



RNA STRUCTURE

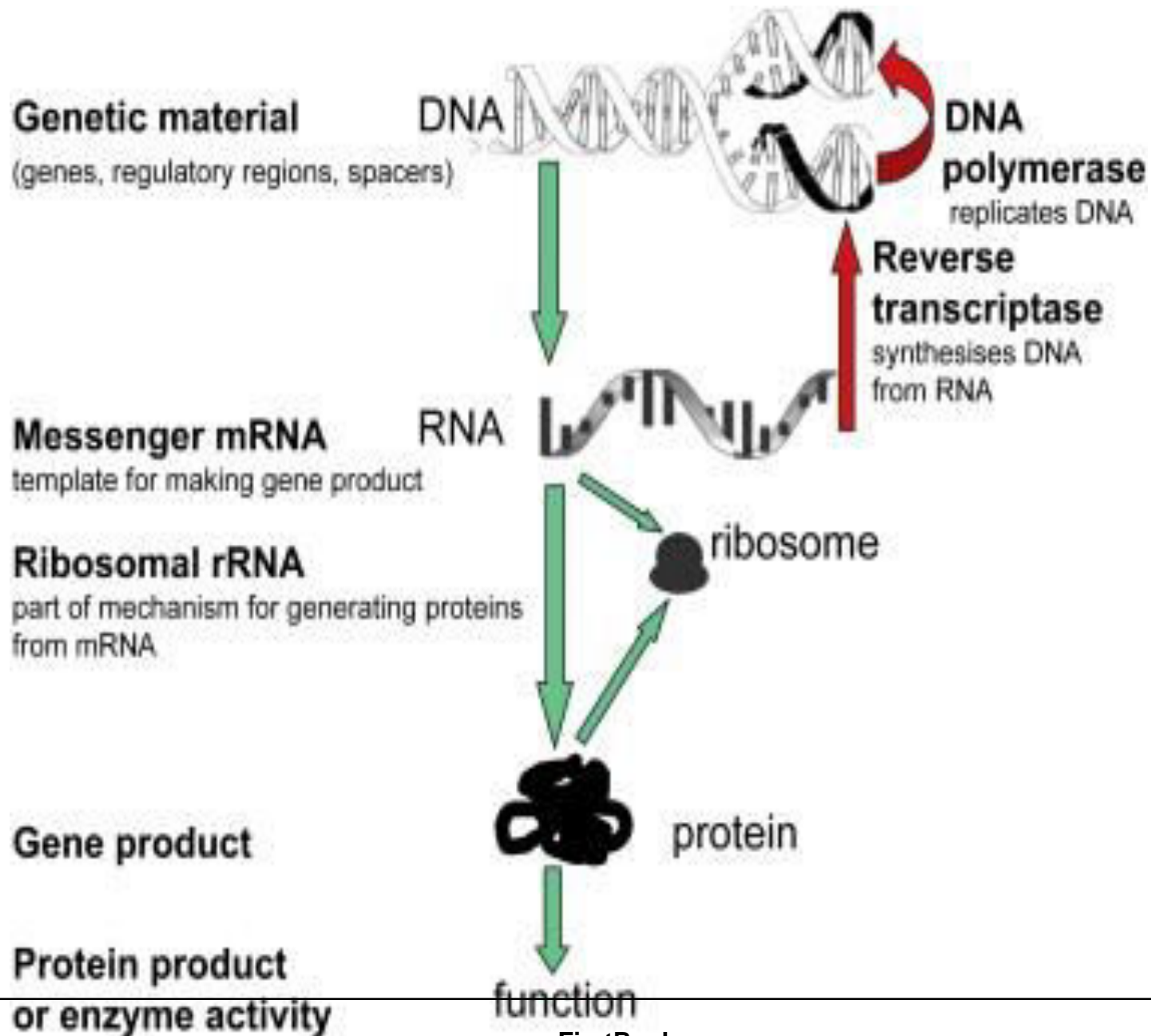
BIOCHEMISTRY

- The genetic master plan of an organism is contained in the sequence of deoxyribonucleotides in its deoxyribonucleic acid (DNA). However, it is through the ribonucleic acid (RNA)—the “working copies” of the DNA—that the master plan is expressed

- The copying process, during which a DNA strand serves as a template for the synthesis of RNA, is called transcription.

- Transcription produces messenger RNAs that are translated into sequences of **amino acids** (polypeptide chains or proteins), and **ribosomal RNAs**, **transfer RNAs**, and **additional small RNA** molecules that perform specialized structural, catalytic, and regulatory functions and are not translated.

- The **final product** of gene expression, therefore, can be **RNA or protein**, depending upon the gene.



Structure of RNA

- There are **three major types** of RNA that participate in the process of protein synthesis:
- ribosomal RNA (rRNA)
- transfer RNA (tRNA)
- messenger RNA (mRNA)

- Like DNA, these three types of RNA are unbranched polymeric molecules composed of nucleoside monophosphates joined together by phosphodiester bonds.

They **differ as a group from DNA** in several ways:

- They are **smaller** than DNA
- They contain **ribose** instead of deoxyribose
- They contain **Uracil** instead of thymine.
- Most RNAs exist as **single strands** that are capable of folding into complex structures.

- The three major types of RNA also differ from each other in size, function, and special structural modifications.

Ribosomal RNA

rRNA make up about **eighty percent** of the total RNA in the cell.

- rRNAs are found in association with several proteins as components of the ribosomes.
- There are three distinct size species of rRNA (**23S, 16S, and 5S**) in **prokaryotic cells**.
- In the **eukaryotic** cytosol, there are four rRNA species (**28S, 18S, 5.8S, and 5S**).

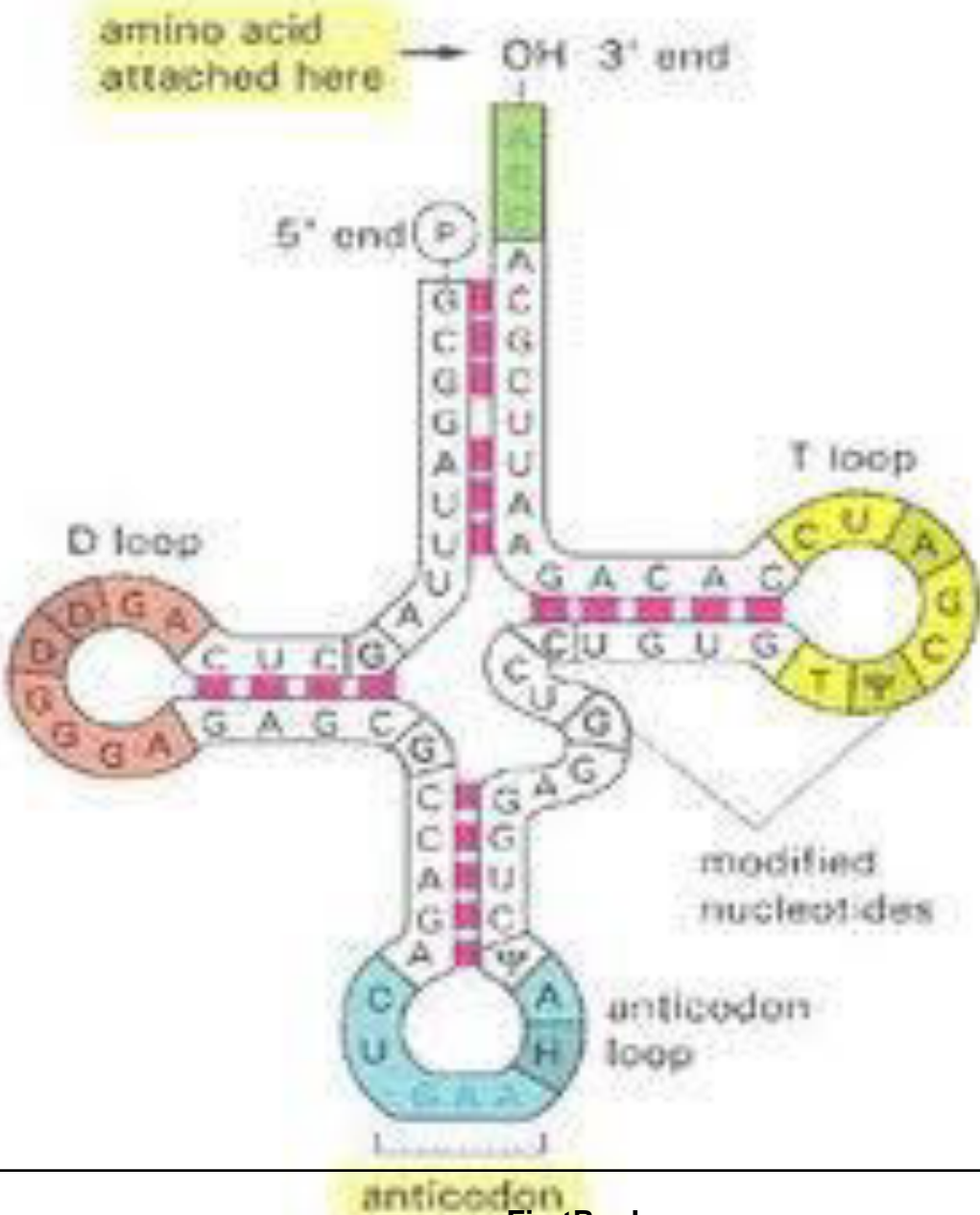
- Some rRNA function **as catalysts** in protein synthesis .
- RNA with catalytic activity is termed a “**ribozyme**”.

Transfer RNA

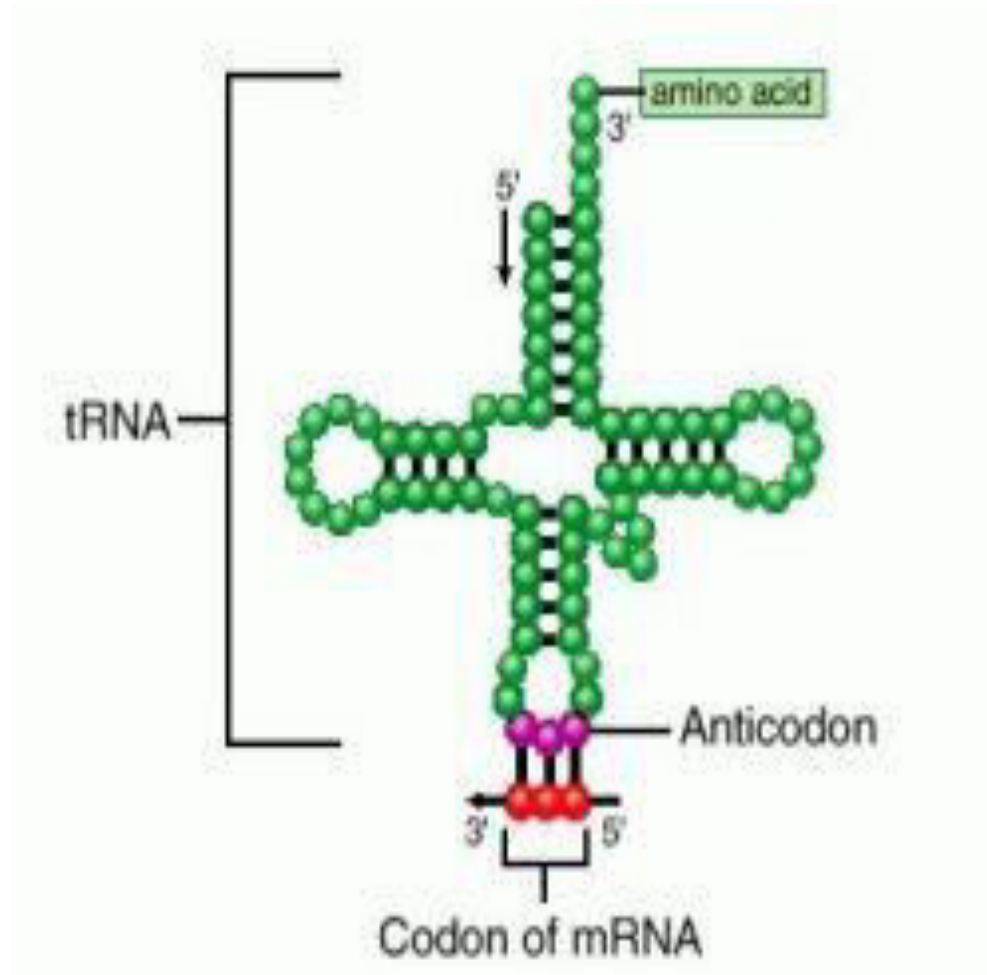
- tRNA are the **smallest** of the three major species of RNA molecules.
- **tRNA** make up about **fifteen percent** of the total RNA in the cell.

- There is at least one specific type of tRNA molecule for each of the twenty amino acids commonly found in proteins.

- The tRNA molecules contain unusual bases (for example, dihydrouracil) and have extensive intrachain base-pairing that leads to characteristic secondary and tertiary structure.

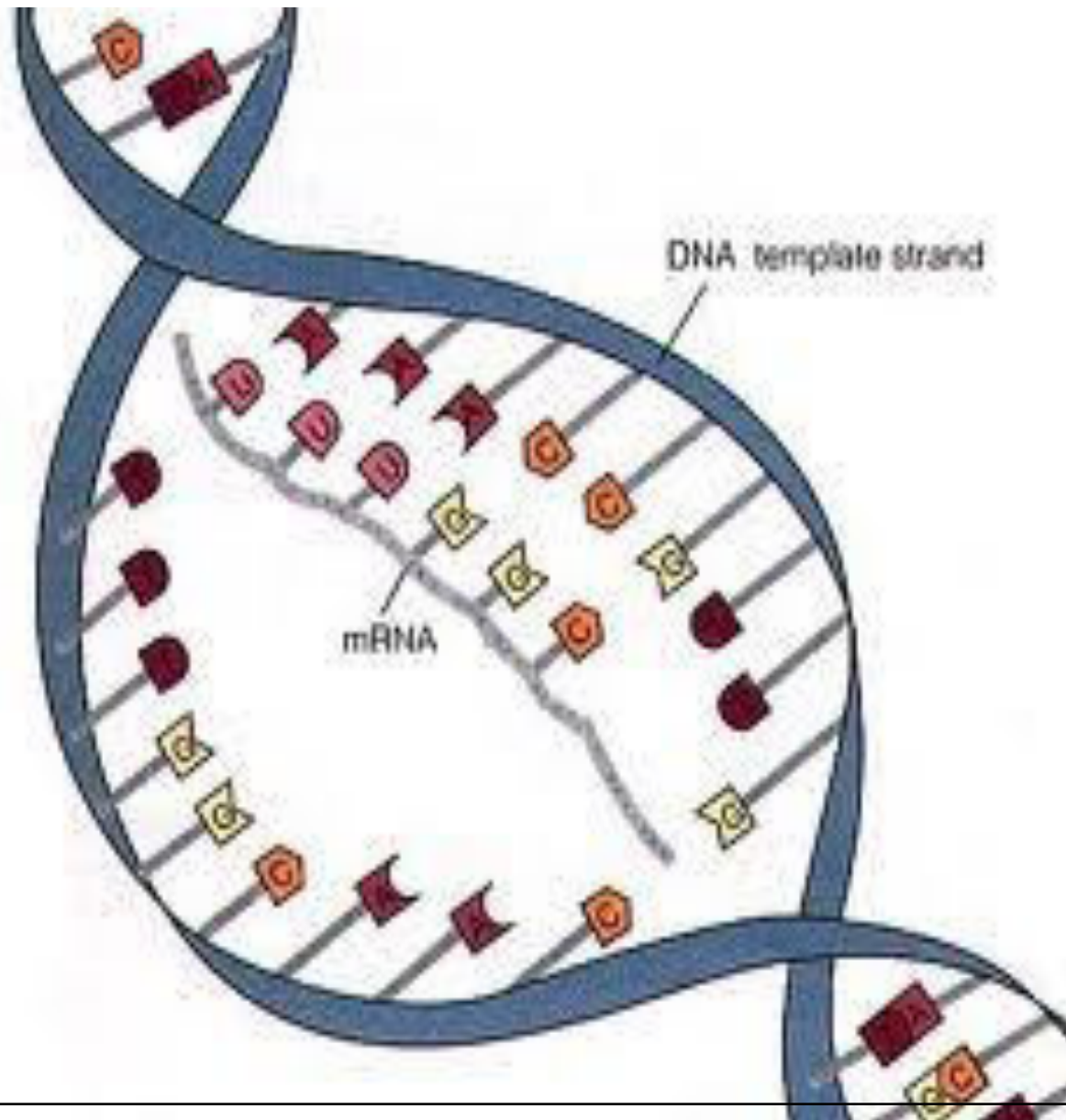


- Each tRNA serves as an “**adaptor**” molecule that carries its specific amino acid—covalently attached to its 3'-end—to the site of protein synthesis.
- There it recognizes the genetic code word on an mRNA, which specifies the addition of its amino acid to the growing peptide chain.



Messenger RNA

- **mRNA** comprises only about **five percent** of the RNA in the cell.
- The most heterogeneous type of RNA in size and base sequence.
- The mRNA carries genetic information from the nuclear DNA to the cytosol, where it is used as the template for protein synthesis.



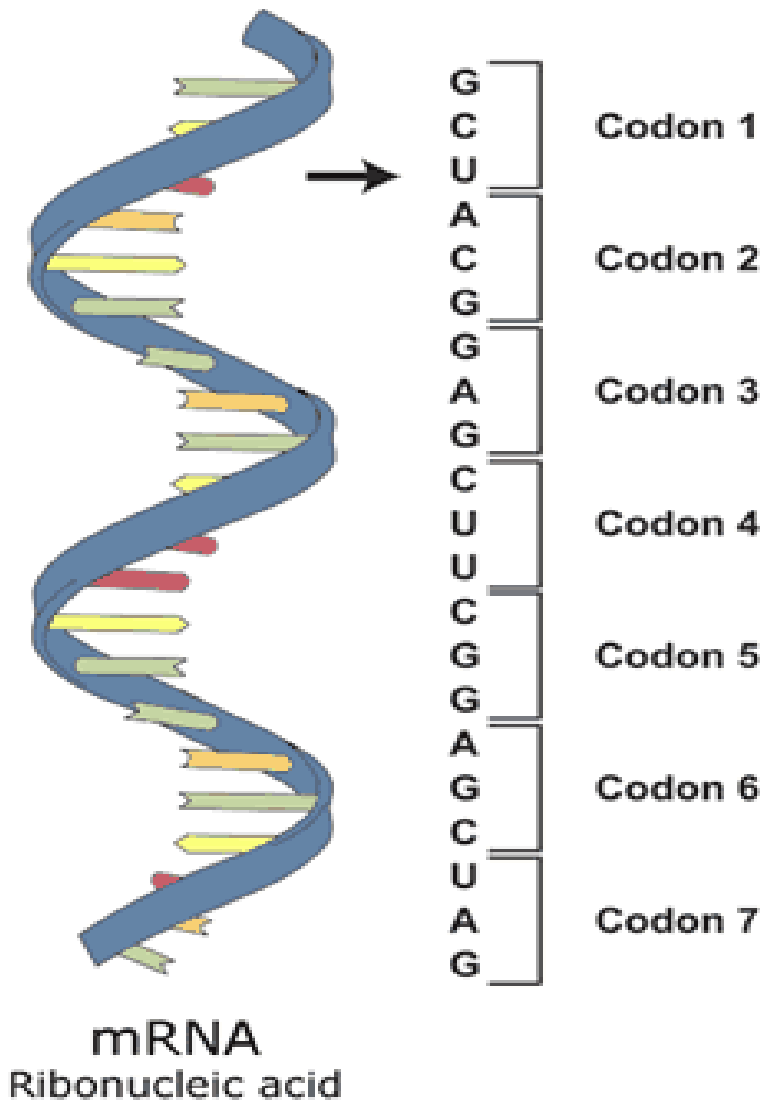
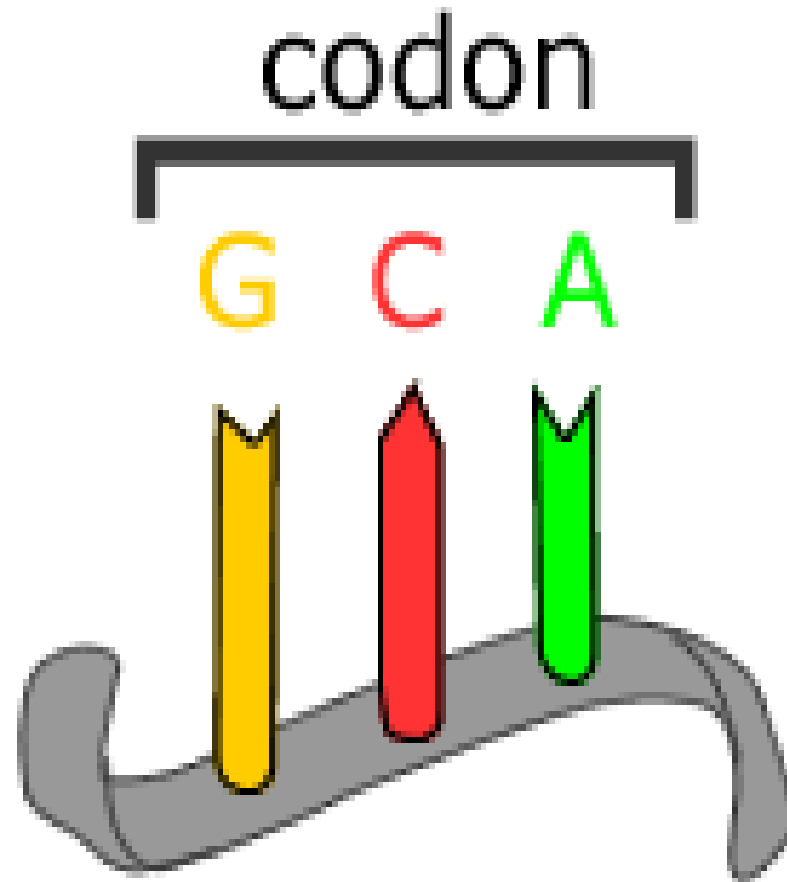


Image adapted from: National Human Genome Research Institute. Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion/DIR//VIP/Glossary/Illustration/codon.shtml.



1 codon = 1 amino acid

- If the mRNA carries information from more than one gene, it is said to be polycistronic. **Polycistronic** mRNA is characteristic of **prokaryotes**.
- If the mRNA carries information from just one gene, it is said to be **monocistronic** and is characteristic of **eukaryotes**.

- Prokaryotic mRNA often have several coding regions, that is, they are polycistronic .They produce a separate species of polypeptide.

- In contrast, each eukaryotic mRNA has only one coding region, that is, it produces only one polypeptide chain. It is monocistronic,

- In addition to the protein coding regions that can be translated, mRNA contains untranslated regions at its 5'- and 3'-ends.

- Special structural characteristics of **eukaryotic** (but not prokaryotic) mRNA include:
- A long sequence of adenine nucleotides (a “poly-A tail”) on the 3'-end of the RNA chain, plus
- A “cap” on the 5'-end consisting of a molecule of 7-methylguanosine attached “backward” (5'→5') through a triphosphate linkage.

- The addition of this 7-methylguanosine “cap” permits the initiation of translation and helps stabilize the mRNA. Eukaryotic mRNA lacking the cap are not efficiently translated.

- A chain of 40–200 adenine nucleotides attached to the 3'-end .This poly-A tail is not transcribed from the DNA, but is added after transcription.
- These tails help stabilize the mRNA and facilitate their exit from the nucleus.After the mRNA enters the cytosol, the poly-A tail is gradually shortened

