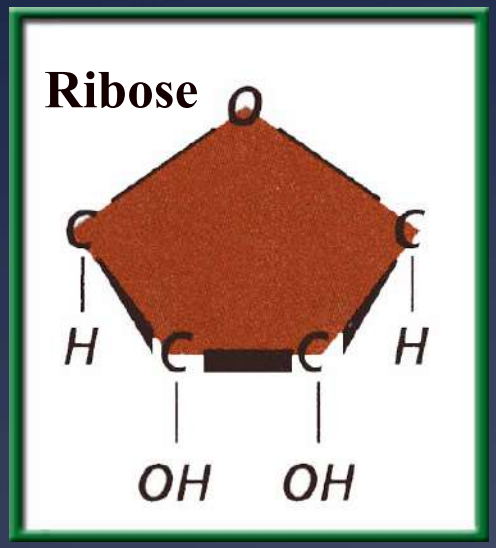
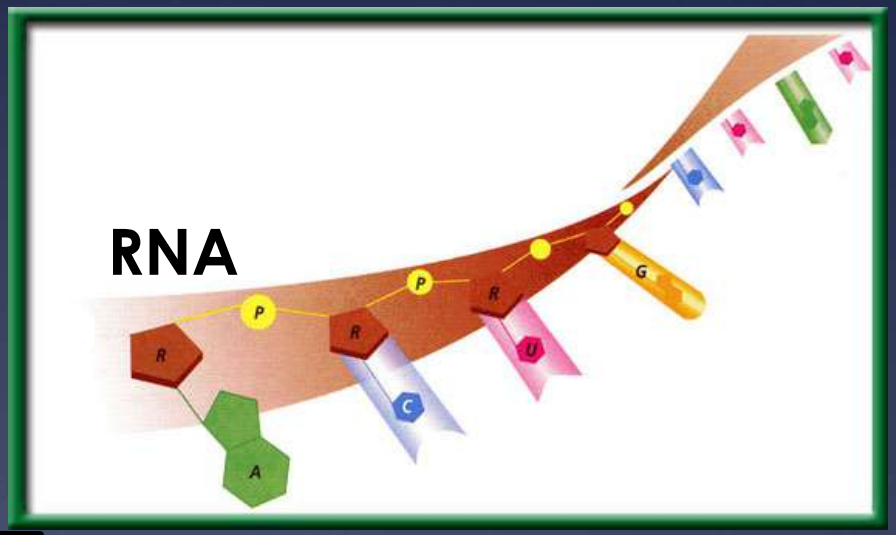
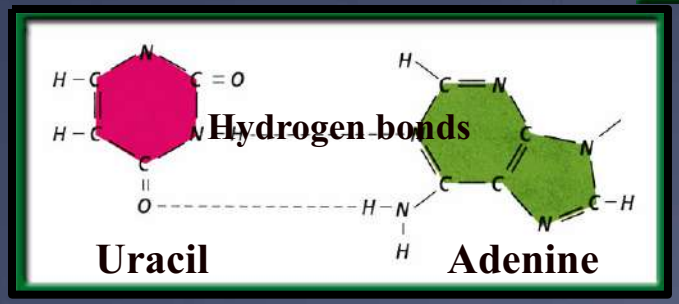
Understanding Protein Synthesis







Biology

Differences between DNA and RNA:

	DNA	RNA
Structure	Double Stranded	Single Stranded
Bases- Purines	Adenine (A)	Adenine (A)
	Guanine (G)	Guanine (G)
Bases - Pyrimidines	Cytosine (C)	Cytosine (C)
	Thymine (T)	Uracil (U)
Sugar	Deoxyribose	Ribose

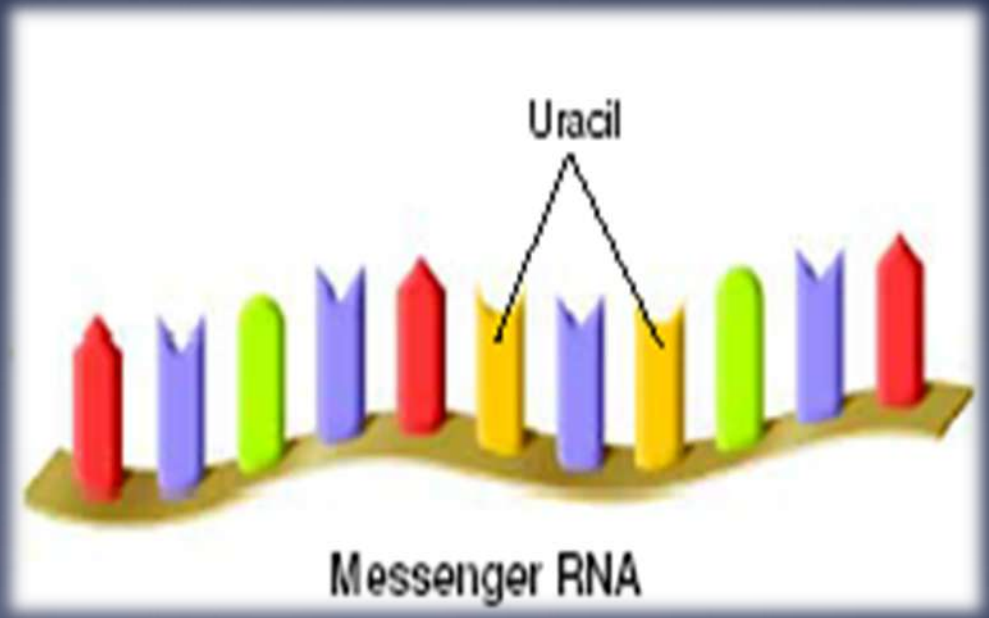
RNA's JOB = Make Proteins!!

Types of RNA

1. messenger RNA ($_{m}$RNA)
2. transfer RNA ($_{t}$RNA)
3. ribosomal RNA ($_{r}$RNA)

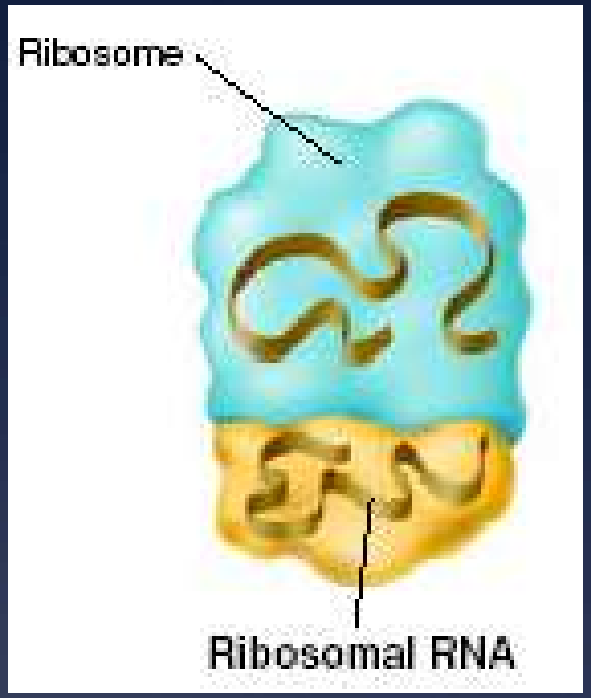
Types of RNA

1) messenger RNA (mRNA)- carries instructions from the DNA in the nucleus to the ribosome



Types of RNA

2) ribosomal RNA (rRNA)- combines with proteins to form the ribosome (proteins made here)



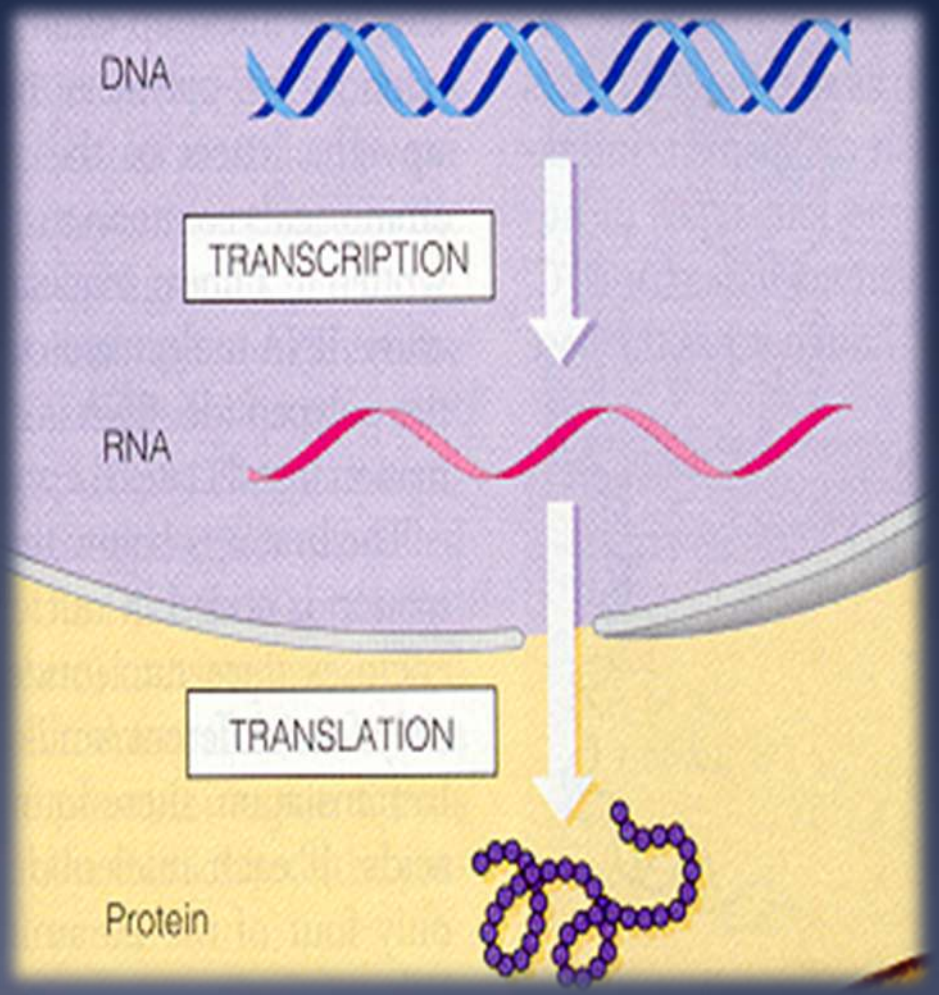
3) transfer RNA (tRNA)- transfers each amino acid to the ribosome as it is specified by coded messages in mRNA during the construction of a protein

Protein Synthesis Overview

There are two steps to making proteins (protein synthesis):

1) Transcription (nucleus)
   DNA → RNA

2) Translation (cytoplasm)
   RNA → protein

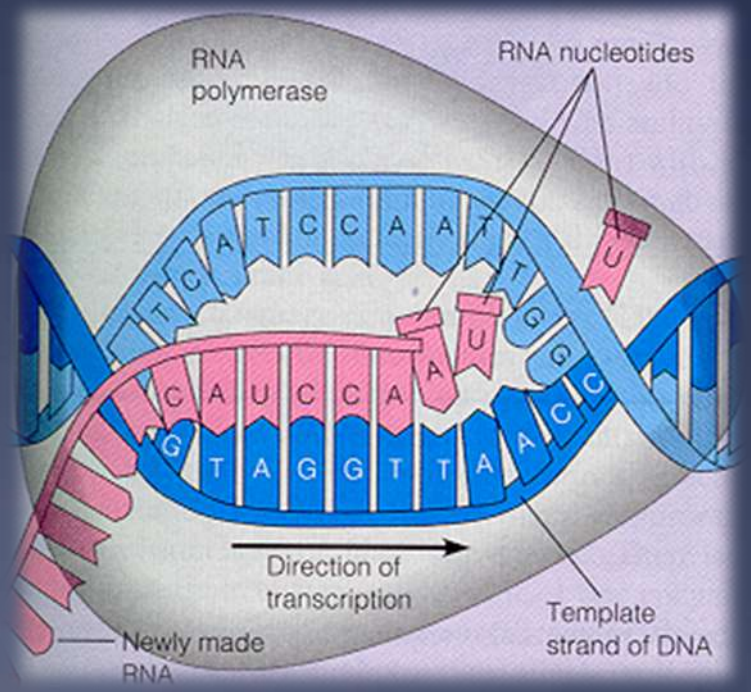


Transcription

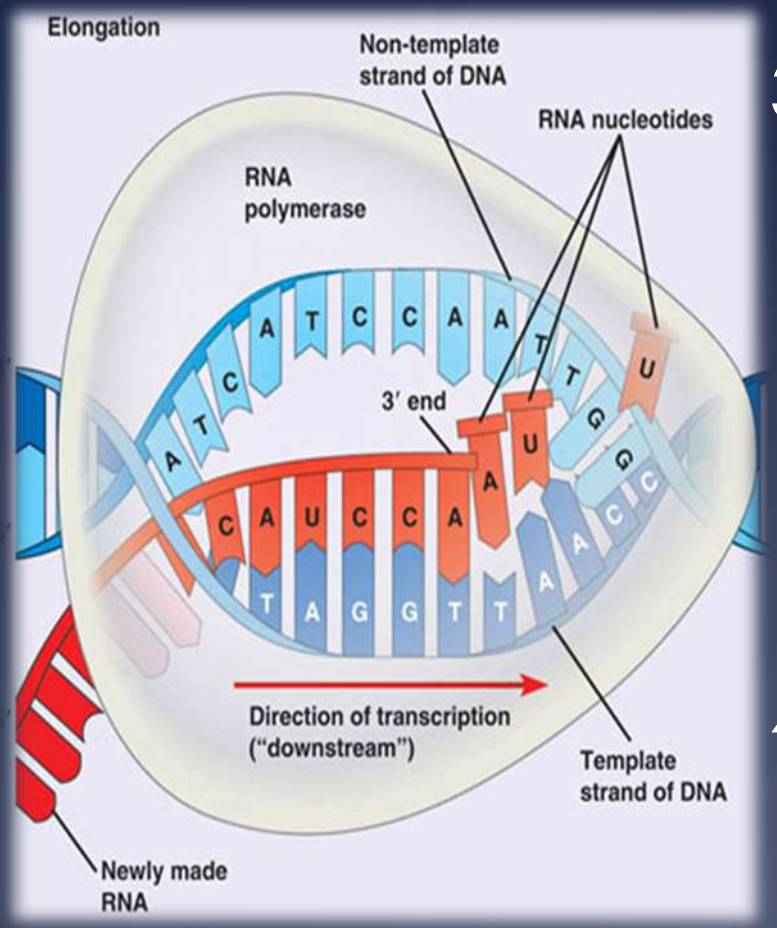
1) Transcription begins when the enzyme RNA polymerase binds to DNA at a promoter region.

Promoters are signals in DNA that indicate to the enzyme where to bind to make RNA.

2) The enzyme separates the DNA strands by breaking the hydrogen bonds, and then uses one strand of DNA as a template from which nucleotides are assembled into a strand of RNA.



Transcription



3) RNA polymerase pairs up free floating RNA nucleotides with DNA template and joins the nucleotides together to form the backbone of the new mRNA strand.
4) When mRNA hits a termination sequence, it separates from the DNA

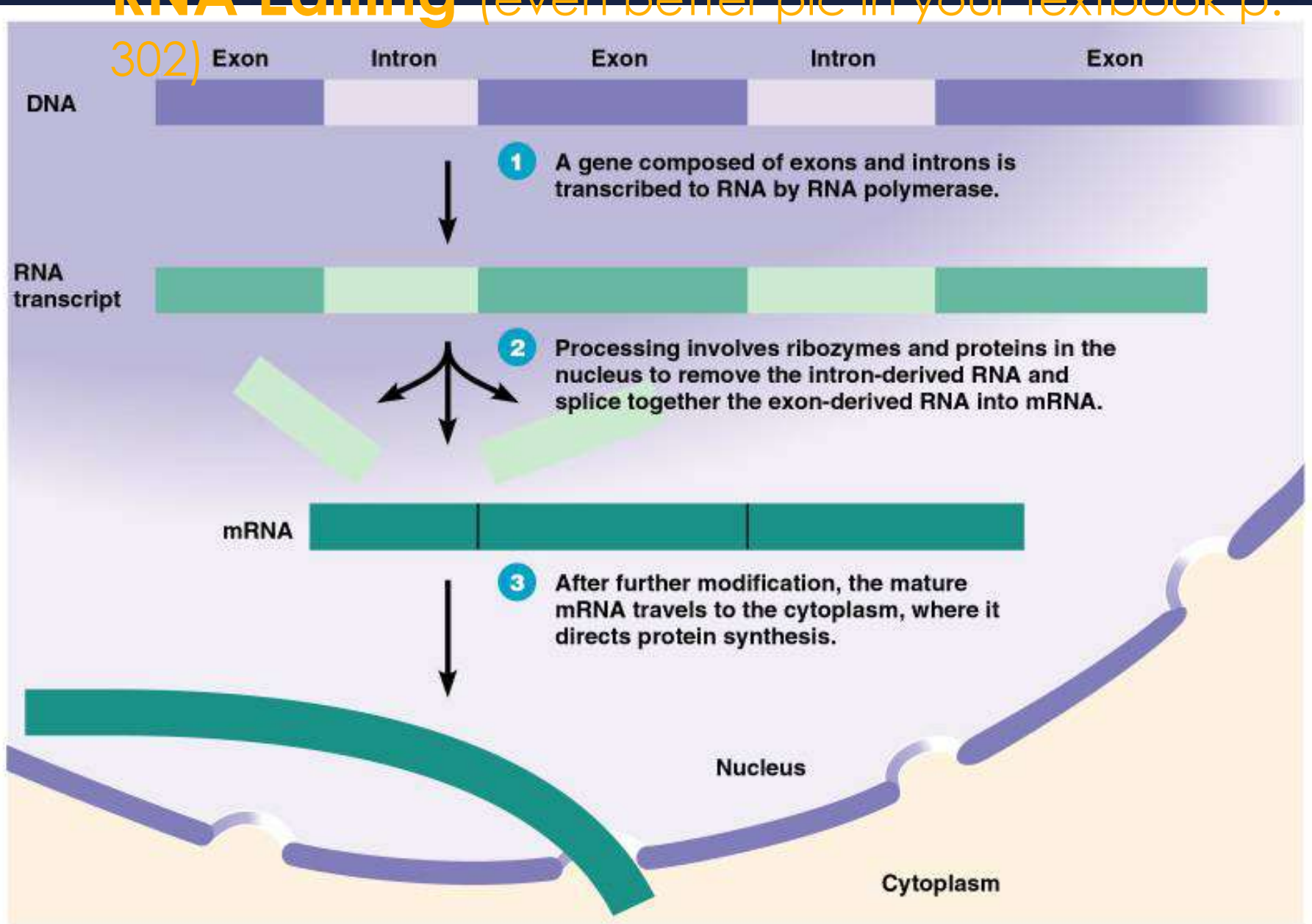
Transcription

5) mRNA editing occurs in the nucleus*

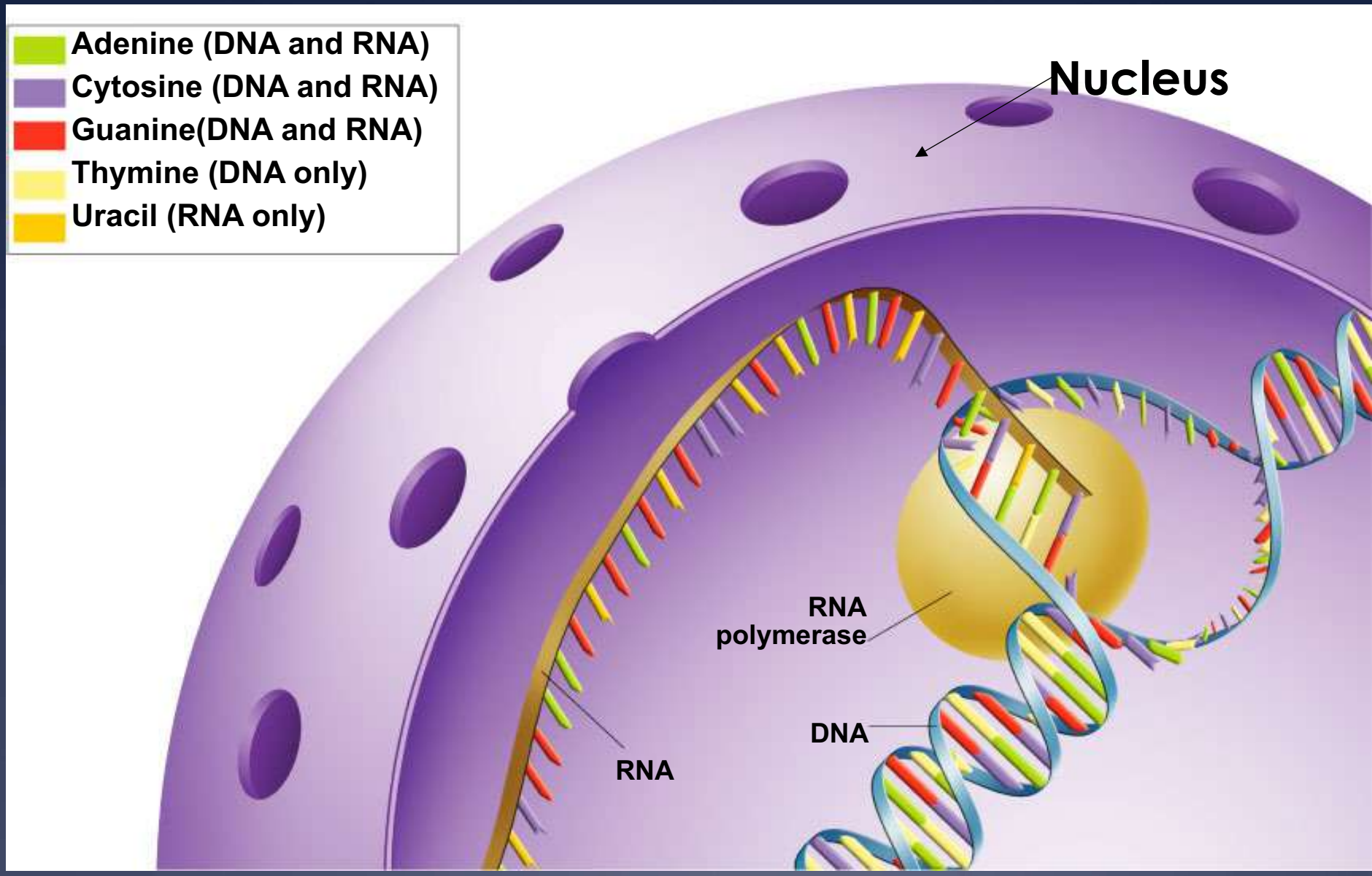
***RNA Editing:** Before the mRNA leaves the nucleus, it is called pre-mRNA and it gets "edited." Parts of the pre-mRNA that are not involved in coding for proteins are called introns and are cut out. The remaining mRNA pieces are called exons (because they are expressed) and are spliced back together to form the mRNA.

6) Then the final mRNA leaves the nucleus through the nuclear poresand enters the cytoplasm headed to the ribosomes.

RNA Editing (even better pic in your textbook p. 302)



Transcription



Transcription vs. Replication

* The main difference: transcription results in the formation of one single-stranded RNA molecule rather than a double-stranded DNA molecule.

Practice

* DNA template
* DNA Complement (replication)
* mRNA (transcription)

ATTCGGAGC

TAAGCCTCG

UAAGCCUCG

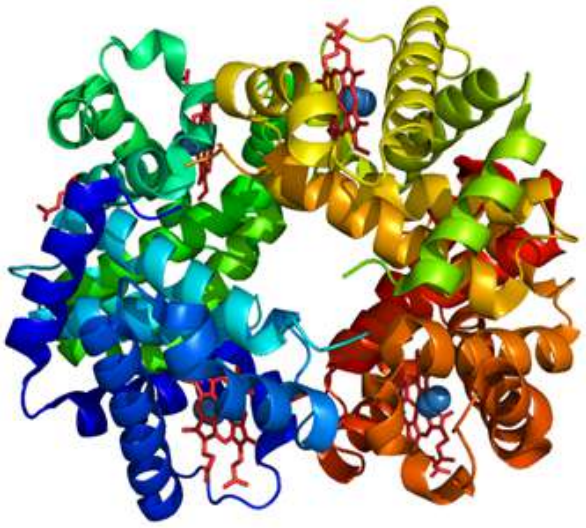
The Genetic Code

Proteins (**polypeptides**) are long chains of amino acids that are joined together.

There are 20 different amino acids. How many come from food?

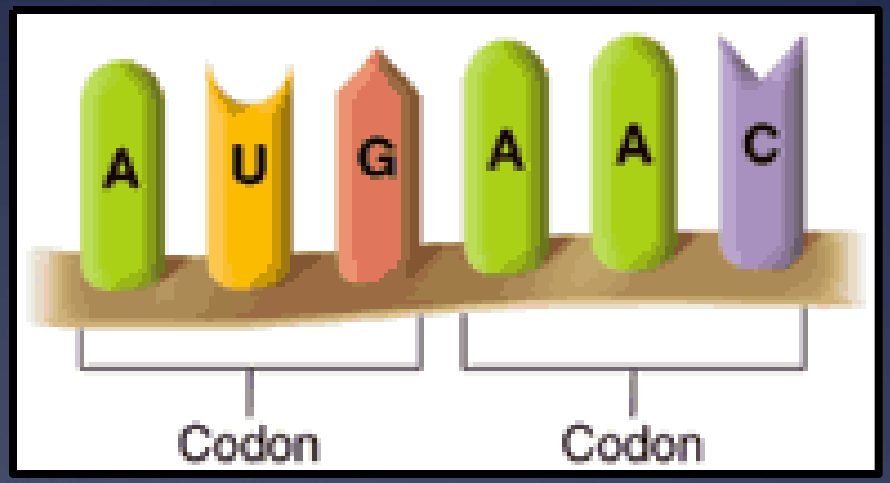
The structure and function of proteins are determined by the order in which different amino acids are joined together to produce them.

The four bases (letters) of mRNA (A, U, G, and C) are read three letters at a time (and translated) to determine the order in which amino acids are added to a protein.



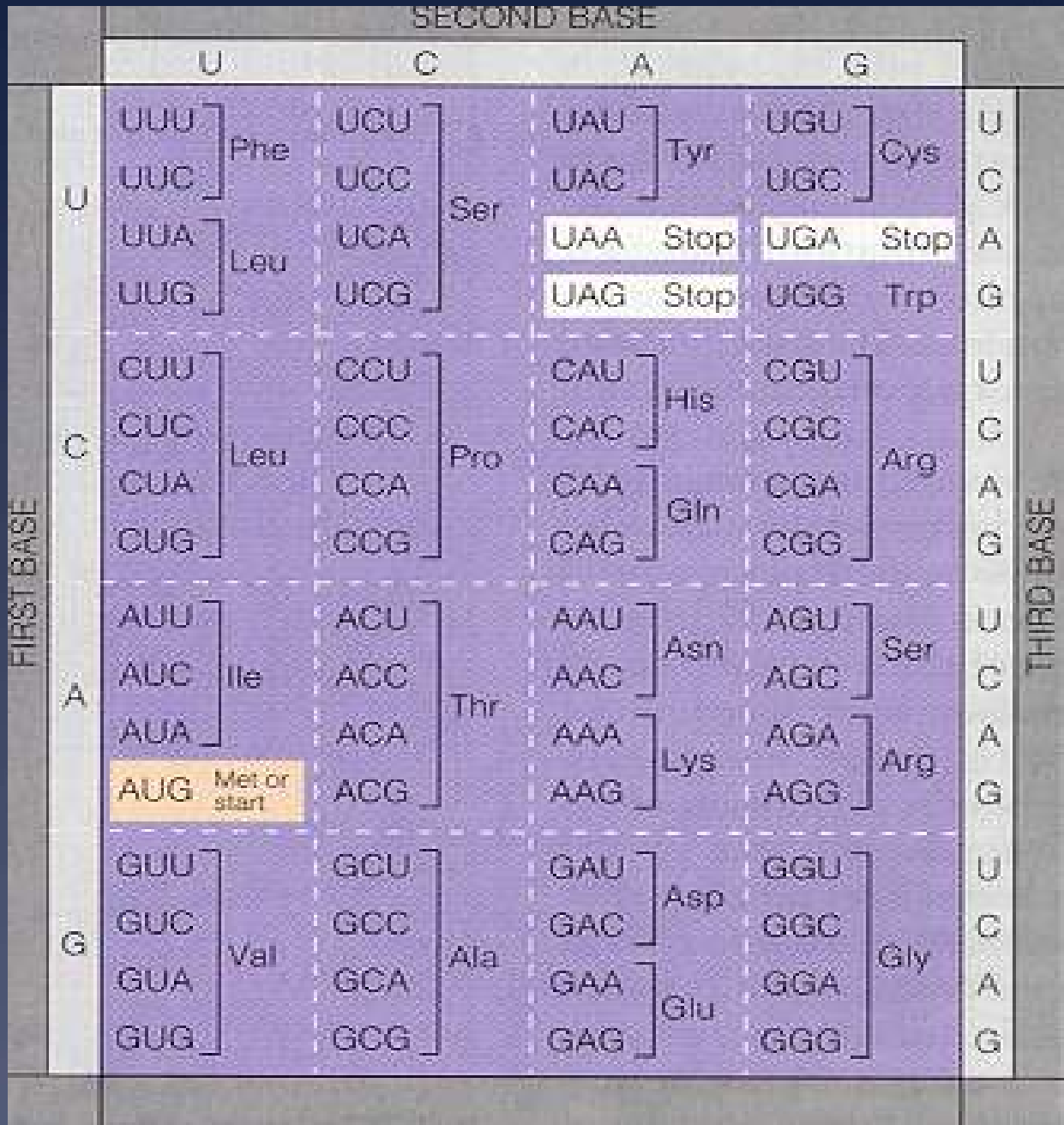
The Genetic Code

A codon consists of three consecutive nucleotides that specify a single amino acid that is to be added to the polypeptide (protein).

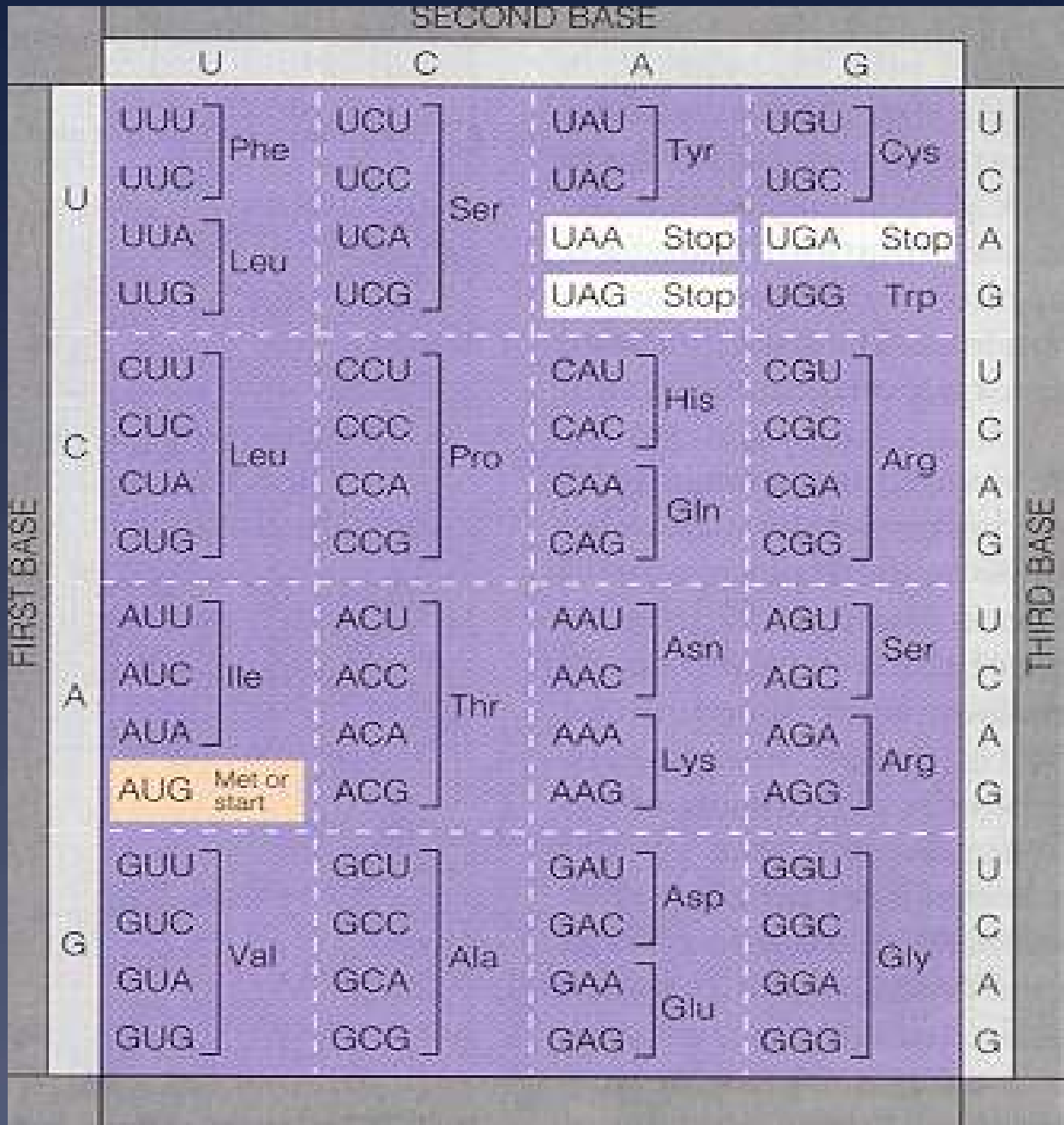


The Codon Table

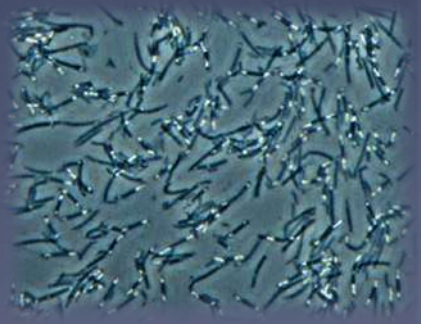
* Sixty-four combinations are possible when a sequence of three bases are used; thus, 64 different mRNA codons are in the genetic code.



* Some codons do not code for amino acids; they provide instructions for making the protein.
* More than one codon can code for the same amino acid.

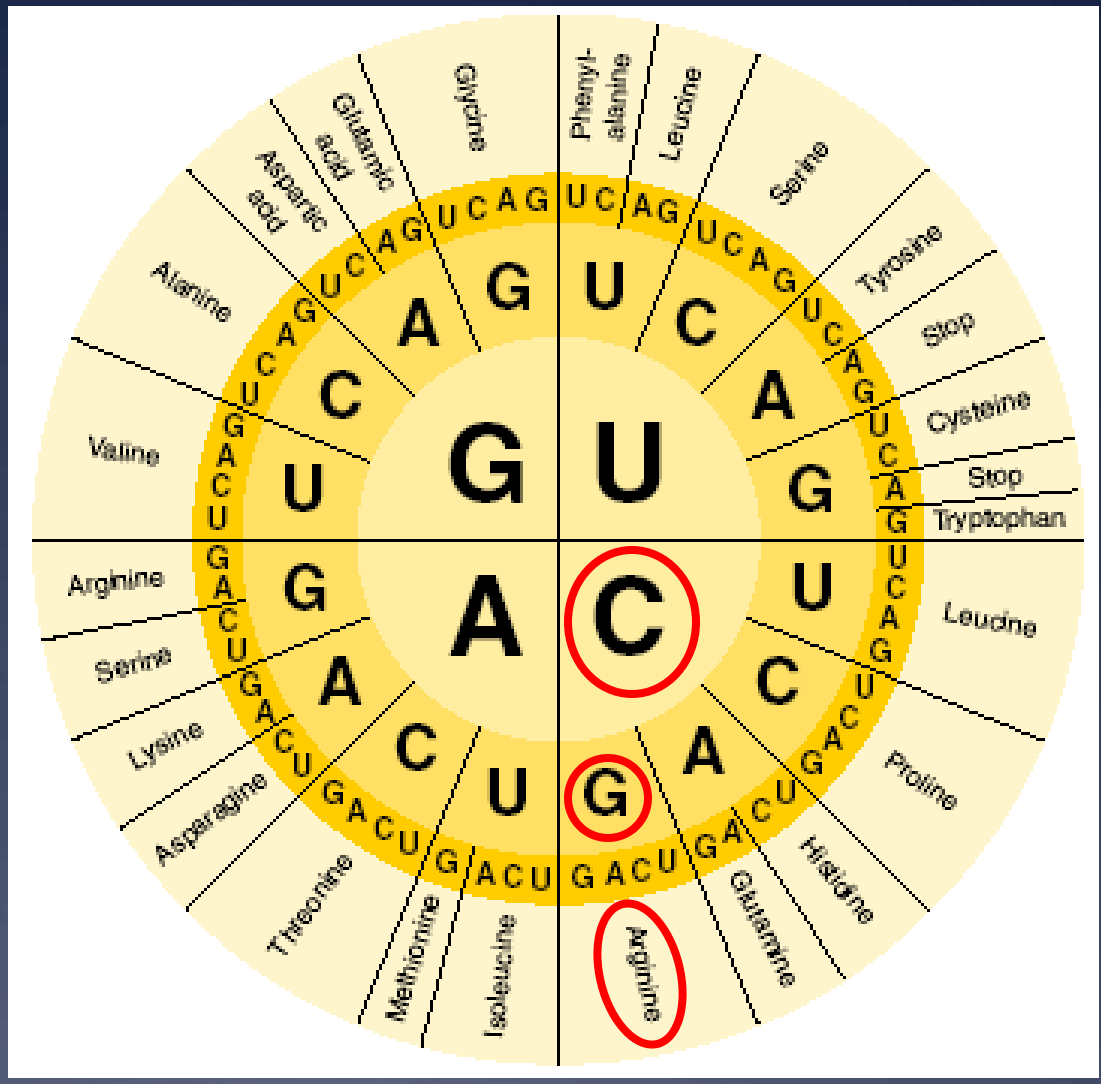


- All organisms use the **same** genetic code **(A,T,C,G).**
  - This provides evidence that all life on Earth evolved from a common **origin**.



Cracking the Code

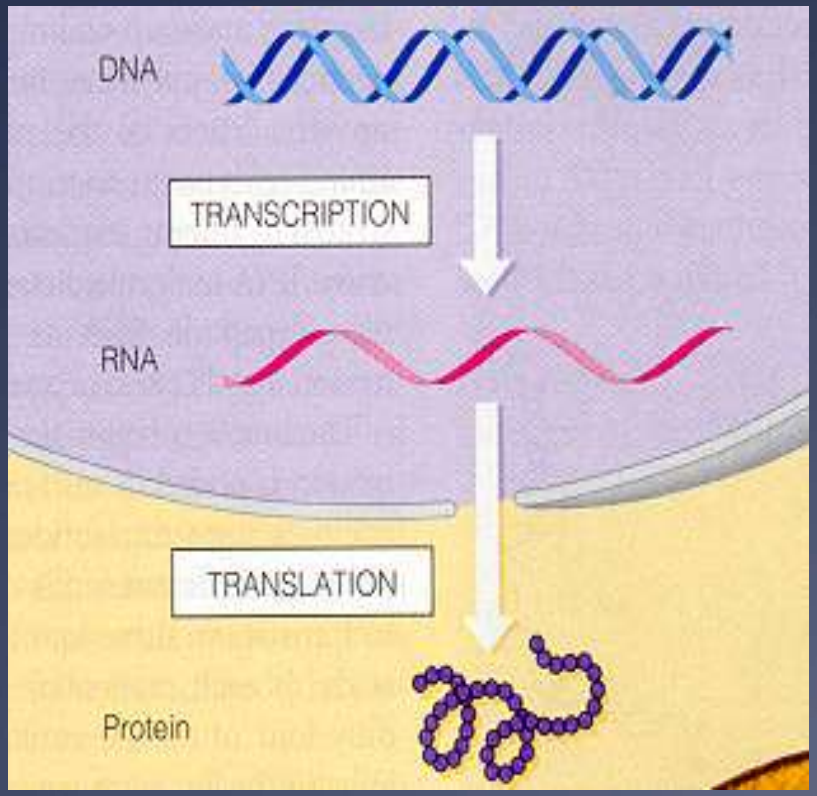
- This picture shows the amino acid to which each of the **64** possible codons corresponds.
- To decode a codon, start at the middle of the circle and move outward.
- Ex: **CGA**
- **Arginine**
- Ex: **GAU**
- **Aspartic Acid**

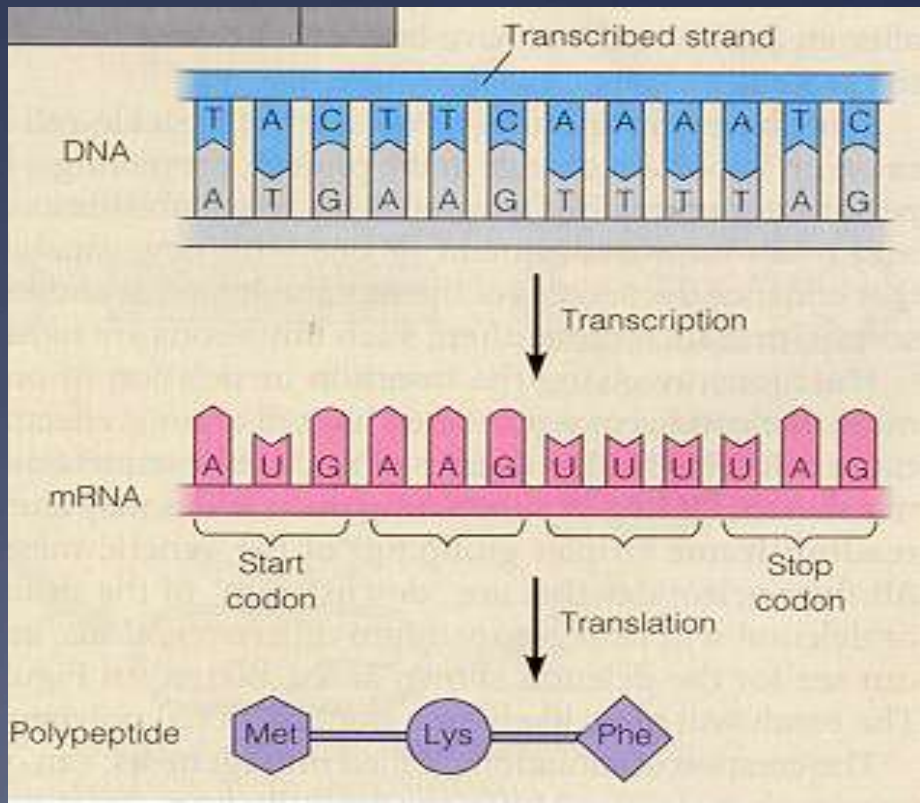


Translation

Translation takes place on ribosomes, in the cytoplasm.

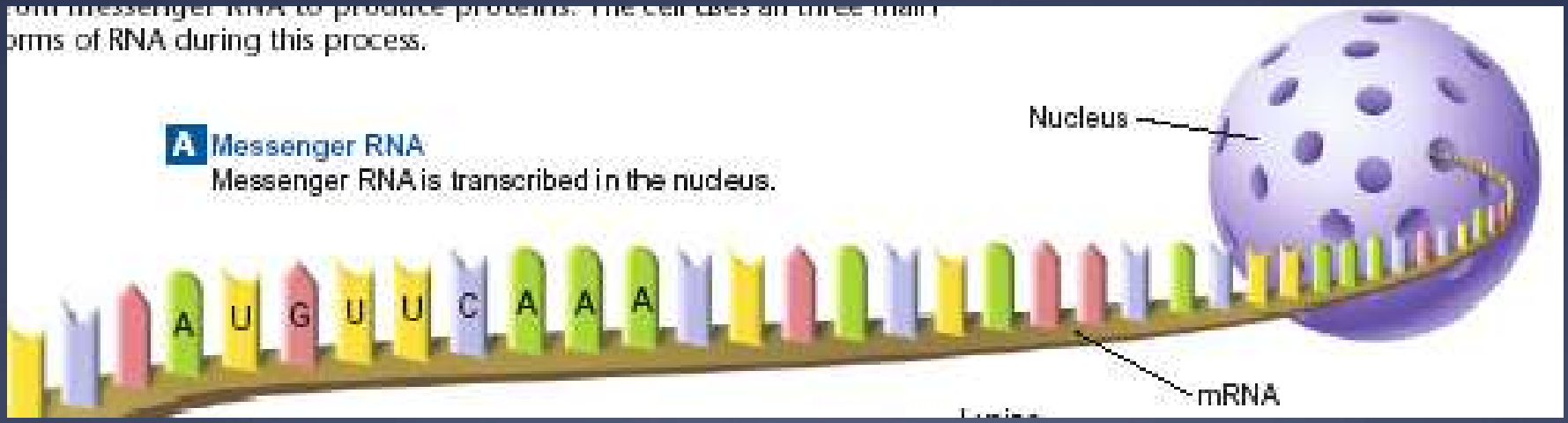
* The cell uses information from messenger RNA (mRNA) to produce proteins, by decoding the mRNA message into a polypeptide chain (protein).





Messenger RNA (mRNA)

1) The mRNA that was transcribed from DNA during transcription, leaves the cell's nucleus and enters the cytoplasm.



Transfer RNA(tRNA)

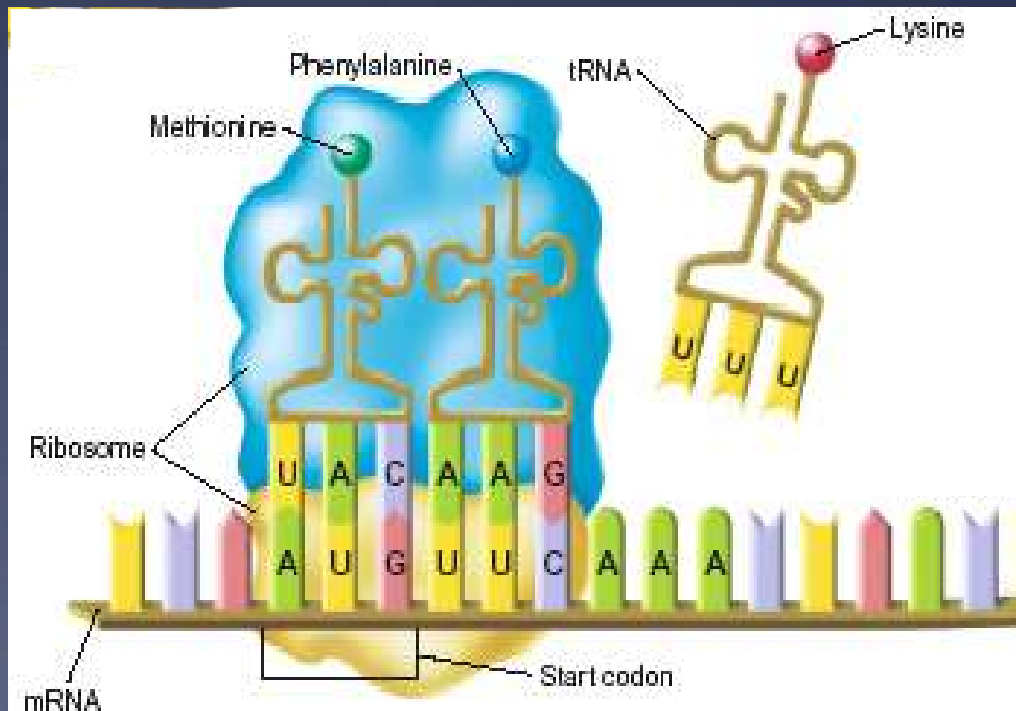
2) The mRNA enters the cytoplasm and attaches to a ribosome at the AUG, which is the start codon. This begins translation.

3) The transfer RNA (tRNA) bonds with the correct amino acid and becomes "charged." (in the cytoplasm)

4) The tRNA carries the amino acid to the ribosome.
   - Each tRNA has an anticodon whose bases are complementary to a codon on the mRNA strand. (The tRNA brings the correct amino acid to the ribosome.)

Ex: The ribosome positions the start codon to attract its anticodon, which is part of the tRNA that binds methionine.

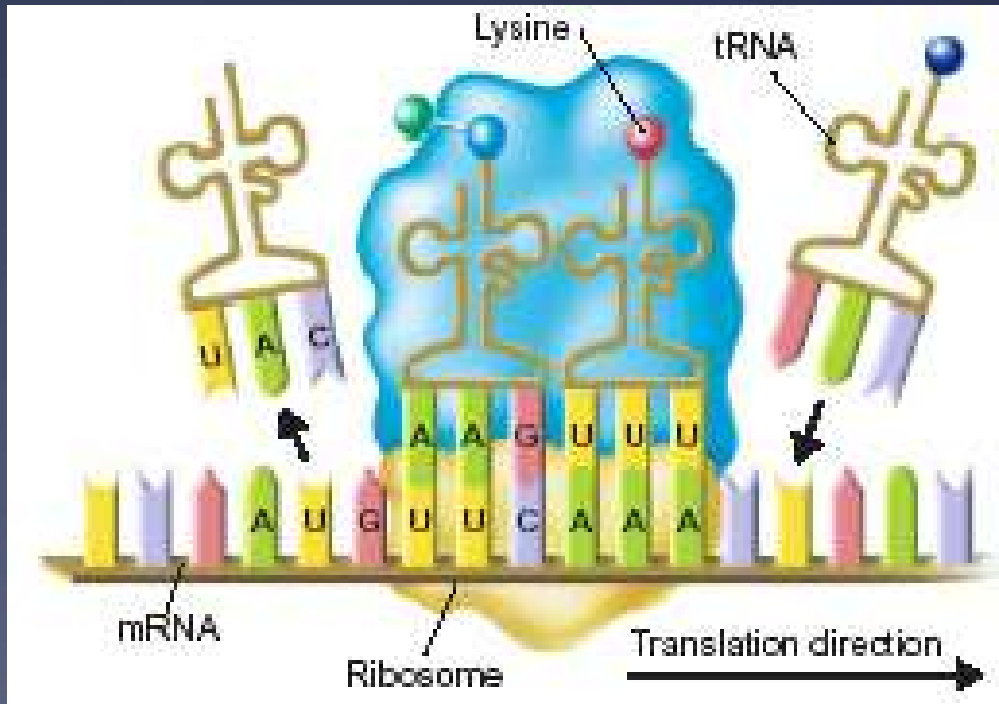
- The ribosome also binds the next codon and its anticodon.



The Polypeptide "Assembly Line"

5) The ribosome moves along the mRNA and adds more amino acids to the growing polypeptide or protein

* The tRNA floats away, allowing the ribosome to bind to another tRNA.
* The ribosome moves along the mRNA, attaching new tRNA molecules and amino acids.



Completing the Polypeptide

6) The process continues until the ribosome reaches one of the three stop codons on the mRNA, and then the ribosome falls off the mRNA.

7) The result is a polypeptide chain or protein that is ready for use in the cell.