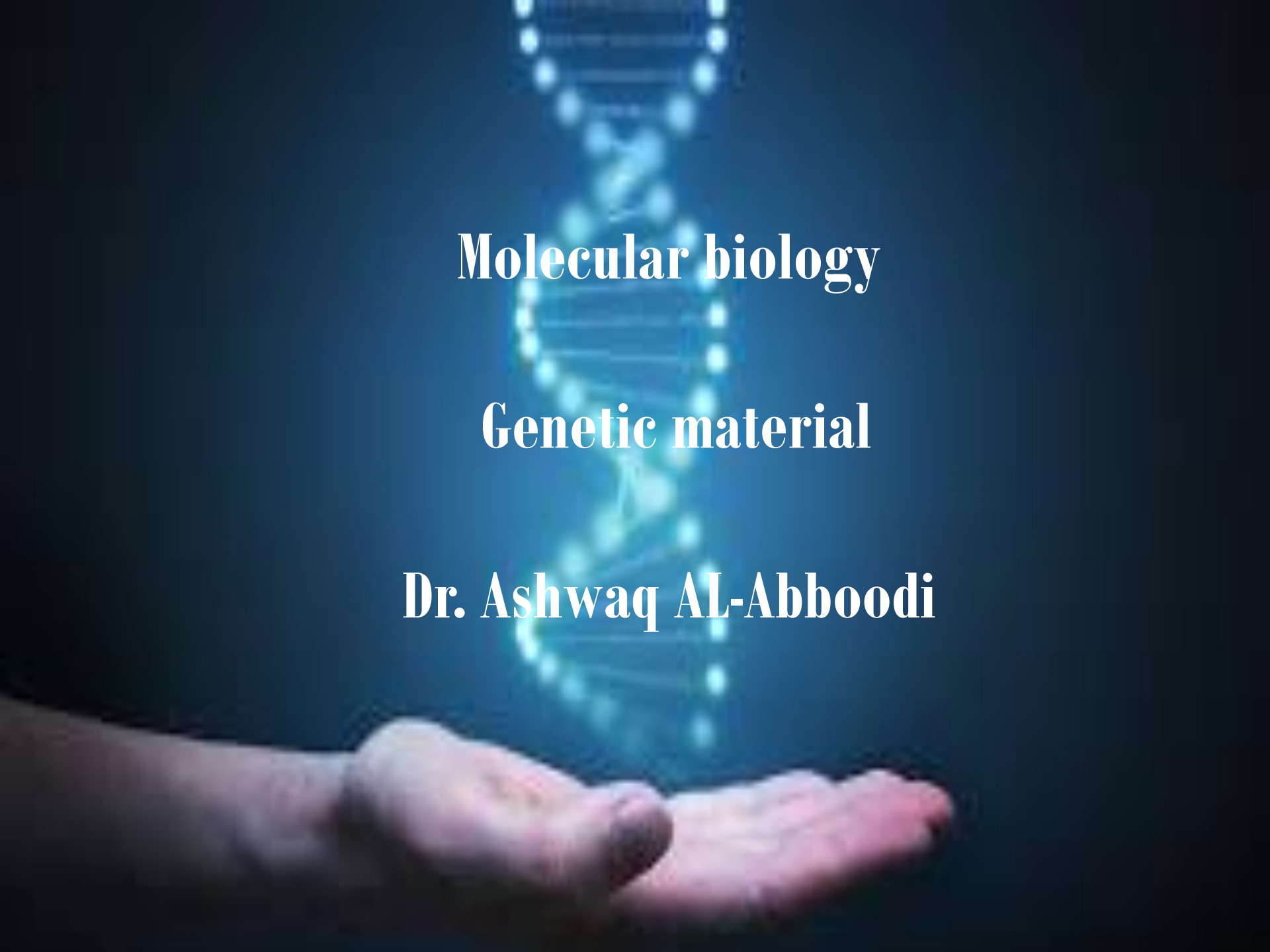


Molecular biology

Genetic material

Dr. Ashwaq AL-Abboodi

DNA replication steps :-

Generally, the synthesis of DNA is aided by specific enzymes called:-

1) **DNA polymerases :- that recognize the template strand and catalyze the addition nucleotide subunits to the polynucleotide chain that is being synthesized.**

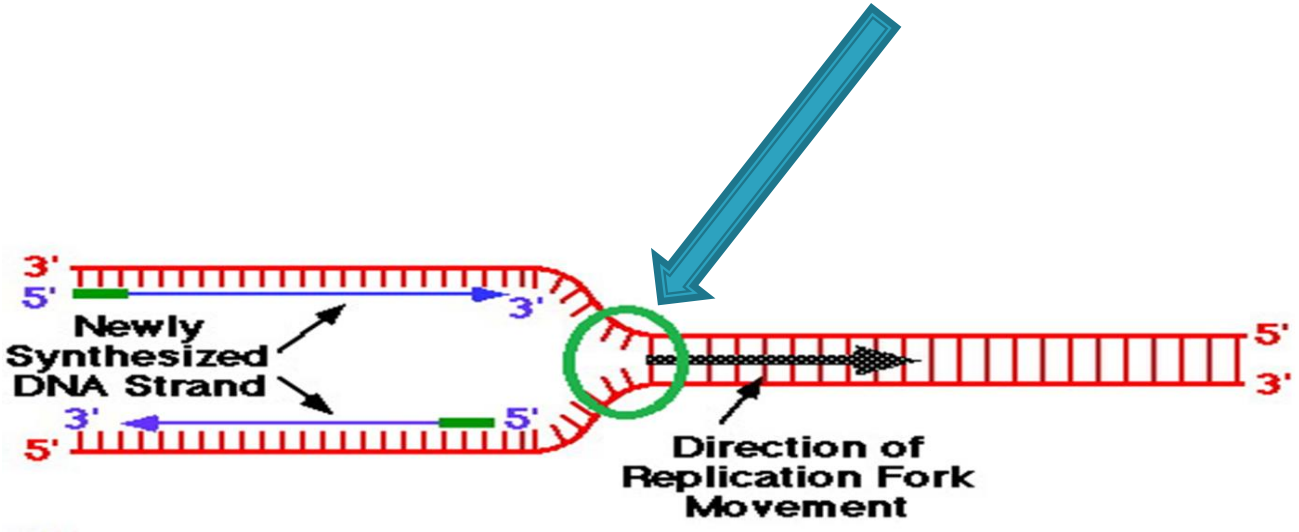
2) **Helicases:- ancillary enzymes that unwind the DNA duplex.**

3) **Primase:- that synthesizes an RNA primer required by DNA polymerase.**

4) **Ligase:- that connects discontinuous DNA strands.**

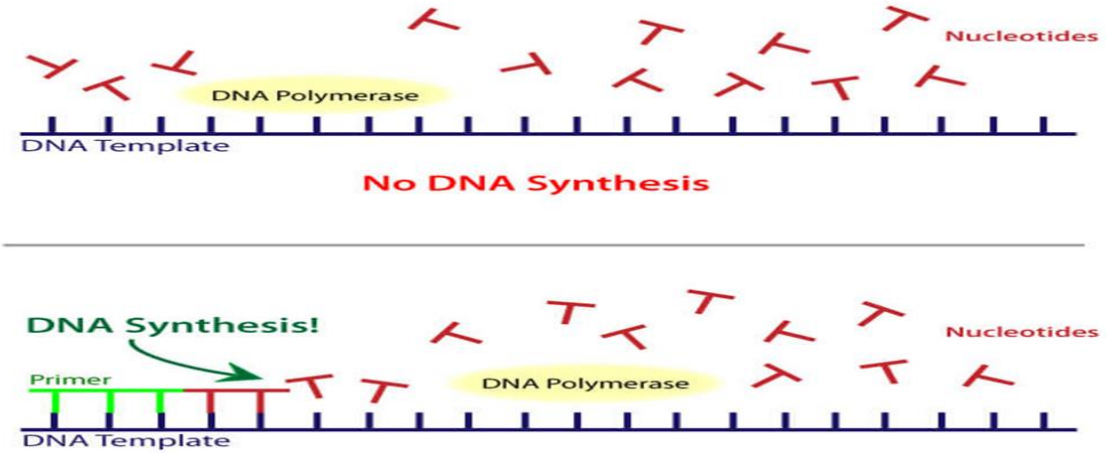
❑ let's go over all the steps of DNA replication

- ❑ The first step occurs when DNA helicase unwinds the double helix by breaking the hydrogen bonds between the parent strands of DNA.
- ❑ This splitting and unwinding process opens up the DNA molecule into a Y-shape, which we call the replication fork. As mention bellow



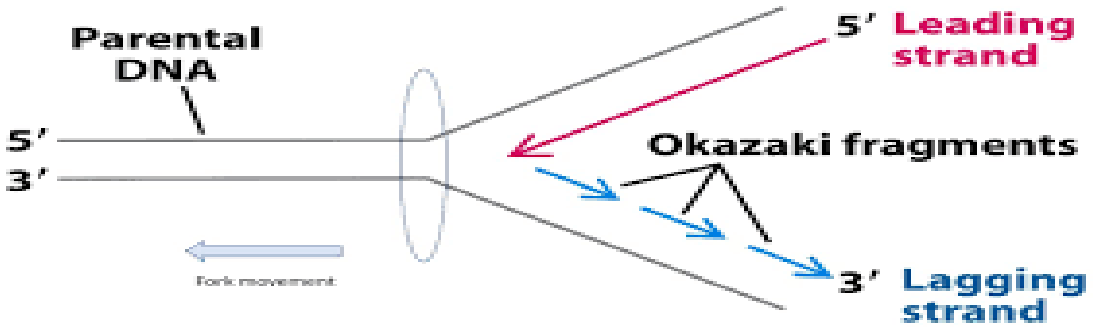
- Before new daughter strands can be added on, the parent strands are first made ready by an RNA primer. The primer is built by the enzyme RNA primase. RNA primase is the enzyme that builds an RNA primer on the parent strand to initiate DNA replication.

- Once the RNA primer is built, then the next enzyme, DNA polymerase, is free to do its job. DNA polymerase slides into the replication fork and positions itself behind the RNA primer. It begins to add DNA nucleotides onto each parent strand. DNA polymerase always works by starting at the 3' end of DNA and moving toward the 5' end. This means that on the leading strand, it works continuously as it follows DNA helicase, which is constantly opening the fork more and more.



- But on the lagging strand, DNA polymerase works discontinuously, making Okazaki fragments in the opposite direction. So, now that we understand what DNA polymerase is the enzyme that matches and lays down nucleotides to build the daughter DNA strand along each parent DNA strand.

- Now we're left with all these Okazaki fragments that are separate from each other, so they need to be joined together by the enzyme DNA ligase. DNA ligase binds the fragments end to end, forming a continuous daughter strand on top of the lagging parent strand. So, that was our last enzyme: DNA ligase joins the adjacent Okazaki fragments on the lagging strand of DNA.

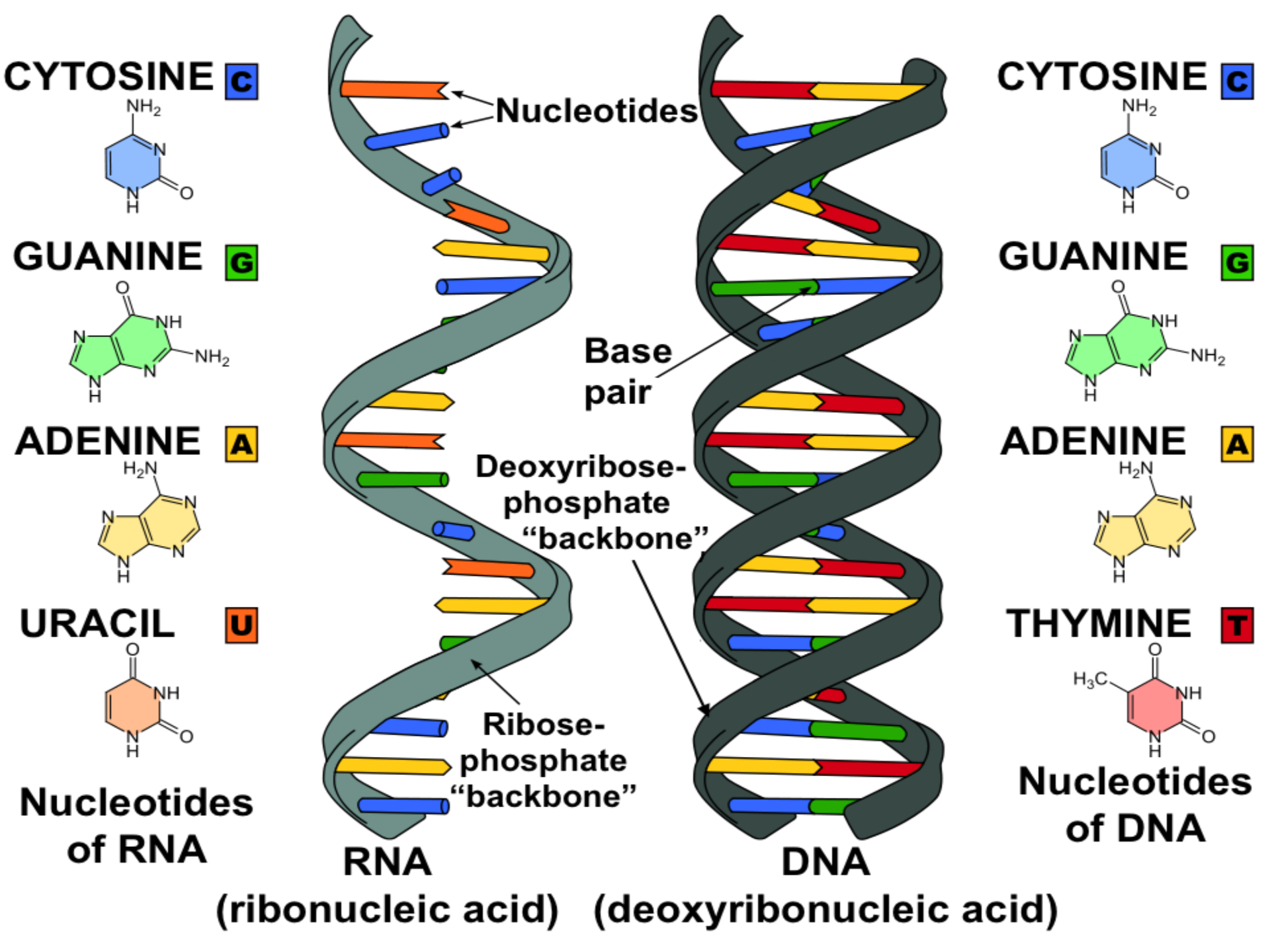


The differences between DNA and RNA

RNA uses the sugar *ribose* instead of *deoxyribose*

RNA is generally single-stranded instead of double-stranded

RNA contains uracil in place of thymine


CYTOSINE C
GUANINE G
ADENINE A
URACIL U
Nucleotides of RNA
Nucleotides
Base pair
Deoxyribose-phosphate "backbone"
Ribose-phosphate "backbone"
RNA
DNA
CYTOSINE C
GUANINE G
ADENINE A
THYMINE T
Nucleotides of DNA
(ribonucleic acid)
(deoxyribonucleic acid)

Protein synthesis process

- is a core biological process which occurring inside cells.
- DNA alone cannot account for the expression of genes.
- RNA is needed to help carry out the instructions in DNA.
- A gene that encodes a polypeptide is expressed in two steps. In this process, information flows from DNA → RNA → protein.
- Proteins are considered a crucial biological components because they perform a variety of critical functions as enzymes, or hormones.
- protein synthesis can be done through two process - transcription and translation.
- The genetic code is read in three-base words called codons. Each codon corresponds to a single amino acid.
- During transcription, a section of DNA encoding a protein, known as a gene.

- The first step in decoding genetic messages is transcription, during which a nucleotide sequence is copied, rewritten or transcribed from DNA to RNA .

- The gene converted into a template molecule called messenger RNA. This conversion is carried out by enzymes, known as RNA polymerases, in the nucleus of the cell.

- The messenger mRNA is exported from the nucleus via nuclear pores to the cytoplasm of the cell for translation to occur.

- translation, the sequence of the mRNA is decoded to specify the amino acid sequence of a polypeptide. The name translation reflects that the nucleotide sequence of the mRNA sequence must be translated into the completely different "language" of amino acids.

- During translation, the mRNA is read by ribosomes which use the nucleotide sequence of the mRNA to determine the sequence of amino acids.

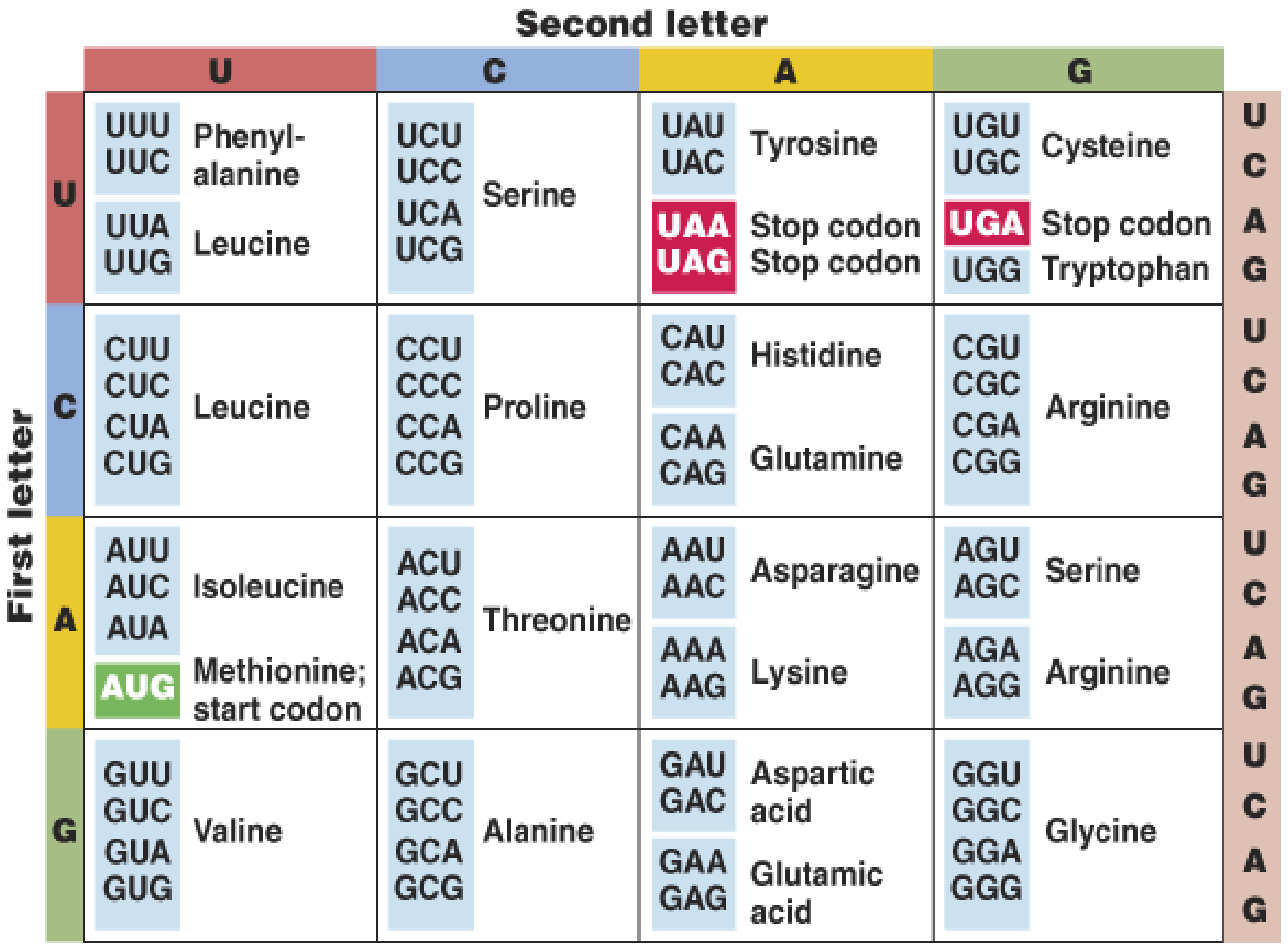
- Ribosomes are complex molecular machines, made of a mixture of protein and ribosome which surround the mRNA molecule.

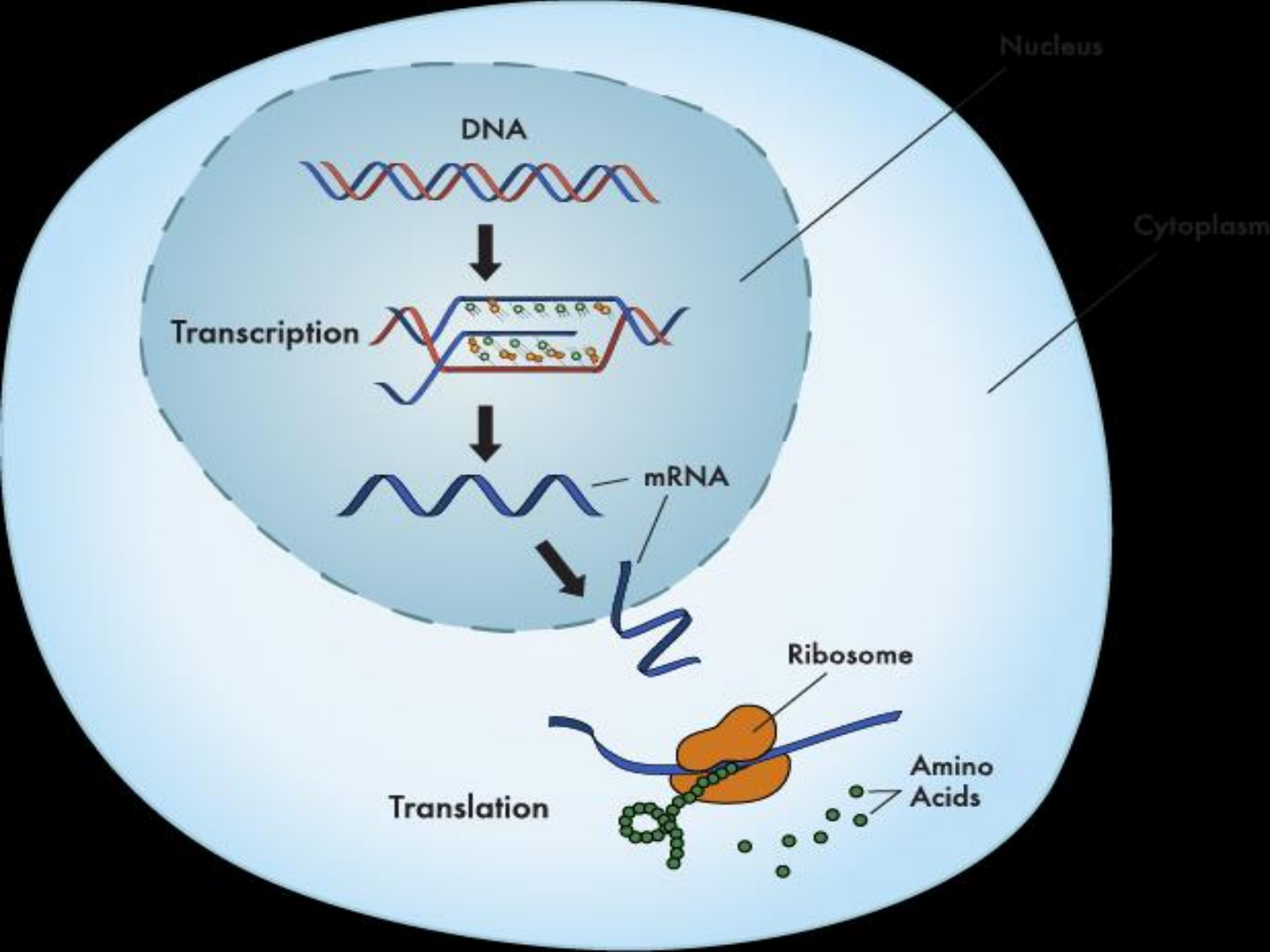
- **The ribosome reads the mRNA molecule in a 5'-3' direction and uses it as a template to determine the order of amino acids in the polypeptide chain.**

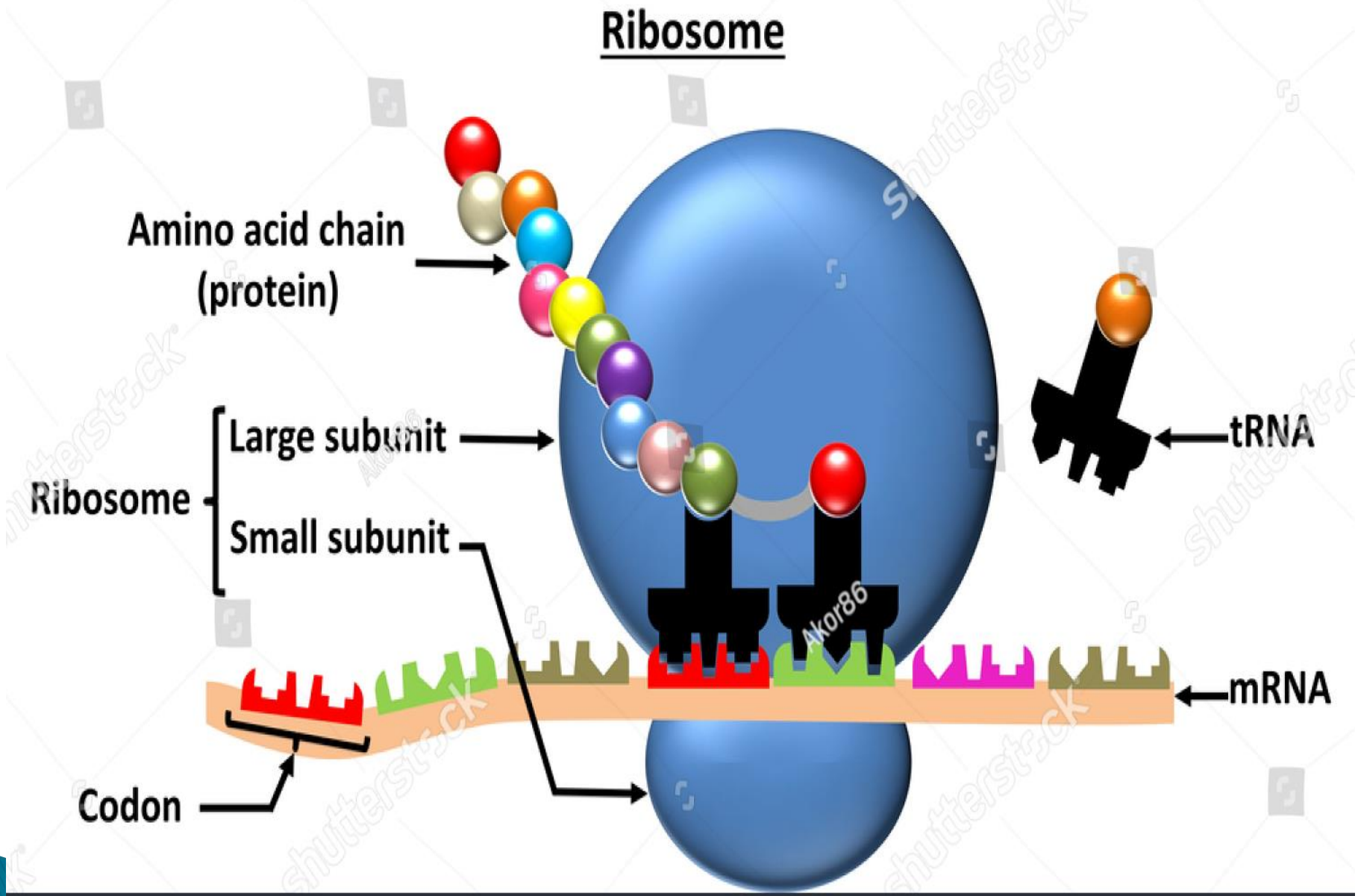
- **In order to translate the mRNA molecule, the ribosome uses small molecules, known as transfer RNAs (tRNA), to deliver the correct amino acids to the ribosome.**

- **Each tRNA is composed of 70-80 nucleotides.**

- **There are around 60 different types of tRNAs, each tRNA binds to a specific sequence of three nucleotides (known as a codon) within the mRNA molecule and delivers a specific amino acid.**


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


Nucleus
DNA
Transcription
mRNA
Cytoplasm
Ribosome
Amino Acids
Translation



Thank You For Your Attention