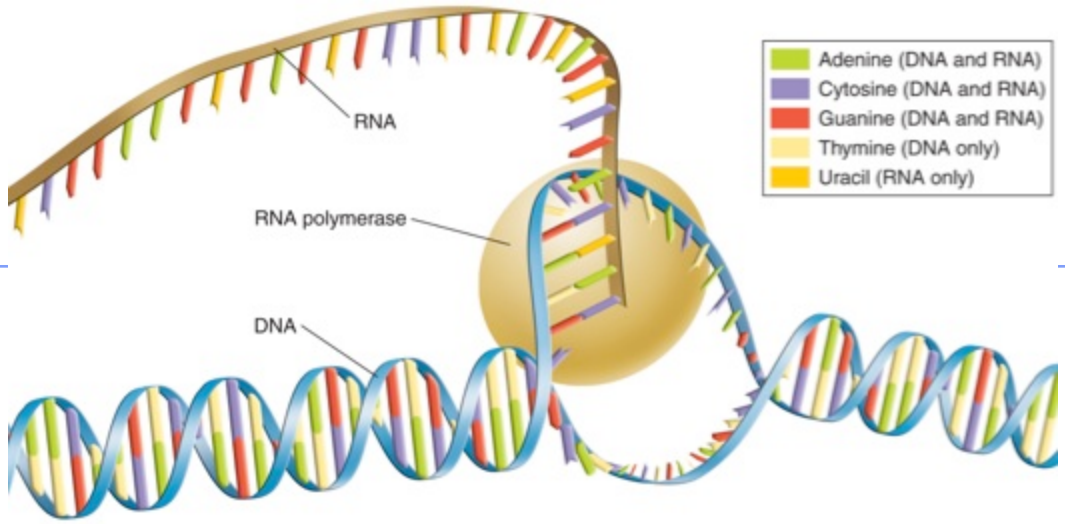
12.3 - RNA and Protein Synthesis

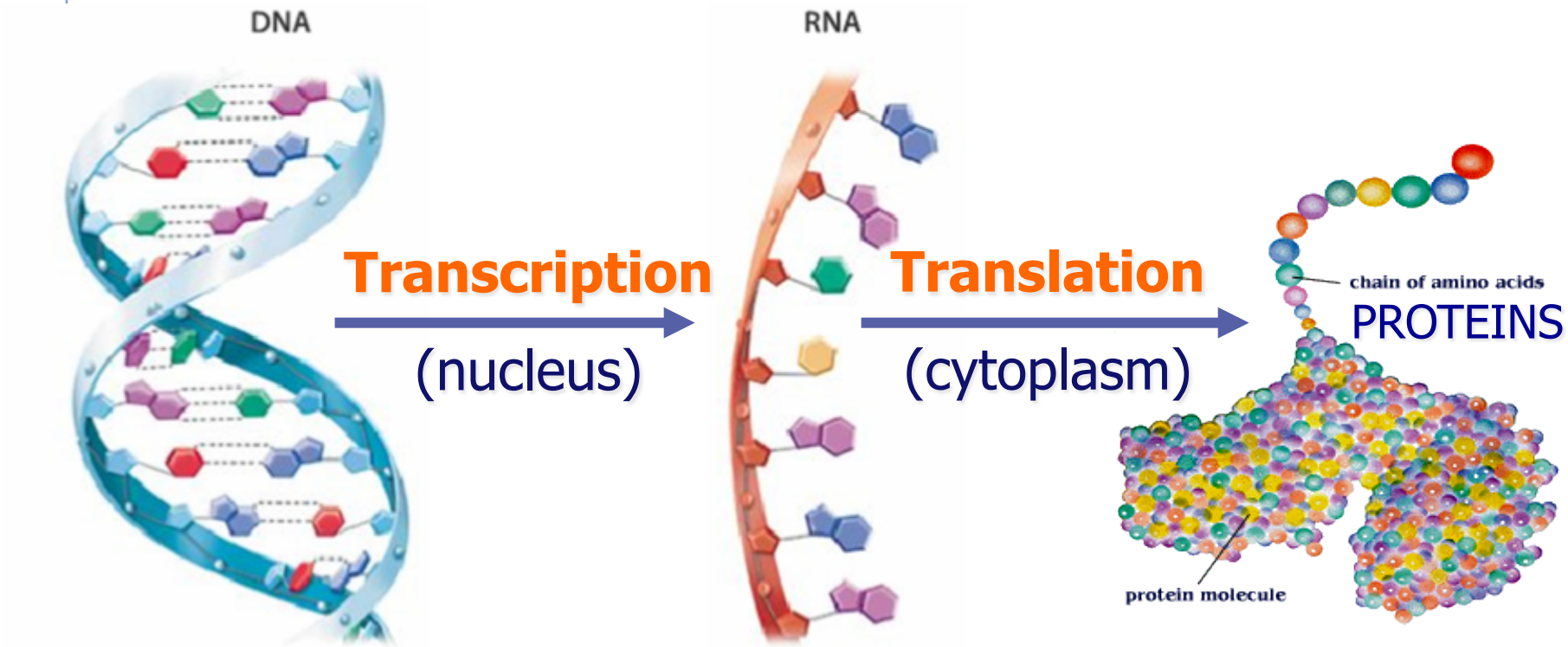


Protein Synthesis

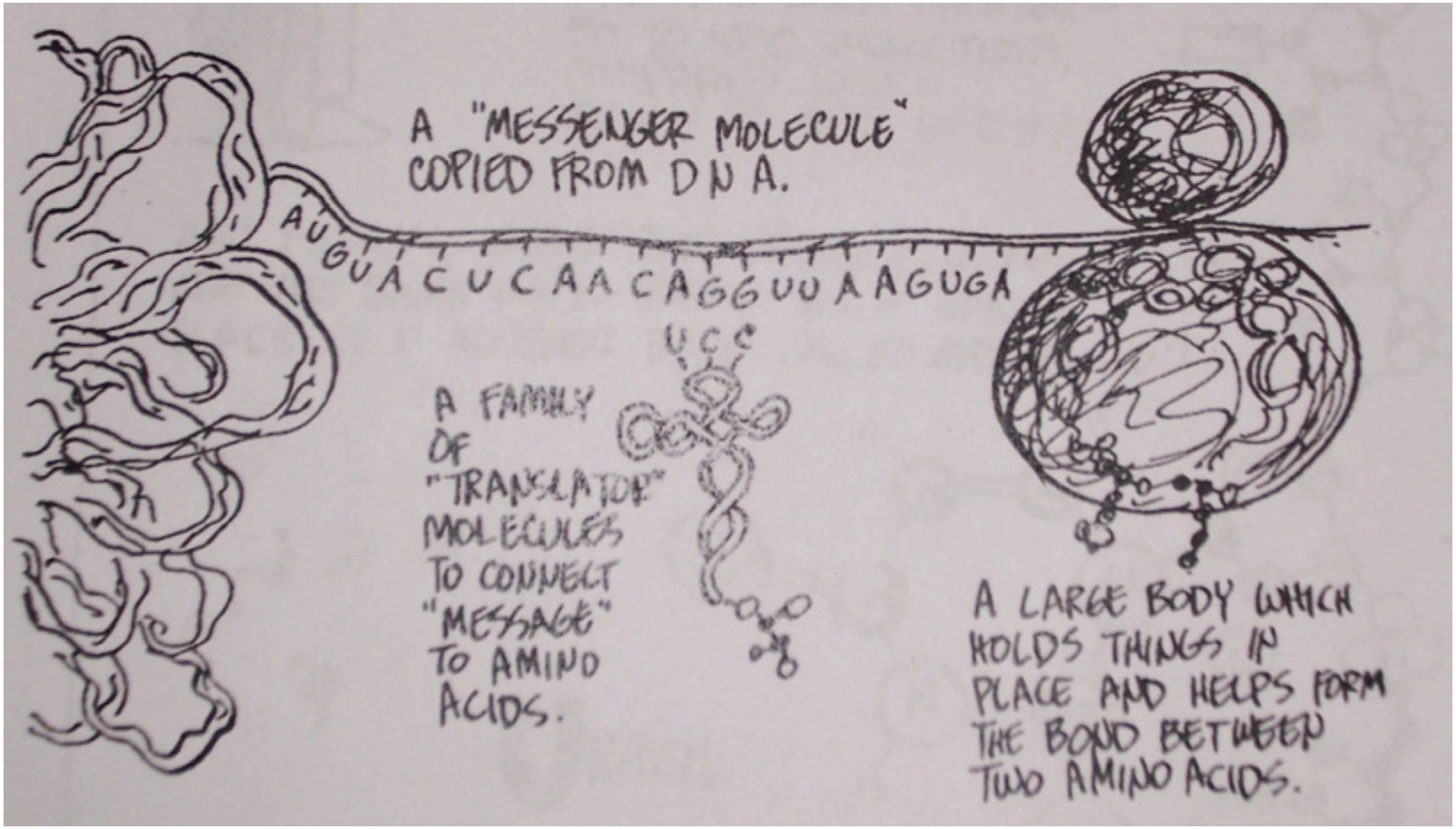
Objectives

- Distinguish **RNA** from **DNA**
- Identify the 3 types of RNA
- Summarize the steps of **transcription** and explain how RNA is edited
- Summarize the steps of **translation**

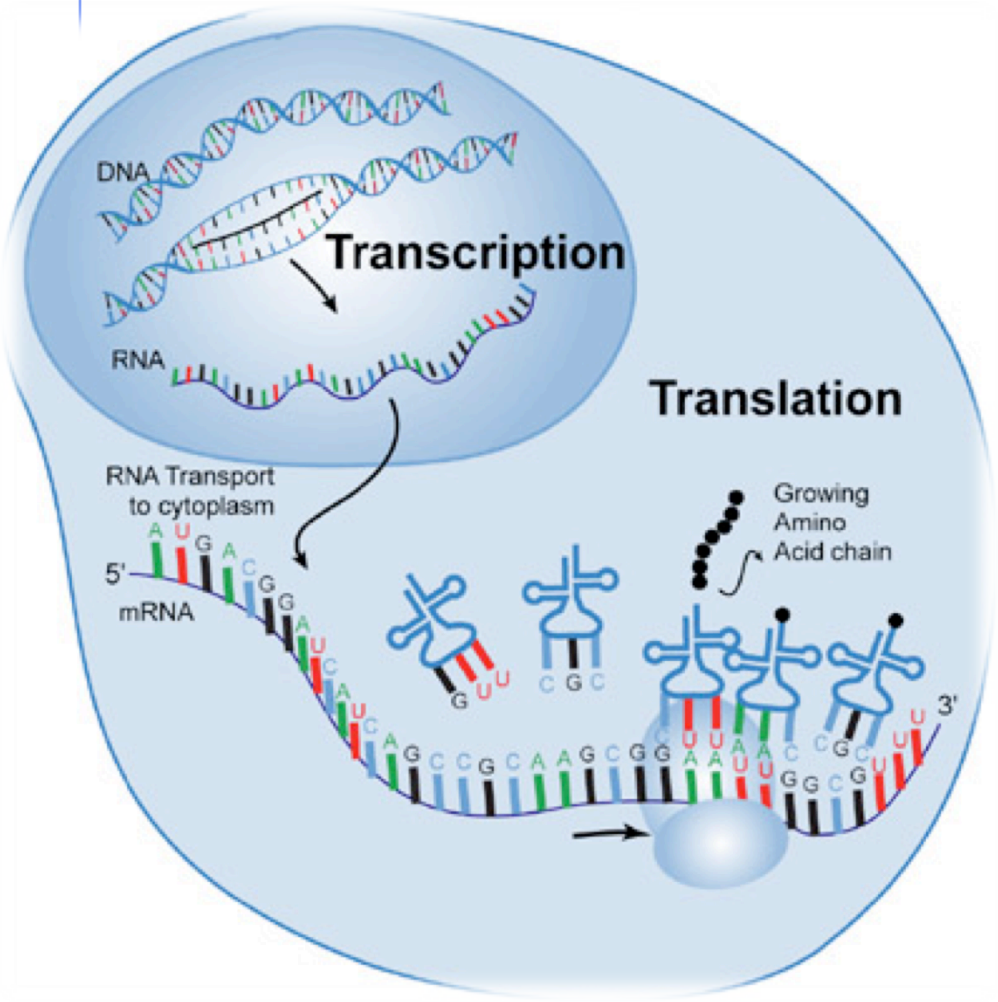
The Central Dogma



The Central Dogma

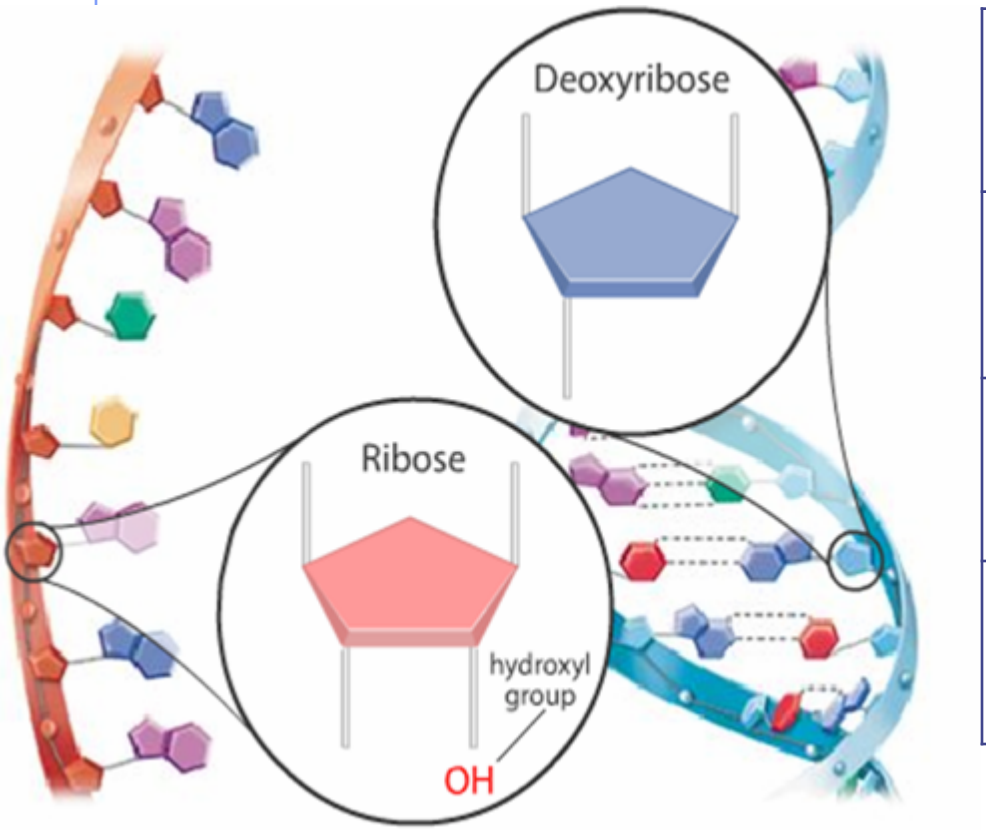


RNA and Protein Synthesis



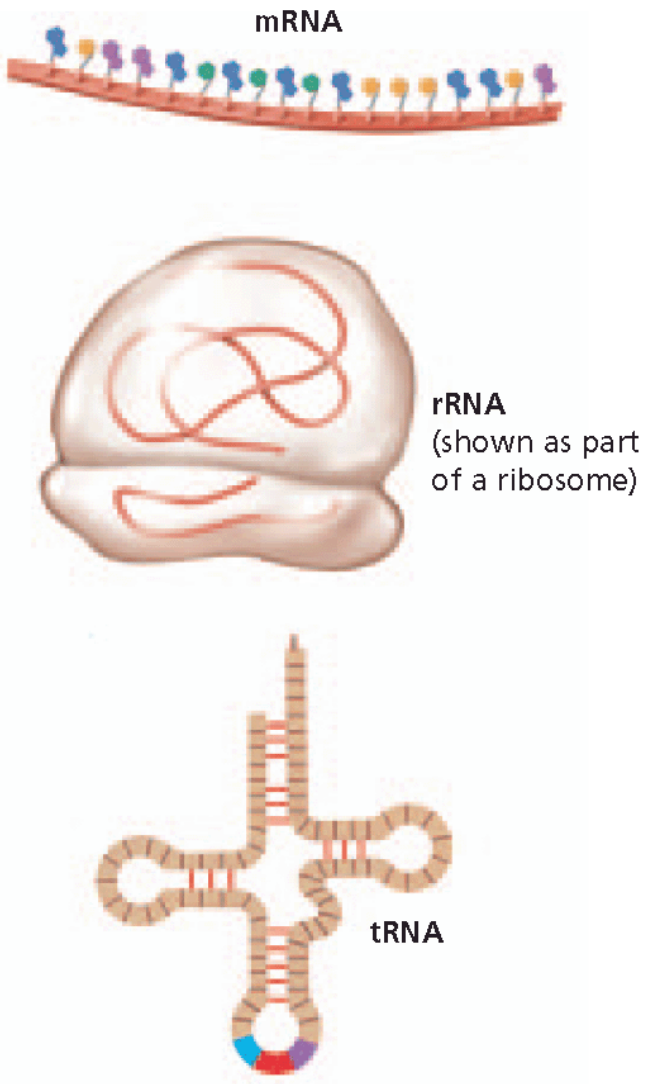
- **Traits** are determined by **proteins** that are built as coded in DNA.
- **Protein synthesis** occurs in the cytoplasm (while DNA is in the nucleus). Thus, **RNA** acts as a **go-between message**.
- Like DNA, RNA is a nucleic acid.

RNA vs. DNA

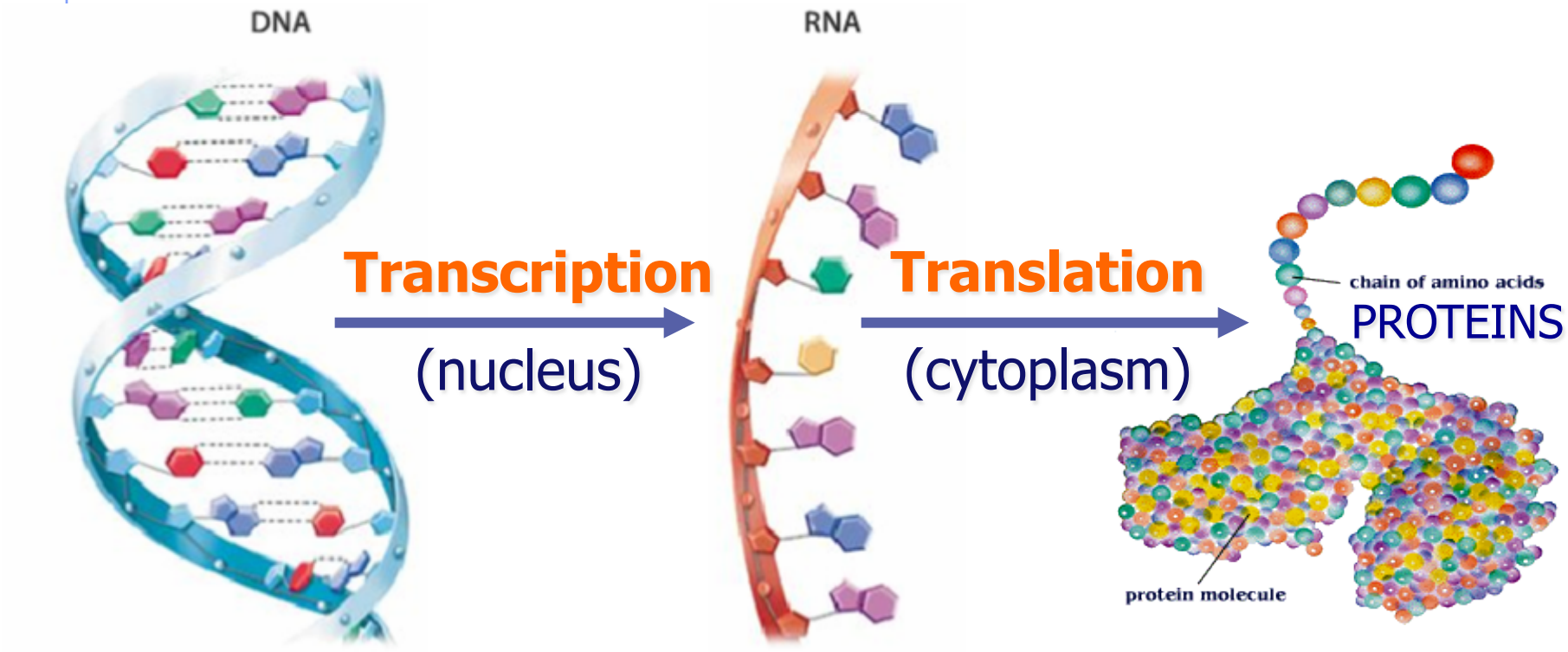


RNA	DNA
Single strand	Double strands
Ribose	Deoxyribose
Uracil (U)	Thymine (T)

- **Messenger RNA** (mRNA) delivers information from DNA to the ribosome.
- **Ribosomal RNA** (rRNA) are parts of the structure of ribosome.
- **Transfer RNA** (tRNA) carries and eventually transfers amino acids.



The Central Dogma



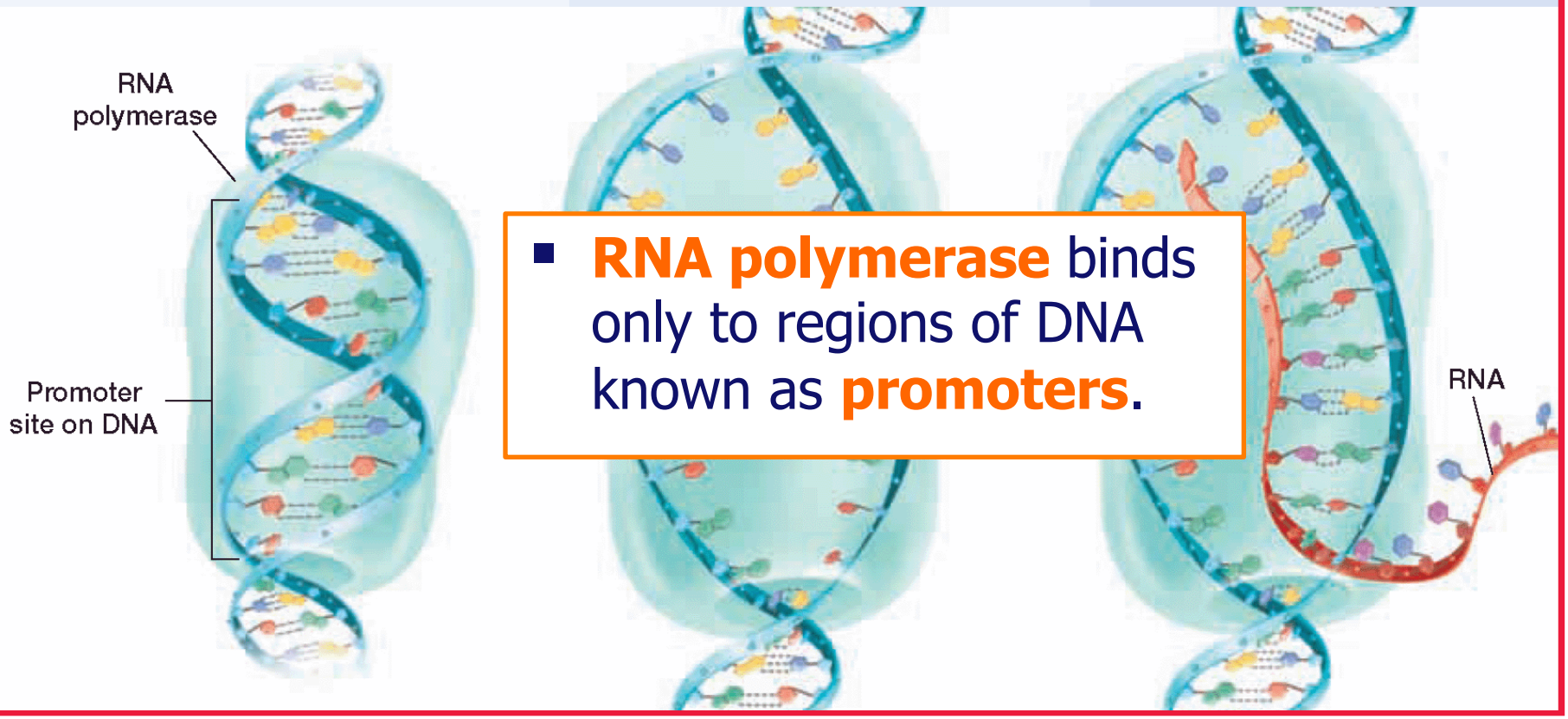
- **Transcription** – Information from DNA (a master copy) is "rewritten" into RNA (a blueprint).

BIO graphic

Transcription: Making RNA

RNA polymerase adds complementary RNA nucleotides as it reads the gene.

1. RNA polymerase binds to the gene's promoter.
2. The two DNA strands unwind and separate.
3. Complementary RNA nucleotides are added.



- **RNA polymerase** binds only to regions of DNA known as **promoters**.

BIO graphic

Transcription: Making RNA

RNA polymerase adds complementary RNA nucleotides as it reads the gene.

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- The two DNA strands unwind and separate.

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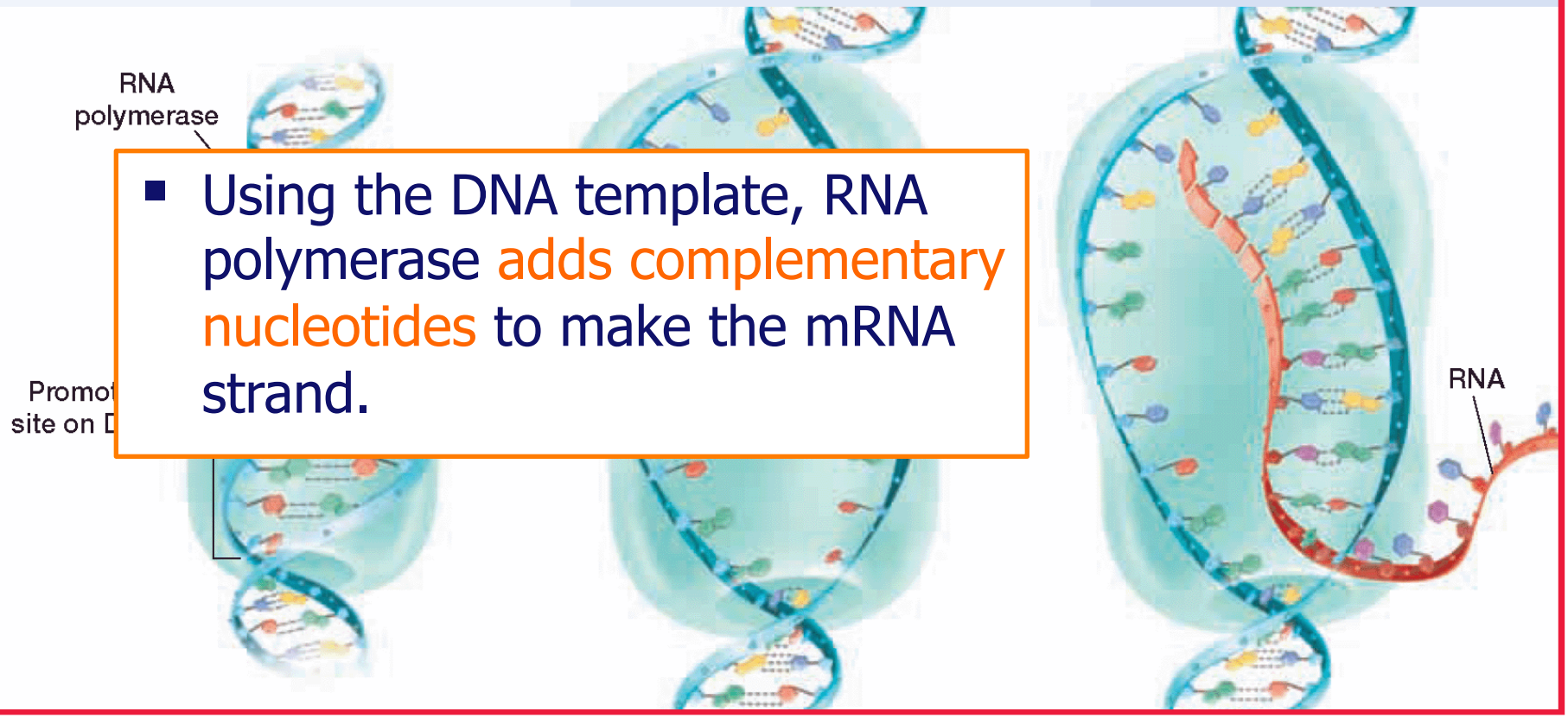
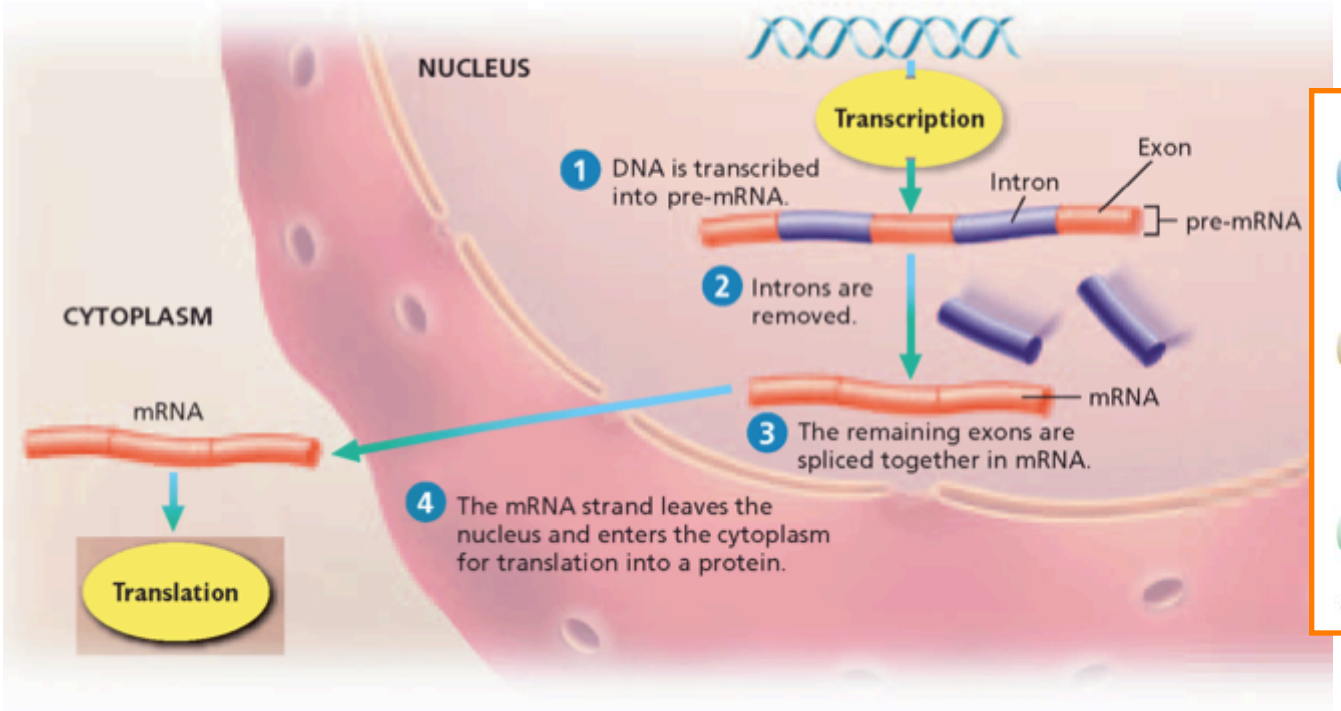
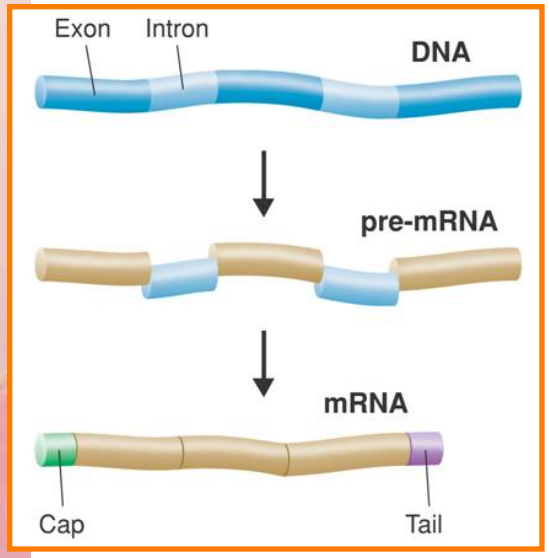


- Using the DNA template, RNA polymerase adds complementary nucleotides to make the mRNA strand.

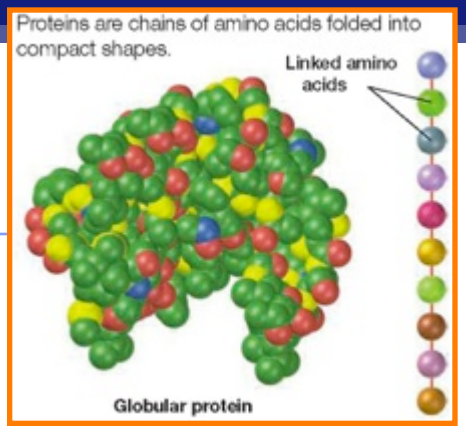
RNA Editing

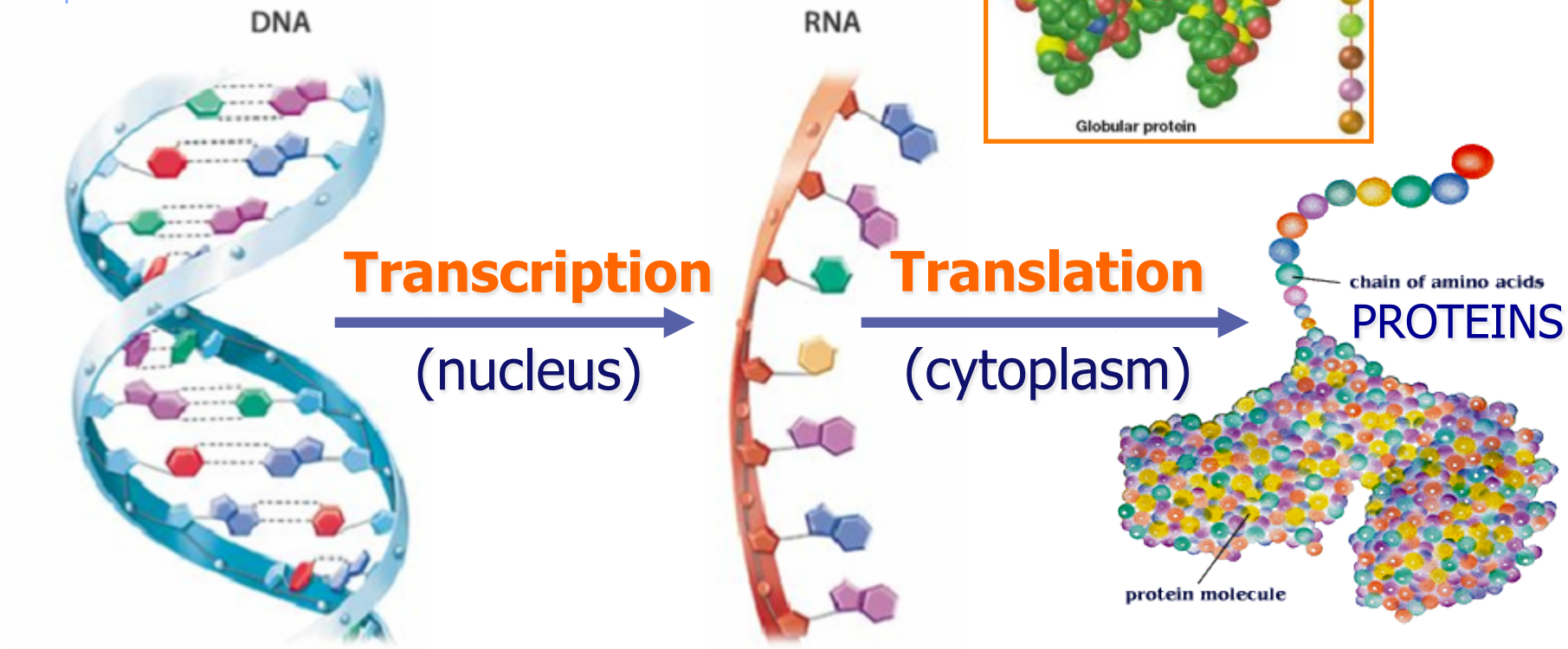




- **Introns** – DNA sequences *NOT* involved in coding for proteins
- **Exons** – sequences that code for proteins (i.e., "expressed")

The Central Dogma





- **Translation** – Information from RNA is "translated" into **proteins**.

How are Proteins Important?

Structural Proteins

Hair (keratin)

Fingernails (keratin)

Skin (collagen)

Muscles (myosin, etc.)

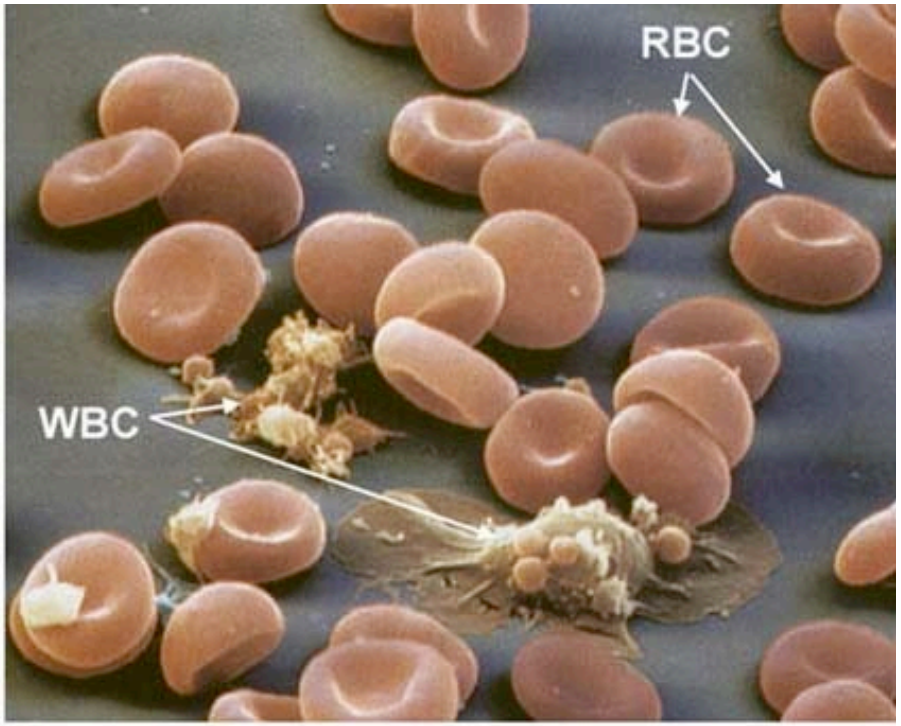
Cartilage (glycoprotein: proteins attached to carbohydrates)

Ligaments (collagen plus glycoproteins)

Eye cornea (collagen/keratin)

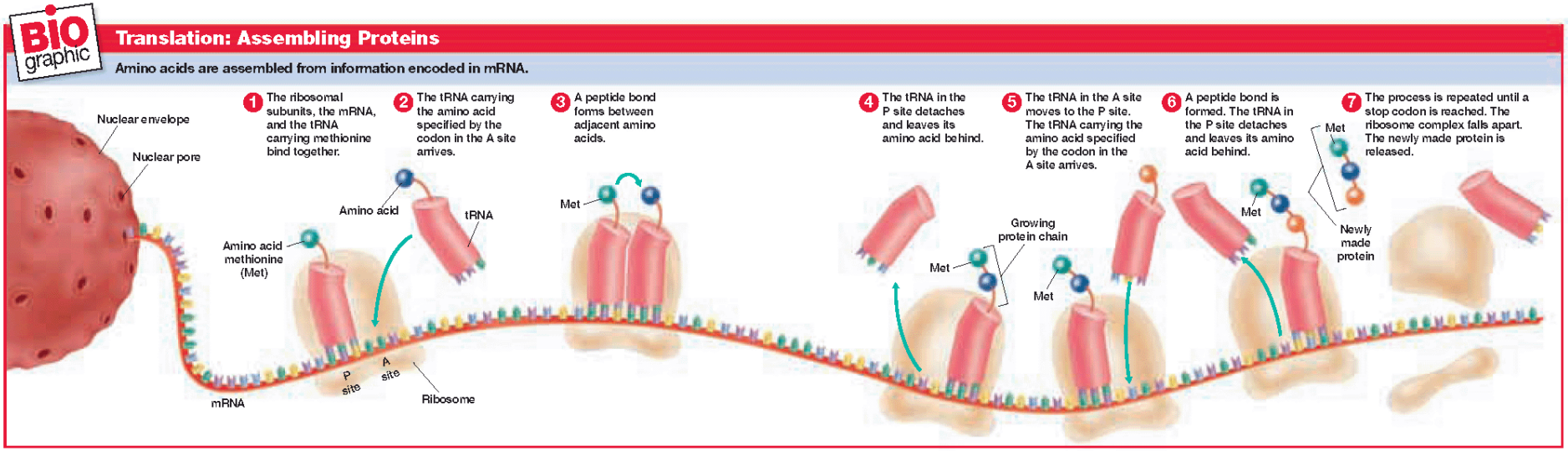
Chemical Proteins

- In red blood cells (RBC), the protein, hemoglobin, carries the oxygen.

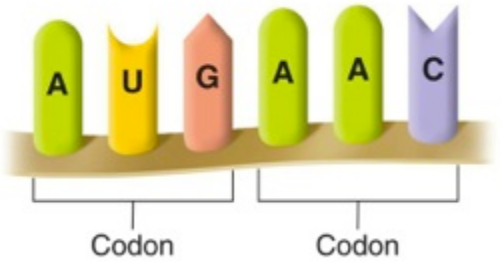


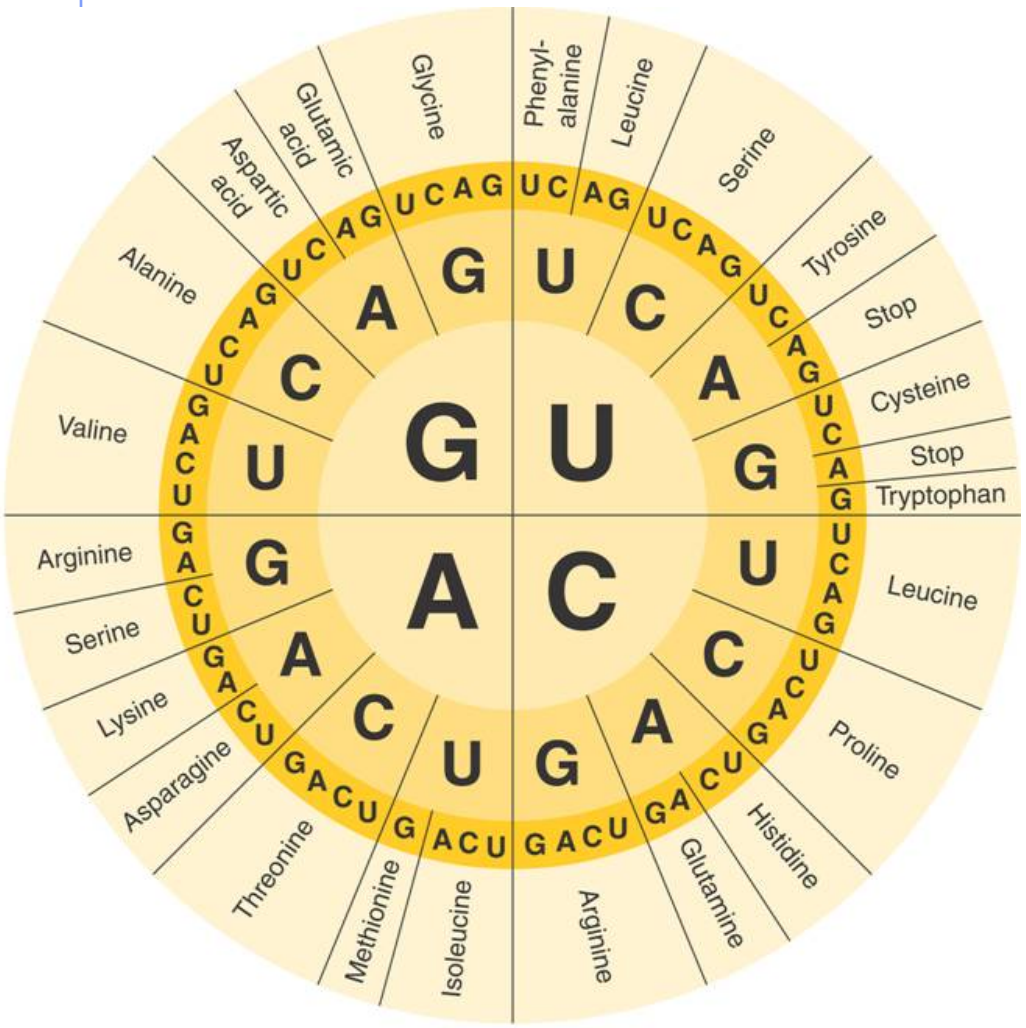
- The white blood cells (WBC) create specialized proteins called antibodies that can neutralize toxic substances in the blood. White blood cells also create hydrogen peroxide to kill bacteria.

Translation

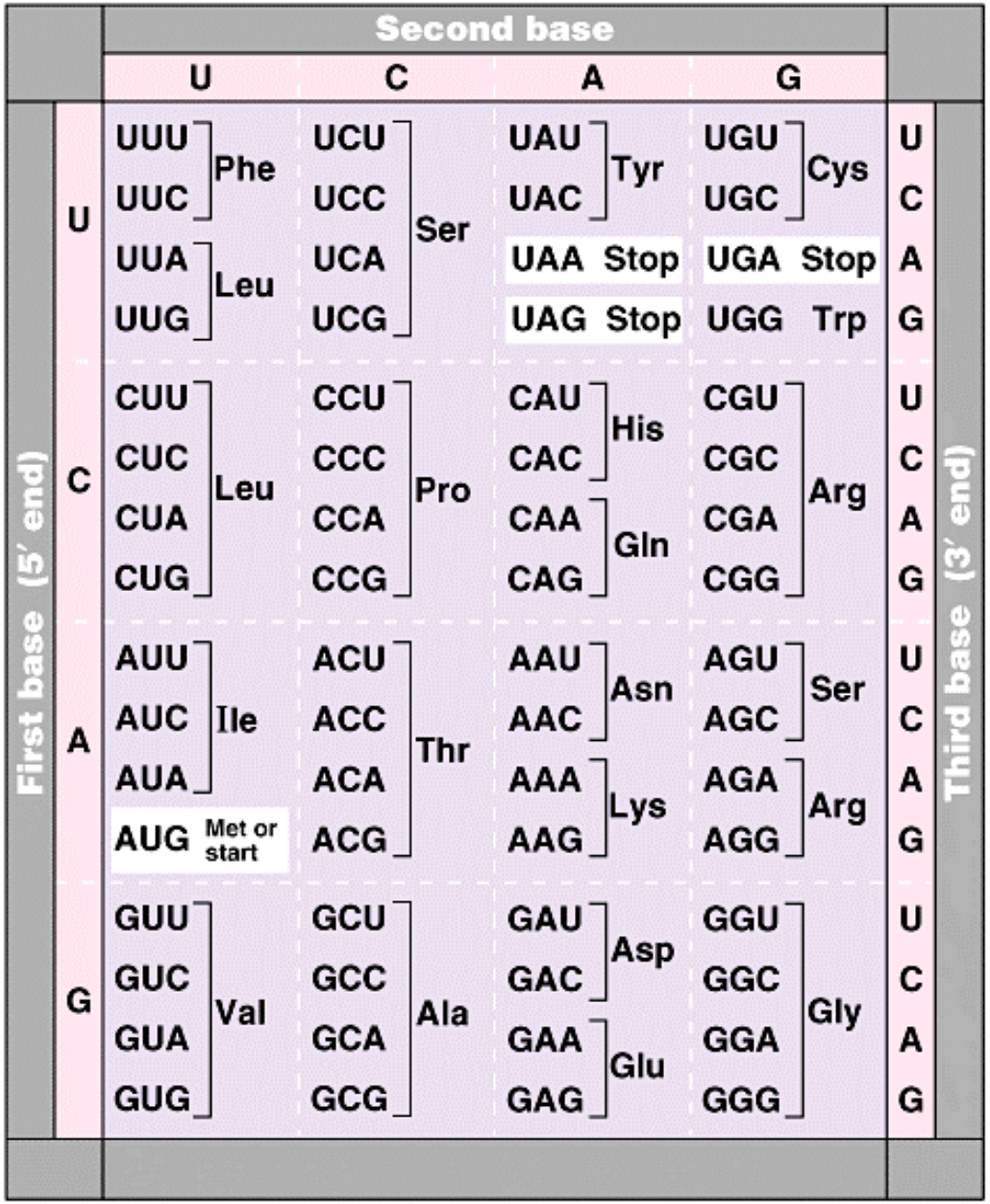


The Genetic Code





- The bases must be read in groups of three bases called **codons**.
- 4 possibilities for each base of a codon, the total number of mRNA codons is _____.
- Each **codon** specifies a particular **amino acid** to be added to the polypeptide chain.



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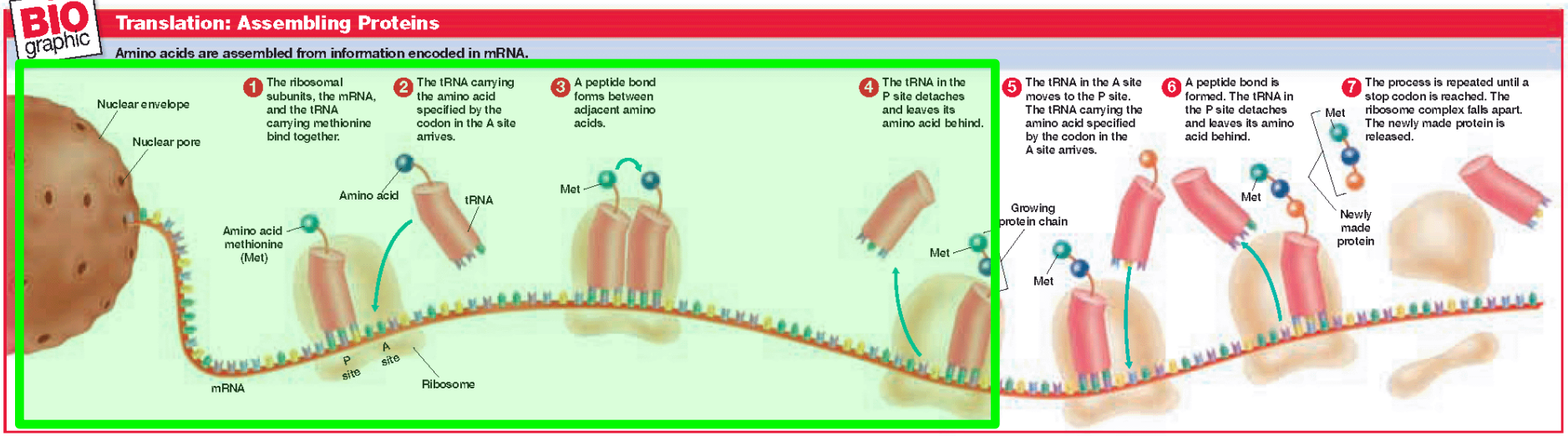
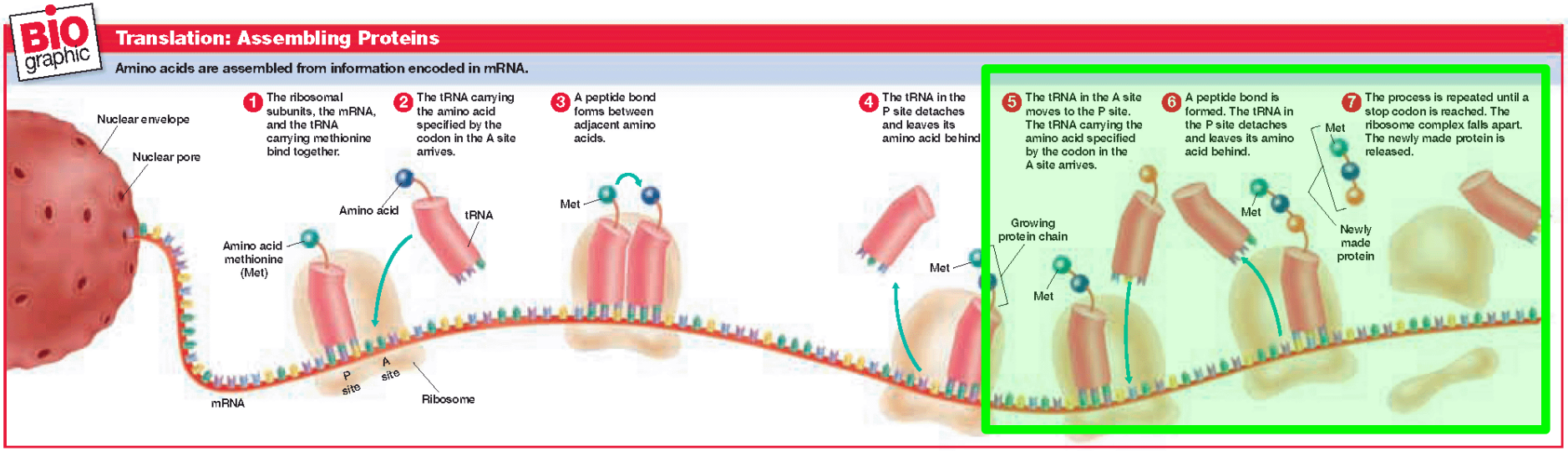
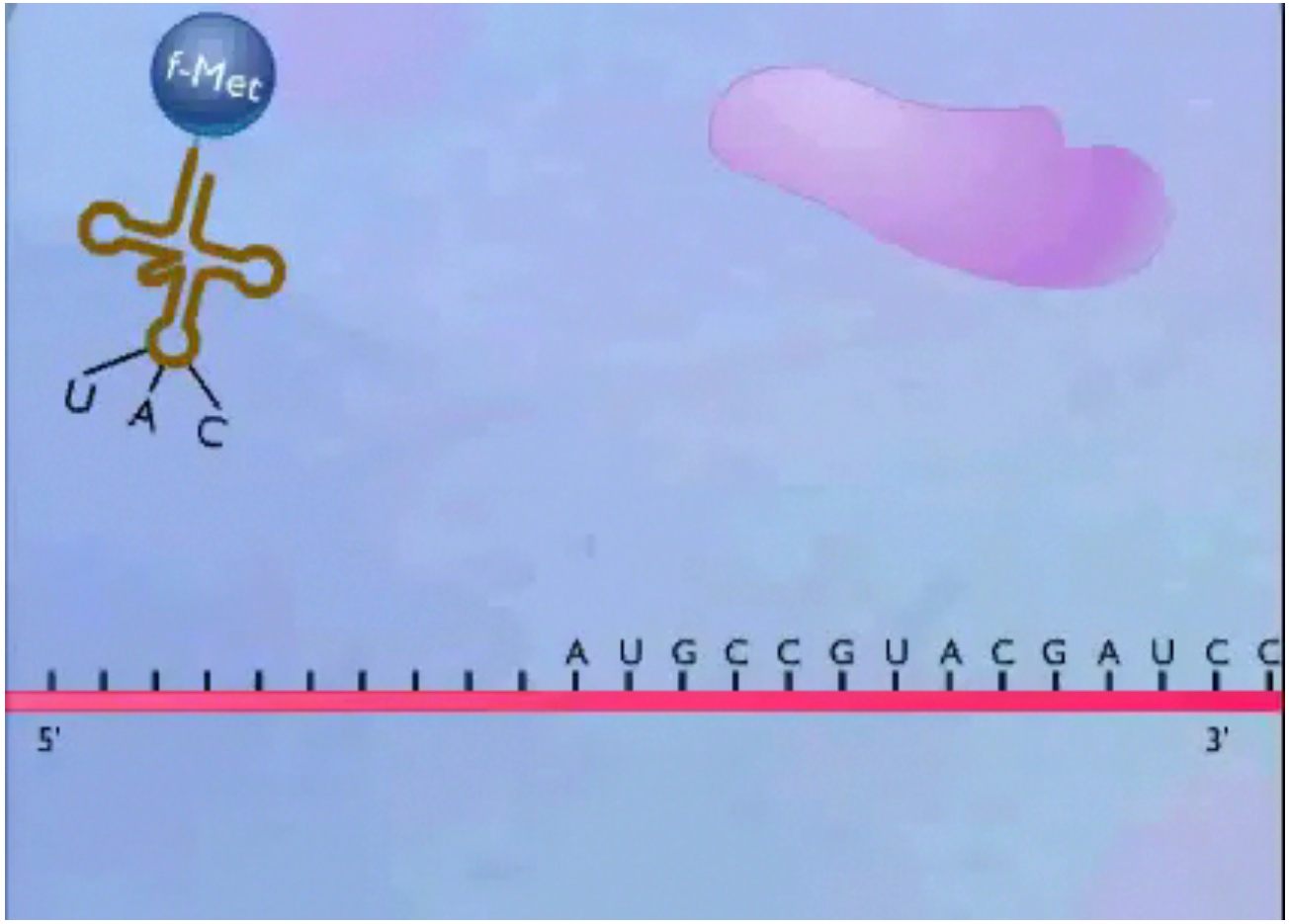


- mRNA "start" codon AUG starts protein synthesis; tRNA with **methionine** is at P site.
- A tRNA with the specified amino acid binds to the A site.
- **Peptide bond** links the 2 amino acids.
- tRNA in P site departs, leaving its amino acid behind.



- tRNA (with protein chain) moves over to P site. Another tRNA arrives with specified amino acid.
- tRNA in P site departs.
- Things keep on going until a stop codon (UAG, UAA, or UGA) is reached. Synthesis stops. Protein is released into the cell.

Translation Animation



Translation Animation
http://www.youtube.com/watch?v=Ikq9AcBcohA