Introduction:

Molecular Biology is not the study of the molecules of living organisms. Biochemistry, also called Biological Chemistry, fits this definition because it studies biological molecules and their chemical reactions in cells (metabolism). The adjective "Molecular" before Biology does not refer to all molecules of living organisms but only to the two crucial ones: nucleic acids and proteins (structural and catalytic, as well as motors, membrane transporters and regulators). Molecular Biology is not the classical study of genes. This corresponds to Genetics, which deals with genes in relation to heredity, loci and genetic variation.

Molecular Biology is an approach to biological phenomena that is based on the atomic structures and genetic modifications of the mechanisms and physiological functions of the two crucial molecules for life: nucleic acids (DNA and RNA) and proteins. It is a reductionist approach derived from Biochemistry and from Genetics and it has developed a specific tool called Genetic Engineering (also known as Recombinant DNA Technology) to isolate genes, modify them in vitro and reintroduce them into organisms to investigate the physiological functions of genes and encoded proteins. It has also developed physical methods to determine the atomic structure and mechanism of these macromolecules. In X-Ray Diffraction, ordered molecules in fibers or crystals give a three-dimensional atomic picture of nucleic acids and proteins. Both Genetic Engineering and structural methods require a specific informatics approach: Bioinformatics, which is crucial to generate and utilize the big data provided by the above methods.

Structure of DNA & RNA:

The two main types of nucleic acids are **deoxy**ribonucleic acid (**DNA**) and ribonucleic acid (**RNA**). DNA is the genetic material in **all** living organisms, ranging from single-celled bacteria to multicellular mammals. It is in the nucleus of eukaryotes and in the organelles mitochondria and chloroplasts. In prokaryotes, the DNA is not enclosed in a membranous envelope. The cell's entire genetic content is its genome, and the study of genomes is genomics. In eukaryotic cells but not in prokaryotes, a DNA molecule may contain tens of thousands of genes. Many genes contain information to make protein products (e.g., mRNA). Other genes code for RNA products. DNA controls all the cellular activities by turning the genes "on" or "off". DNA can exist in three different conformations namely A-, B- and Z-DNAs.

The other type of nucleic acid, RNA, is mostly involved in protein synthesis. The DNA molecules never leave the nucleus but instead use an intermediary molecule to communicate with the rest of the cell. This intermediary is the messenger RNA (mRNA). Other types of RNA—like rRNA, tRNA, and microRNA—are involved in protein synthesis and its regulation but do **not** carry code for proteins (they are non-coding RNAs).

DNA and RNA are comprised of monomers that scientists call nucleotides. The nucleotides combine with each other to form a polynucleotide, DNA or RNA. Three components comprise each nucleotide: a nitrogenous base, a pentose (five-carbon) sugar, and a phosphate group. Each nitrogenous base in a nucleotide is attached to a sugar molecule, which is attached to one or more phosphate groups. Therefore, although the terms "base" and "nucleotide" are sometimes used interchangeably, a nucleotide contains a base as well as part of the sugar-phosphate backbone.

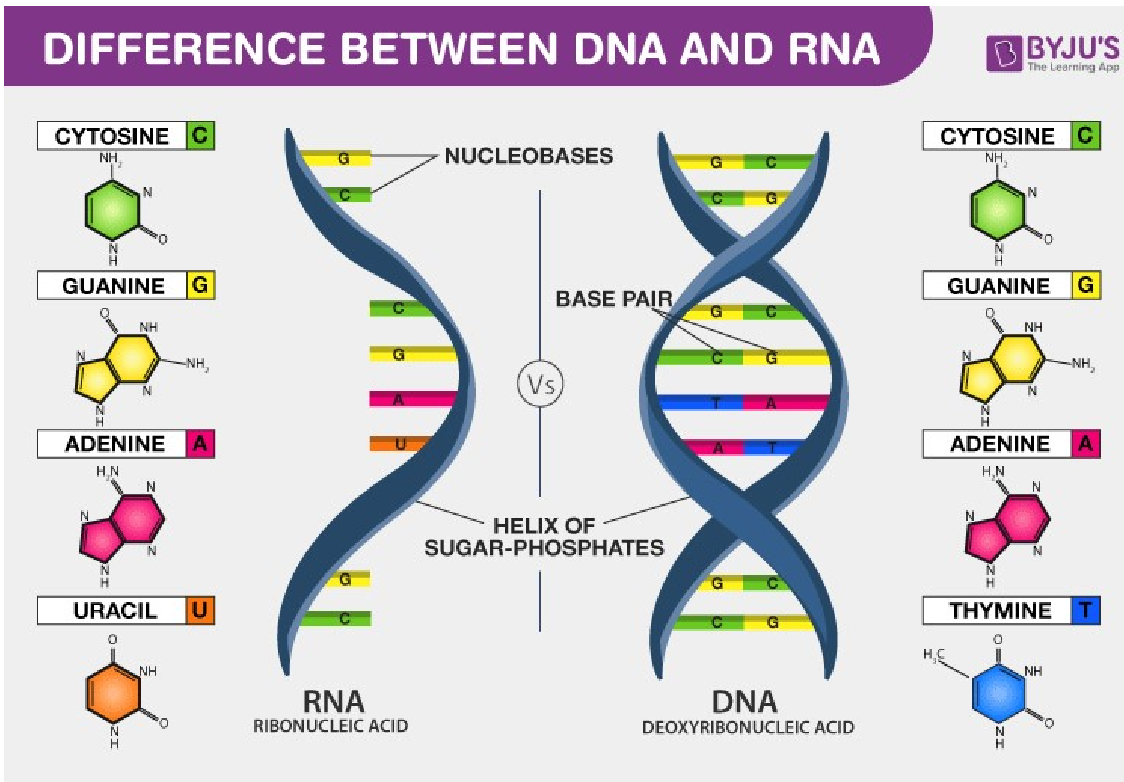

Figure 1: Comparison of DNA and RNA structure