Protein Synthesis

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📖What **important molecule** is produced from specific sequence of nucleotide of DNA?

Proteins

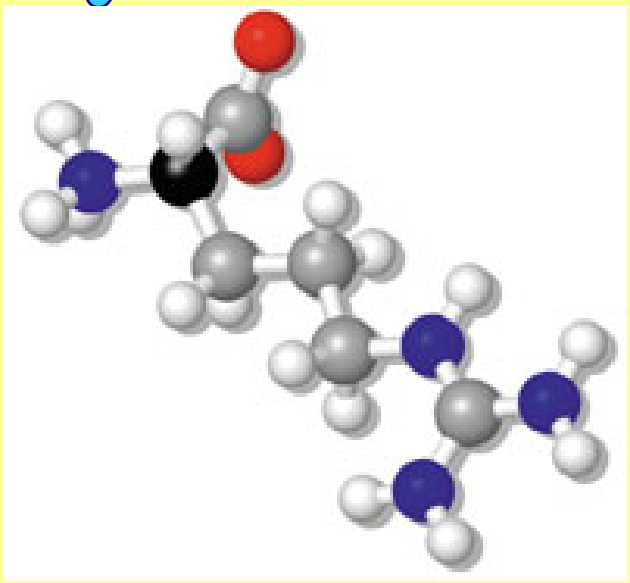
📖 How are proteins **folded**?

- **Proteins** fold into complex, **3-D** shapes to become important structures and regulators of cell functions.

🗣**Recall**: ***Structure*** of proteins determine the ***function*** of proteins that determines ***cell activity*** of organism's body.

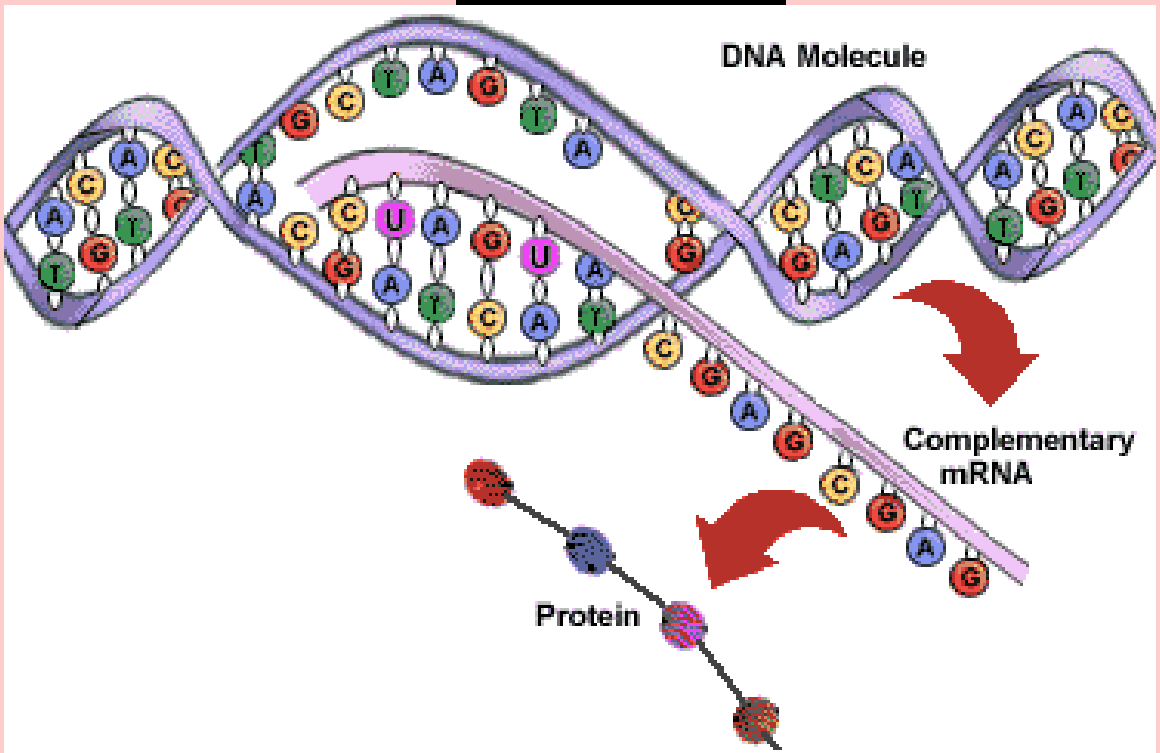
📖 What are proteins are made up of?

Amino Acids



🗣 Need to understand that…

- The **sequence** of nucleotides of DNA will be transcribed into **amino acids** needed to make **proteins**.

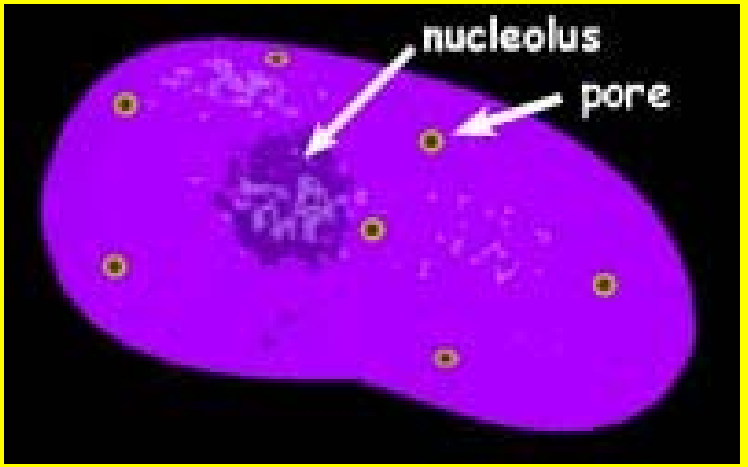


RNA

📖 RNA, like DNA, is a

nucleic acid

➔ located in the ***nucleus***



📖 How many ways does RNA **differ** in structure? Name them.

RNA	DNA
1.) single stranded	1.) double stranded
2.) sugar ***ribose***	2.) sugar ***deoxyribose***
3.) nitrogen bases	3.) nitrogen bases

A-U
C-G

Uracil

A-T
C-G

What is the role of RNA in a cell?

What job process is associated with protein synthesis (production)?

Car Factory	Protein Synthesis
Who tells the workers to make the cars?	Who provides the instructions to make proteins?
Engineers	DNA
Who follows the directions to build the cars?	Who follows the directions to make the proteins?
Workers	messenger RNA
Who brings the parts to be installed?	Who brings the parts (amino acids) to make the proteins?
Suppliers	transfer RNA

📖 How **many types** of RNA molecules are there? Name them and their associate functions.

Types	Function
1.) messenger RNA (mRNA)	Brings instructions from DNA in nucleus to cell's factory floor; the cytoplasm.
2.) ribosomal RNA (rRNA)	Binds to mRNA. Reads the instructions to assembly the amino acids.
2.) transfer RNA (tRNA)	Suppliers. Delivers the amino acids to the ribosome to be assembled into proteins

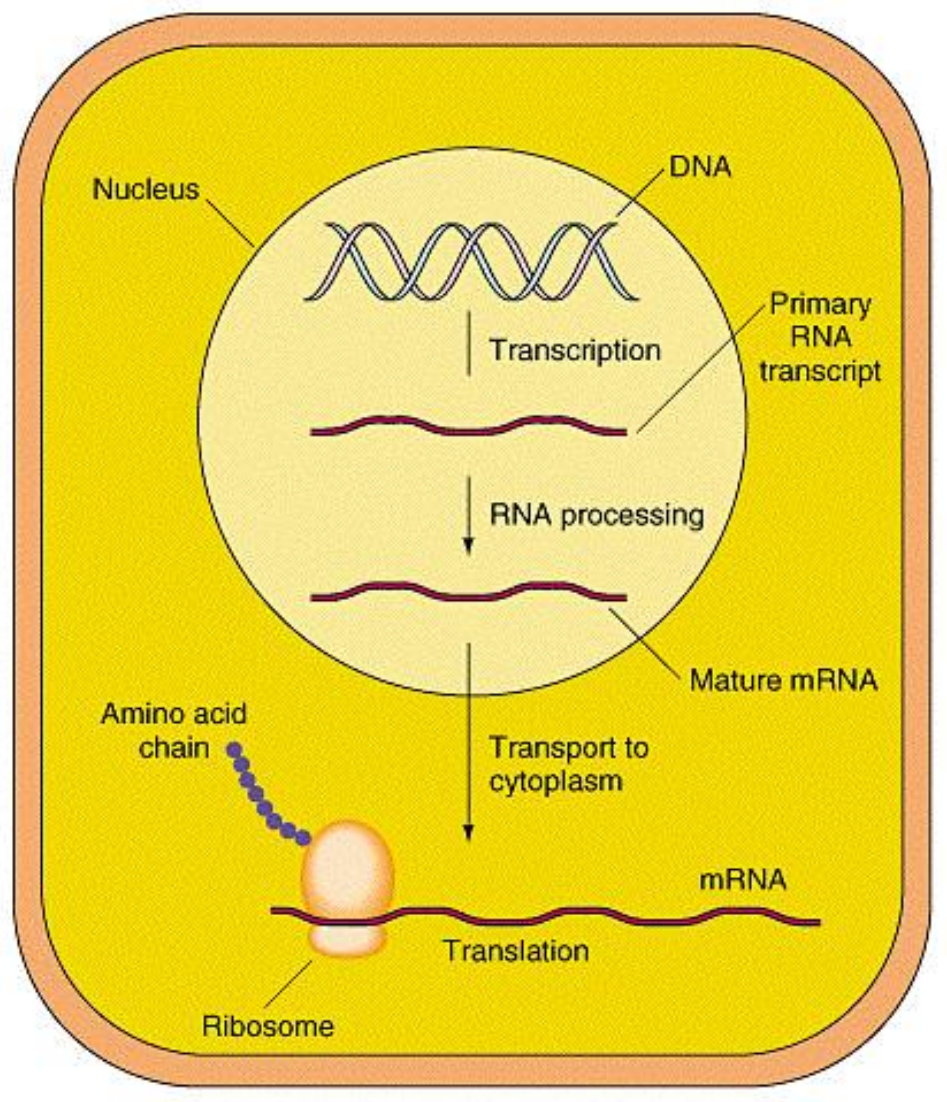
Protein Synthesis Production

Part I: Transcription

📖 How does the information of DNA get to the ribosomes floating in the cytoplasm?

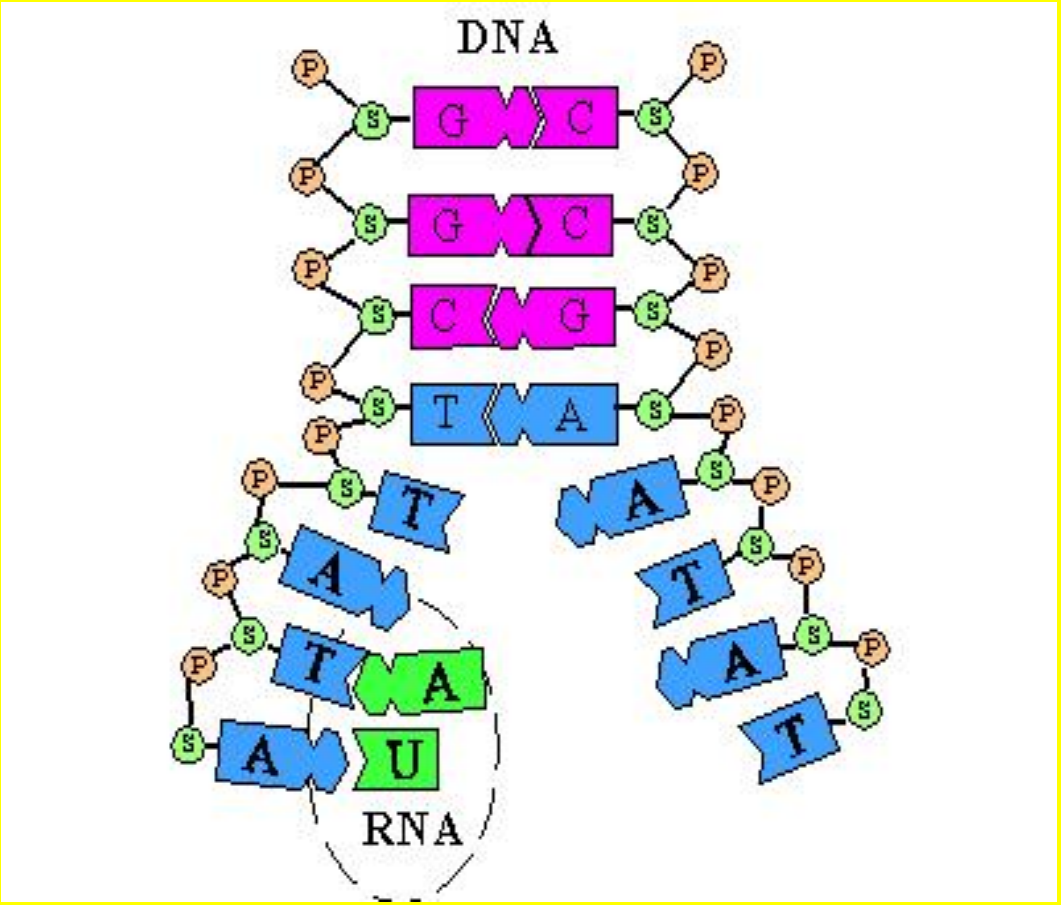
➔ By mRNA passing through the nuclear membrane of nucleus.

Part I: Transcription



📖 Define ***transcription***

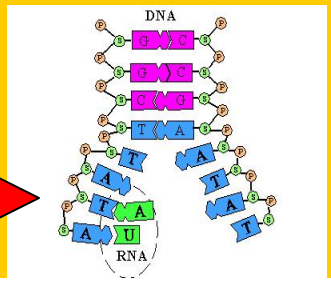
- ***Transcription*** is making a mRNA copy (***single stranded***) of **<u>one</u> <u>side</u>** of the DNA molecules.



📖 Name the **main difference** between ***DNA replication*** and ***transcription***.

- ***DNA replication*** means **copying** the **entire double stranded DNA** molecule.

- ***Transcription*** means making **single stranded mRNA** from one side of DNA molecule.



🗣 Steps of Transcription:

1.) **Enzymes unzips** the DNA molecule.

2.) **Free floating nitrogen bases** in cytoplasm match up with DNA only on one side of molecule.

3.) Nitrogen bases join by a **weak hydrogen bond**.

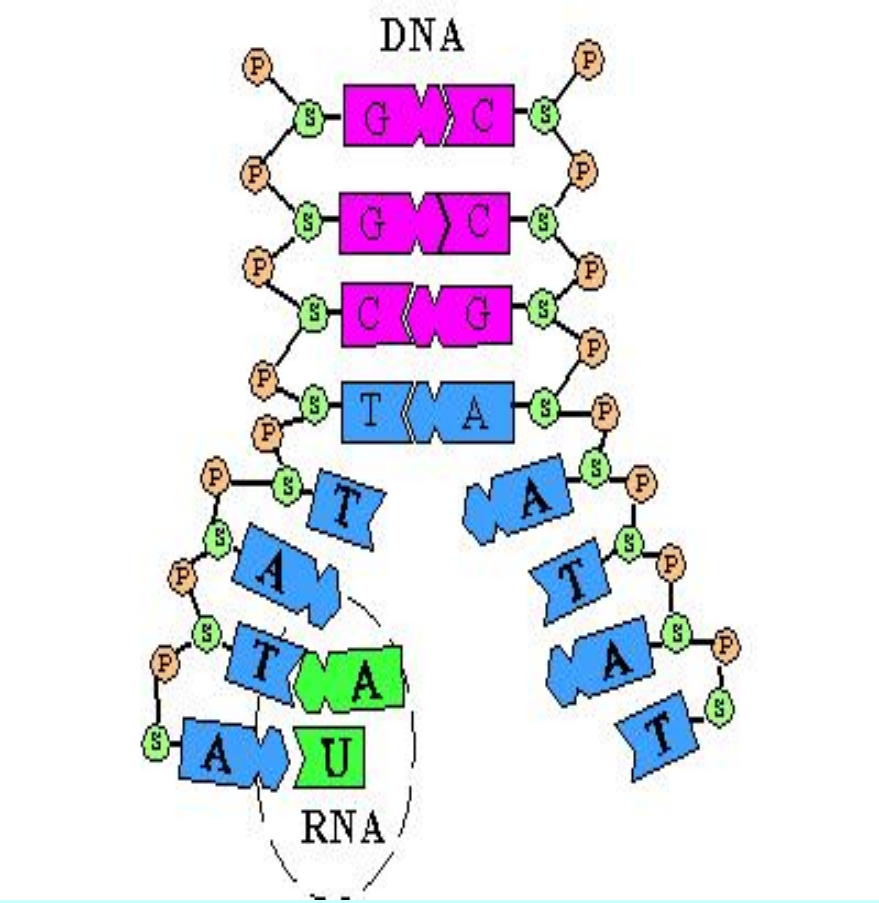
🗣 Steps of Transcription:

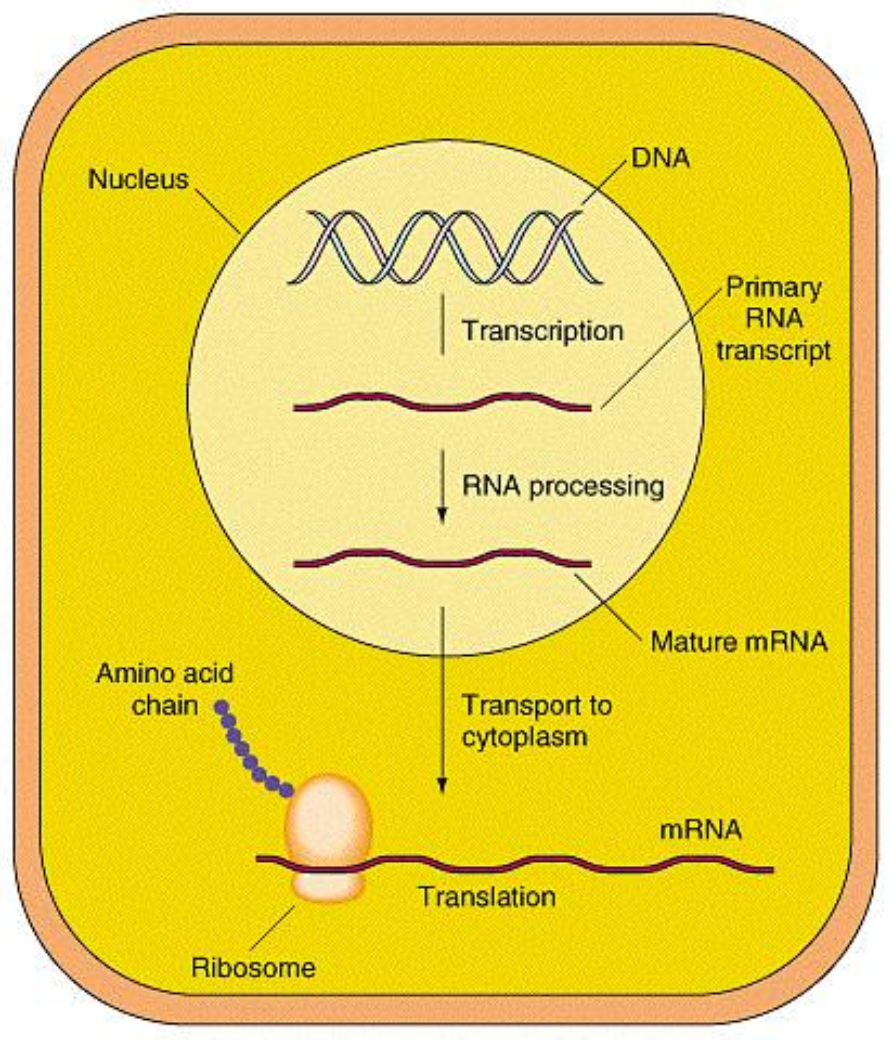
4.) mRNA **breaks away** from the DNA molecule.

5.) mRNA **leaves** the nucleus and moves to the ribosome in order to make proteins.

6.) DNA molecules **retwist** back up.

🗣 Steps of Transcription:





Transcription Continues:

- 📖 How **many nitrogen bases** of mRNA are needed for one amino acid? 3

- 📖 This group is known as a codon

  - 🗣 Greek word:

codex ➔ " a tablet for writing"

📖 How **many combinations** are possible when **sequences** of <u>3</u> nitrogen bases are used?

64

📖 Refer to Table 11.1:

📖 How many **start codons** are there? 1

Name them. AUG

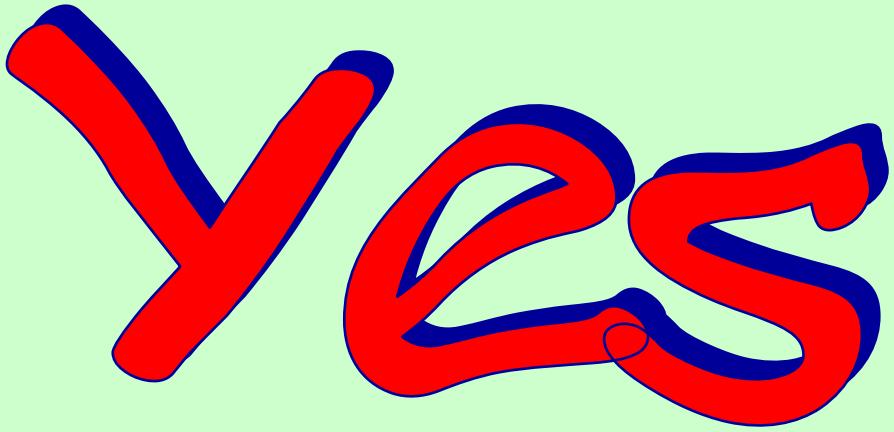
📖 How many **stop codons** are there? 3

Name them.

UAA UAG UGA

?

📖 Can **more** than one codon code for the **same** amino acid?



🗣 Need to understand that…

each amino acid has **one** codon at a time.

📖 Refer to Table 11.1:

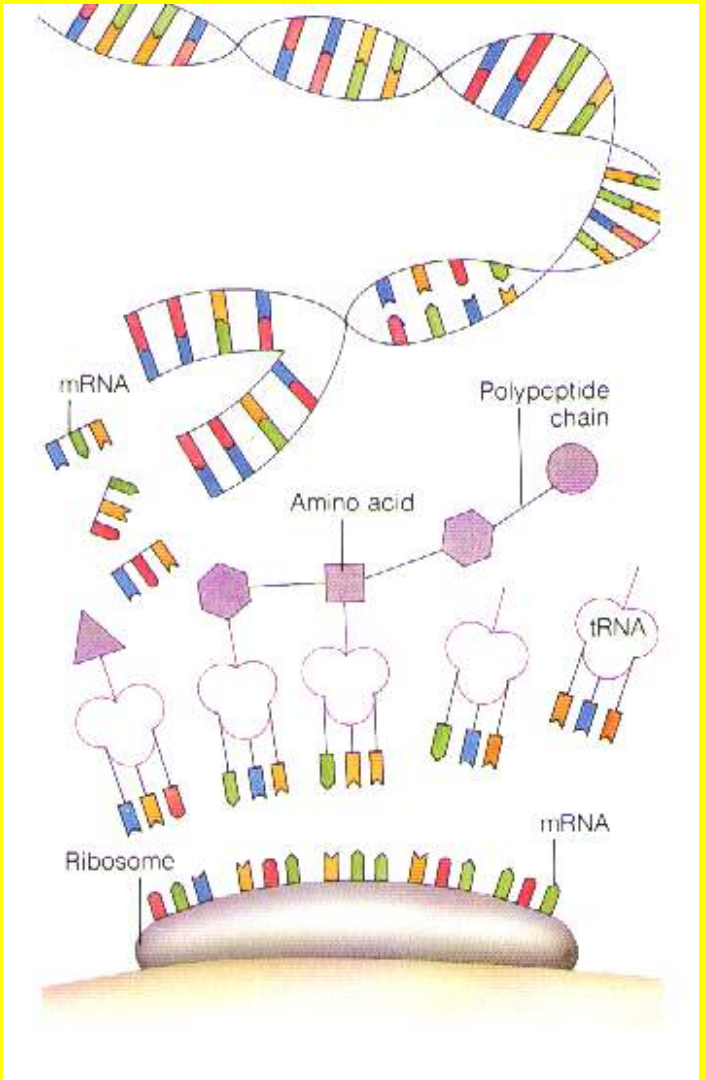
Table 11.1 The Messenger RNA Genetic Code

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

Part II of Protein Synthesis: <u>Translation</u>

📖 Define ***translation***.

➔ is the process of **<u>converting</u>** the sequence of nitrogen bases of mRNA into sequence of amino acids.



- Who brings the floating amino acids to the **mRNA** hooked on the ribosome?

tRNA

?

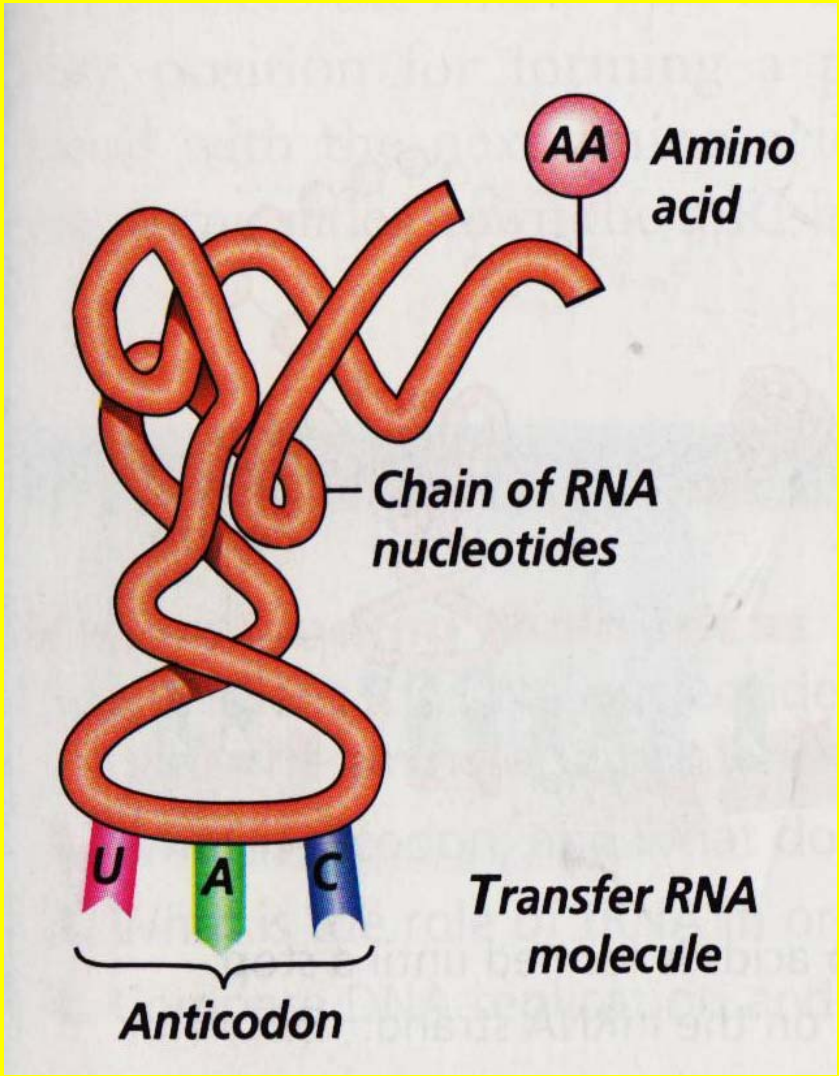
- What is attached to **<u>one</u> end** of **tRNA**?

amino acids

- What is attached to the **<u>other</u> end** of **tRNA**?

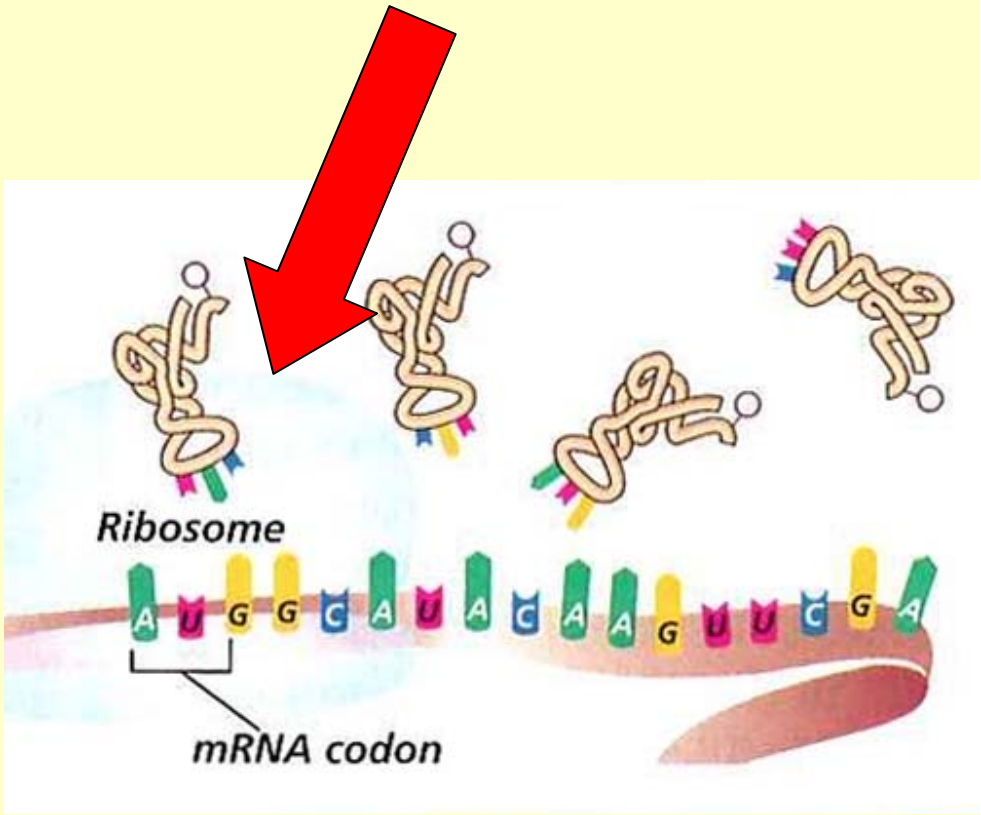
anticodon

tRNA


AA
Amino acid
Chain of RNA nucleotides
U
A
C
Anticodon
Transfer RNA molecule

🗣 Translating the mRNA to Proteins

1.) ribosome attaches to mRNA.

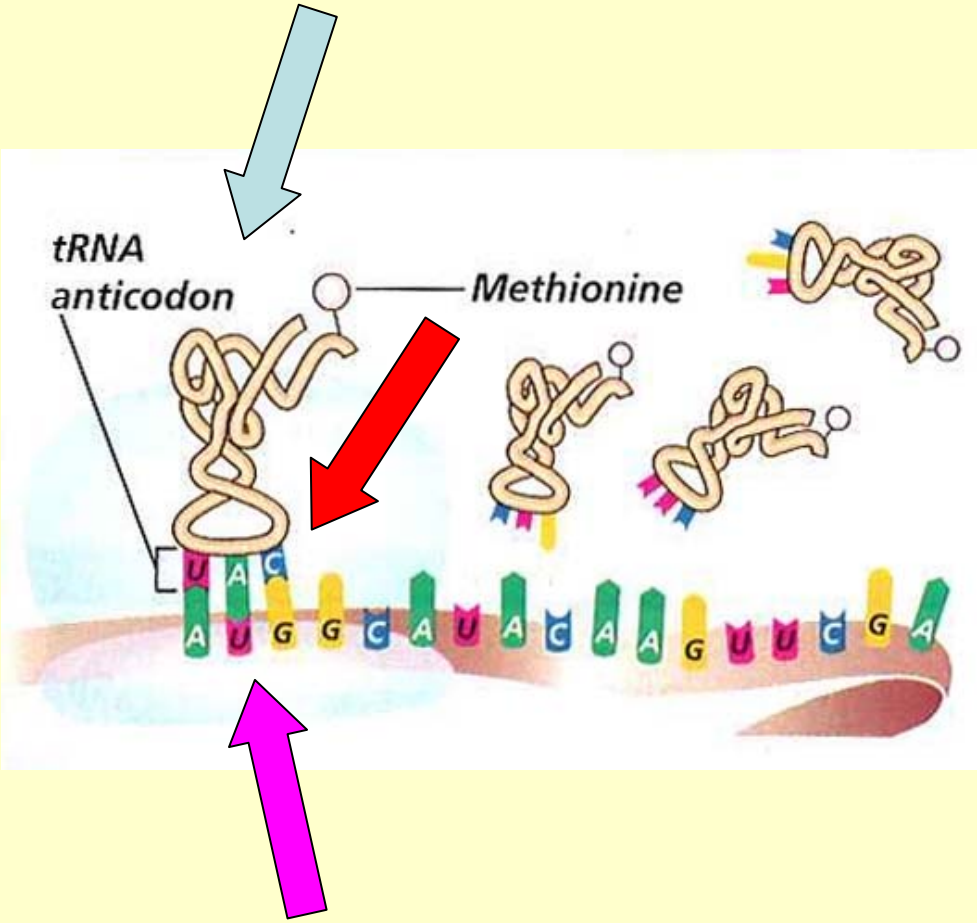


🗣 Translating the mRNA to Proteins

2.) ***tRNA*** comes along and **attaches** to ***mRNA*** where the ribosome is located.

3.) **<u>First</u> anticodon** is read. It's always the **<u>start</u>** codon: ***AUG***

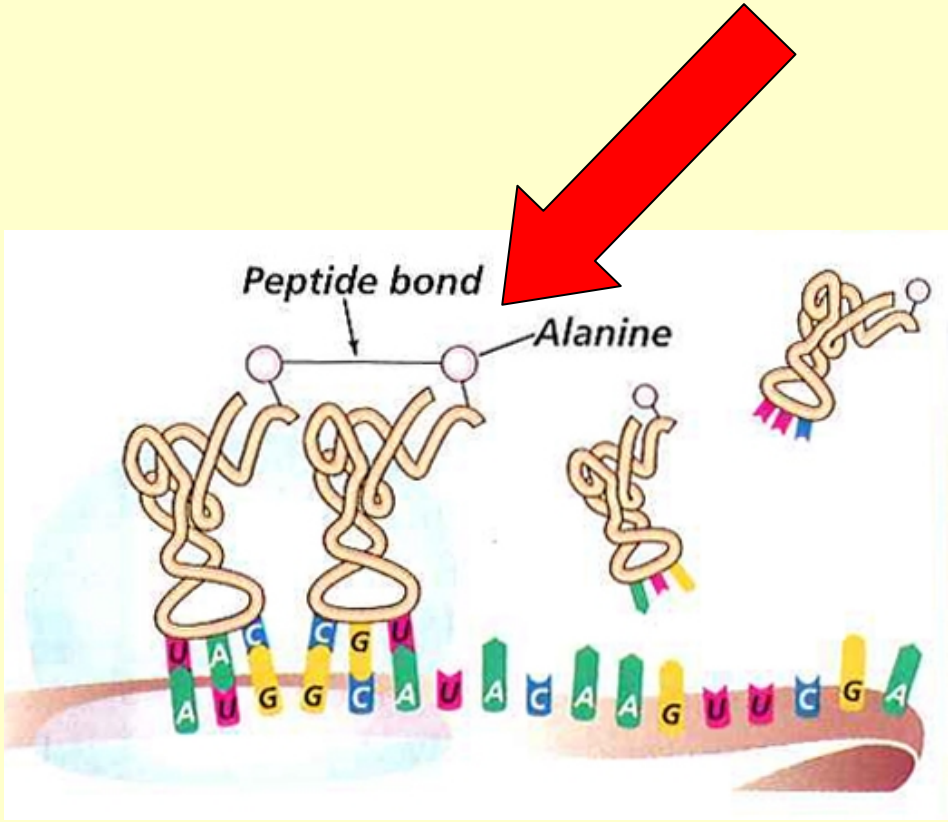
➔ ***methionine*** (amino acid)



🗣 Translating the mRNA to Proteins

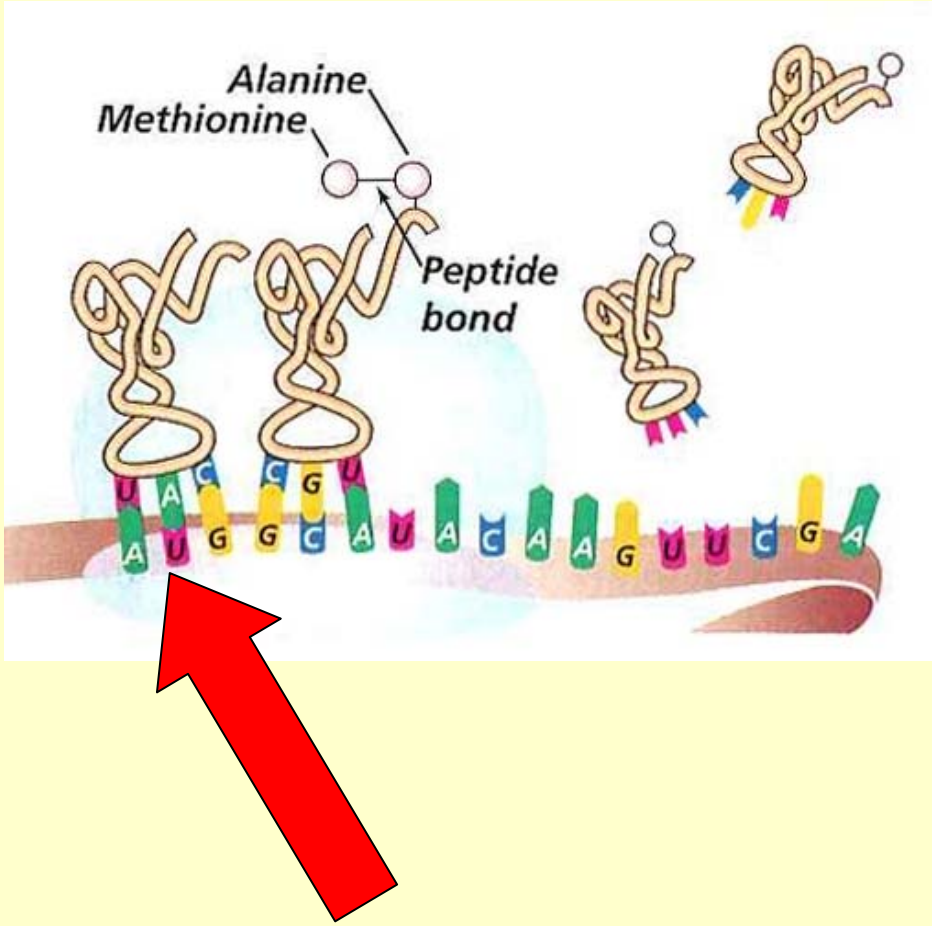
4.) another ***tRNA*** comes along with a **<u>new</u>** amino acid and attaches to mRNA.

5.) **<u>Peptide</u> <u>bonds</u>** form between the amino acids.



🗣 Translating the mRNA to Proteins

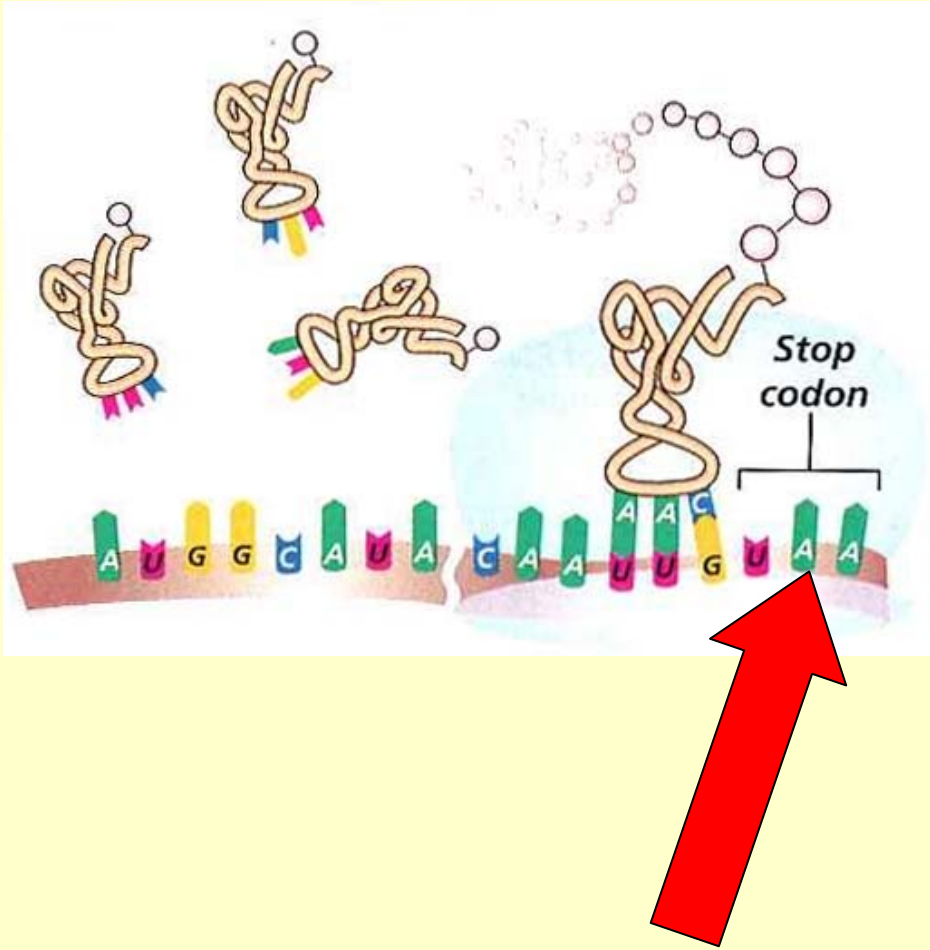
6.) **<u>old</u>** ***tRNAs*** are release to go get another new amino acid.



🗣 Translating the mRNA to Proteins

7.) Ribosome continues to move along the mRNA untill **all** the codons are read.

8.) Last condon to be read is the **stop codon**; *UAA*



📖 When do amino acids become proteins?

- Amino acids become proteins when they are released from the ribosome of mRNA.

📖 Does the same protein chain form the same shape every time it is produced?

Yes

📖 Define ***Central Dogma of Biology***.

Information that goes from

DNA → mRNA → proteins

GENES are a segment of **DNA** that codes for **PROTEINS**.

Let's Practice!

?

Always use mRNA codon

Data Table

	A	B	C	D	E
DNA Base Sequence	Process	mRNA Codon	Process	tRNA Anticodon	Amino Acid
AAT	→	UUA	→	AAU	leucine
GGG	→	CCC	→	GGG	proline
ATA	→	UAU	→	AUA	tyrosine
AAA	→	UUU	→	AAA	phenylalanine
GTT	→	CAA	→	GUU	glutamine

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	Leucine (UUA)	Serine (UCA)	Stop (UAA)	Stop (UGA)	A
	Leucine (UUG)	Serine (UCG	Stop (UAG)	Tryptophan (UGG)	G
C	Leucine (CUU)	Proline (CCU)	Histidine (CAU)	Arginine (CGU)	U
	Leucine (CUC)	Proline (CCC)	Histidine (CAC)	Arginine (CGC)	C
	Leucine (CUA)	Proline (CCA)	Glutamine (CAA)	Arginine (CGA)	A
	Leucine (CUG)	Proline (CCG)	Glutamine (CAG)	Arginine (CGG)	G
A	Isoleucine (AUU)	Threonine (ACU)	Asparagine (AAU)	Serine (AGU)	U
	Isoleucine (AUC)	Threonine (ACC)	Asparagine (AAC)	Serine (AGC)	C
	Isoleucine (AUA)	Threonine (ACA)	Lysine (AAA)	Arginine (AGA)	A
	Methionine; Start (AUG)	Threonine (ACG)	Lysine (AAG)	Arginine (AGG)	G
G	Valine (GUU)	Alanine (GCU)	Aspartate (GAU)	Glycine (GGU)	U
	Valine (GUC)	Alanine (GCC)	Aspartate (GAC)	Glycine (GGC)	C
	Valine (GUA)	Alanine (GCA)	Glutamate (GAA)	Glycine (GGA)	A
	Valine (GUG)	Alanine (GCG)	Glutamate (GAG)	Glycine (GGG)	G