

# 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 rollerblading.

### Brain and Nerves

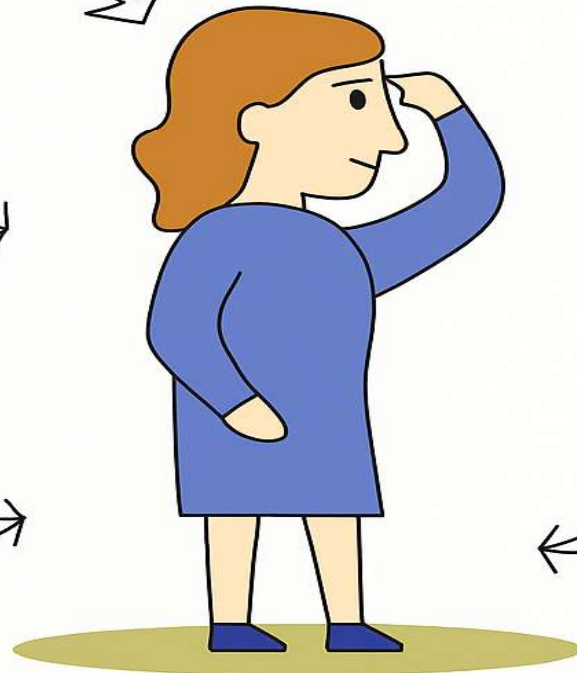
Ion channel proteins control brain signaling by allowing small molecules in and out of nerve cells.

### Antibodies

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

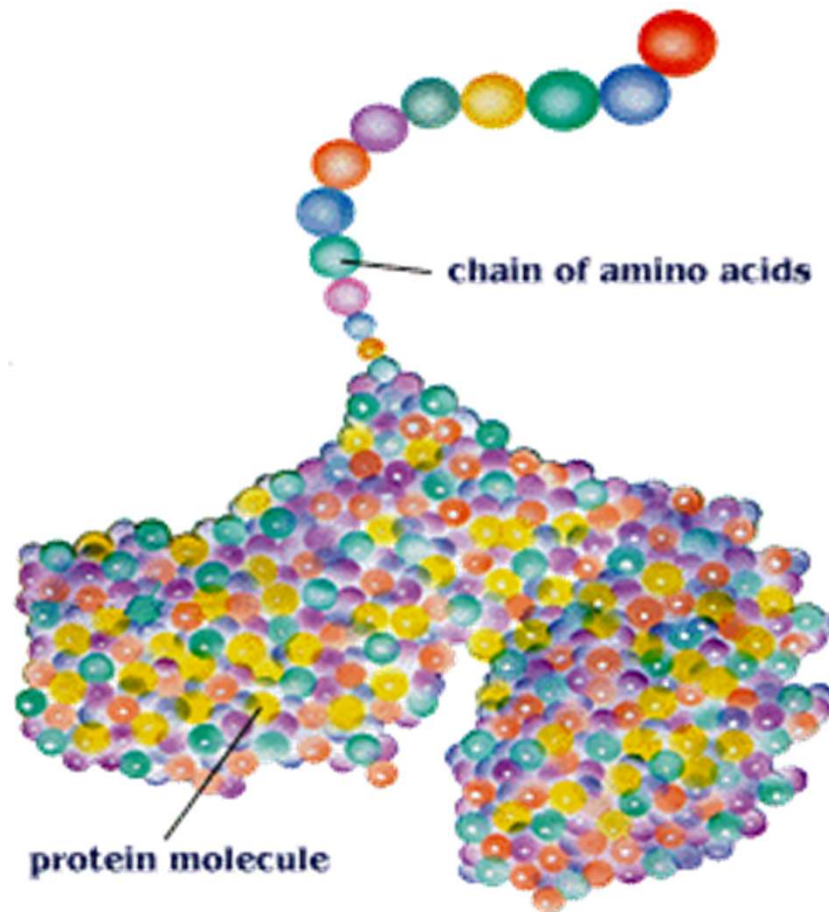
### Enzymes

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

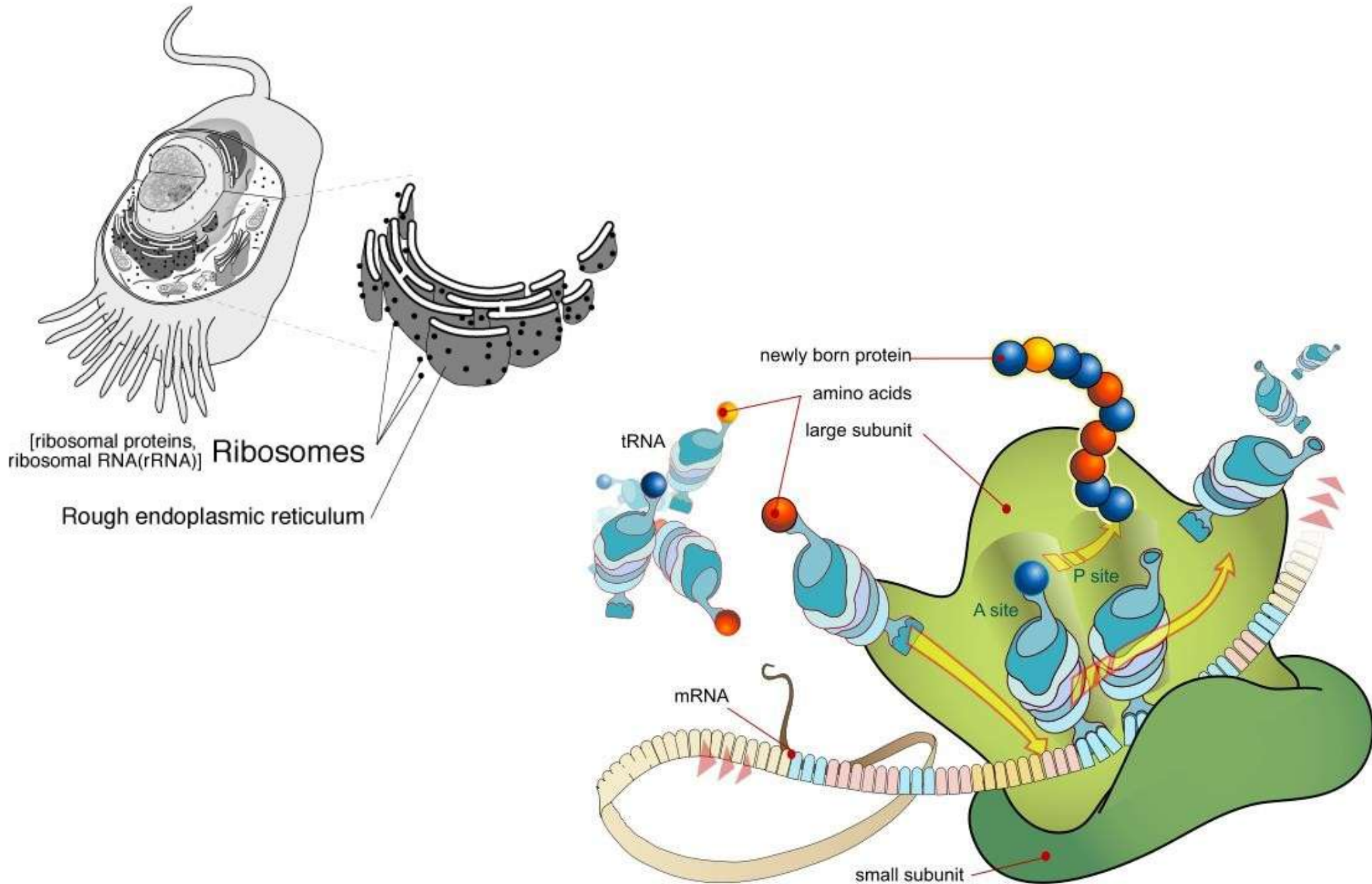




- Proteins are composed of amino acids – there are 20 different amino acids
- Different proteins are made by combining these 20 amino acids in different combinations



- Proteins are manufactured (made) by the ribosomes



- Function of proteins:

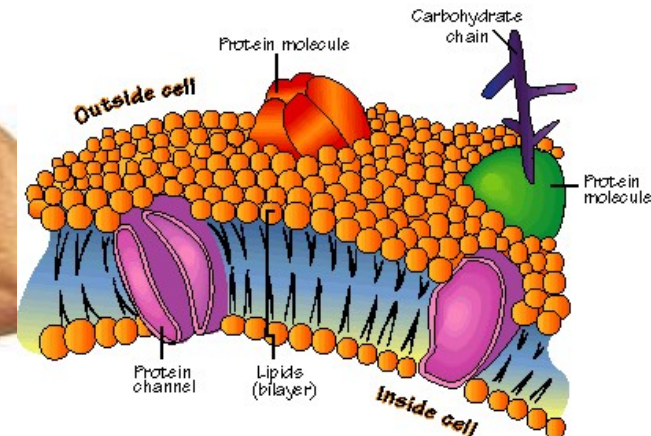
1. Help fight disease

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

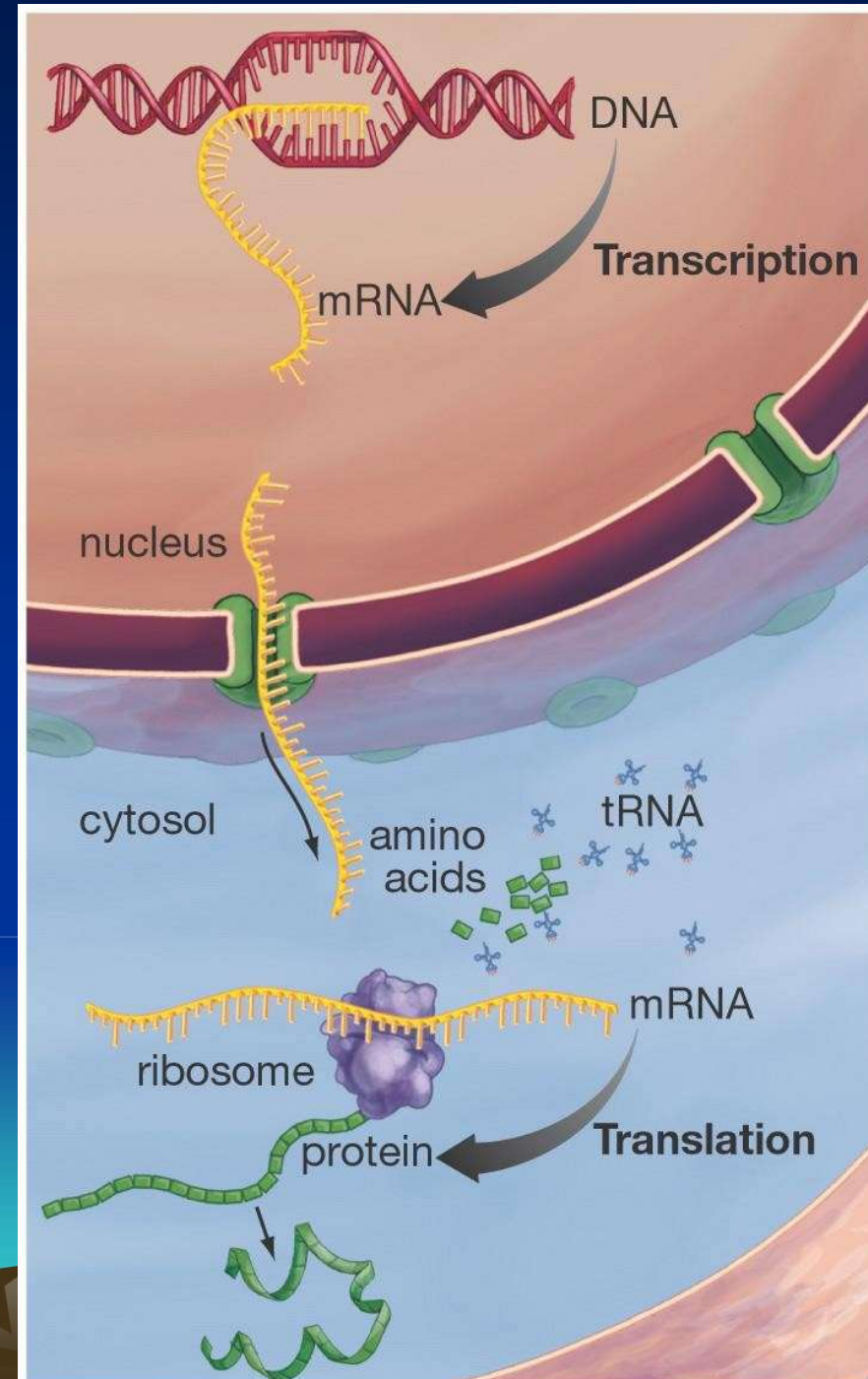
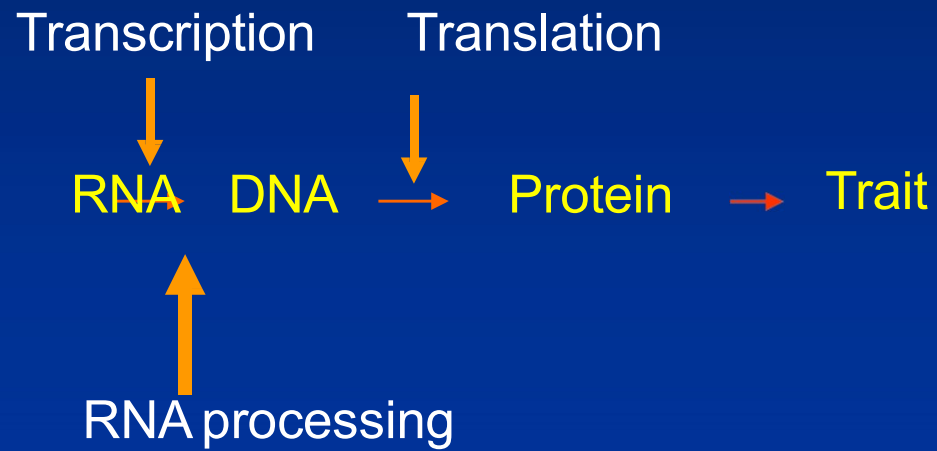


# MAKING PROTEINS

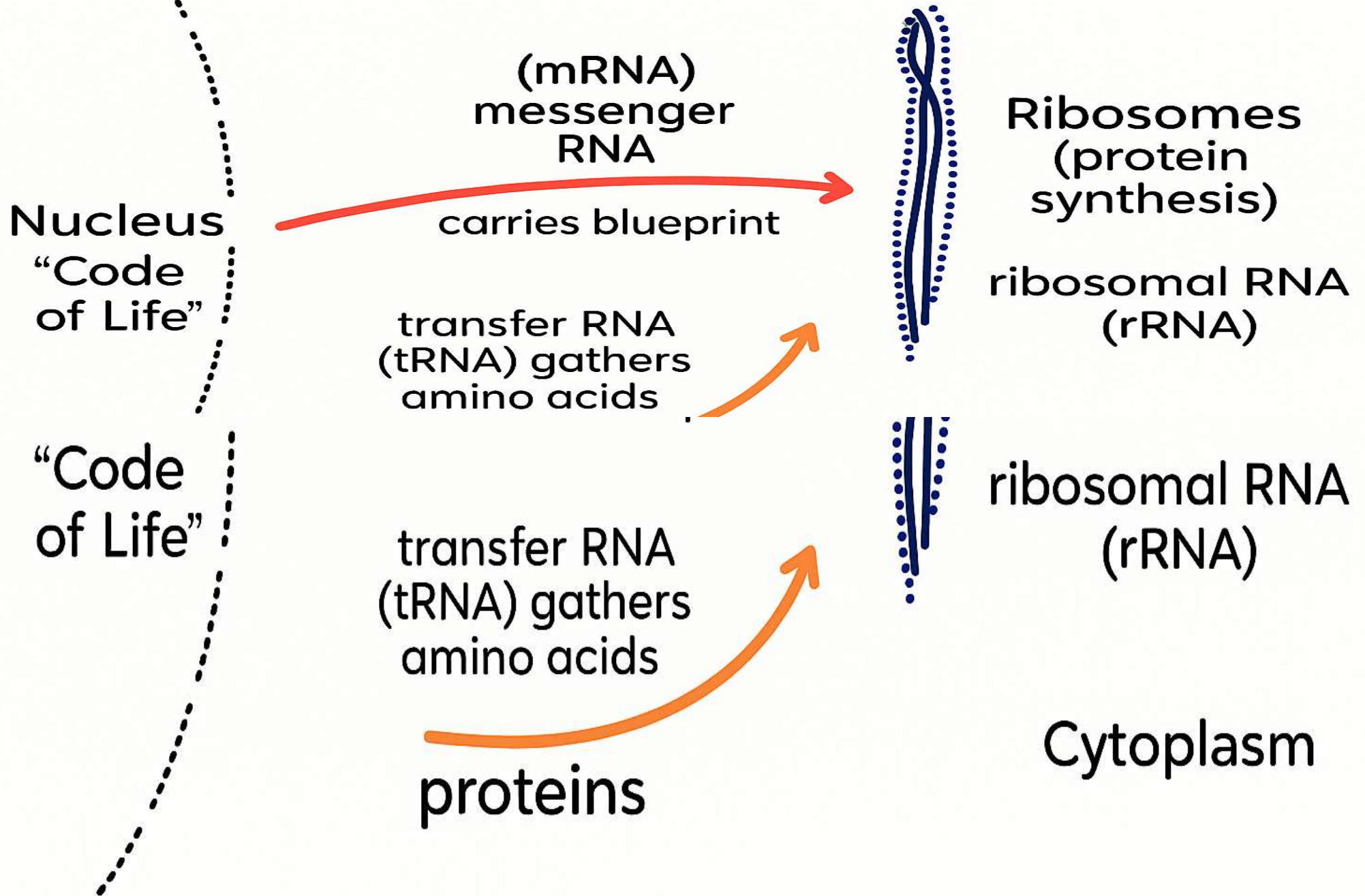
Step 1: Transcription



# The “Central Dogma” of Molecular Genetics



# Protein Synthesis



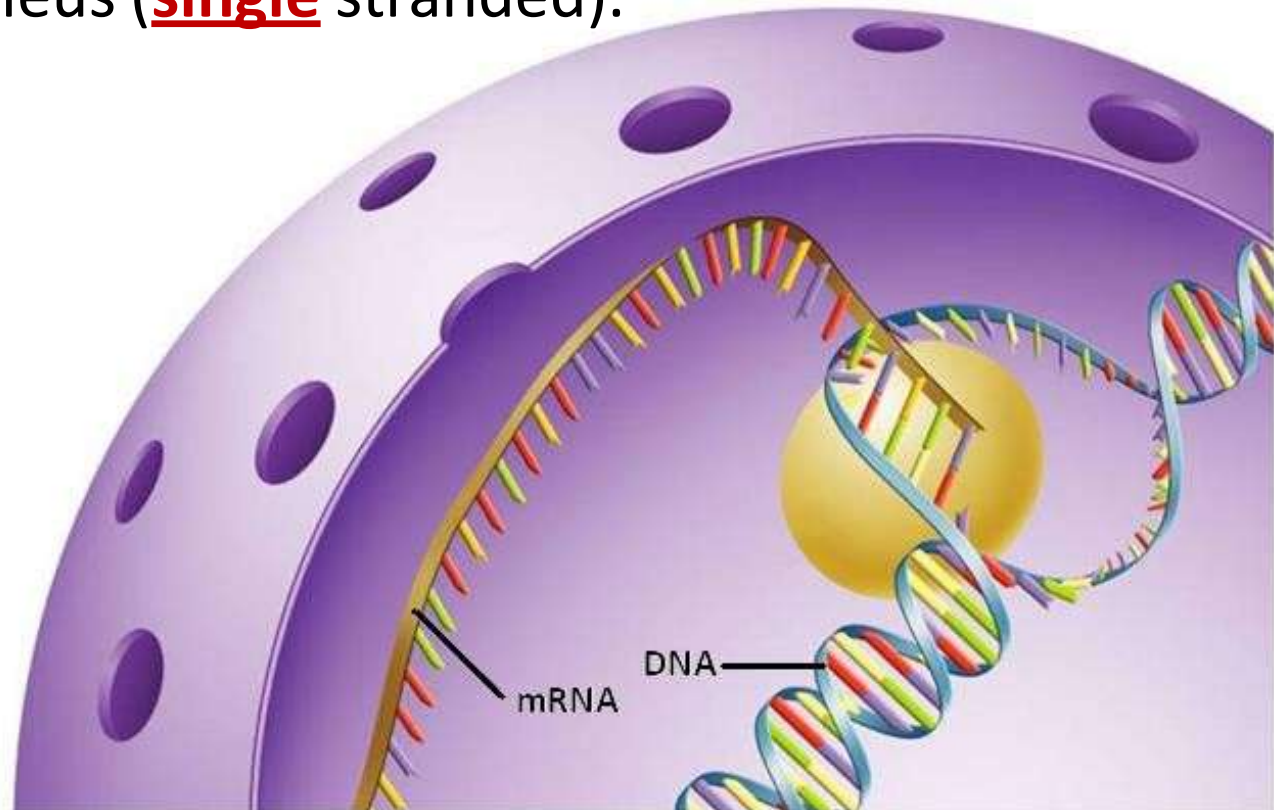


# Making a Protein—Transcription

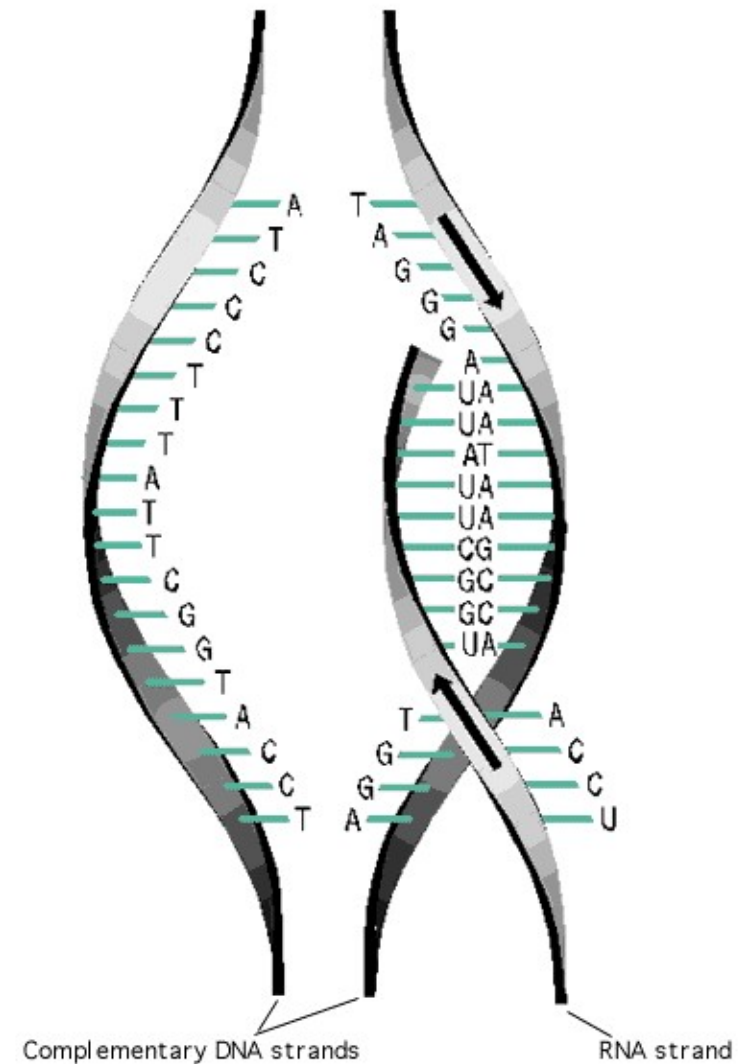
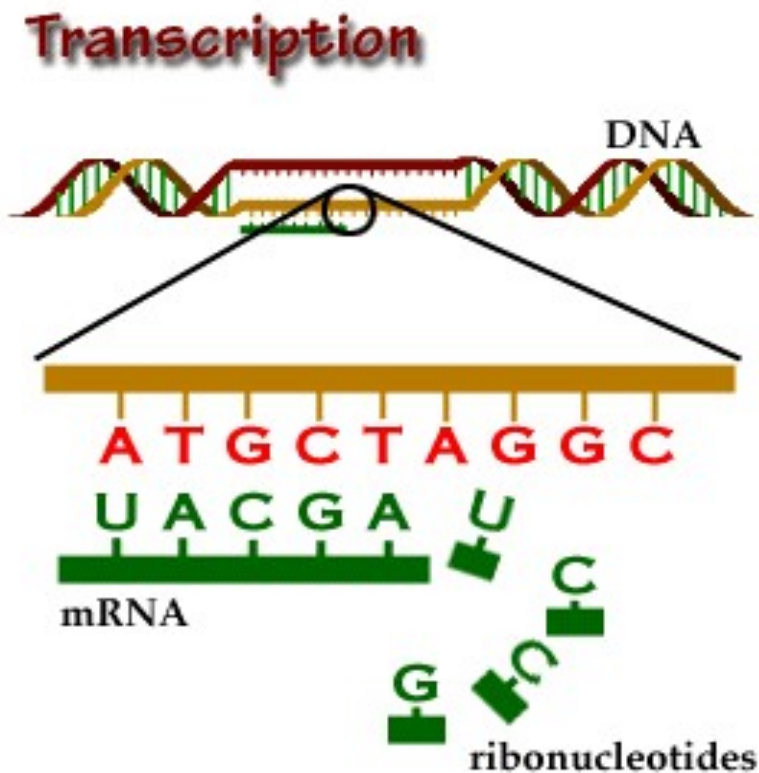
- **First Step:** **Copying** of genetic information from **DNA** to **RNA** called **Transcription**

**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**.

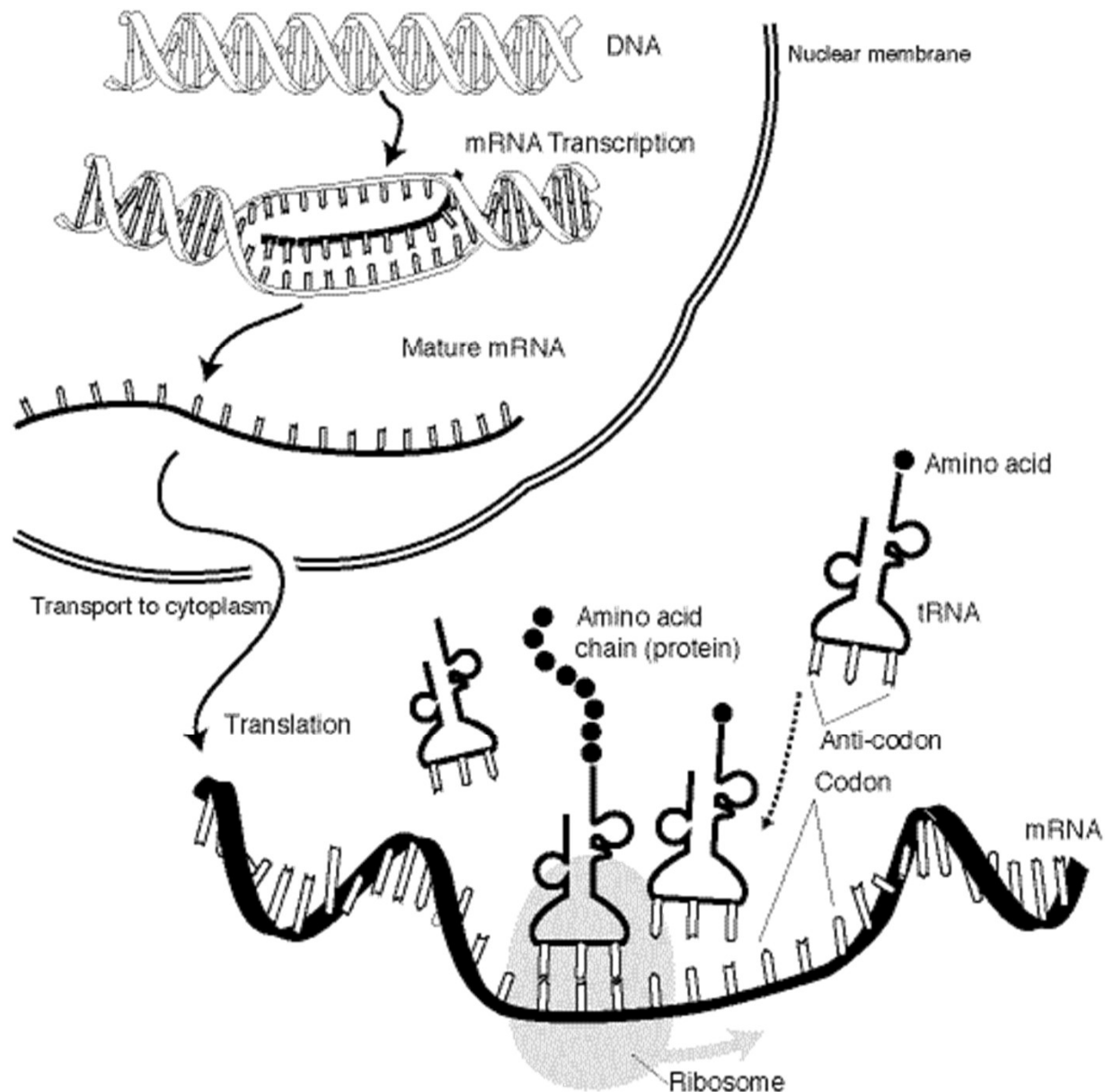
DNA is too **large** to leave the nucleus (**double** stranded), but RNA **can leave** the nucleus (**single** stranded).



- 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.



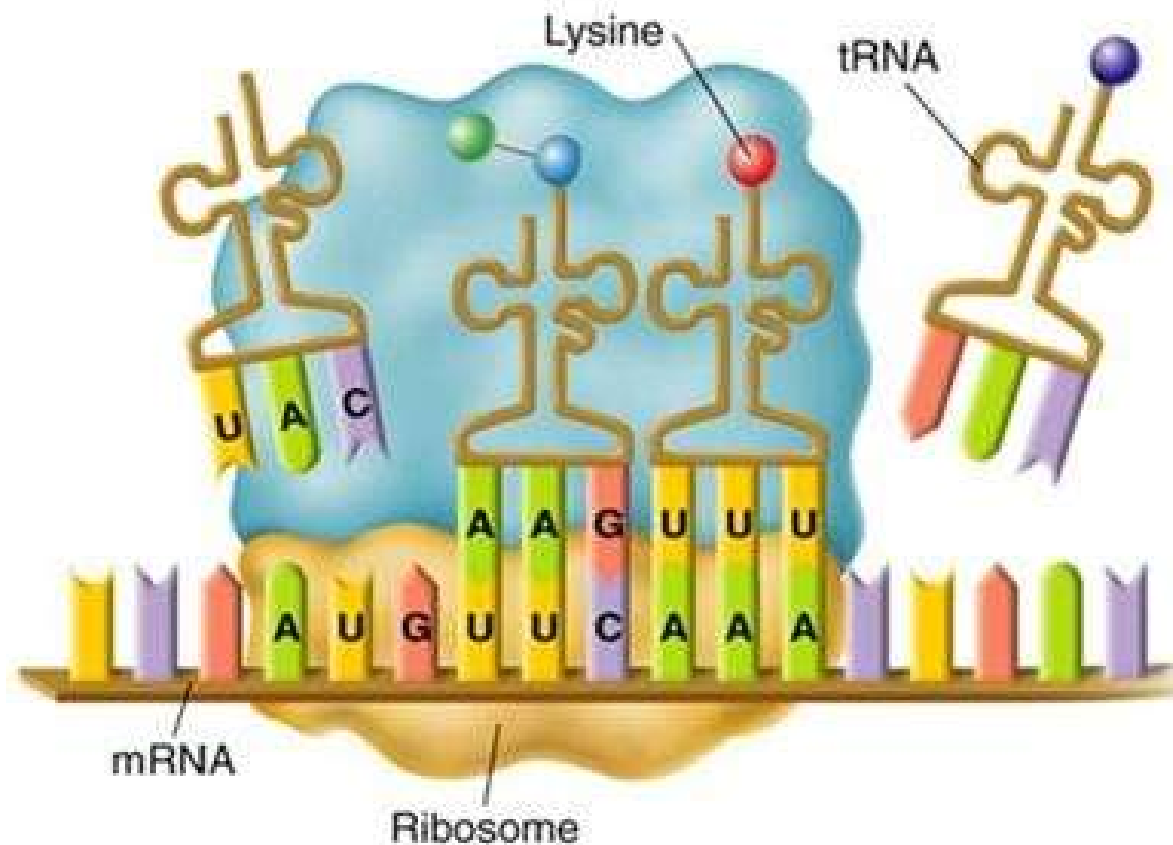


# MAKING PROTEINS

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**.



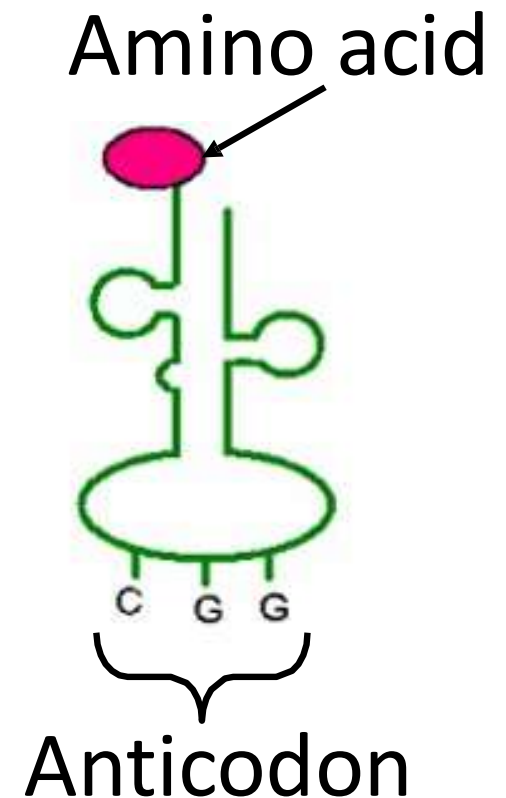
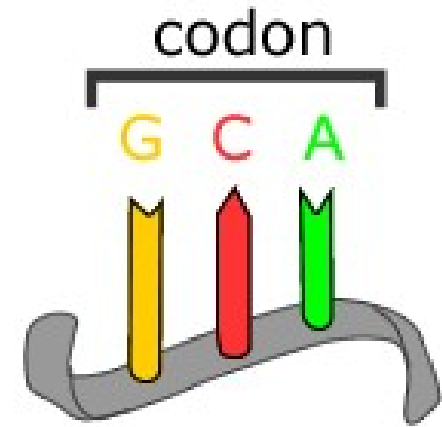
These amino acids come from the food we eat. Proteins we eat are broken down into individual amino acids and then simply rearranged into new proteins according to the needs and directions of our DNA.

## Proteins

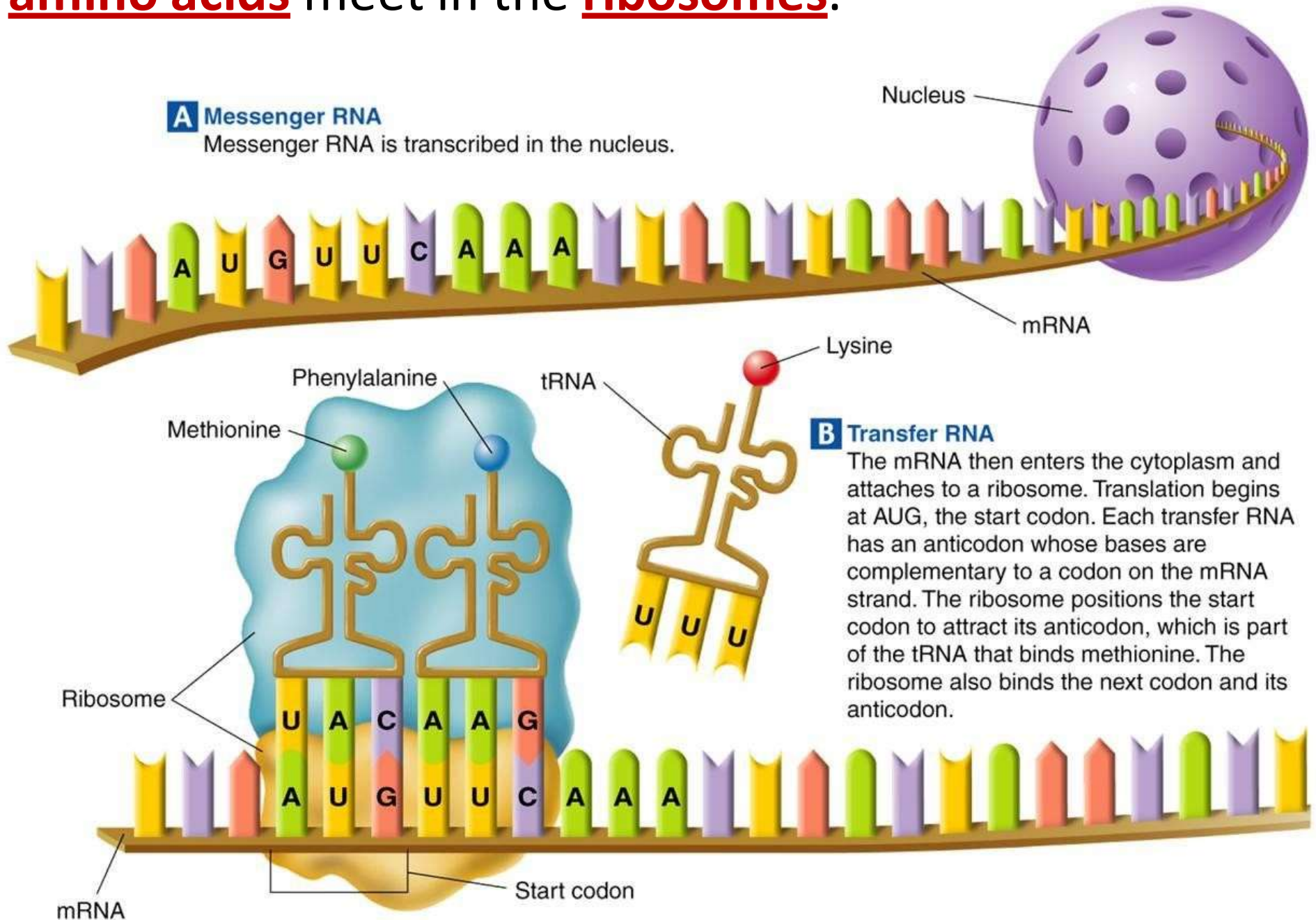




- A series of three adjacent bases in an mRNA molecule codes for a specific amino acid—called a codon.
- Each tRNA has 3 nucleotides that are complementary to the codon in mRNA.
- Each tRNA codes for a different amino acid.



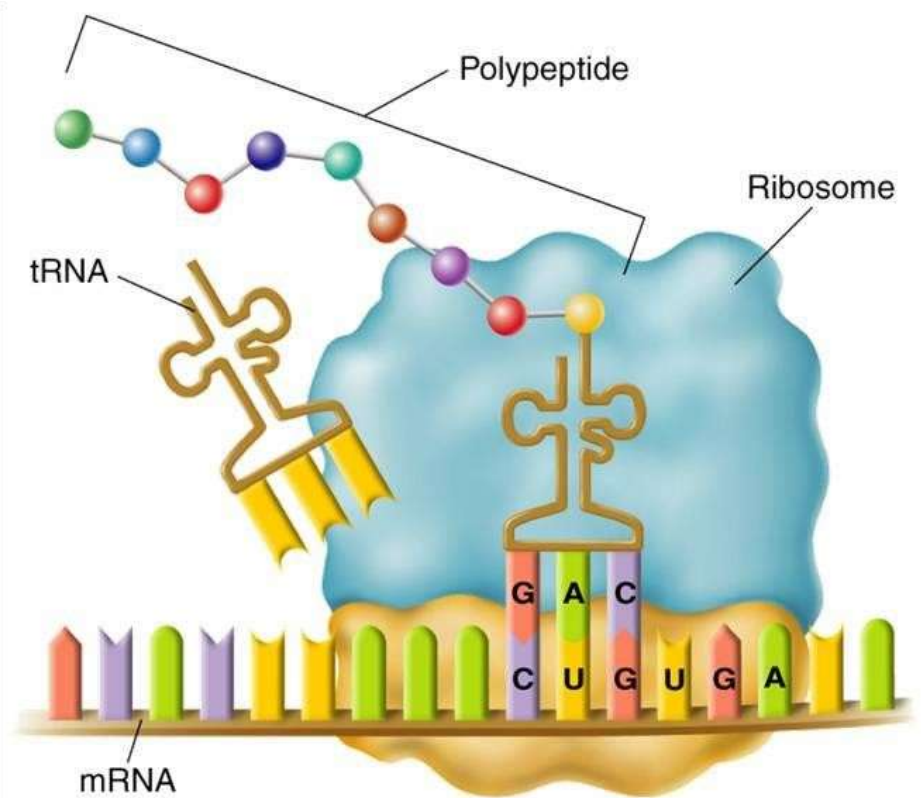
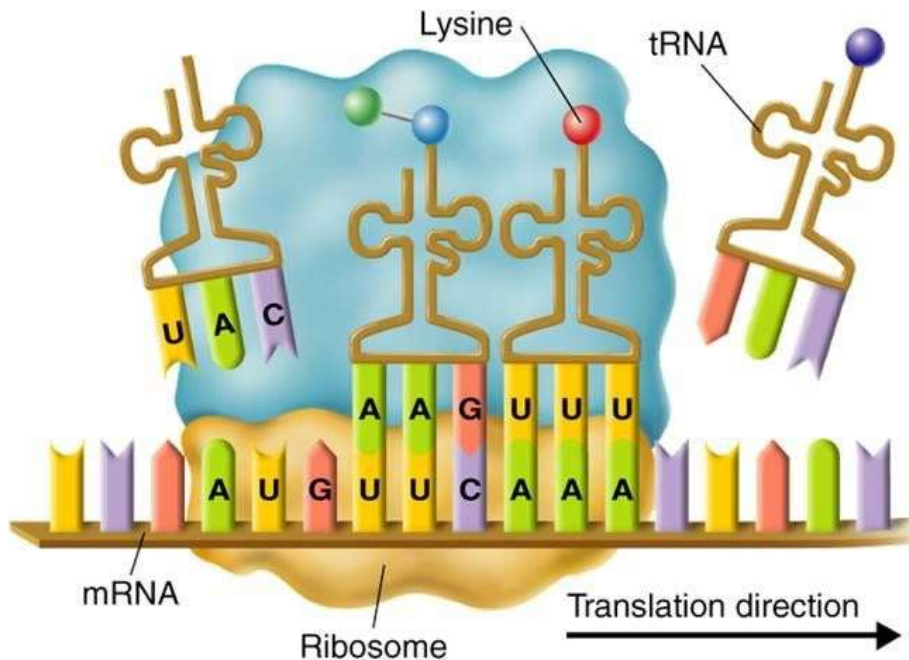
- mRNA carrying the DNA instructions and tRNA carrying amino acids meet in the ribosomes.



- 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**

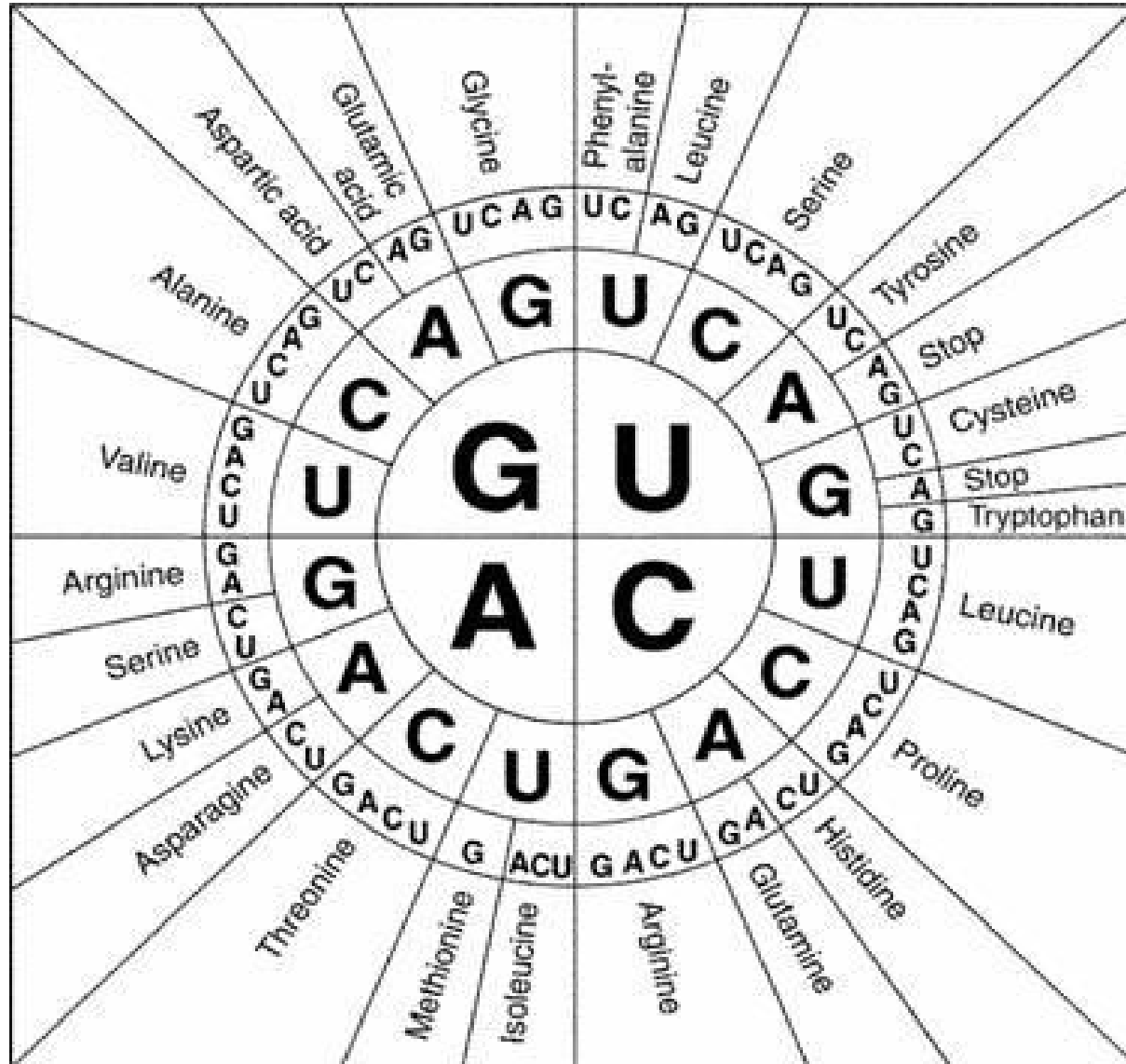
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**AUG/AAC/GAC/UAA**

\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

**AUG/AAC/GAC/UAA**

**Methionine / Asparagine / Aspartic Acid / Stop**



# Protein Synthesis



DNA

transcription



mRNA

translation



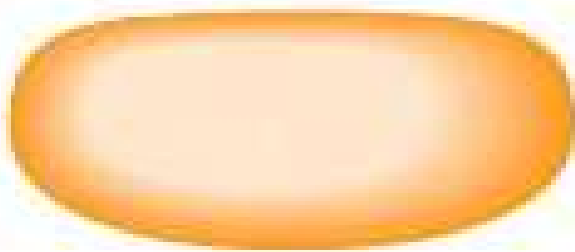
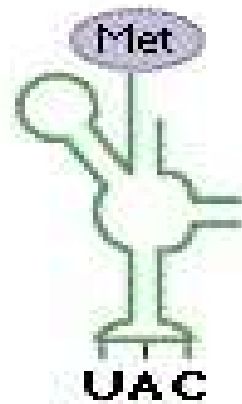
protein





# How Proteins Are Made

# Protein synthesis in motion



# PROTEIN SYNTHESIS

