Ribonucleic Acid (RNA)

RNA is typically single stranded and is made of ribonucleotides that are linked by phosphodiester bonds. A ribonucleotide in the RNA chain contains ribose (the pentose sugar), one of the four nitrogenous bases (A, U, G and C) and phosphate group.

RNA molecules are single-stranded nucleic acids composed of nucleotides carrying the genetic code, which play a major role in protein synthesis, being translated to corresponding proteins. RNA stands for ribonucleic acid.

Although single-stranded, RNA is not always linear. It has the ability to fold into complex three-dimensional shapes and form hairpin loops. When this occurs, the nitrogenous bases bind to one another. Adenine pairs with uracil (A-U) and guanine pairs with cytosine (G-C). Hairpin loops are commonly observed in RNA molecules such as messenger RNA (mRNA) and transfer RNA (t RNA).

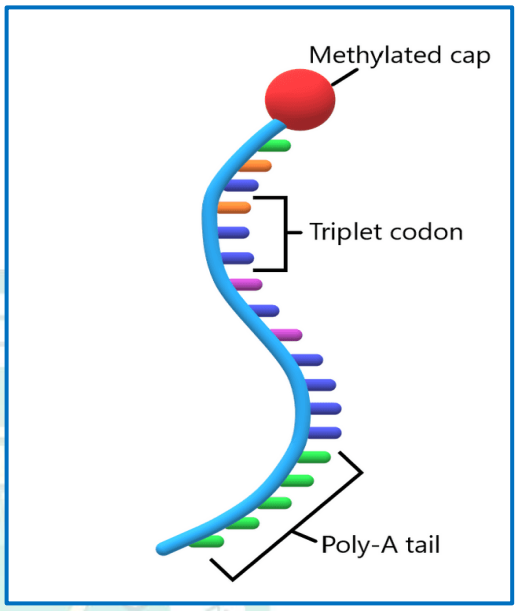
Types of RNA

In both prokaryotes and eukaryotes, there are three main types of RNA – messenger RNA (mRNA), ribosomal RNA (rRNA), and transfer RNA (tRNA).

Messenger RNA (mRNA)

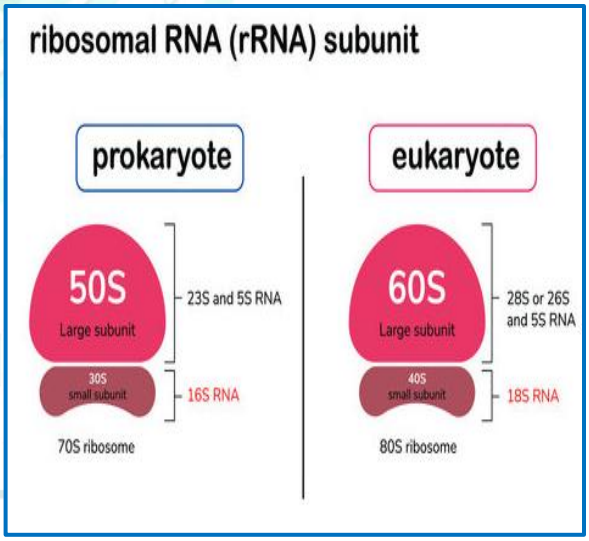
mRNA accounts for just 5% of the total RNA in the cell. mRNA is the most heterogeneous of the 3 types of RNA in terms of both base sequence and size. It carries complimentary genetic code copied, from DNA during transcription, in the form of triplets of nucleotides called codons. which controls all of the cellular

activities in a cell. If a cell requires a certain protein to be synthesized, the gene for this product is “turned on” and the mRNA is synthesized through the process of transcription. mRNA is relatively unstable and short-lived in the cell, especially in prokaryotic cells, ensuring that proteins are only made when needed.



Ribosomal RNA (rRNA)

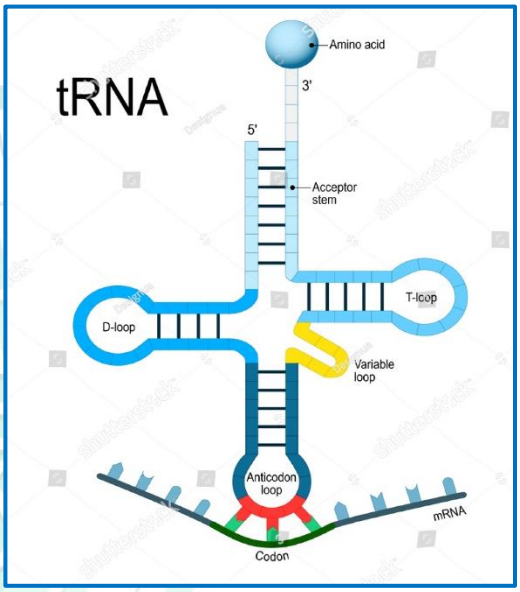
rRNAs are found in the ribosomes and account for 80% of the total RNA present in the cell. Ribosomes are composed of a large subunit called the 50S and a small subunit called the 30S, each of which is made up of its own specific rRNA molecules. Different rRNAs present in the ribosomes include small rRNAs and large rRNAs, which belong to the small and large subunits of the ribosome, respectively.



The rRNA ensures the proper alignment of the mRNA, tRNA, and the ribosomes; the rRNA of the ribosome also has an enzymatic activity (peptidyl transferase) and catalyzes the formation of the peptide bonds between two aligned amino acids during protein synthesis.

Transfer RNA (tRNA)

tRNA is the smallest of the 3 types of RNA, possessing around 75-95 nucleotides. tRNAs are an essential component of translation, where their main function is the transfer of amino acids during protein synthesis. Therefore, they are called transfer RNAs.



Transfer RNA is shaped like a clover leaf with three hairpin loops. It contains an amino acid attachment site on one end and a special section in the middle loop called the anticodon site. The anticodon recognizes a specific area on mRNA called a codon. A codon consists of three continuous nucleotide bases that code for an amino acid or signal the end of translation.

General functions of RNA

1- RNA is a nucleic acid messenger between DNA and ribosomes.

2- It serves as the genetic material in some organisms (viruses).

3- Some RNA molecules play an active role within cells by catalyzing biological reactions, controlling gene expression, or sensing and communicating responses to cellular signals.

4- Messenger RNA (mRNA) copies DNA in the nucleus and carries the info to the ribosomes (in cytoplasm).

5- Ribosomal RNA (rRNA) makes up a large part of the ribosome; reads and decodes mRNA.

6- Transfer RNA (tRNA) carries amino acids to the ribosome where they are joined to form proteins

7- Certain RNAs are able to catalyze chemical reactions such as cutting and ligating other RNA molecules, and the catalysis of peptide bond formation in the ribosome; these are known as ribosomes.

Differences between DNA and RNA		
	DNA	RNA
Full Name	Deoxyribonucleic Acid	Ribonucleic Acid
Function	DNA replicates and stores genetic information. It is a blueprint for all genetic information contained within an organism.	RNA converts the genetic information contained within DNA to a format used to build proteins, and then moves it to ribosomal protein factories.
Structure	DNA consists of two strands, arranged in a double helix. These strands are made up of subunits called nucleotides. Each nucleotide contains a phosphate, a 5- carbon sugar molecule and a nitrogenous base.	RNA only has one strand, but like DNA, is made up of nucleotides. RNA strands are shorter than DNA strands. RNA sometimes forms a secondary double helix structure, but only intermittently.
Length	DNA is a much longer polymer than RNA. A chromosome, for example, is a single, long DNA molecule, which would be several centimeters in length when unravelled	RNA molecules are variable in length, but much shorter than long DNA polymers. A large RNA molecule might only be a few thousand base pairs long.
Sugar	The sugar in DNA is deoxyribose, which contains one less hydroxyl group than RNA's ribose.	RNA contains ribose sugar molecules, without the hydroxyl modifications of deoxyribose.
Bases	The bases in DNA are Adenine ('A'), Thymine ('T'), Guanine ('G') and Cytosine ('C')	RNA shares Adenine ('A'), Guanine ('G') and Cytosine ('C') with DNA, but contains Uracil ('U') rather than Thymine
Base Pairs	Adenine and Thymine pair (A-T) Cytosine and Guanine pair (C-G)	Adenine and Uracil pair (A-U) Cytosine and Guanine pair (C-G)
Location	DNA is found in the nucleus, with a small amount of DNA also present in mitochondria.	RNA forms in the nucleolus, and then moves to specialised regions of the cytoplasm depending on the type of RNA formed.
Reactivity	Due to its deoxyribose sugar, which contains one less oxygen-containing hydroxyl group, DNA is a more stable molecule than RNA, which is useful for a molecule which has the task of keeping genetic information safe.	RNA, containing a ribose sugar, is more reactive than DNA and is not stable in alkaline conditions. RNA's larger helical grooves mean it is more easily subject to attack by enzymes.
Ultraviolet (UV) Sensitivity	DNA is vulnerable to damage by ultraviolet light.	RNA is more resistant to damage from UV light than DNA.