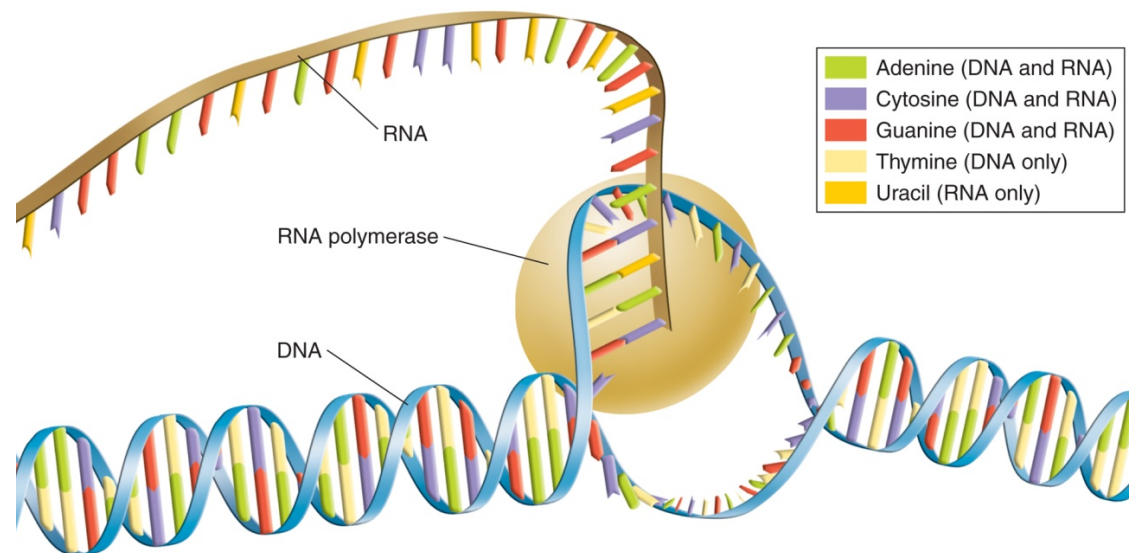


# 12-3 RNA and Protein Synthesis

Objectives:

- **Tell** how RNA differs from DNA.
- **Name** the three main types of RNA
- **Describe** transcription and the editing of RNA.





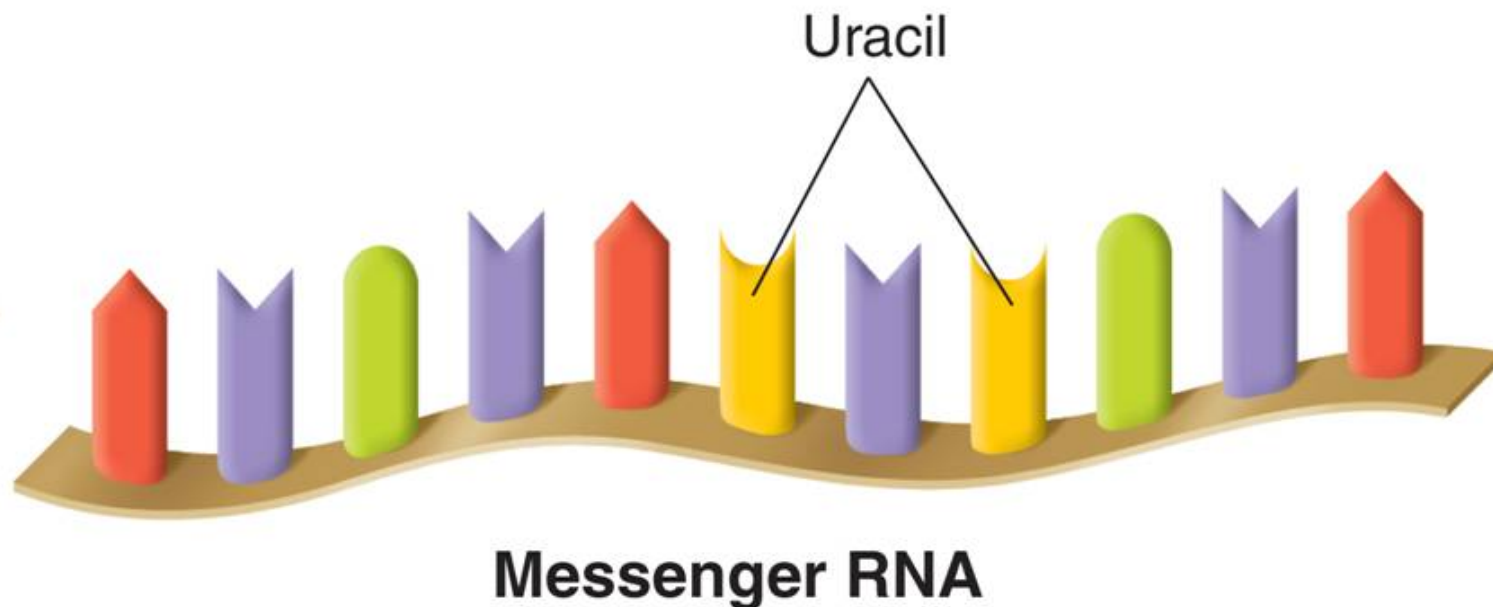
# How is the code of DNA used?

- Parts of DNA called genes are used as instructions to control the making of proteins.
- Genetic messages can be **decoded** by copying part of the nucleotide sequence from DNA into RNA. (Transcription)
- RNA contains **coded** information for making proteins. (Translation)

# The Structure of RNA

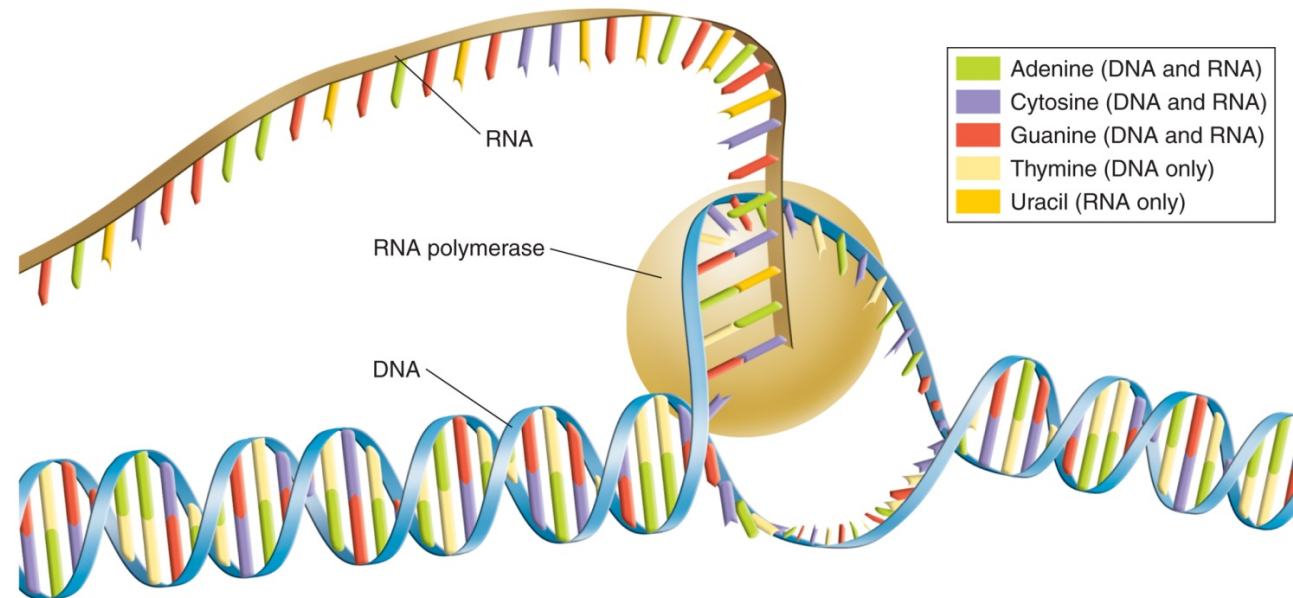
■ There are 3 main structural differences between RNA and DNA:

1. The sugar in RNA is ribose instead of deoxyribose.
2. RNA is single-stranded.
3. RNA contains uracil instead of thymine.



# Transcription

- RNA molecules are made by copying part of a nucleotide sequence of DNA into a **complementary** sequence in RNA.
- Transcription needs the enzyme RNA polymerase.





# Transcription

- Step 1: **RNA polymerase** binds to DNA and separates the DNA strands.
- Step 2: **RNA polymerase** binds to parts of DNA called promoters.
- Step 3: **RNA polymerase** travels along the DNA strand and makes an RNA strand.

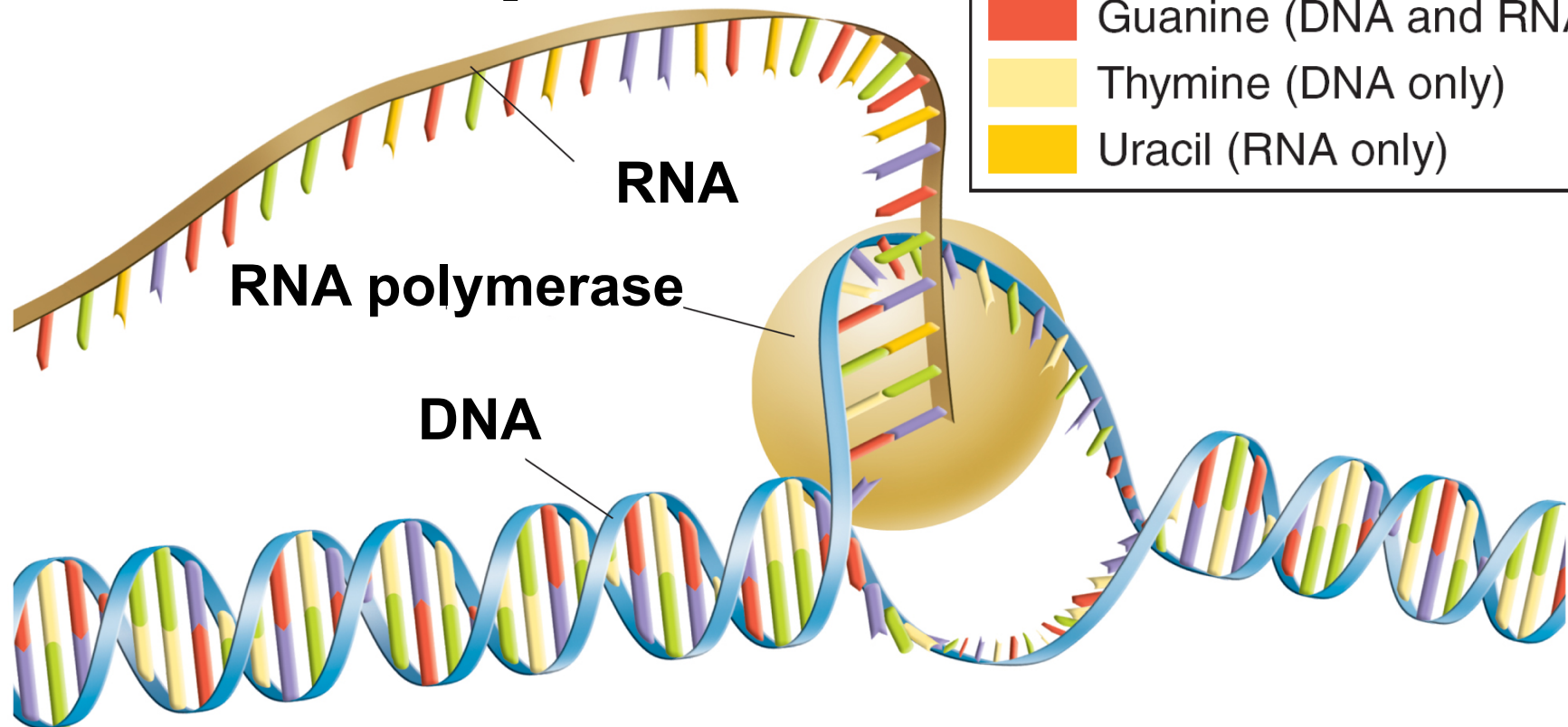


## For Example:

- If RNA Polymerase traveled along a DNA strand with the sequence **ATCGGATG** what would the **mRNA sequence** look like?

ATCGGATG  
UAGCCUAC

# Transcription





# RNA Editing

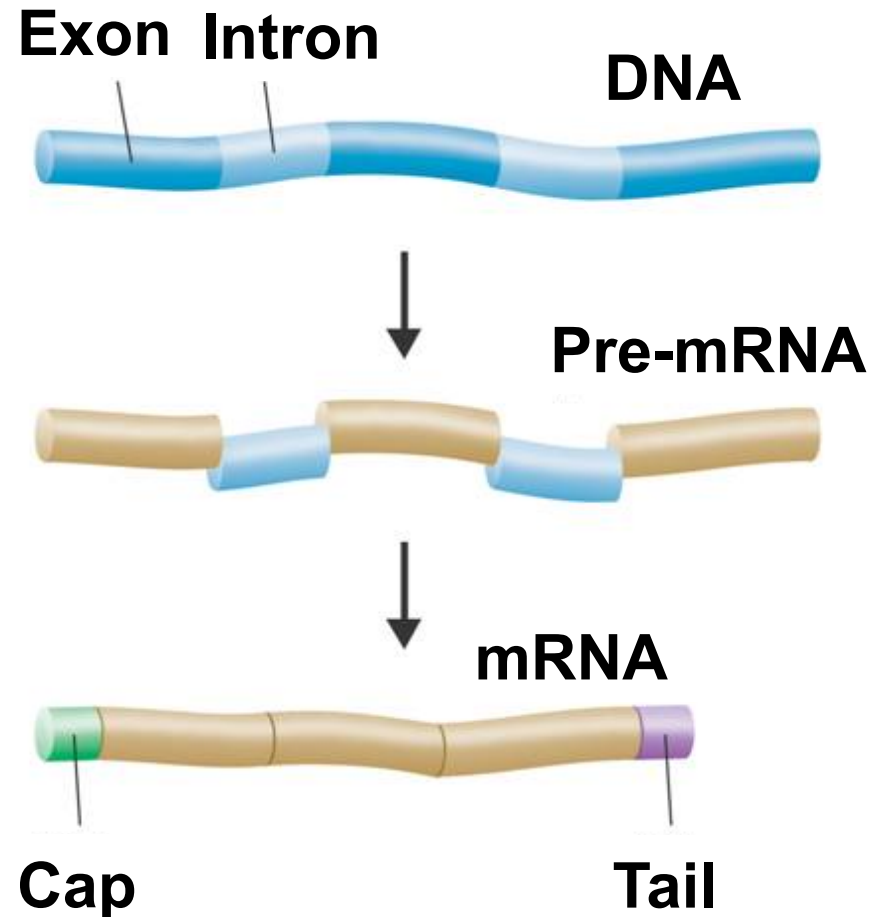
- the DNA of eukaryotic genes contains 2 different sequences of nucleotides:
  1. **Introns**: that are not involved in coding for proteins.
  2. **Exons**: code for proteins.



# RNA Editing

- The introns are cut out of RNA molecules.

- The exons are joined (spliced) together to make mRNA.







# DO NOW!

1. Why do you think DNA replication is described as semi-conservative?
2. Replicate this section of DNA:  
– ATGCATATCGACGGGATAGCCCGAAATT–

Can you name the processes involved?





## More 12-3 Objectives:

- **Identify** the genetic code.
- **Summarize** translation
- **Explain** the relationship between genes and proteins.

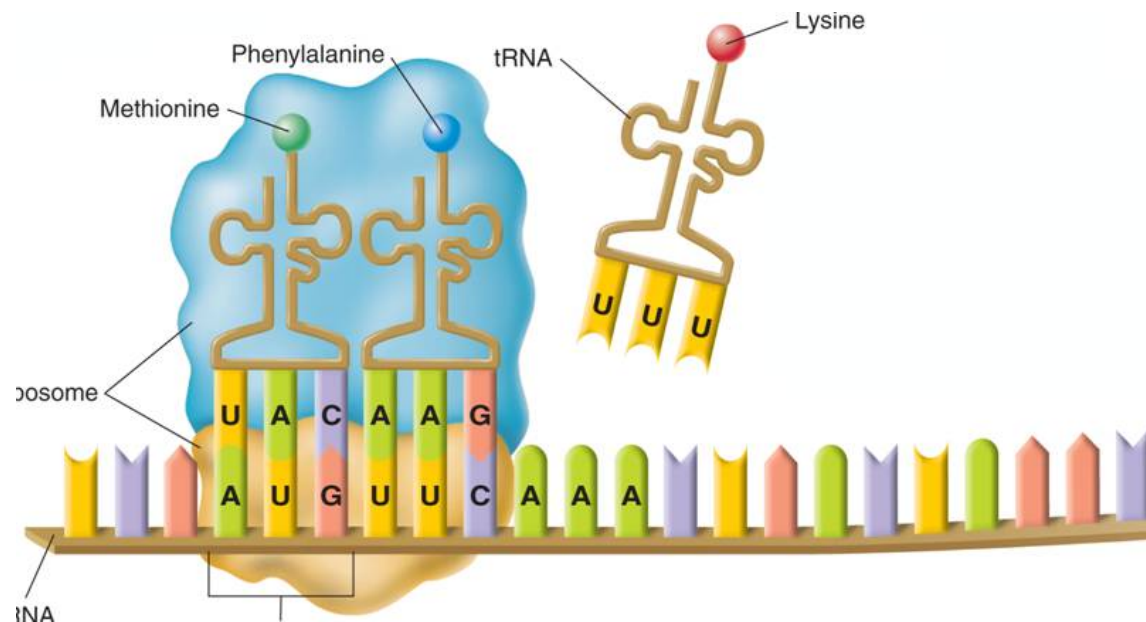


# Questions:

- What is a polymer?
- Which monomer is DNA made out of?
- Which monomer is protein made out of?

# Translation:

- What is **involved**? The three types of RNA
- What is **made**? A Protein
- **Where** does it happen? On a ribosome in the cytoplasm



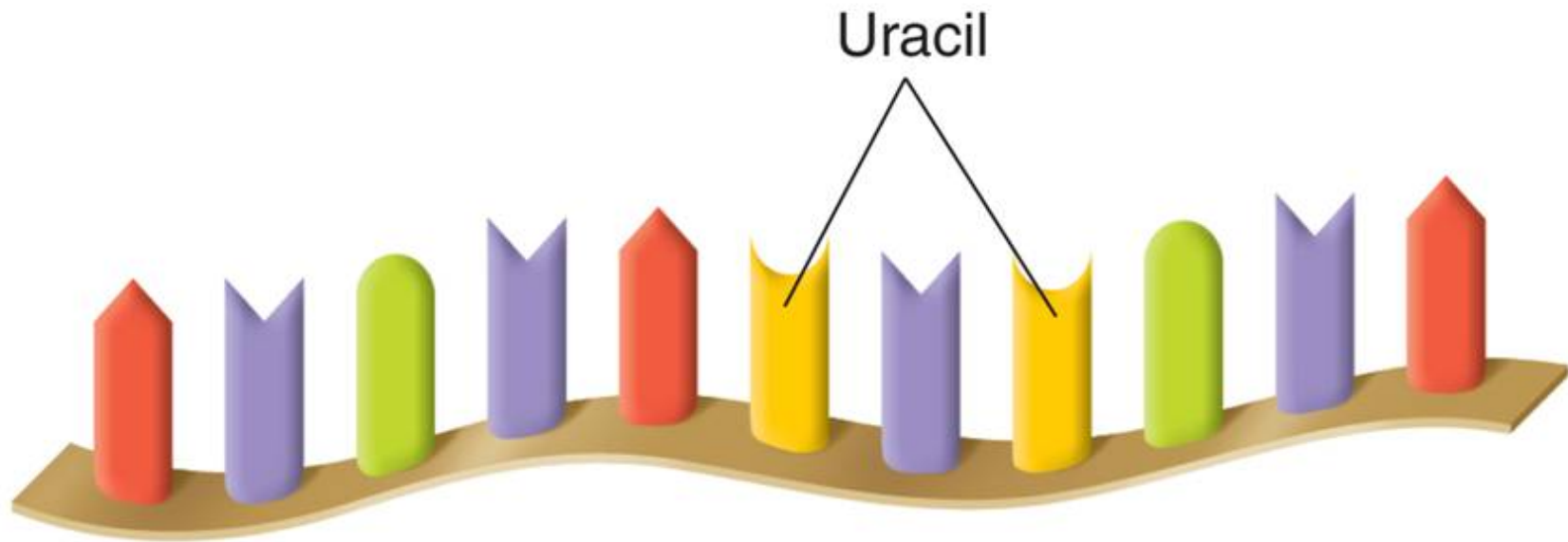
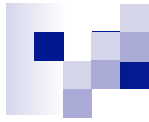


# Types of RNA

There are 3 main types of RNA:

1. **messenger RNA**
2. **ribosomal RNA**
3. **transfer RNA**

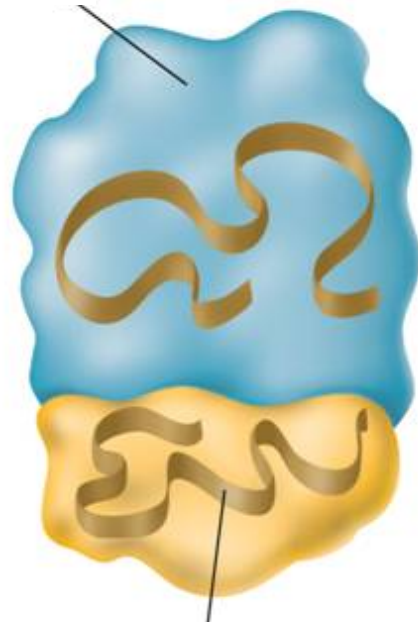




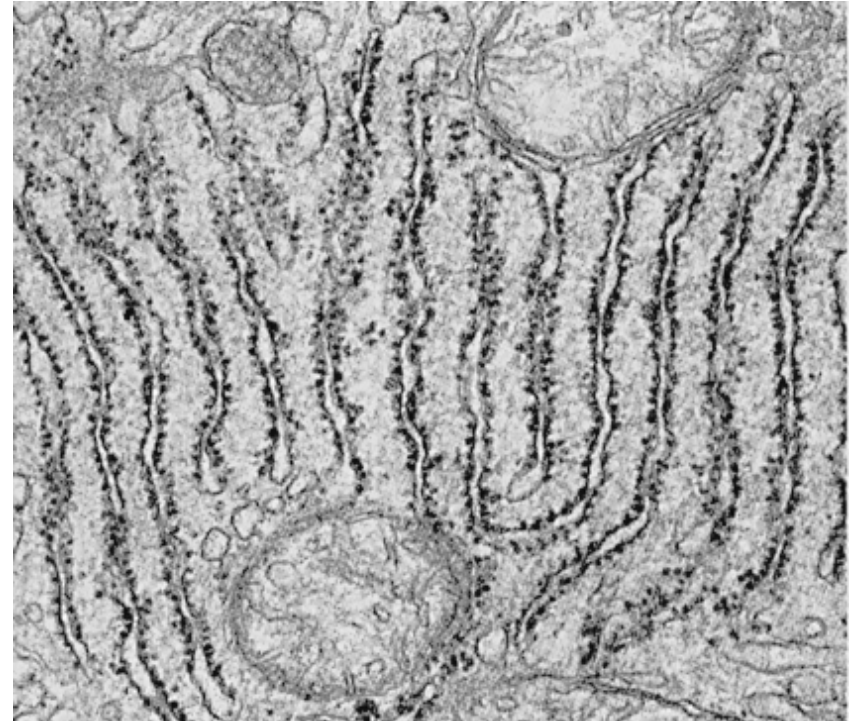
## Messenger RNA

**Messenger RNA (mRNA)** carries copies of instructions for making amino acids into proteins.

## Ribosome



Ribosomal RNA



Ribosomes are made up of proteins and **ribosomal RNA** (rRNA).

Amino acid

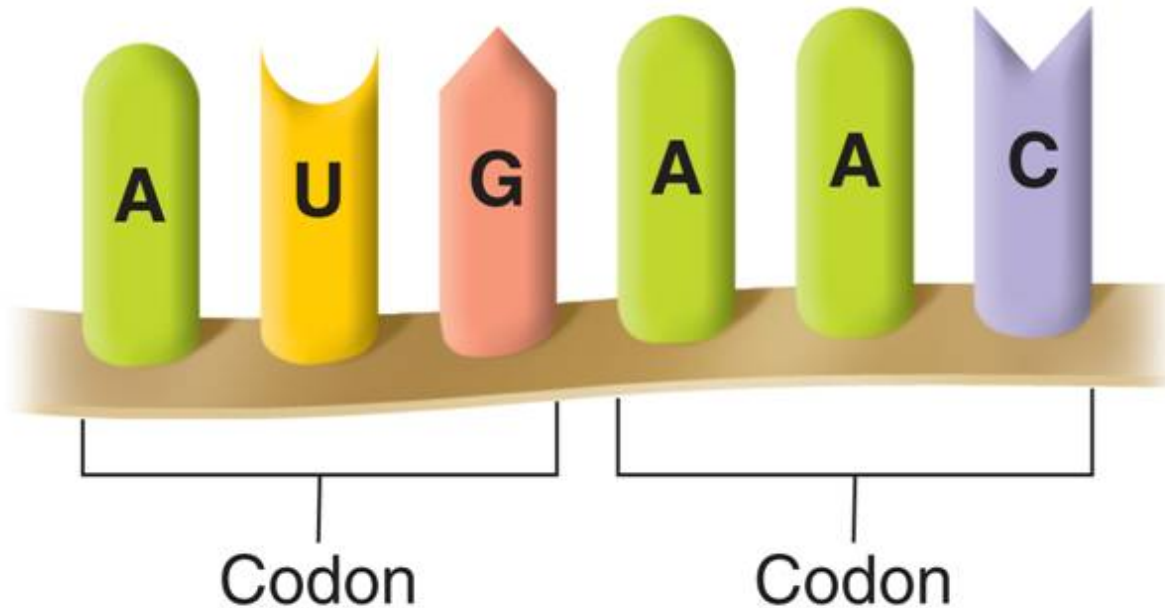
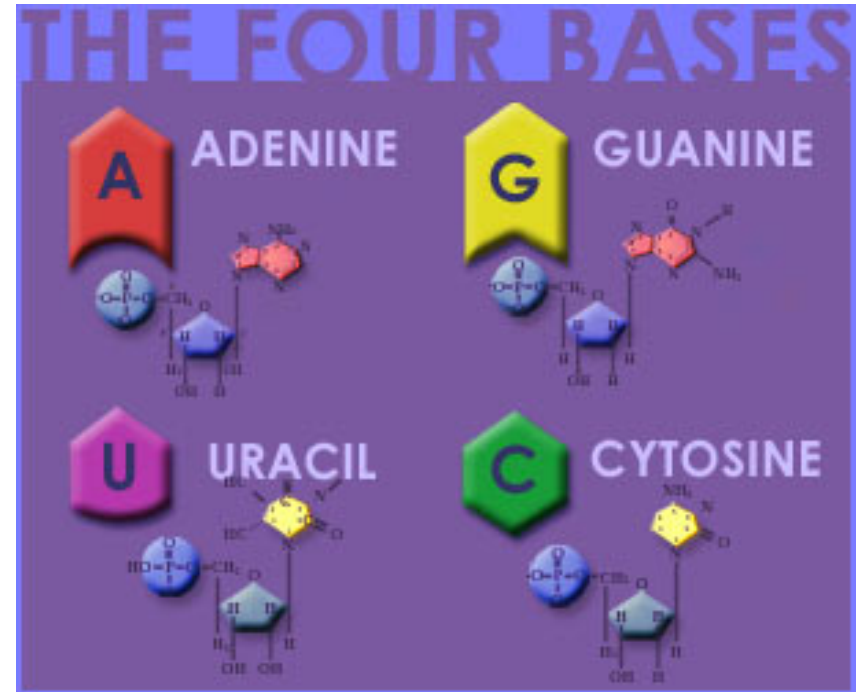


Transfer RNA

While proteins are being made, **transfer RNA** (tRNA) transfers each amino acid to the ribosome.

# The Genetic Code

- A **codon** has three nucleotides on mRNA that code for an amino acid.



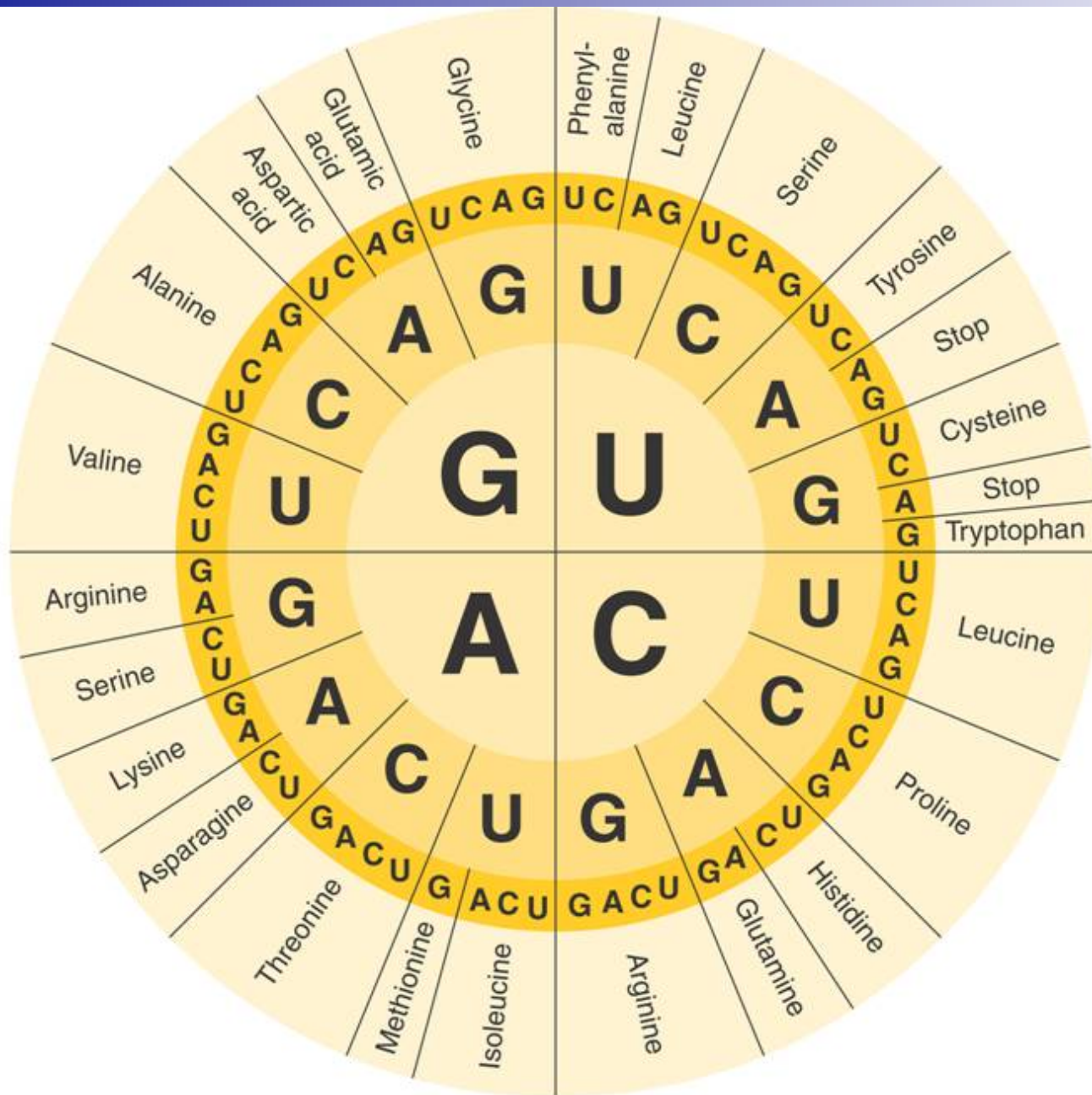
# The Genetic Code

- Each codon codes for a specific amino acid that is placed on the polypeptide chain.
- Some amino acids can be specified by more than one codon.

		Second Letter				
		U	C	A	G	
First Letter	U	UUU	UCU	UAU	UGU	U
		UUC	UCC	UAC	UGC	C
		UUA	UCA	UAA	UGA	A
		UUG	UCG	UAG	UGG	G
	C	CUU	CCU	CAU	CGU	U
		CUC	CCC	CAC	CGC	C
		CUA	CCA	CAA	CGA	A
		CUG	CCG	CAG	CGG	G
	A	AUU	ACU	AAU	AGU	U
		AUC	ACC	AAC	AGC	C
		AUA	ACA	AAA	AGA	A
		AUG	ACG	AAG	AGG	G
	G	GUU	GCU	GAU	GGU	U
		GUC	GCC	GAC	GGC	C
		GUA	GCA	GAA	GGA	A
		GUG	GCG	GAG	GGG	G

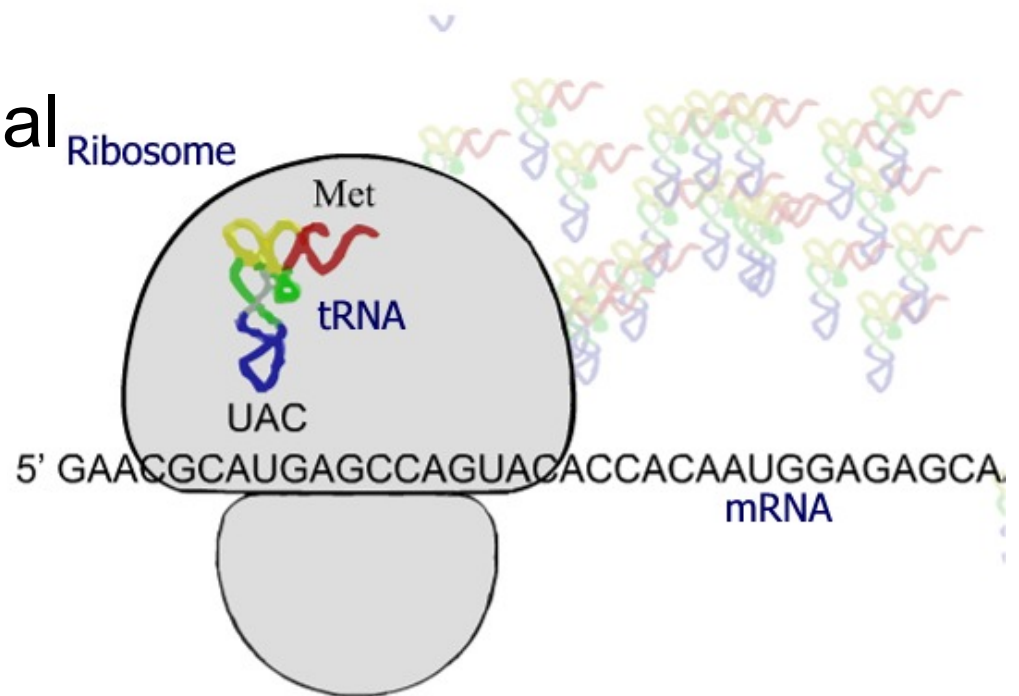
Initiation      Termination

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# Codon Instructions

- **AUG** is a codon that can code for the amino acid methionine *OR* is a “start” codon for protein synthesis.
- There are 3 “stop” codons that do not code for any amino acid.
- These “stop” codons signal the end of a polypeptide.



# Translation

## ■ Step 1:

- **Messenger RNA** is transcribed in the nucleus, and moves to the cytoplasm where it attaches to a ribosome.

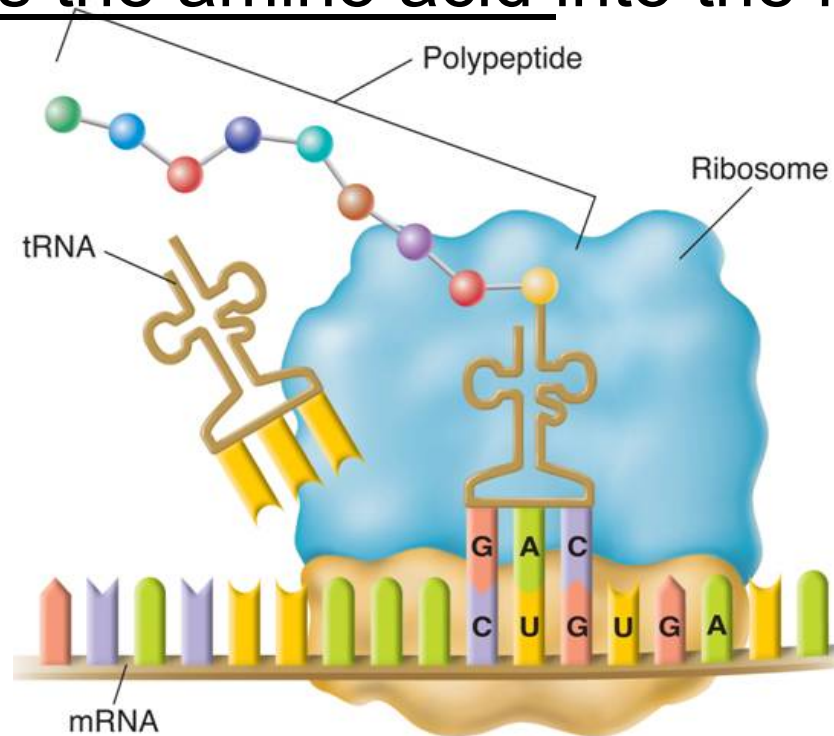




# Translation

## ■ Step 2:

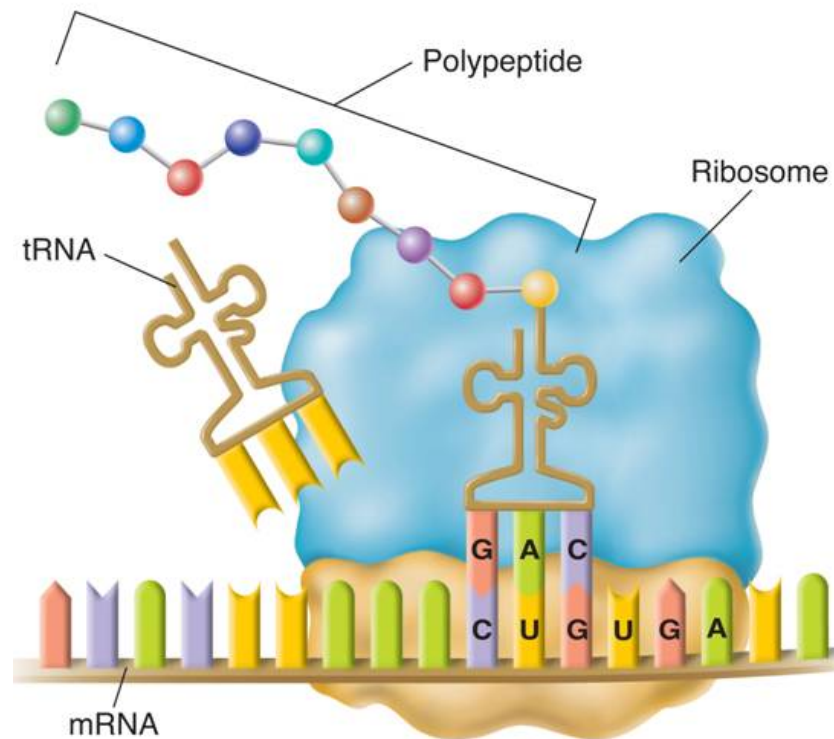
- Codons of the mRNA molecule move through the ribosome,
- tRNA brings the amino acid into the ribosome.



# Translation

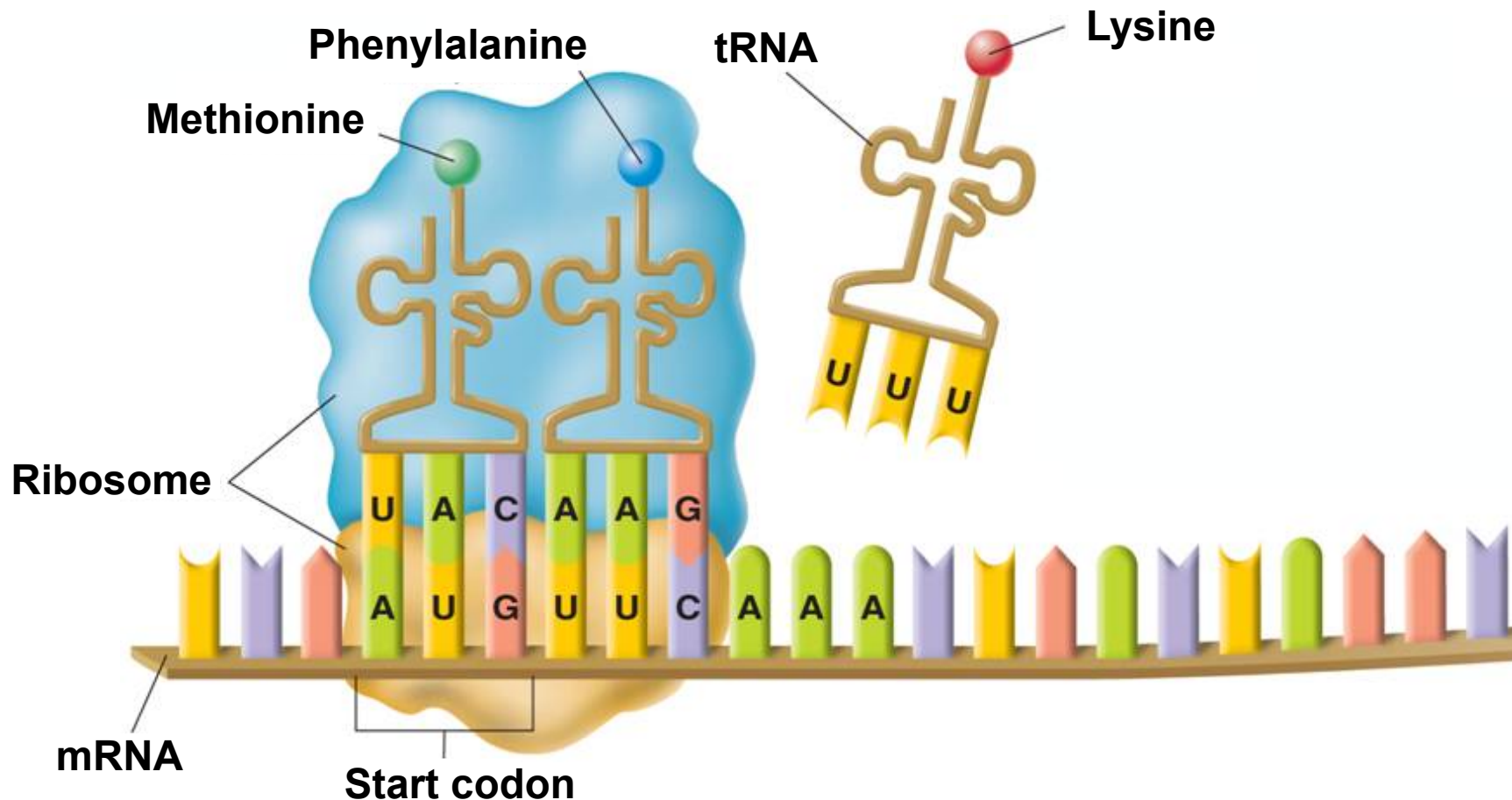
## ■ Step 3:

□ In the ribosome, the amino acid is transferred to the growing polypeptide chain.



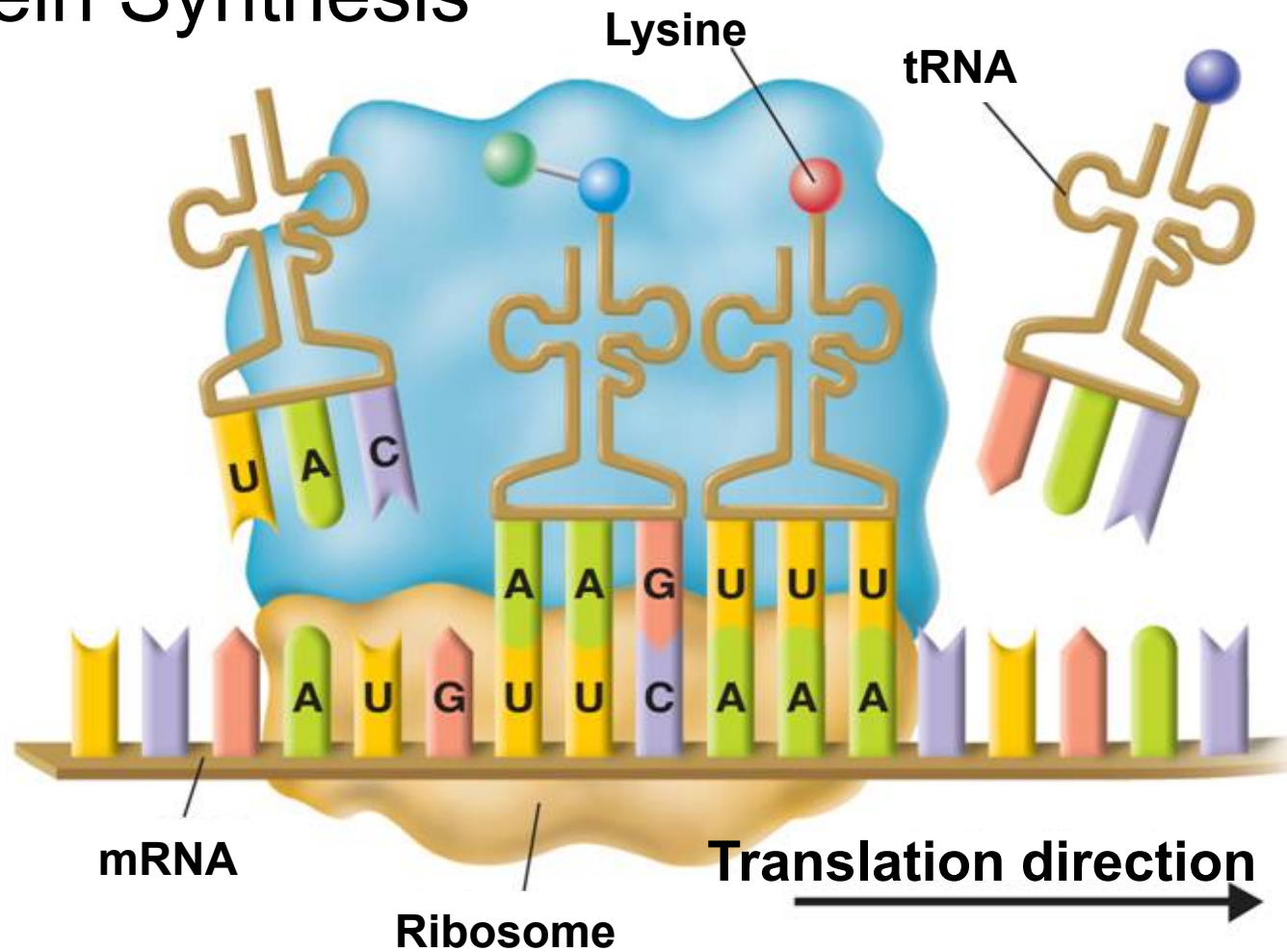
# Translation

- The ribosome binds new tRNA molecules and amino acids as it moves along the mRNA.



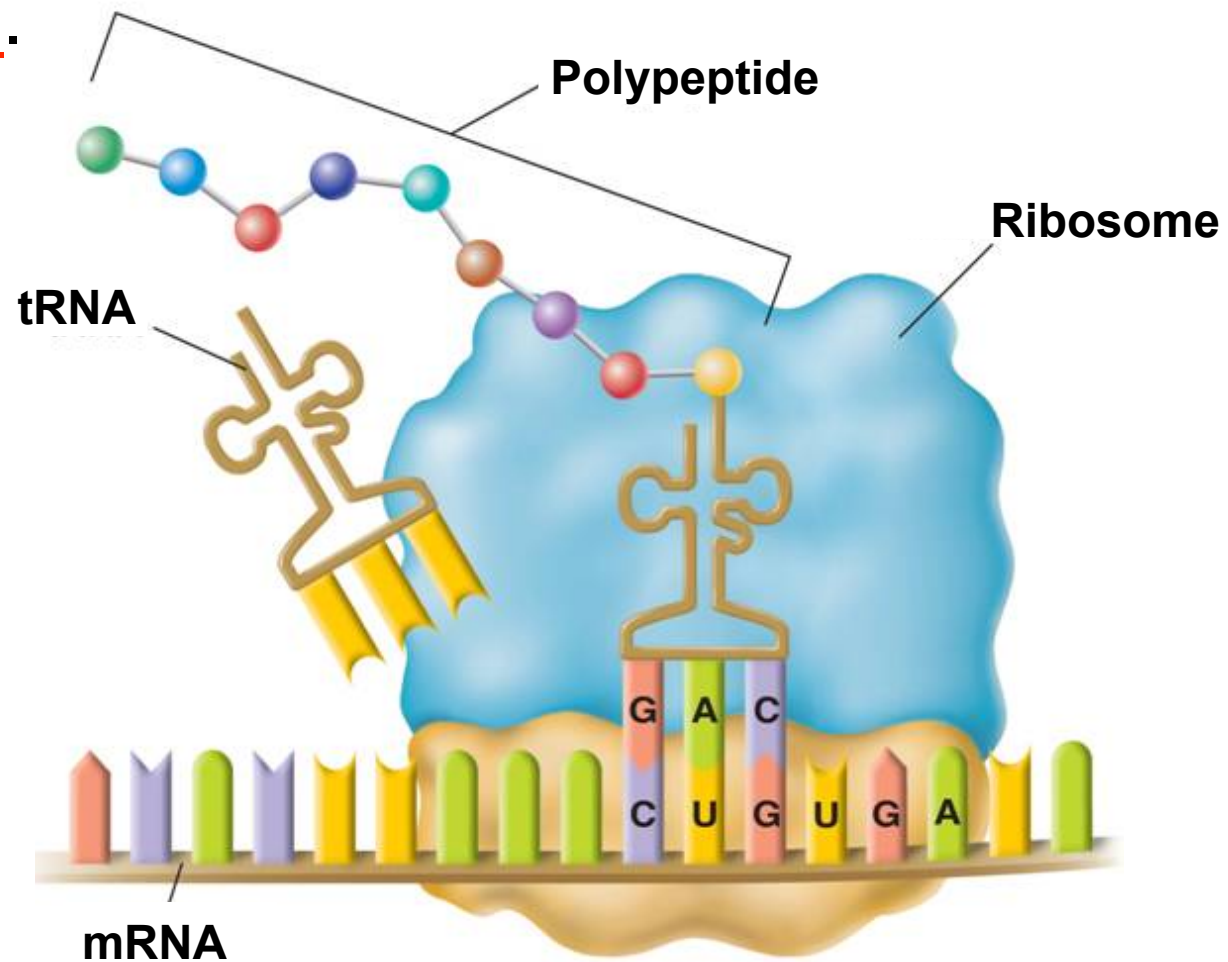
# Translation

## ■ Protein Synthesis



# Translation

- The process continues until the ribosome reaches a **stop codon**.





# The Roles of RNA and DNA

## ■ The Roles of RNA and DNA

- The cell uses the DNA “master plan” to prepare RNA “blueprints.” The DNA stays in the nucleus.
- The RNA molecules go to the protein building sites in the cytoplasm — the ribosomes.



# Genes and Proteins

## ■ Genes and Proteins

- Genes contain instructions for assembling proteins.

- Many proteins are enzymes, which catalyze and regulate chemical reactions.

- Proteins are each specifically designed to build or operate a component of a living cell.

# Genes and Proteins

- The sequence of bases in DNA is used as a template for mRNA.
- The codons of mRNA specify the sequence of amino acids in a protein.

