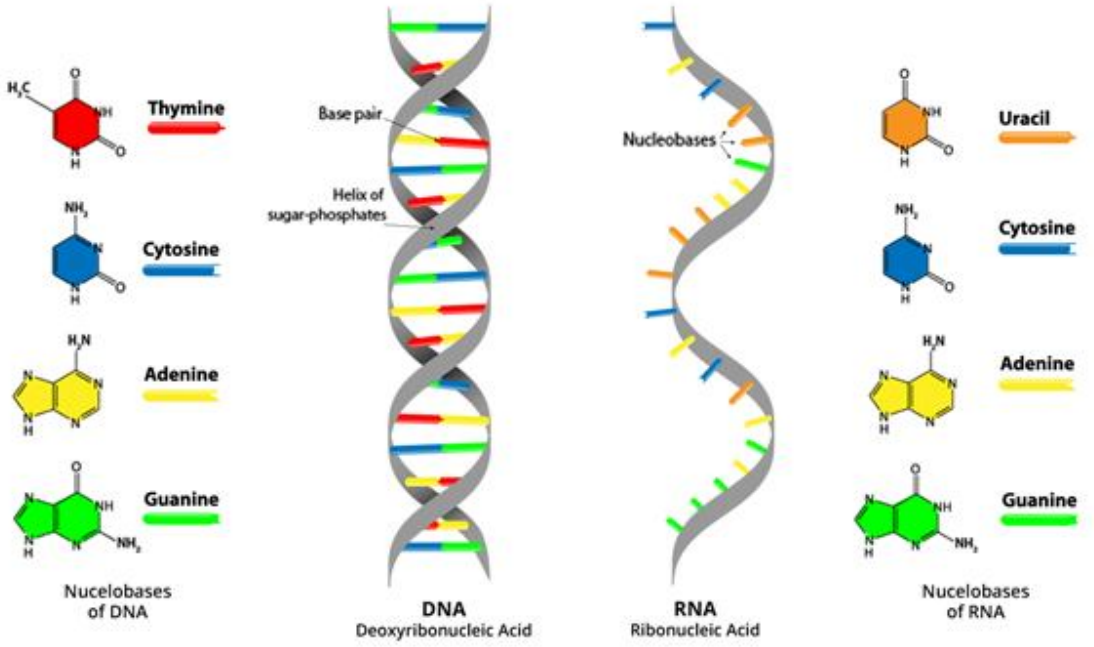
Structure of RNA and its type

RNA or ribonucleic acid is a polymer of nucleotides which is made up of a ribose sugar, a phosphate, and bases such as adenine, guanine, cytosine, and uracil. RNA has a structure very similar to that of DNA. The key difference in RNA structure is that the ribose sugar in RNA has a hydroxyl (-OH) group which is absent in DNA. RNA plays a very crucial role in the gene expression pathway by which genetic information in DNA is coded into proteins that determine cell function.



Types of RNA

In both prokaryotes and eukaryotes, there are three main types of RNA – messenger RNA or mRNA, ribosomal or rRNA, and transfer RNA or tRNA. These 3 types of RNA are discussed below.

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 the genetic code copied from the DNA during transcription in the form of triplets of nucleotides called codons. Each

codon specifies a particular amino acid, but one amino acid can be coded by many different codons. Although there are 64 possible codons or triplet bases in the genetic code, only 20 of them represent amino acids; there are also 3 stop codons.

As part of post-transcriptional processing in eukaryotes, the 5' end of mRNA is capped with a guanosine triphosphate nucleotide, which helps in mRNA recognition during translation or protein synthesis. Similarly, the 3' end of an mRNA has a poly A tail or multiple adenylate residues added to it, which prevent enzymatic degradation of mRNA. Both 5' and 3' end of an mRNA imparts stability to the mRNA.

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 has its own rRNA molecules. Different rRNAs present in the ribosomes include small rRNAs and large rRNAs, which denote their presence in the small and large subunits of the ribosome.

rRNAs combine with proteins in the cytoplasm to form ribosomes, which act as the site of protein synthesis and has the enzymes needed for the process. These complex structures travel along the mRNA molecule during translation and facilitate the assembly of amino acids to form a polypeptide chain. They bind to tRNAs and other molecules that are crucial for protein synthesis.

In bacteria, the small and large rRNAs contain about 1500 and 3000 nucleotides, respectively, whereas in humans, they have about 1800 and 5000 nucleotides, respectively. However, the structure and function of ribosomes is largely similar across all species.

Transfer RNA (tRNA)

tRNA is the smallest of the 3 types of RNA having about 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. Each of the 20 amino acids has a specific tRNA that binds with it and transfers it to the growing polypeptide chain. tRNAs also act as adapters in the translation of the genetic sequence of mRNA into proteins. Therefore they are also called adapter molecules.

tRNAs have a clover leaf structure which is stabilized by strong hydrogen bonds between the nucleotides. Apart from the usual 4 bases, they normally contain some unusual bases mostly formed by methylation of the usual bases, for example, methyl guanine and methylcytosine.