RNA & PROTEIN SYNTHESIS

DNA & RNA

- **Genes** are coded DNA instructions that control the production of proteins within the cell.
- The first step in decoding these genetic messages is to copy part of the nucleotide sequence from DNA into RNA or ribonucleic acid.
  - RNA is a Nucleic Acid
    - made up of nucleotides
    - contains the elements – **C, H, O, N, P**

STRUCTURE OF RNA

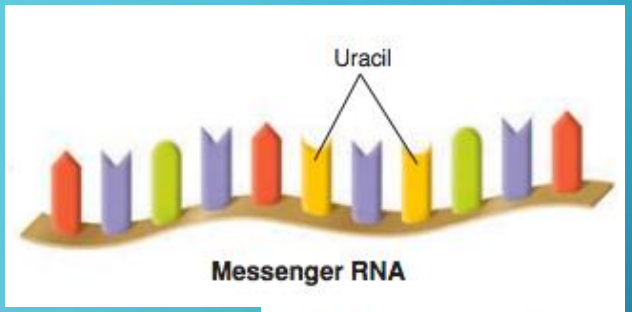
- **Single** stranded
- Contains the following:
  - Phosphate group
  - 5 carbon sugar (**ribose**)
  - Nitrogenous base: Adenine, **Uracil**, Cytosine, and Guanine
- ***The function of RNA is to synthesize proteins***

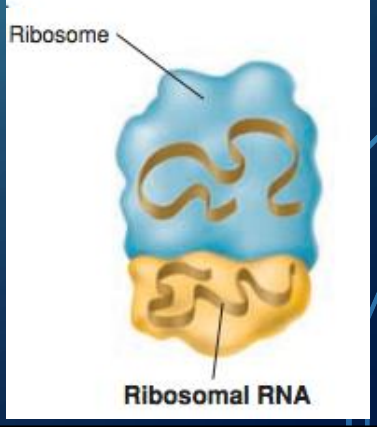
DIFFERENCES BETWEEN DNA AND RNA

DNA	RNA
Double stranded	Single stranded
Sugar group is deoxyribose	Sugar group is ribose
Nitrogenous base: Thymine	Nitrogenous base: Uracil
Stores genetic information	Passes on the DNA code

TYPES OF RNA

- Three (3) main types
  - 1.**Messenger RNA (mRNA)**
    - transfers DNA code to ribosomes for translation.
  - 2. **Transfer RNA (tRNA)**
    - brings amino acids to ribosomes for protein synthesis.
  - 3. **Ribosomal RNA (rRNA)**
    - Ribosomes are made of rRNA and protein; rRNA helps to identify/read the mRNA





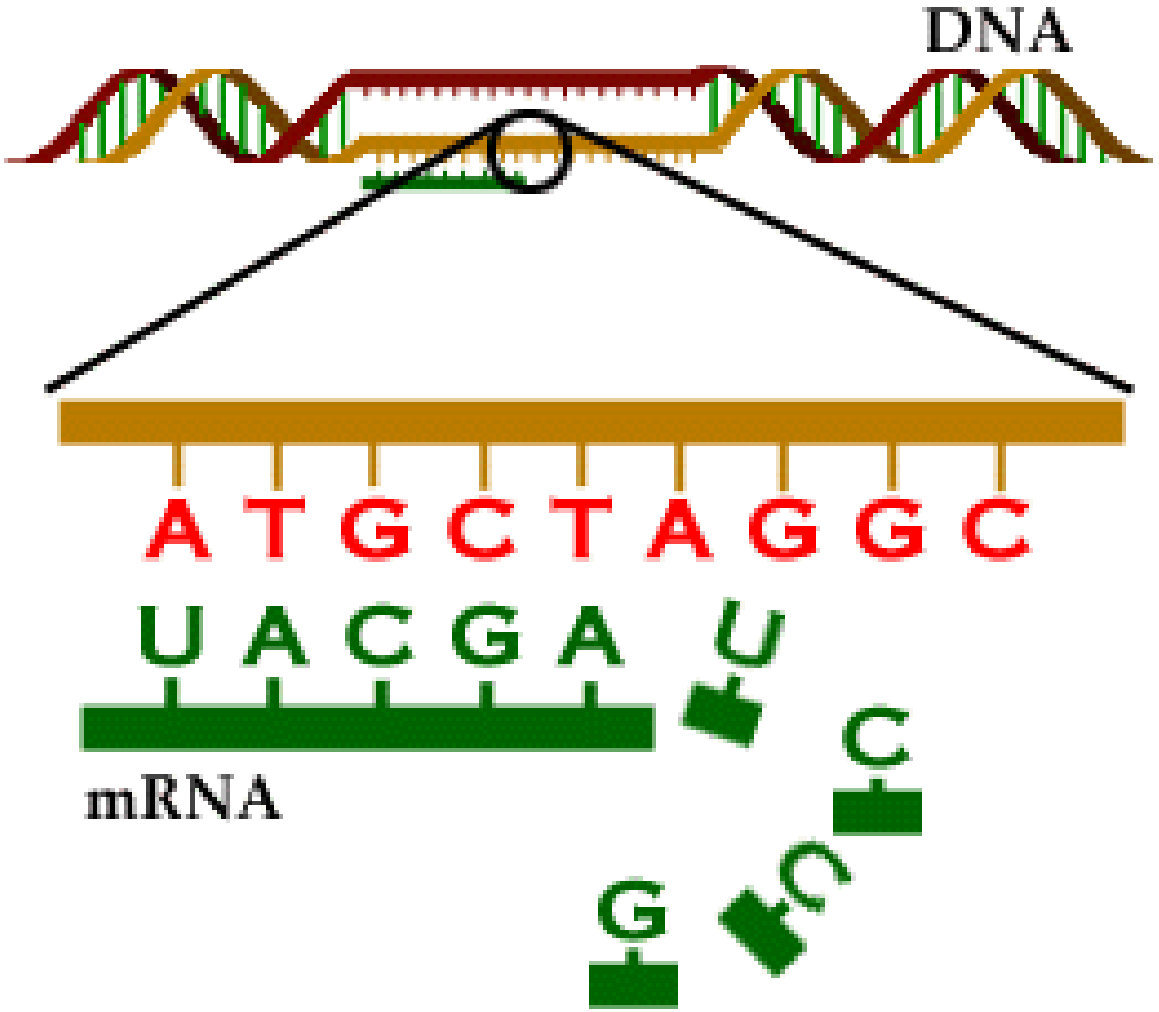
TRANSCRIPTION: CHANGING DNA TO RNA

- It is important to realize that DNA and proteins have a direct relationship.
- In other words, DNA is used to make proteins and the first step by which it does this is a process called **transcription**.

TRANSCRIPTION: 1ST STEP IN PROTEIN SYNTHESIS

- In **transcription**, an **RNA** (ribonucleic acid) strand is made from a strand of **DNA**.
  - Takes place in the **nucleus**.
- In order for this to occur, a DNA strand unzips and **RNA** bases come along and pair up with the exposed DNA bases.
- Enzymes reassemble the nucleotides and the strand is now called **mRNA**, or **messenger** RNA.

Transcription



TRANSCRIPTION: CHANGING DNA TO RNA

- Messenger RNA (**mRNA**) will now deliver a message telling the ribosomes in the cell to get ready to start making proteins.

THE GENETIC CODE

- Proteins are made by joining amino acids together into a long chain called polypeptides held together by peptide bonds.
  - There are 20 different amino acids.
- The specific amino acids in a polypeptide, and the order in which they are joined, determine the properties of different proteins.
- The **sequence** of amino acids influences its **shape** which determine its **function**.

THE GENETIC CODE

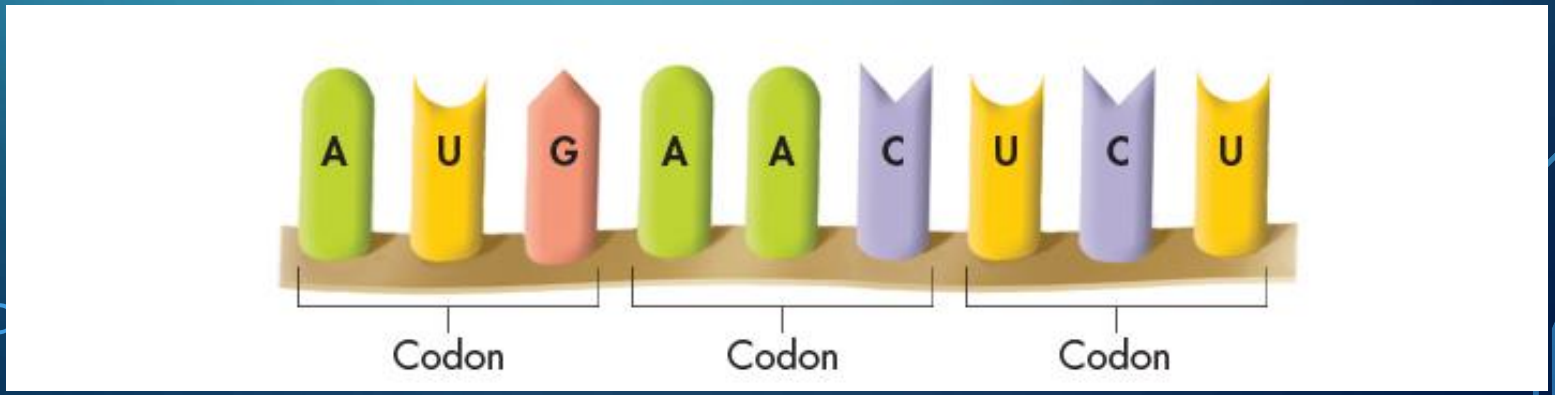
- This is the language of **mRNA**.
  - Based on the 4 bases of mRNA
    - Adenine, Guanine, Cytosine, and Uracil (AGCU)

- The genetic code is read **three** (3) "letters" at a time, so that each "word" is three (3) bases long and corresponds to a single amino acid.

- These "words" are 3 RNA sequences called **codons**.

THE GENETIC CODE

- Each three-letter “word” in mRNA is known as a **codon**.
  - A **codon** consists of three consecutive **nitrogen bases** that specify a single amino acid to be added to the polypeptide chain.
  - Each codon specifies **1 amino acid**



READING THE GENETIC CODE

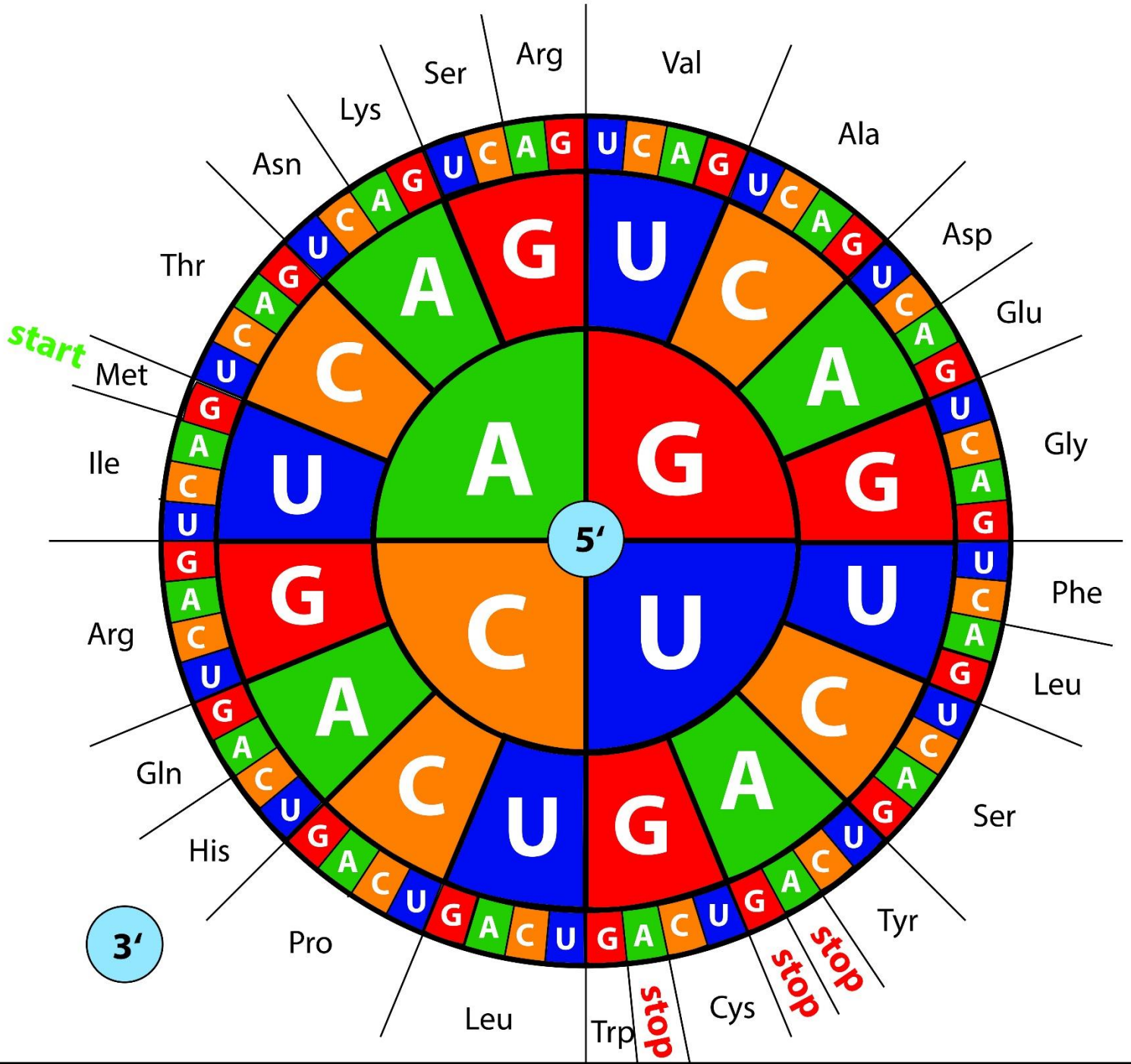
- When you read one codon at a time it can be used to determine which **amino acid** (and this determines which protein) each strand of DNA or RNA will code for.

Example: Use the codon chart to determine which protein the codon ACG codes for.

CODON CHART

FIRST LETTER	SECOND LETTER: U	C	A	G	THIRD LETTER
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	(Start) Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartate	Glycine	U
	Valine	Alanine	Aspartate	Glycine	C
	Valine	Alanine	Glutamate	Glycine	A
	Valine	Alanine	Glutamate	Glycine	G

CODON CHART


Arg
Ser
Lys
Asn
Thr
start
Met
Ile
Arg
Gln
His
Pro
Leu
Trp
stop
Cys
stop
stop
Tyr
Ser
Leu
Phe
Gly
Glu
Asp
Ala
Val
5'
3'

RNA SEQUENCE PRACTICE

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

mRNA:

Which **RNA** bases complement the above strand of DNA?

RNA SEQUENCE PRACTICE

Amino acids:

Use your codon chart to find out which amino acids are formed!

TRANSLATION: 2ND STEP IN PROTEIN SYNTHESIS

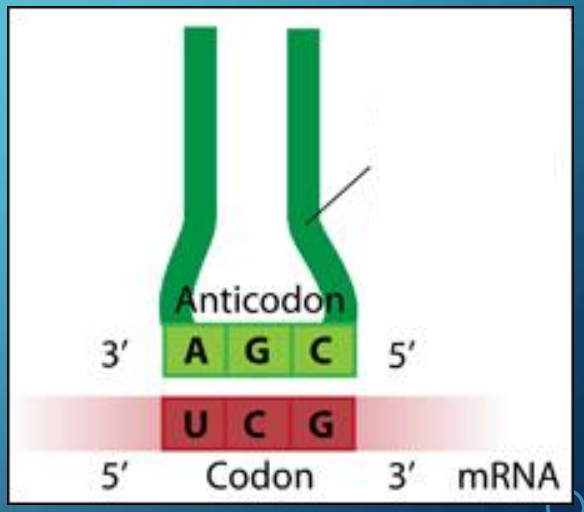
- **Translation** is the process by which proteins are made using RNA.
- This process occurs in the **ribosomes** of the cell.
- Translation begins when an mRNA in the cytoplasm attaches to a **ribosome**.

TRANSLATION: 2ND STEP IN PROTEIN SYNTHESIS

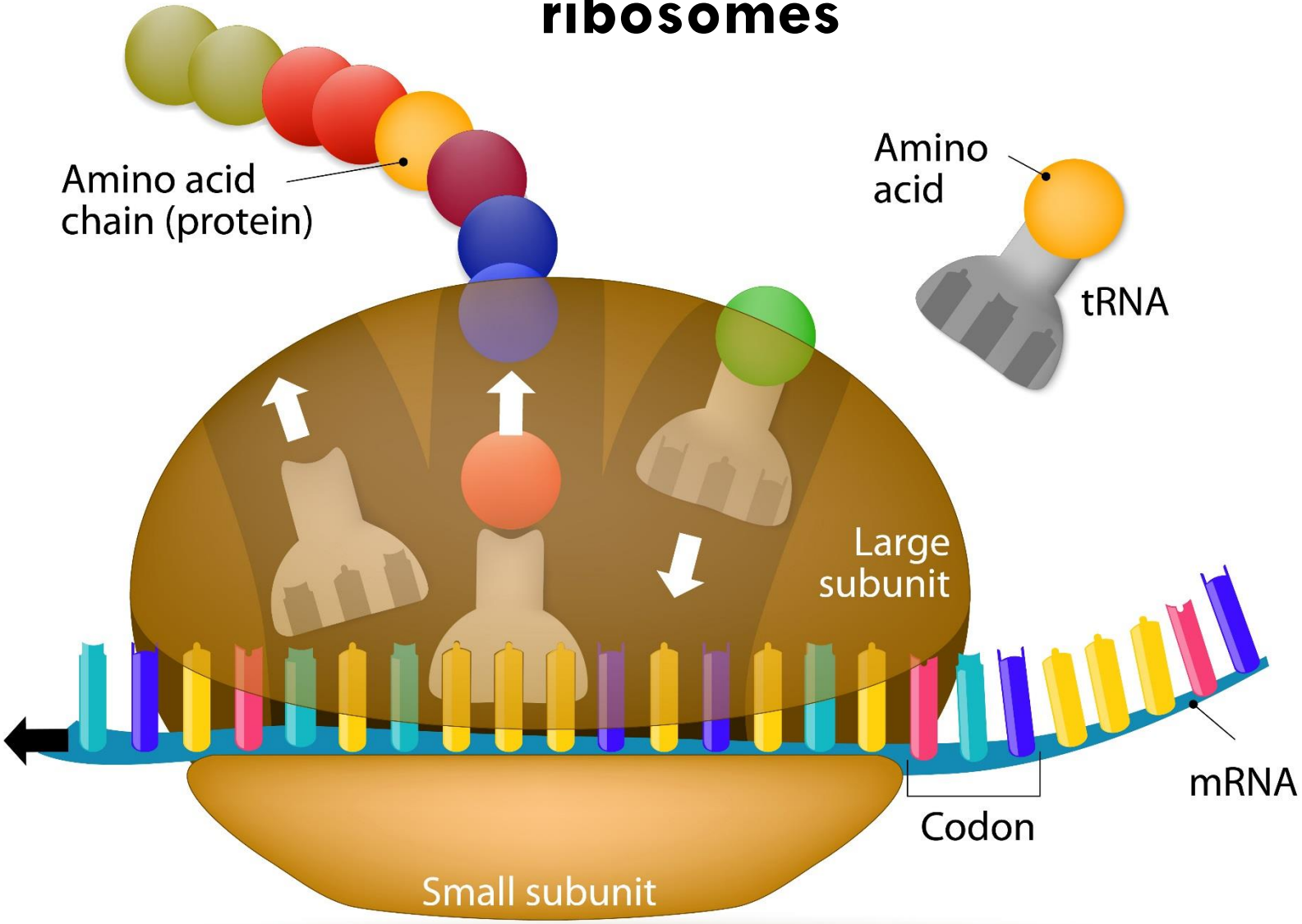
- As each codon of mRNA moves through the ribosome (rRNA), the proper amino acid is brought in by **tRNA**
- In the ribosome the amino acid is transferred to the growing **polypeptide** chain

TRANSLATION: CONVERTING RNA TO PROTEINS

- Each tRNA carries only **one** kind of amino acid
- Each tRNA has three unpaired bases, called the **anticodon**
- The anticodon is complementary to the mRNA codon



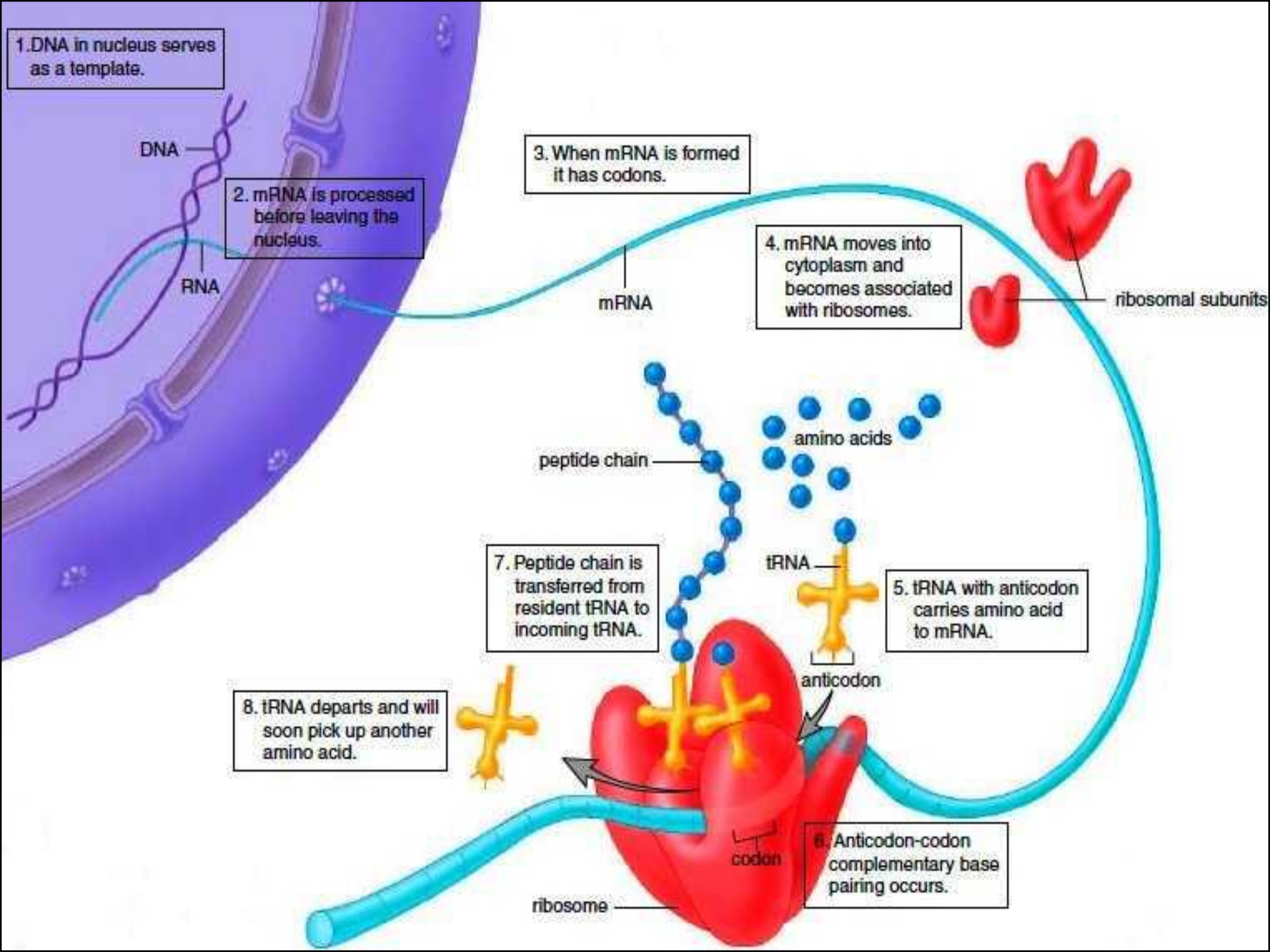
Translation- in the ribosomes



TRANSLATION: CONVERTING RNA TO PROTEINS

- Amino acids continue to link together to form proteins inside the ribosomes until a "**stop**" **codon** is read and the finished proteins are released into the cell.

- ***Therefore, ribosomes use the sequence of codons in mRNA to assemble amino acids into polypeptide chain.***


1. DNA in nucleus serves as a template.
DNA
2. mRNA is processed before leaving the nucleus.
RNA
3. When mRNA is formed it has codons.
mRNA
4. mRNA moves into cytoplasm and becomes associated with ribosomes.
ribosomal subunits
peptide chain
amino acids
tRNA
5. tRNA with anticodon carries amino acid to mRNA.
anticodon
7. Peptide chain is transferred from resident tRNA to incoming tRNA.
8. tRNA departs and will soon pick up another amino acid.
codon
6. Anticodon-codon complementary base pairing occurs.
ribosome