

PROTEIN SYNTHESIS

Lecture 4 Theory

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Protein Synthesis (Gene Expression) Notes

Proteins (Review)

- Proteins make up all living materials

Hair and Nails

A protein called alpha-keratin forms your hair and fingernails, and also is the major component of feathers, wool, claws, scales, horns, and

Blood

The hemoglobin protein carries oxygen in your blood to every part of your body.

Muscles

Muscle proteins called actin and myosin enable all muscular movement—from blinking to breathing to rollerblading.

Antibodies

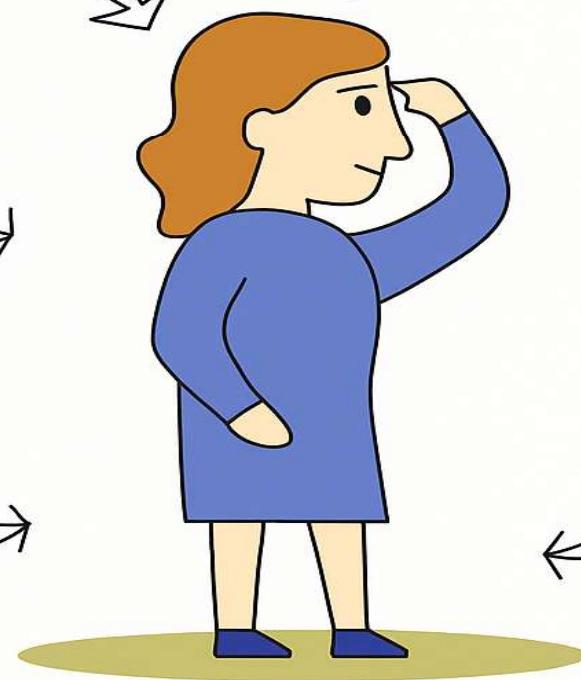
Antibodies are proteins that help defend your body against bacteria and viruses.

Brain and Nerves

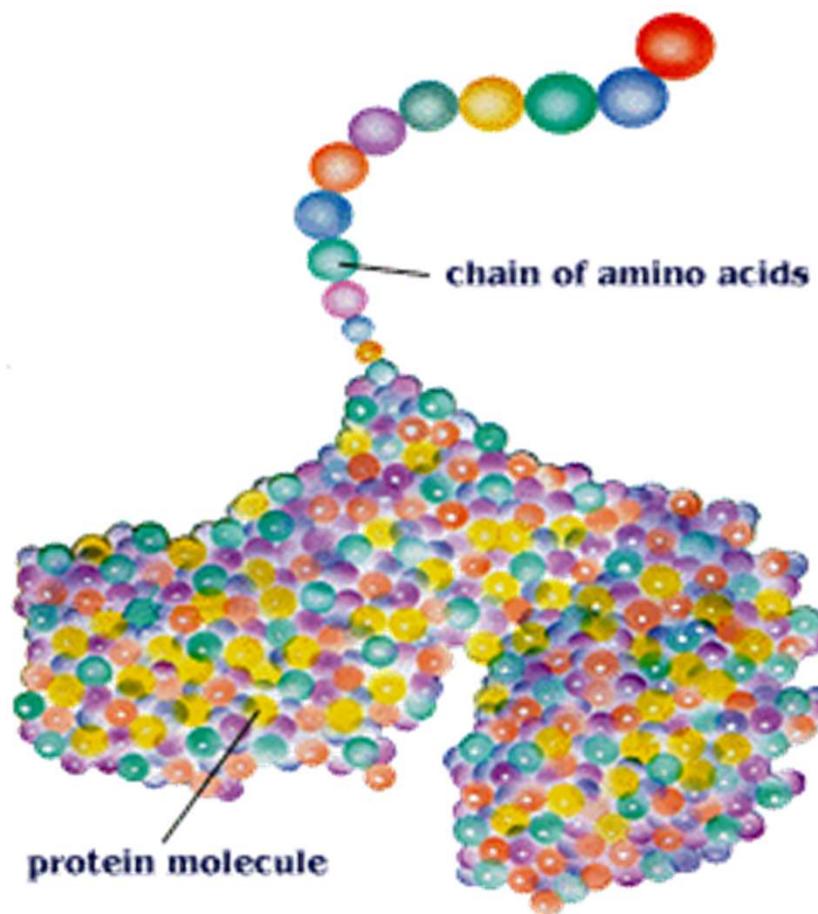
Ion channel proteins control brain signaling by allowing small molecules in and out of nerve cells.

Enzymes

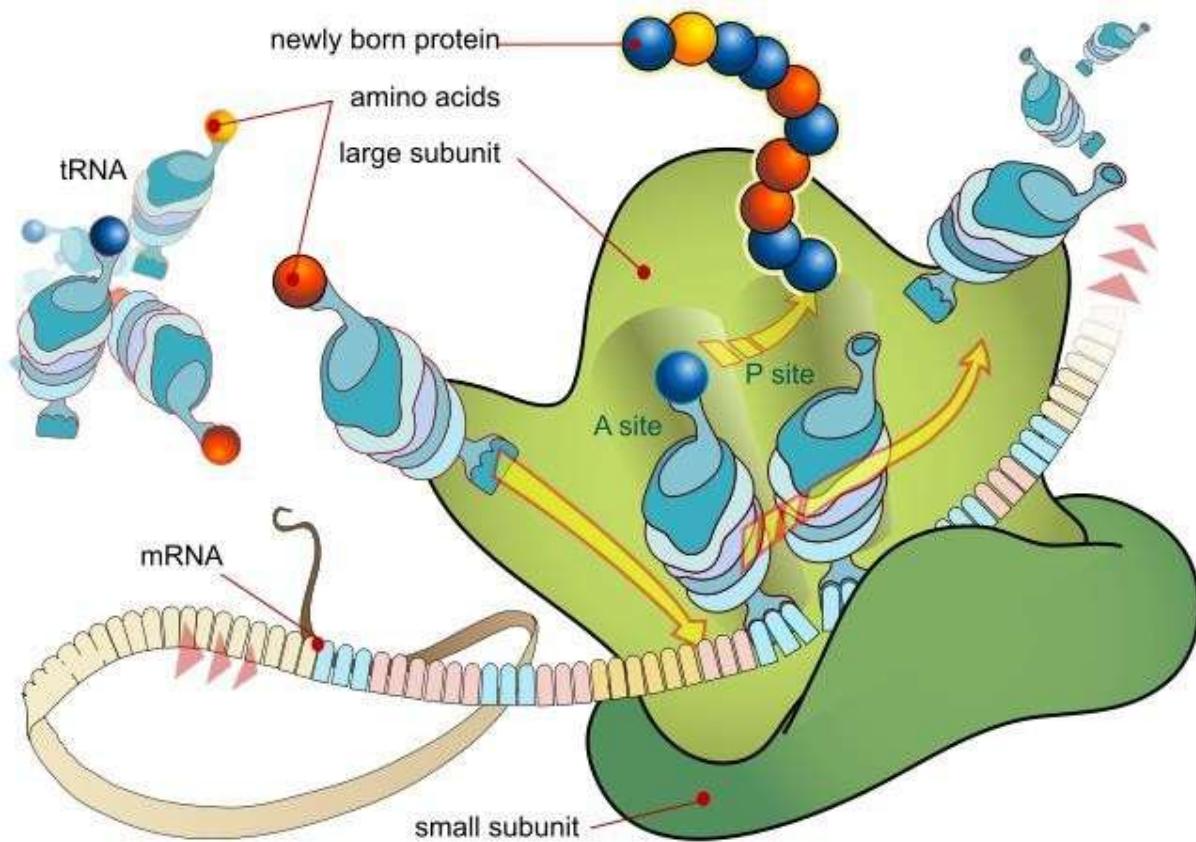
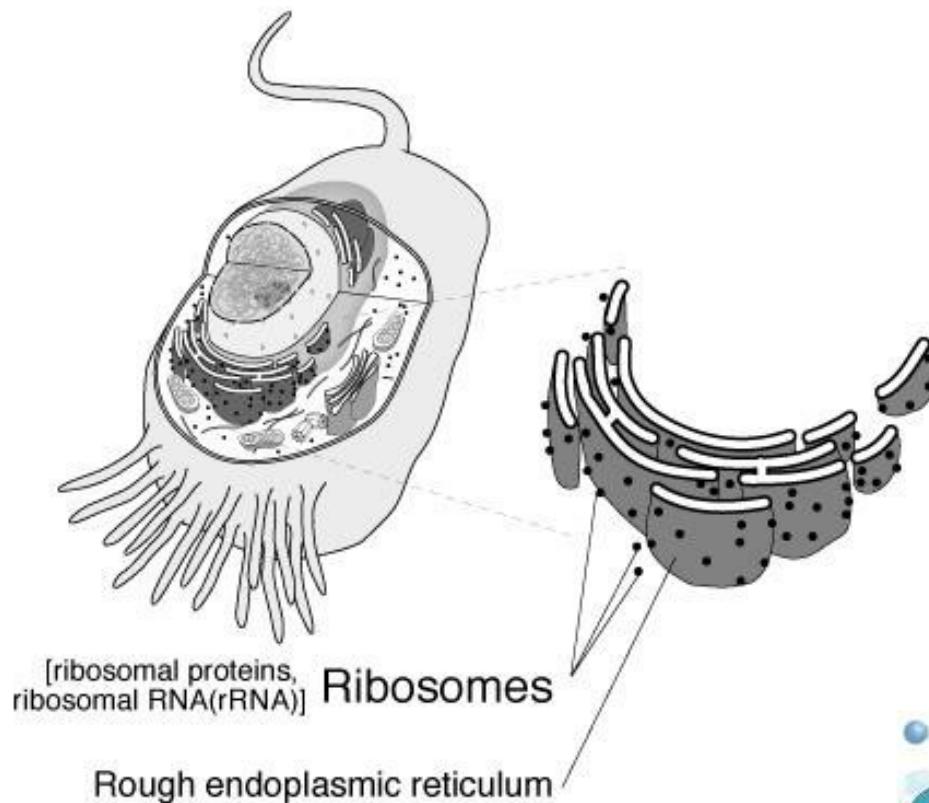
Enzymes in your saliva, stomach, and small intestine are proteins that help you digest food



- Proteins are composed of **amino acids** – there are **20** different amino acids
- Different **proteins** are made by **combining** these 20 amino acids in different combinations

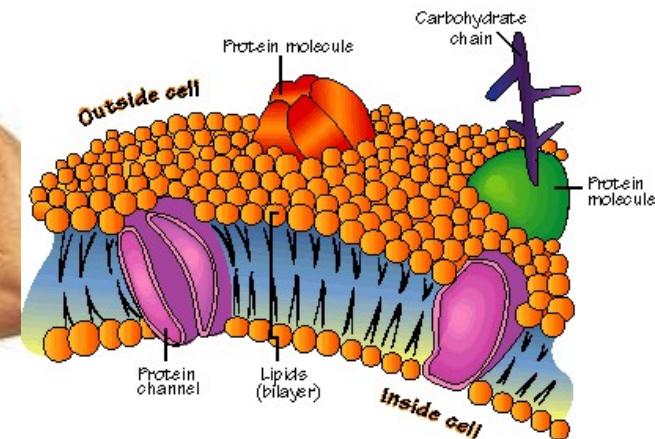


- Proteins are manufactured (made) by the **ribosomes**



- Function of proteins:

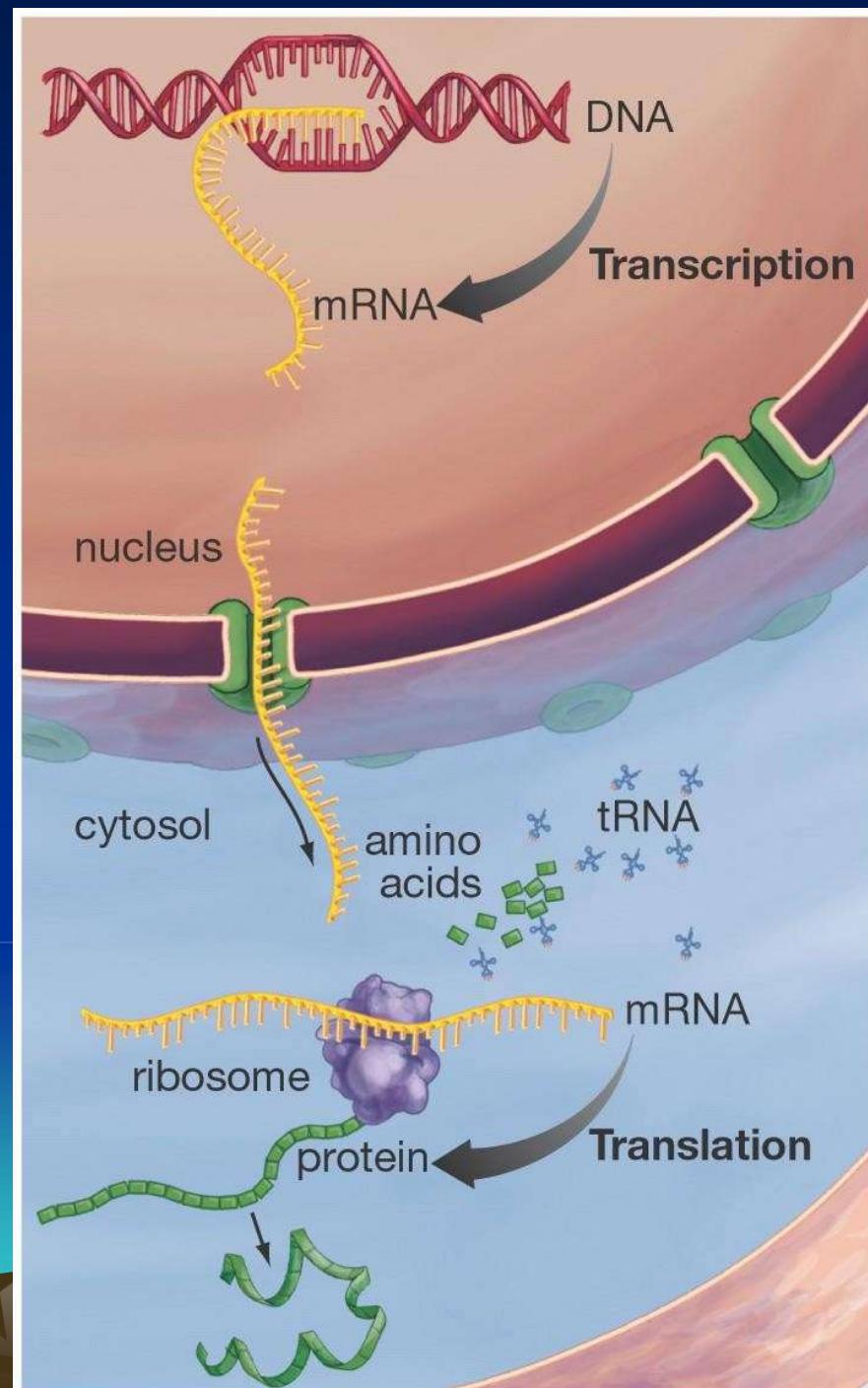
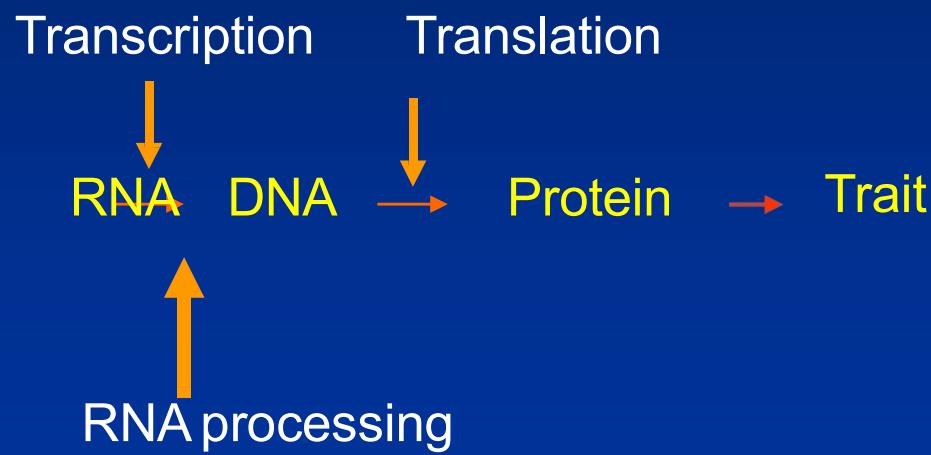
1. Help fight **disease**
2. Build new body **tissue**
3. **Enzymes** used for digestion and other chemical reactions are proteins
(Enzymes **speed up** the **rate** of a reaction)
4. Component of all **cell membranes**



MAKING PROTEINS

Step 1: Transcription

The “Central Dogma” of Molecular Genetics



Protein Synthesis

Nucleus

“Code
of Life”

“Code
of Life”

(mRNA)
messenger
RNA

carries blueprint

transfer RNA
(tRNA) gathers
amino acids

transfer RNA
(tRNA) gathers
amino acids

proteins



Ribosomes
(protein
synthesis)

ribosomal RNA
(rRNA)

ribosomal RNA
(rRNA)

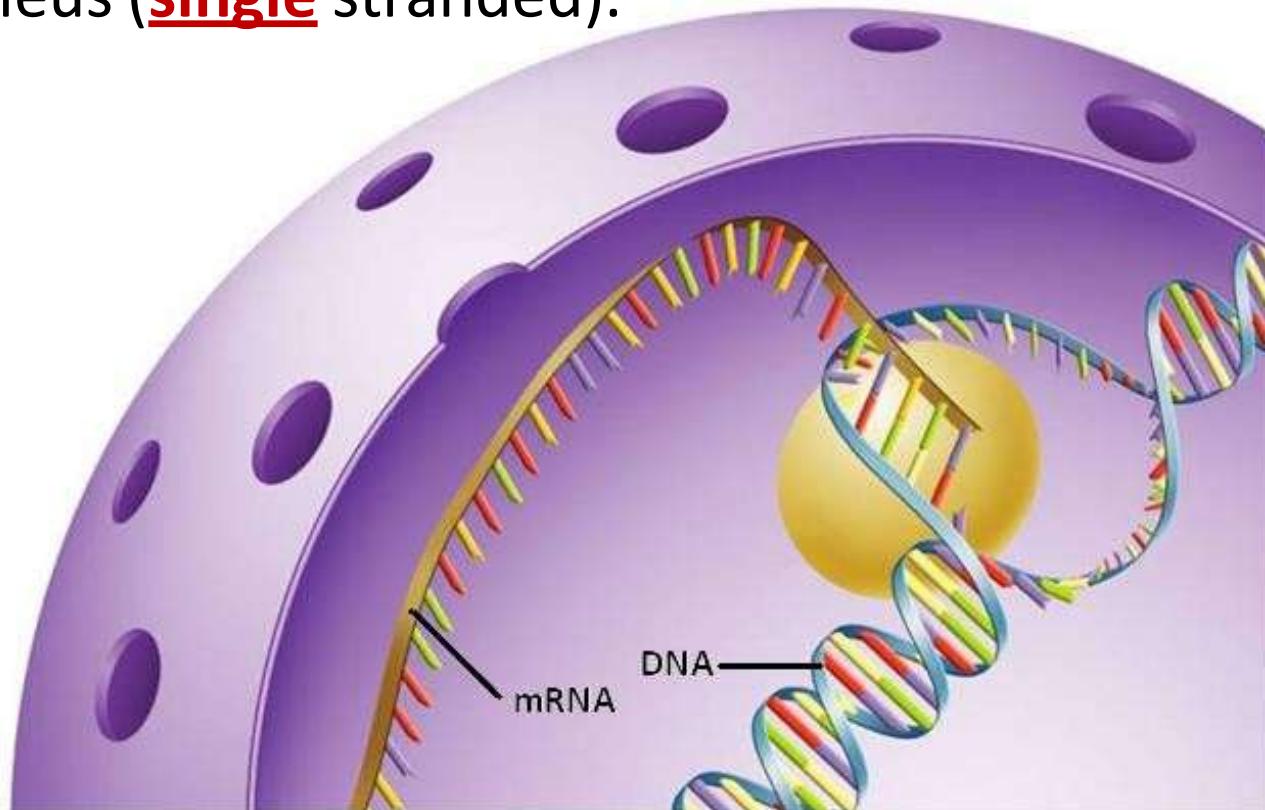
Cytoplasm

Making a Protein—Transcription

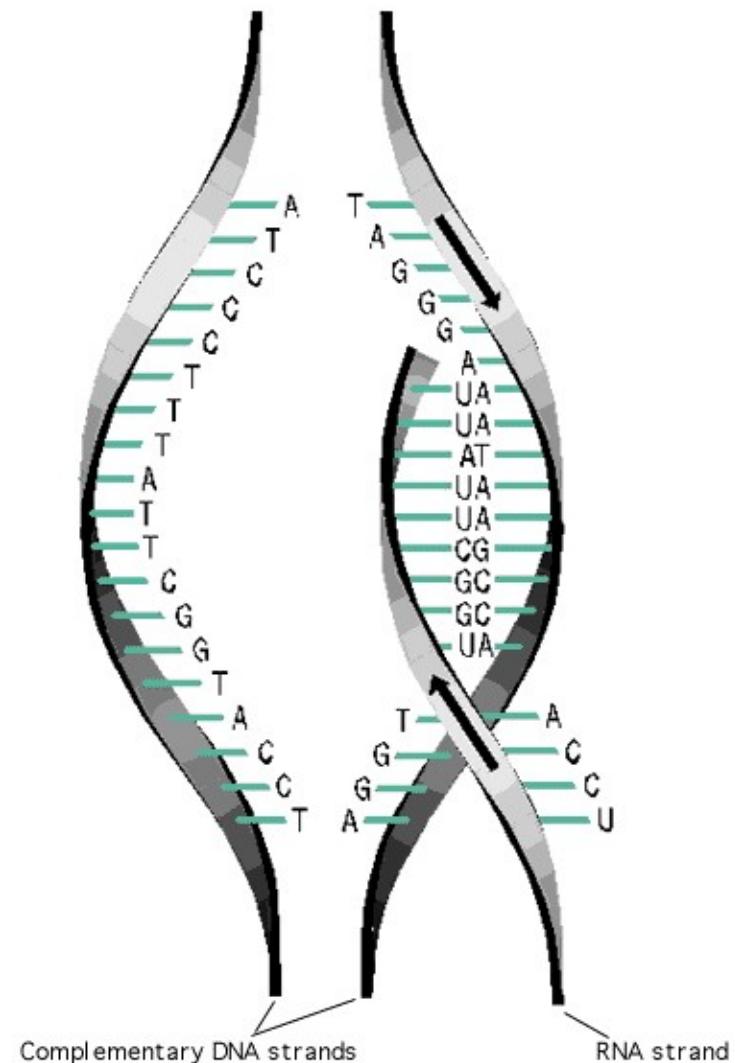
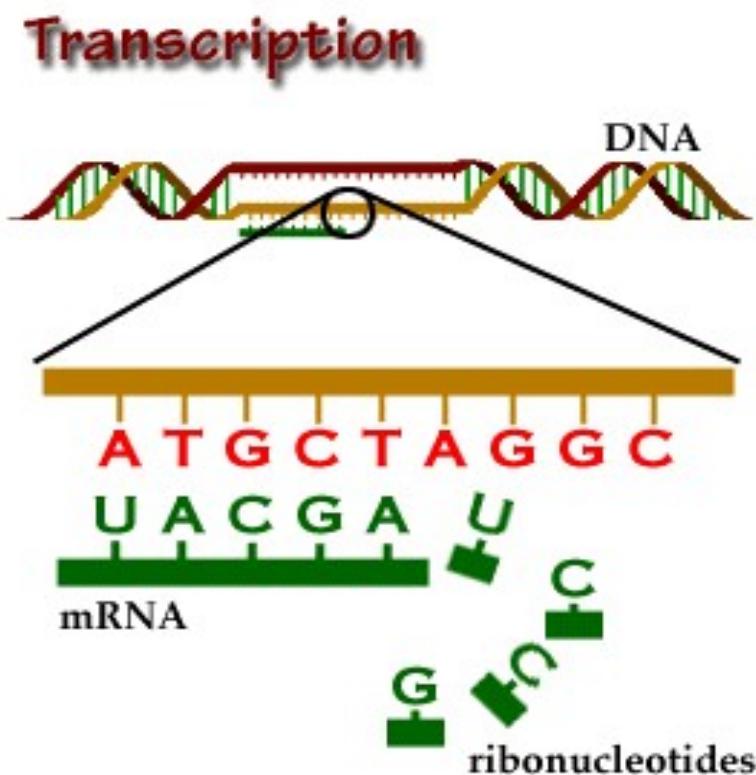
- First Step: Copying of genetic information from DNA to RNA called Transcription

Why? DNA has the genetic code for the protein that needs to be made, but proteins are made by the ribosomes—ribosomes are outside the nucleus in the cytoplasm.

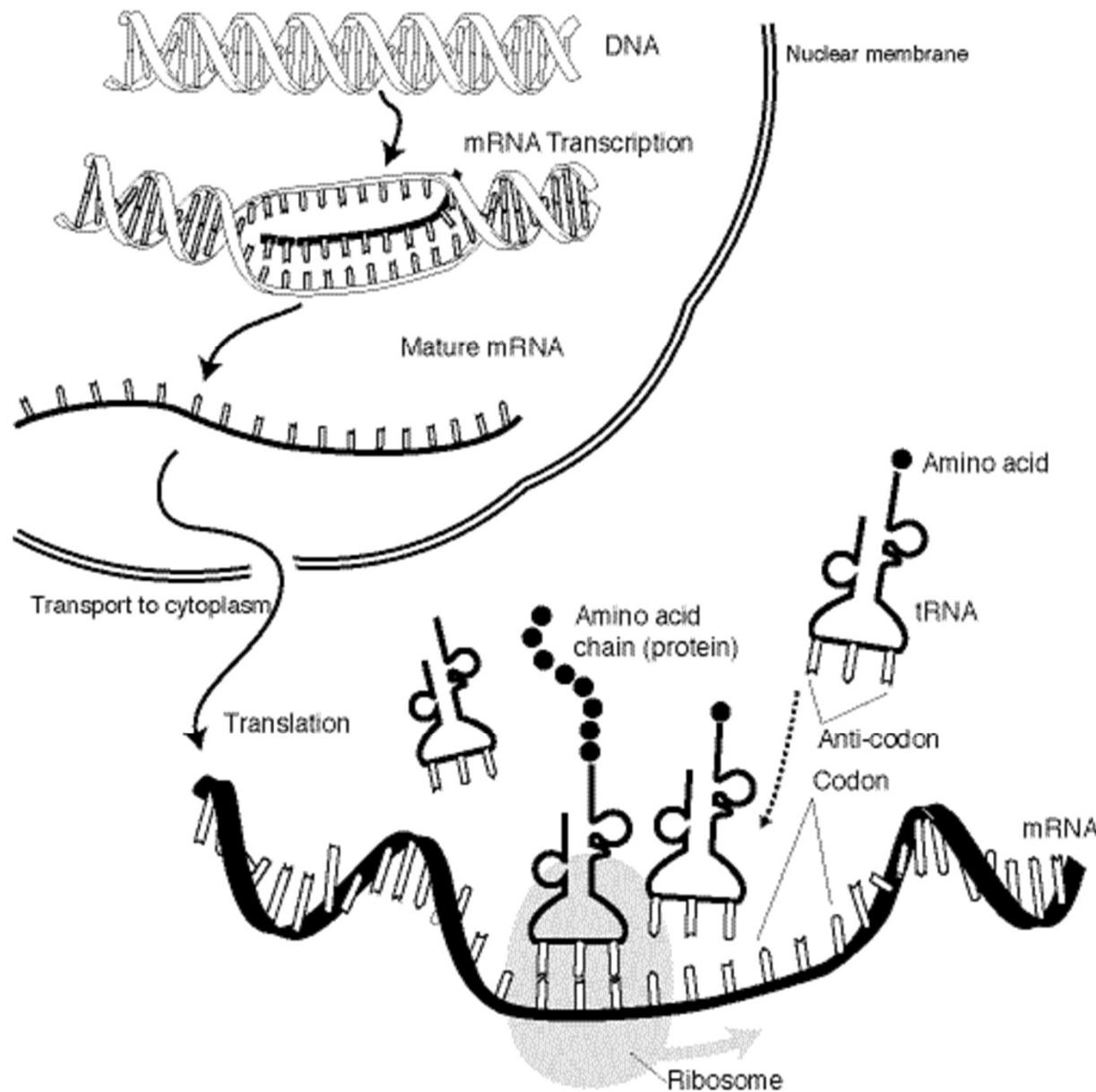
DNA is too large to leave the nucleus (double stranded), but RNA can leave the nucleus (single stranded).



- Part of DNA temporarily unzips and is used as a template to assemble complementary nucleotides into messenger RNA (mRNA).



- mRNA then goes through the **pores** of the nucleus with the DNA **code** and attaches to the **ribosome**.

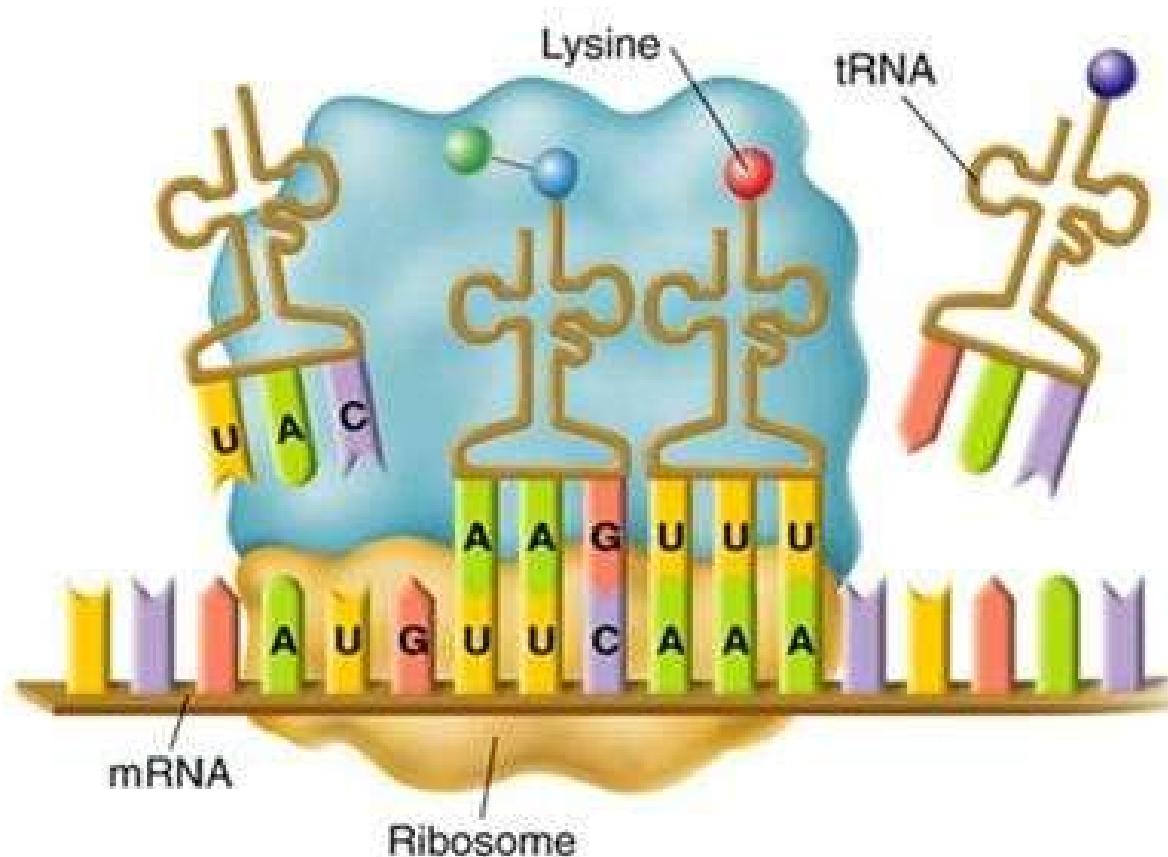


MAKING PROTEINS

Step 2: Translation

Making a Protein—Translation

- Second Step: **Decoding** of mRNA into a **protein** is called **Translation**.
- **Transfer RNA** (tRNA) carries **amino acids** from the cytoplasm to the **ribosome**.



These amino acids come from the **food we eat**.

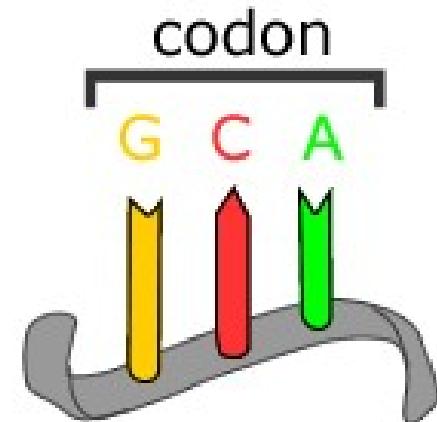
Proteins we eat are broken down into individual **amino acids** and then simply **rearranged** into new **proteins** according to the needs and directions of our **DNA**.

Proteins

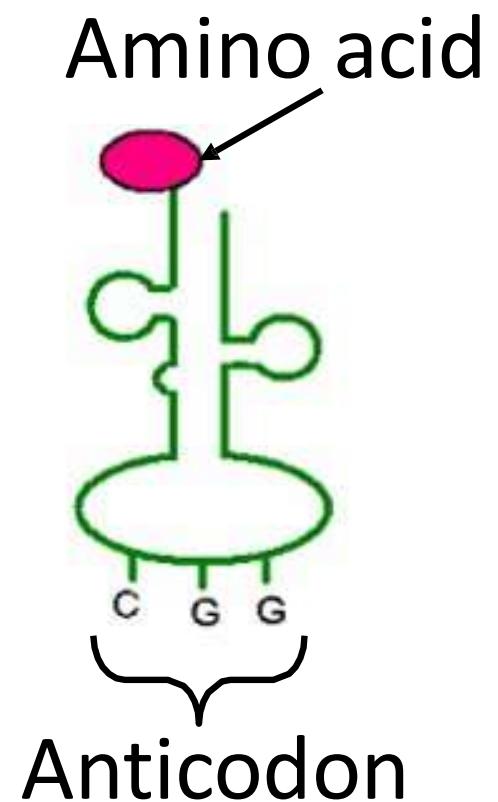


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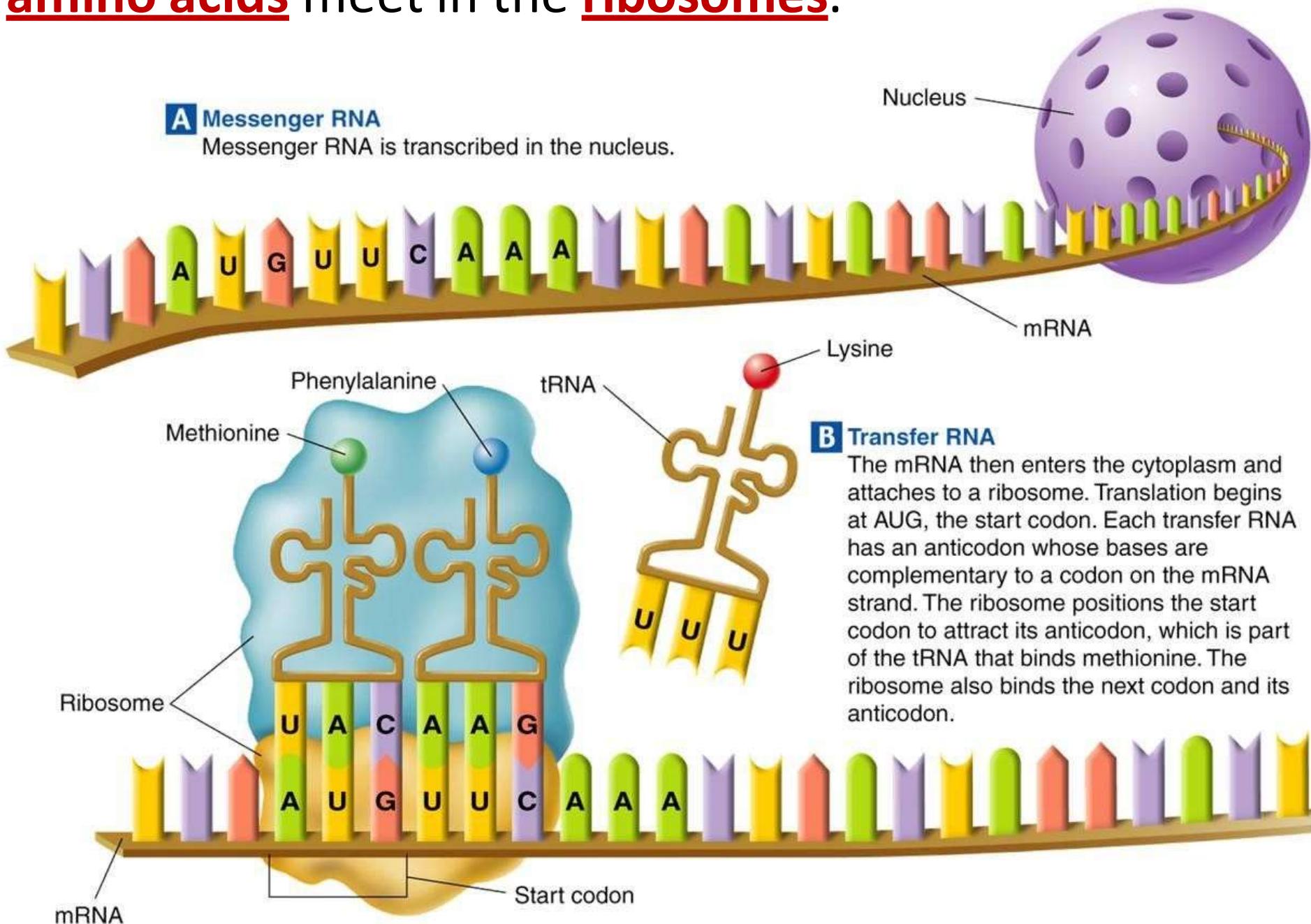
- A series of **three** adjacent **bases** in an mRNA molecule codes for a specific amino acid—called a **codon**.



- Each **tRNA** has 3 nucleotides that are **complementary** to the **codon** in mRNA.
- Each **tRNA** codes for a **different** amino acid.



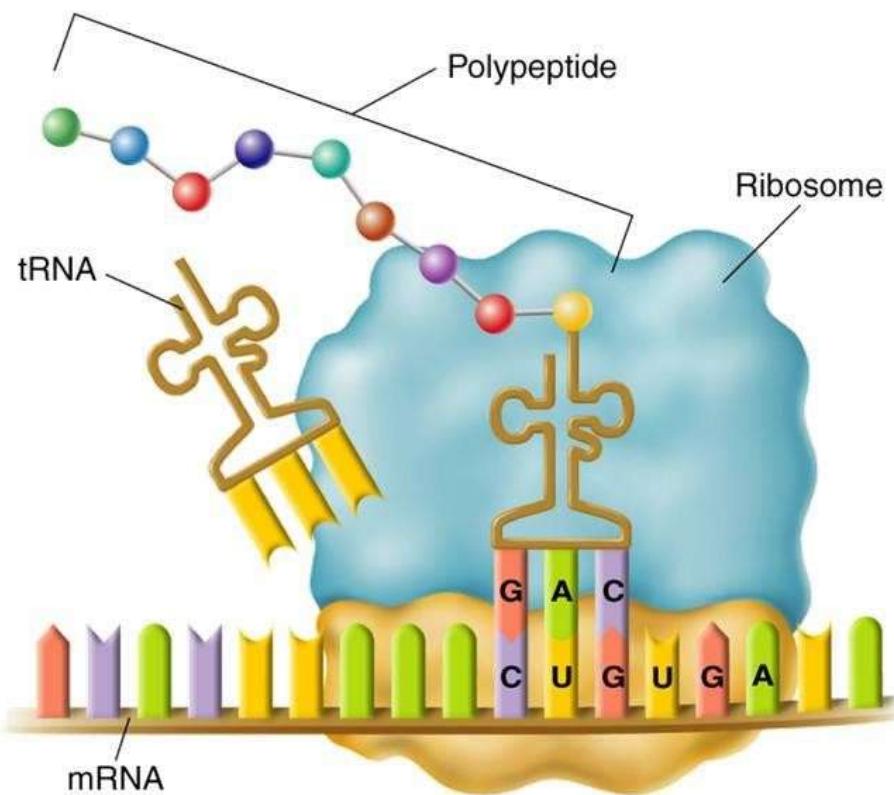
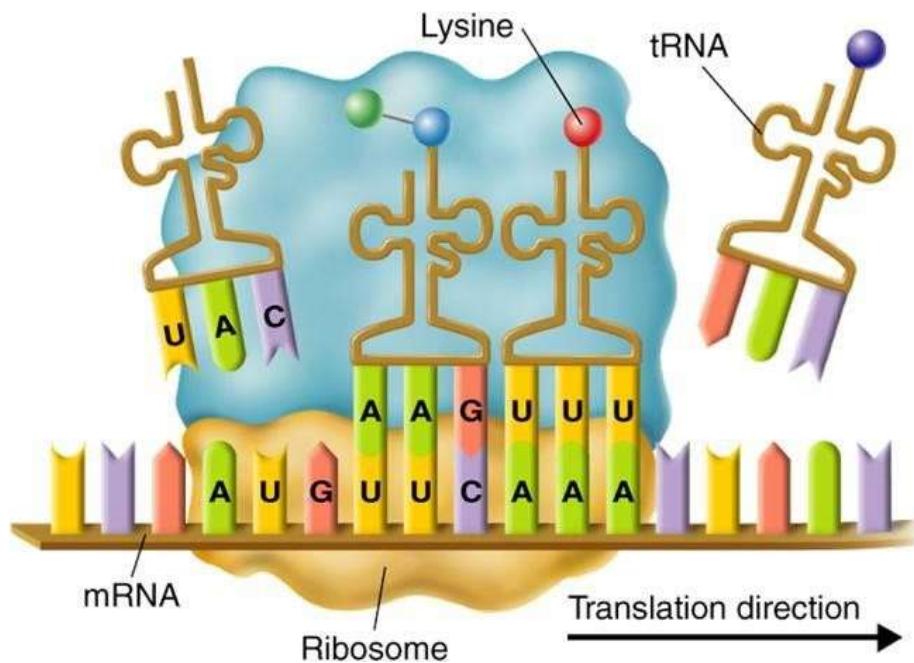
- mRNA carrying the DNA instructions and tRNA carrying amino acids meet in the ribosomes.



- Amino acids are joined together to make a **protein**.

C The Polypeptide “Assembly Line”

The ribosome joins the two amino acids—methionine and phenylalanine—and breaks the bond between methionine and its tRNA. The tRNA floats away from the ribosome, allowing the ribosome to bind another tRNA. The ribosome moves along the mRNA, binding new tRNA molecules and amino acids.



D Completing the Polypeptide

The process continues until the ribosome reaches one of the three stop codons. The result is a complete polypeptide.

Polypeptide = **Protein**

Use one of the codon charts on the next page to find the amino acid sequence coded for by the following mRNA strands.

CAC/CCA/UGG/UGA

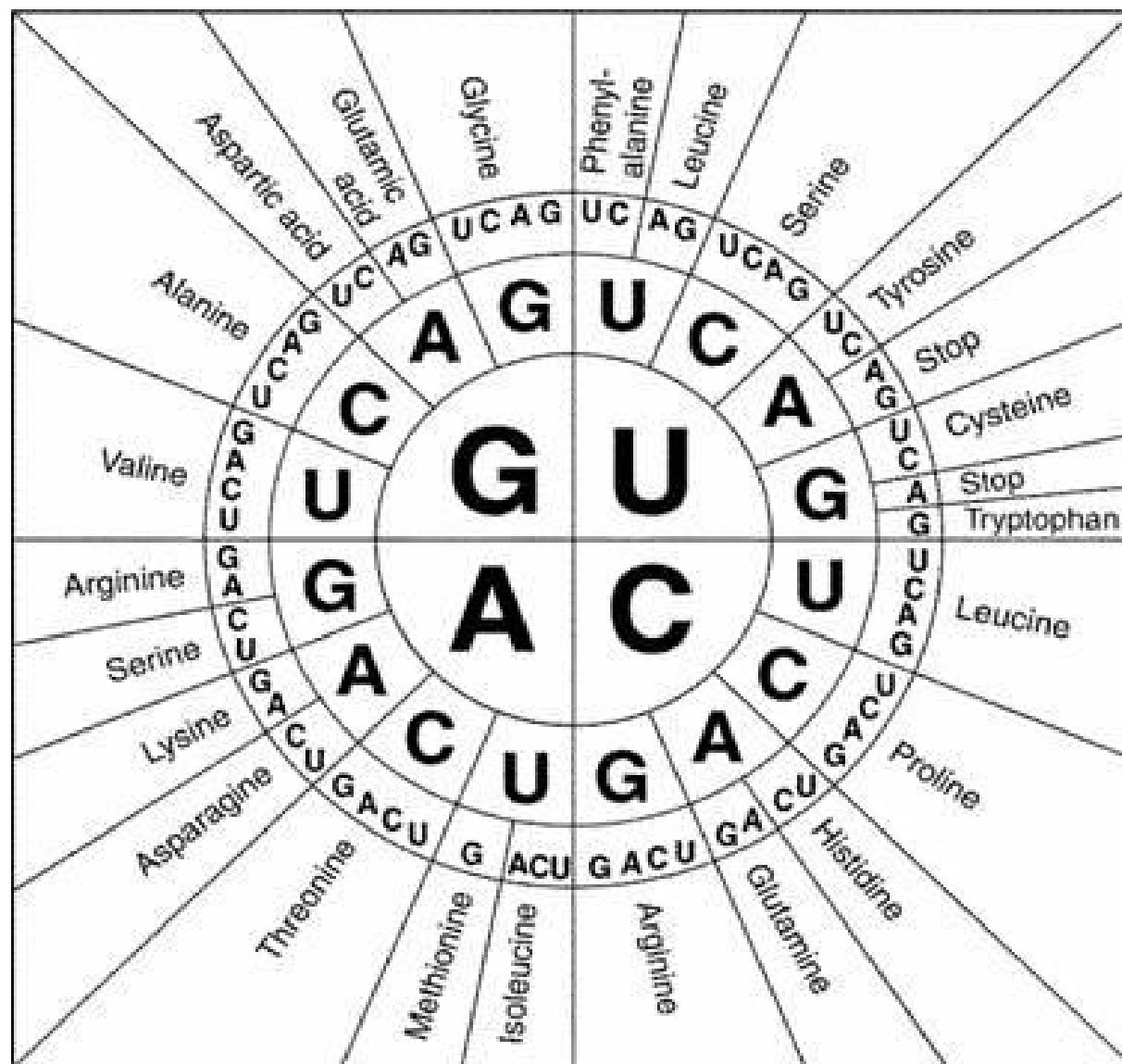
_____ / _____ / _____ / _____

AUG/AAC/GAC/UAA

_____ / _____ / _____ / _____

AUG/AAC/GAC/UAA

Methionine / Asparagine/Aspartic Acid/ Stop



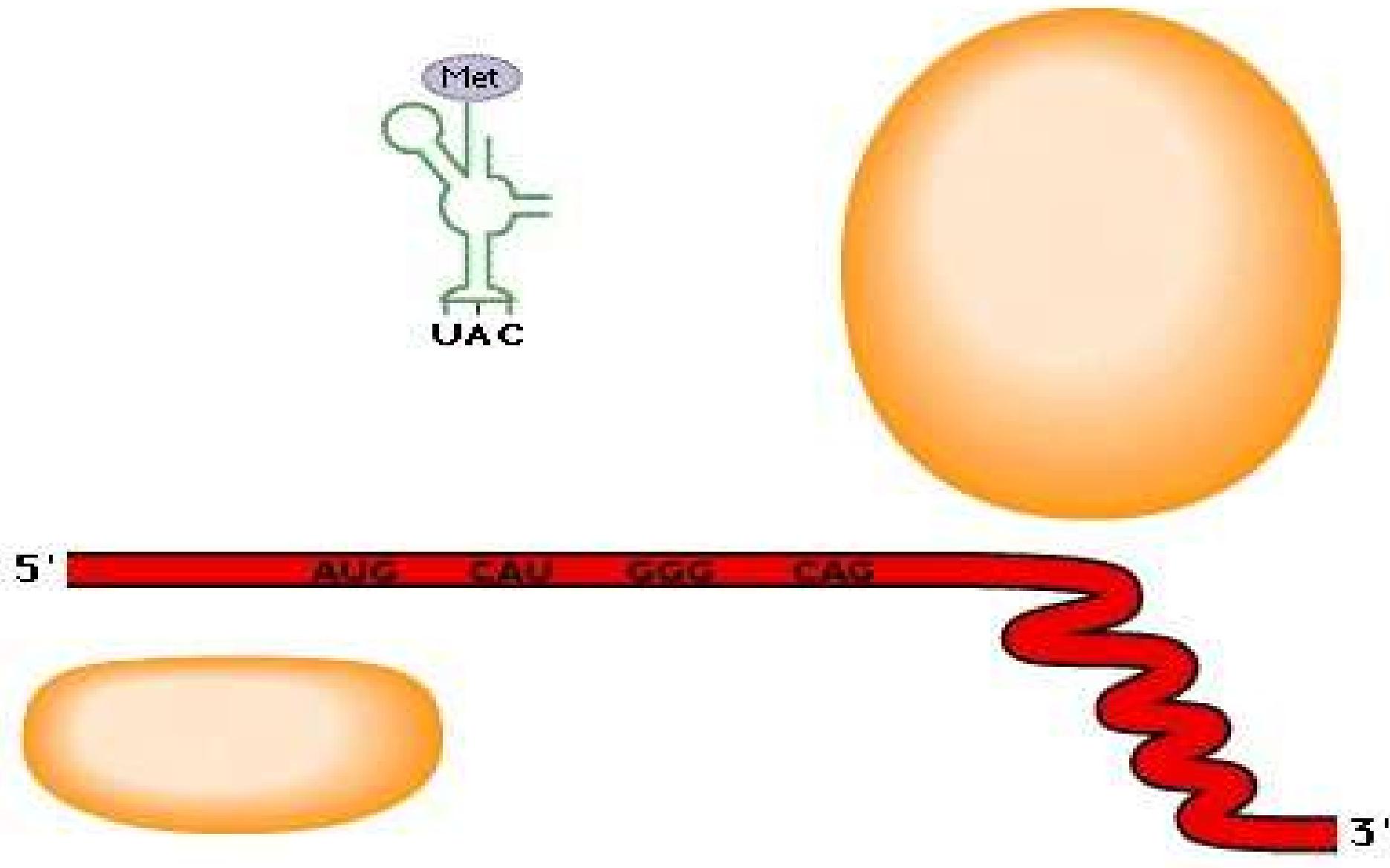
Protein Synthesis





How Proteins Are Made

Protein synthesis in motion



PROTEIN SYNTHESIS

