Nanobiotechnology and Nanomedicine
Course code: 601104

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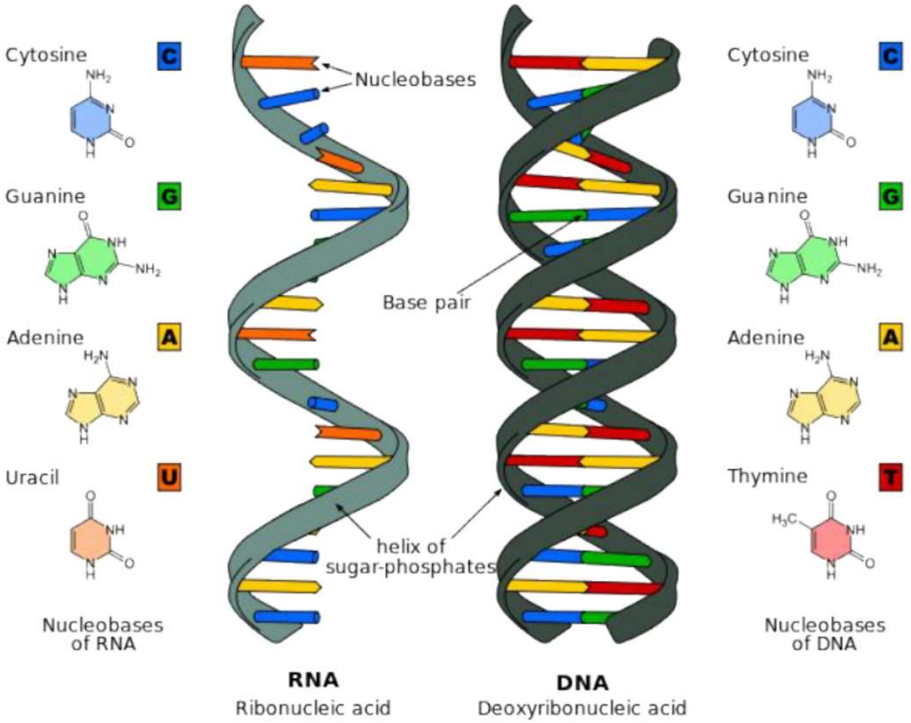
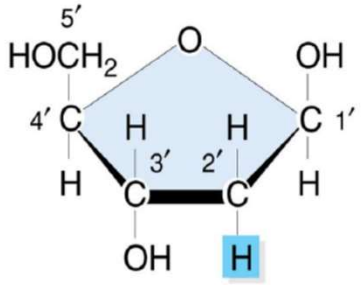
RNA Decodes Information in DNA

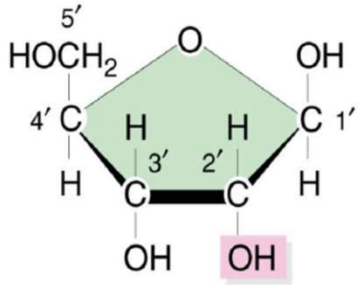


- **Single stranded**
- **Difference in Ribose sugar (OH group)**
- **Base difference -Thymine replaced by Uracil**



Deoxyribose

DNA

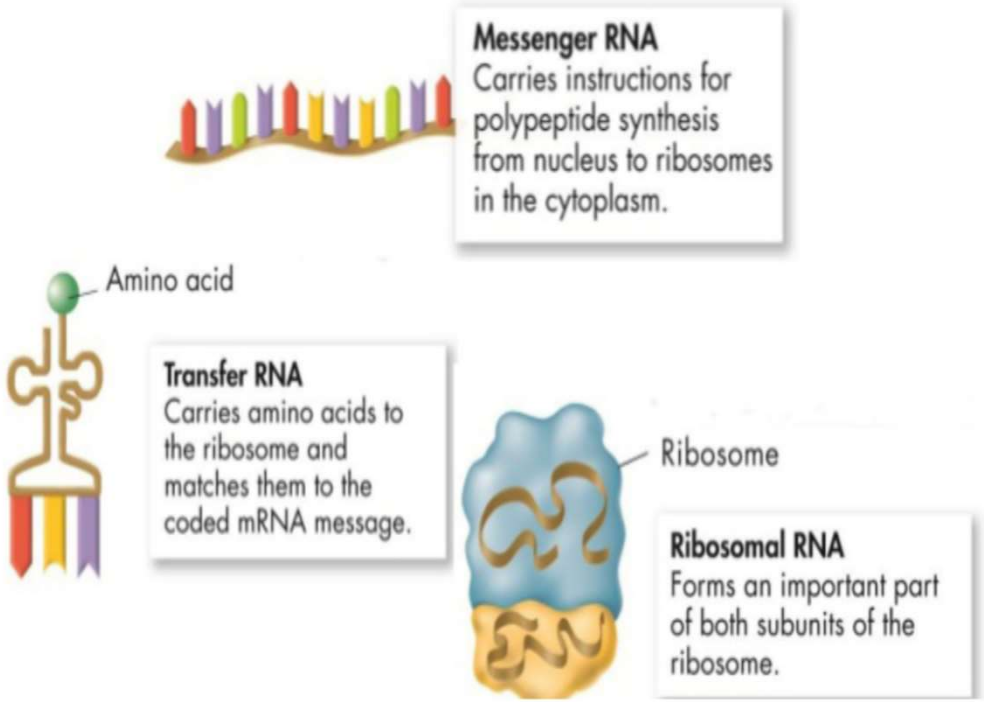


Ribose

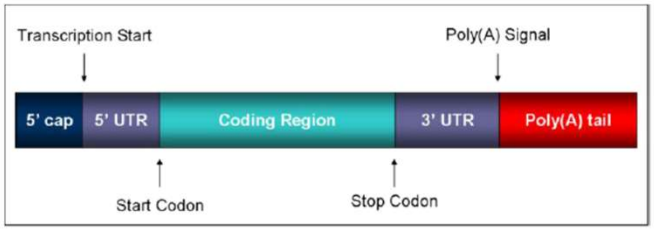
RNA

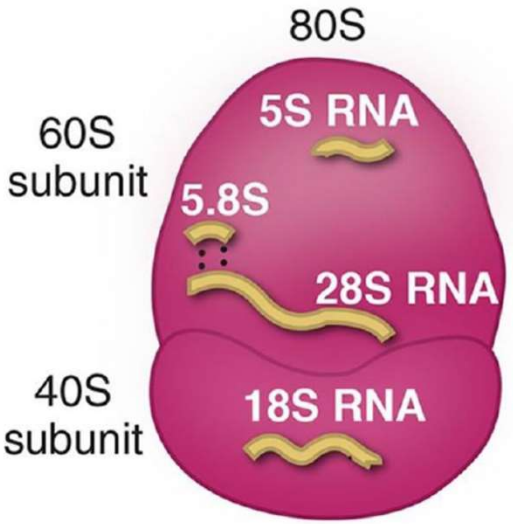
Types of RNA

There are three types of RNA



Structures of RNA





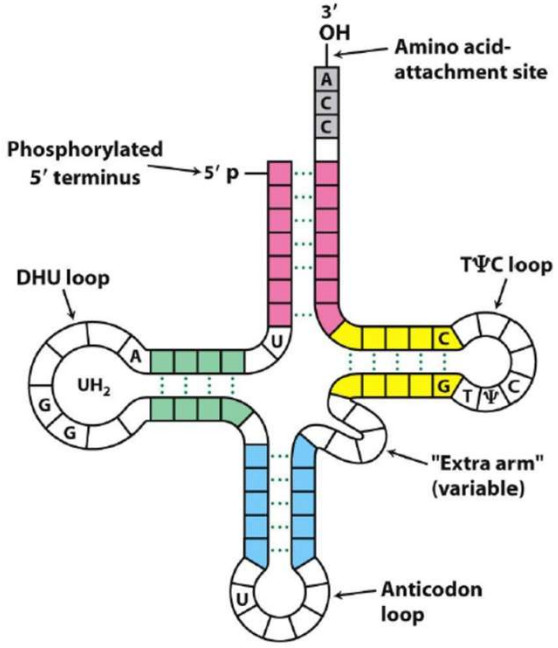


Figure 30.3
Biochemistry, Seventh Edition

RNA

- **Genes identify the kinds of proteins that are made by cells, DNA is not consider the direct template for protein synthesis.**
- **The templates for protein synthesis are RNA (ribonucleic acid) molecules.**
- **A class of RNA molecules called *messenger RNA* (mRNA) are the information-carrying intermediates in protein synthesis.**
- ***Transfer RNA* (tRNA) and *ribosomal RNA* (rRNA), are the protein-synthesizing machinery.**
- **All forms of cellular RNA are synthesized through RNA polymerases and that receive instructions from DNA templates.**
- **This process of *transcription* is followed by *translation*, the synthesis of proteins according to instructions given by mRNA templates.**

RNA

- **This flow of information is dependent on the genetic code, which defines the relation between the sequence of bases in DNA (or its mRNA transcript) and the sequence of amino acids in a protein.**
- **The code is nearly the same in all organisms: a sequence of three bases, called a *codon*, specifies an amino acid.**
- **Codons in mRNA are read sequentially by tRNA molecules, it serve as adaptors in protein synthesis.**
- **Protein synthesis takes place on ribosomes, which are complex assemblies of rRNAs and more than 50 kinds of proteins.**

RNA Folding

Figure: Stem- loop structure of DNA and RNA from single strand

Complex structure of RNA Molecule

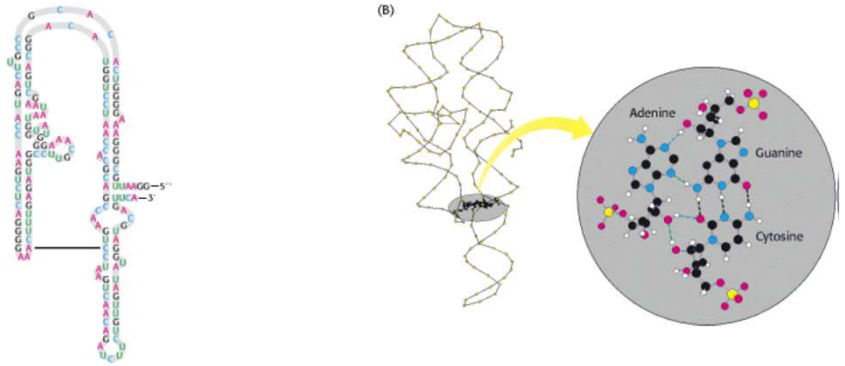


Figure: A single-stranded RNA molecule may fold back on itself to form a complex structure. (A) The nucleotide sequence showing Watson-Crick base pairs and other nonstandard base pairings in stem-loop structures. (B) The three-dimensional structure and one important long-range interaction between three bases. Hydrogen bonds within the Watson-Crick base pair are shown as dashed black lines; additional hydrogen bonds are shown as dashed green lines.

Structure of RNA

- **RNA, similar to DNA, is a long unbranched polymer comprises of nucleotides joined by 3' to 5' phosphodiester bonds.**
- **The covalent structure of RNA is invariant from DNA, by its name, the sugar units in RNA are riboses rather than deoxyriboses. Ribose contains a 2' -hydroxyl group not present in deoxyribose.**
- **As a consequence, in addition to the standard 3' to 5' linkage, a 2' to 5' linkage is possible for RNA.**
- **This linkage is important in the removal of introns and the joining of exons for the formation of mature RNA.**
- **The other difference is that one of the four major bases in RNA is uracil (U) instead of thymine (T).**
- **Absence of the 2' -hydroxyl group in DNA increases its resistance to hydrolysis.**
- **The excellent stability of DNA probably accounts for its use rather than RNA as the hereditary material in all modern cells and in many viruses.**

RNA genetic Material

- **DNA is genetic material, however RNA is genetic materials for some Viruses that enclosed in protein coats that can move from one cell to another but are not capable of independent growth.**
- **One well-studied example of an RNA virus is the tobacco mosaic virus, (TMV) which infects the leaves of tobacco plants.**
- **This virus consists of a single strand of RNA (6930 nucleotides) surrounded by a protein coat of 2130 identical subunits.**
- **An RNA-directed RNA polymerase catalyzes the replication of this viral RNA.**

RNA genetic Material

- **Another important class of RNA virus comprises the *retroviruses*, because the genetic information flows from RNA to DNA rather than from DNA to RNA.**
- **This class of virus is human immunodeficiency virus 1 (HIV-1), the cause of AIDS, as well as a number of RNA viruses that produce tumors in susceptible animals.**
- **Retrovirus particles contain two copies of a single-stranded RNA molecule.**
- **On entering the cell, the RNA is copied into DNA through the action of a viral enzyme called *reverse transcriptase.***
- **The resulting double-helical DNA version of the viral genome can incorporated into the chromosomal DNA of the host and further is replicated along with the normal cellular DNA.**
- **Later, the integrated viral genome is expressed to form viral RNA and viral proteins, which assemble into new virus particles.**

Reference

- **J. M. Berg, J. L. Tymoczko, and L. Stryer Biochemistry (2002) 5th edition, New York WH Freeman, ISBN-10: 0-7167-3051-0.**