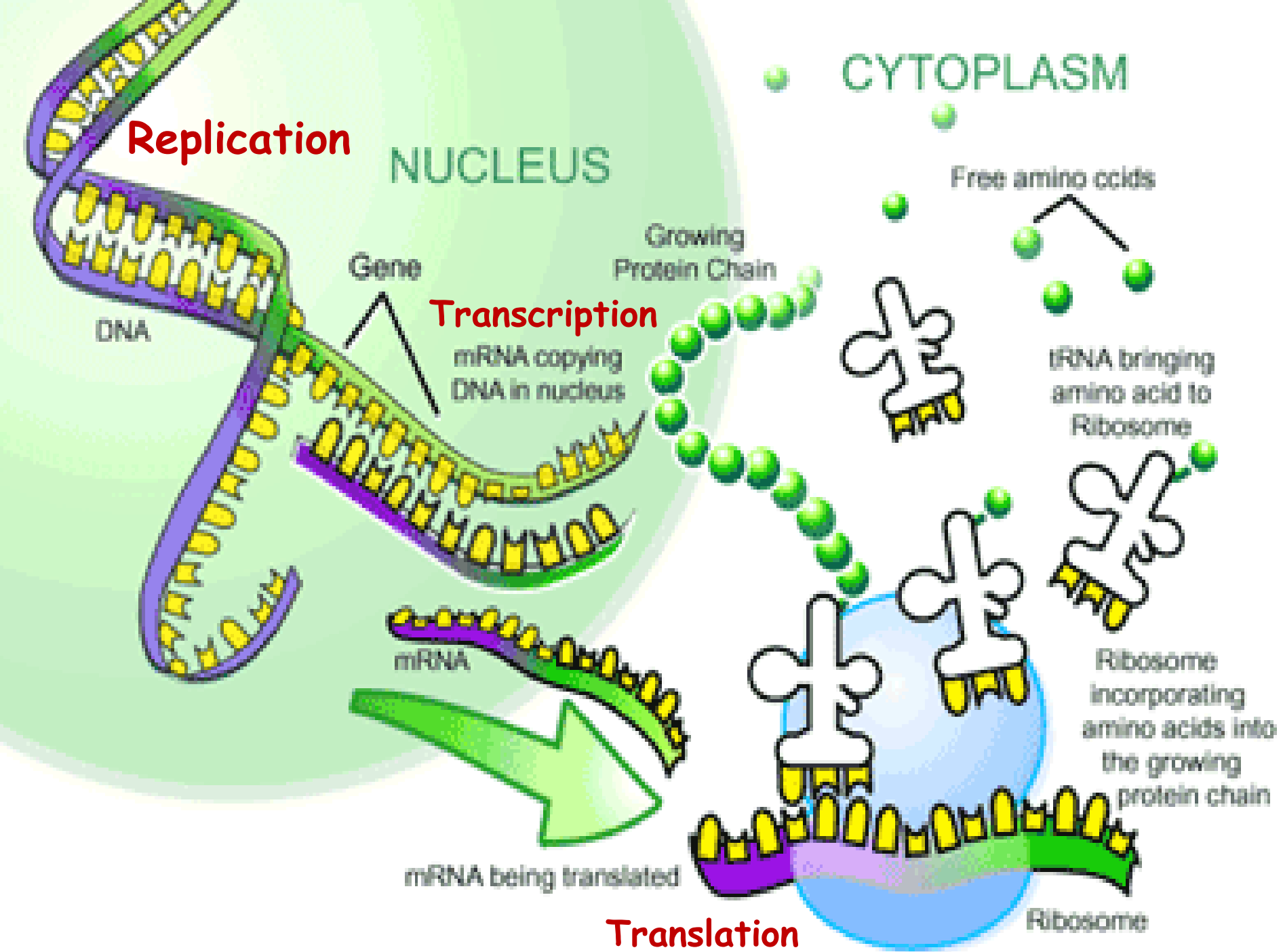
### Translation:

Make protein



# How does transcription works?





# Amino Acid

## Second letter

Codons

First letter

	U	C	A	G	
U	UUU Phenylalanine UUC Phenylalanine UUA Leucine UUG Leucine	UCU Serine UCC Serine UCA Serine UCG Serine	UAU Tyrosine UAC Tyrosine UAA Stop codon UAG Stop codon	UGU Cysteine UGC Cysteine UGA Stop codon UGG Tryptophan	U C A G
C	CUU Leucine CUC Leucine CUA Leucine CUG Leucine	CCU Proline CCC Proline CCA Proline CCG Proline	CAU Histidine CAC Histidine	CGU Arginine CGC Arginine CGA Arginine CGG Arginine	U C A G
A	AUU Isoleucine AUC Isoleucine AUA Methionine AUG Methionine; initiation codon	ACU Threonine ACC Threonine ACA Threonine ACG Threonine	AAC Asparagine AAA Lysine AAG Lysine	AGC Serine AGA Arginine AGG Arginine	U C A G
G	GUU Valine GUC Valine GUA Valine GUG Valine	GCU Alanine GCC Alanine GCA Alanine GCG Alanine	GAU Aspartic acid GAC Aspartic acid GAA Glutamic acid GAG Glutamic acid	GGU Glycine GGC Glycine GGA Glycine GGG Glycine	U C A G

- Every three base pairs is a Codon for one amino acid.
- The order of the amino acids forms polypeptides which fold into proteins.



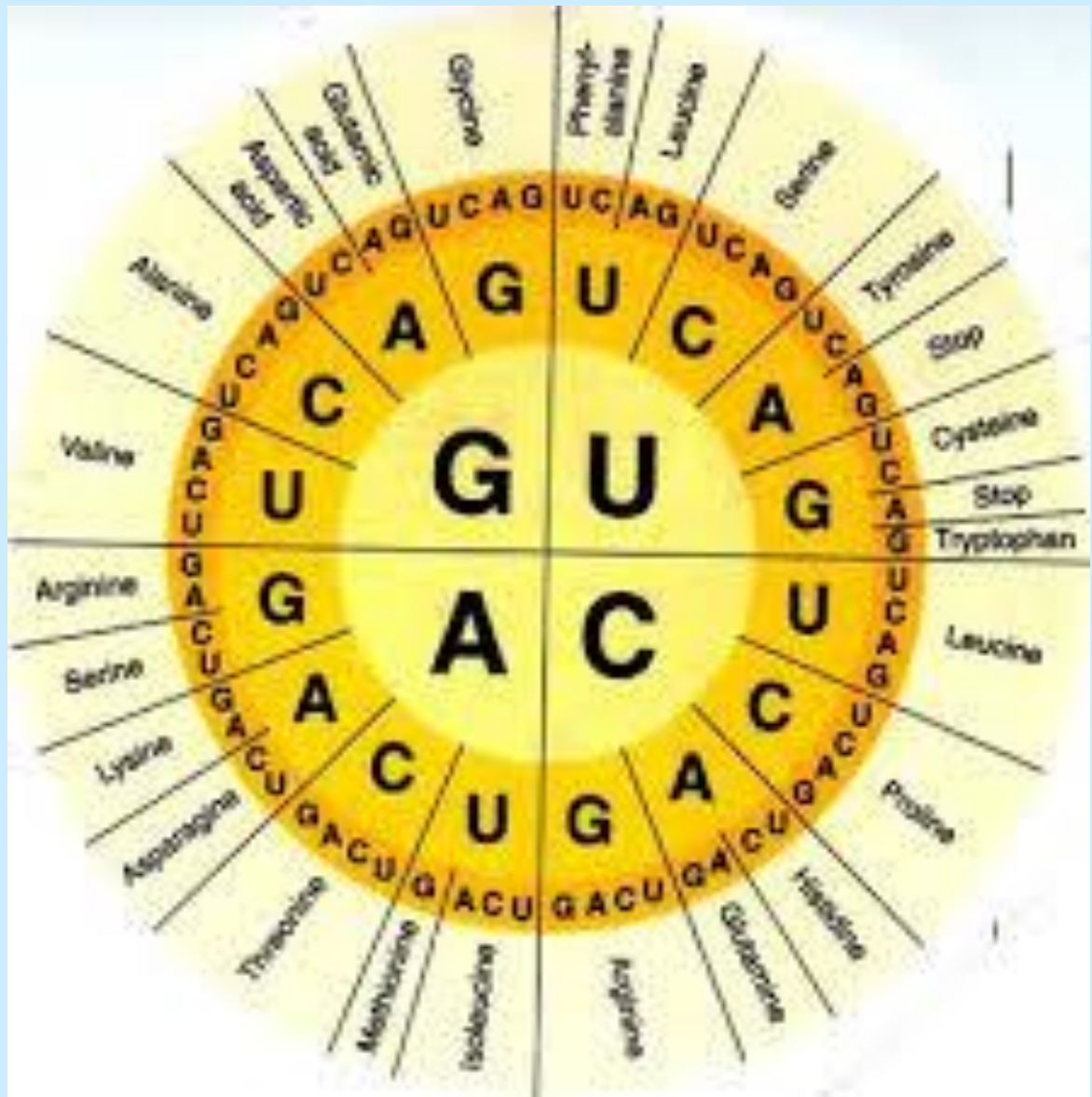
# 20 amino acids

		Second base of codon							
		U	C	A	G				
U	UUU	Phenylalanine phe	UCU	Serine ser	UAU	Tyrosine tyr	UGU	Cysteine cys	U
	UUC		UCC		UAC		UGC		C
	UUA	Leucine leu	UCA		STOP codon	UAA	STOP codon	UGA	A
	UUG		UCG			UAG		UGG	Tryptophan trp
C	CUU	Leucine leu	CCU	Proline pro	CAU	Histidine his	CGU	Arginine arg	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	CGA	A		
	CUG		CCG		CAG	CGG	G		
A	AUU	Isoleucine ile	ACU	Threonine thr	AAU	Asparagine asn	AGU	Serine ser	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	AGA	Arginine arg	A	
	AUG	Methionine met (start codon)	ACG		AAG	Lysine lys	AGG	G	
G	GUU	Valine val	GCU	Alanine ala	GAU	Aspartic acid asp	GGU	Glycine gly	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	GGA	A		
	GUG		GCG		GAG	GGG	G		

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DNA sequence: TAC GGA CAT AAC ACC TGC ATC

mRNA sequence: AUG CCU GUA UUG UGG ACG UAG

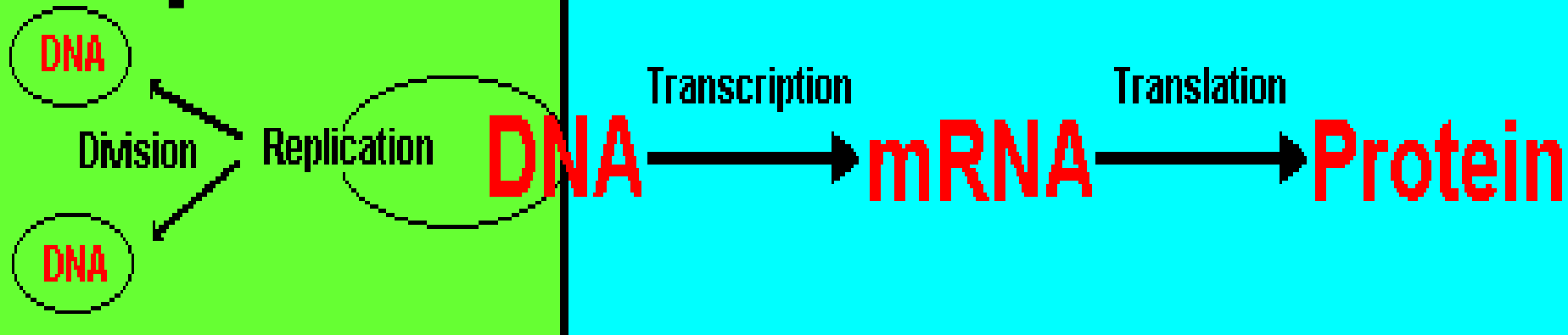


# Protein Synthesis

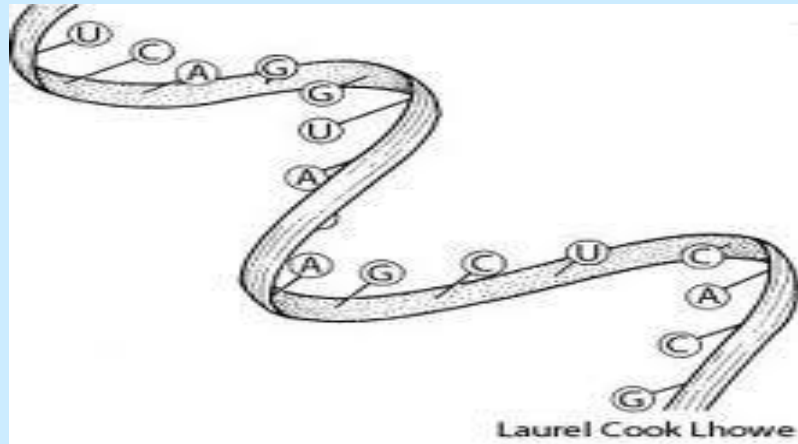


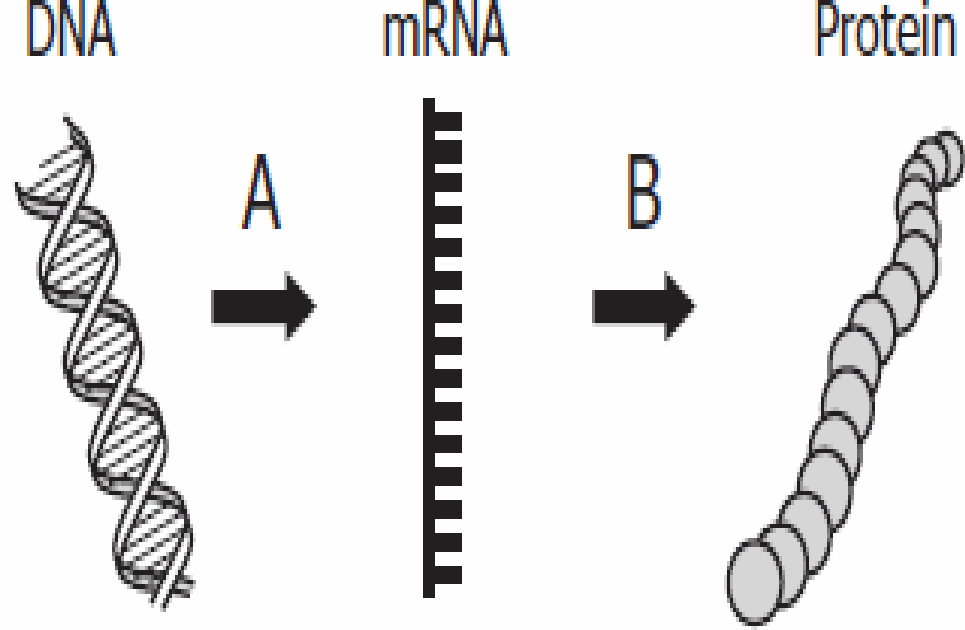
## Copies

## Rewrites Builds



- Look at the figure below: What structure does this figure show?
- A. DNA
- B. RNA
- C. Protein
- D. Amino Acid





In eukaryotic cells, the process indicated by arrow A occurs in the —

- A. Cytoplasm
- B. Nucleus
- C. Ribosome
- D. Cell Membrane

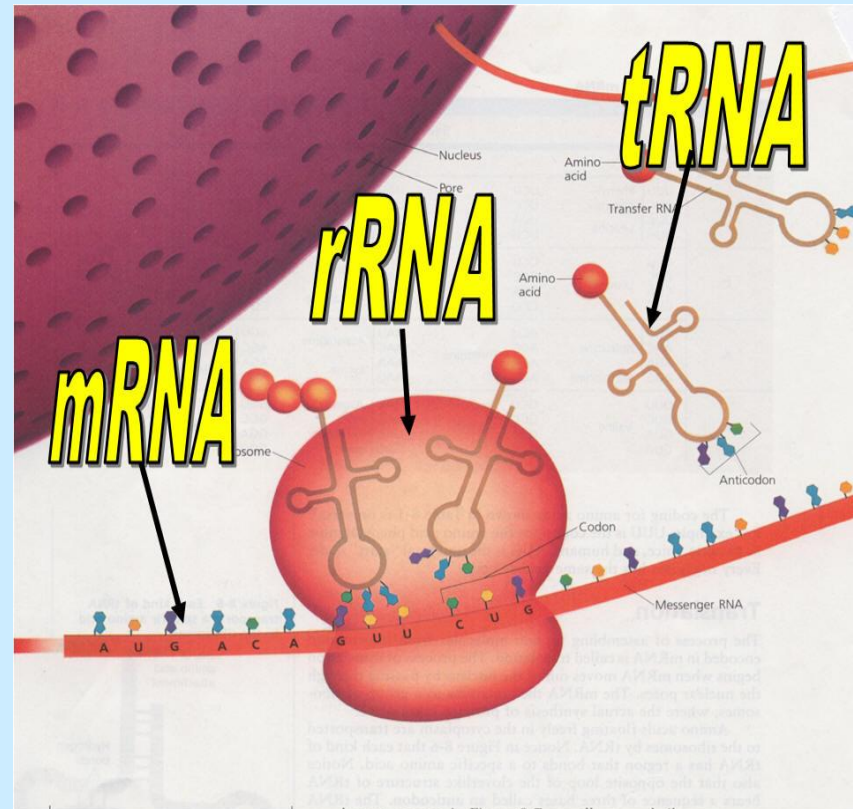
Which of the following carries amino acids to the site of protein synthesis?

A. mRNA

B. rRNA

 C. tRNA

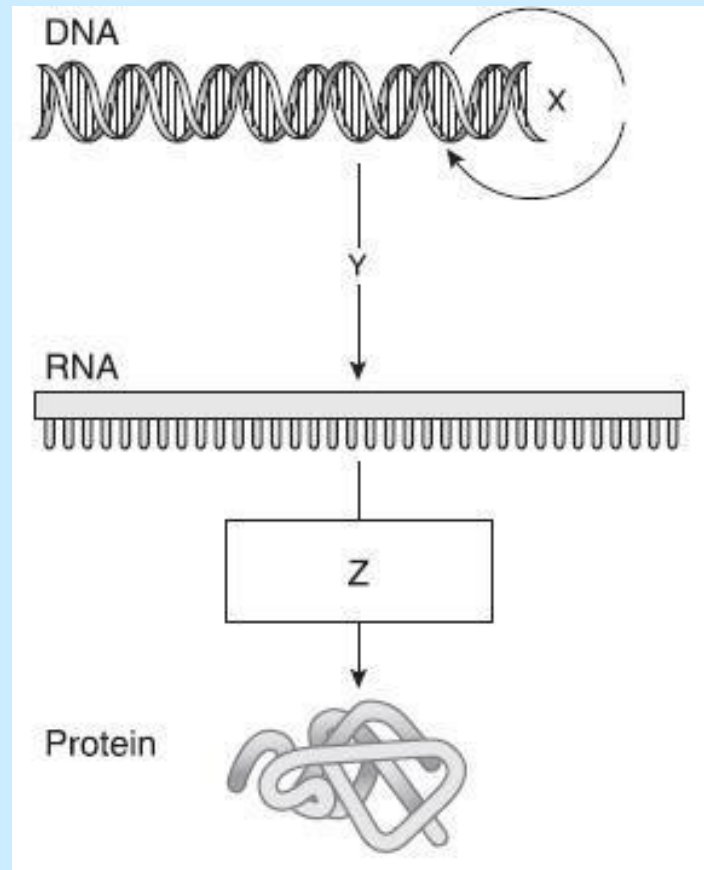
D. nRNA



A diagram of a cellular process is shown below.


Which of the following identifies the process shown at point Z?

- A. Translation
- B. Translocation
- C. Replication
- D. Transcription



The sequence of DNA below is part of a gene.  
How many amino acids are coded for by this  
segment?


5' ATCAGCGCTGGC 3'

-  A. 4
- B. 8
- C. 12
- D. 20



Four different segments of a DNA molecule are represented below.

There is an **error** in the DNA in which molecule?

- A. segment 1 only
-  B. segment 3 only
- C. segment 2 and 3
- D. segment 2 and 4

Segment 1	Segment 2	Segment 3	Segment 4
T-A-G-G-C	G-G-T-G-A	G-A-T-T-A	C-A-A-T-G
A-T-C-C-G	C-C-A-C-T	C-C-A-A-T	G-T-T-A-C

Which of the following would most likely cause a mutation?

A. the placement of ribosomes on the endoplasmic reticulum

 the insertion of a nucleotide into DNA


C. the movement of transfer RNA out of the nucleus

D. the release of messenger RNA from DNA

During transcription the DNA base sequence is transcribed into a complimentary mRNA sequence. A codon table like the one shown below lists the amino acids coded for by particular triads of mRNA bases. A segment of DNA has undergone a mutation in which one nucleotide has been changed. The original sequence was ACG and the new sequence is ACA. Use the codon table to determine whether or not this mutation will cause a change in the phenotype of the organism.

**Codons Found in Messenger RNA**  
*Second Base*

		U	C	A	G		
<b>First Base</b>	<b>U</b>	Phe	Ser	Tyr	Cys	<b>Third Base</b>	<b>U</b>
		Phe	Ser	Tyr	Cys		<b>C</b>
		Leu	Ser	Stop	Stop		<b>A</b>
		Leu	Ser	Stop	Trp		<b>G</b>
	<b>C</b>	Leu	Pro	His	Arg	<b>U</b>	
		Leu	Pro	His	Arg	<b>C</b>	
		Leu	Pro	Gln	Arg	<b>A</b>	
		Leu	Pro	Gln	Arg	<b>G</b>	
	<b>A</b>	Ile	Thr	Asn	Ser	<b>U</b>	
		Ile	Thr	Asn	Ser	<b>C</b>	
		Ile	Thr	Lys	Arg	<b>A</b>	
		Met	Thr	Lys	Arg	<b>G</b>	
	<b>G</b>	Val	Ala	Asp	Gly	<b>U</b>	
		Val	Ala	Asp	Gly	<b>C</b>	
		Val	Ala	Glu	Gly	<b>A</b>	
		Val	Ala	Glu	Gly	<b>G</b>	

- A. yes, the phenotype of the organism would change because a new amino acid will be coded for.
- B. yes, the phenotype of the organism would change because any change in the DNA sequence will cause a change in phenotype.
-  Even though the DNA sequence changed, the sequence still codes for the same amino acid, so no change in phenotype will occur.