

# RNA

**Ribonucleic acid** (RNA, also RNK) is a nucleic acid consisting of a strand of nucleotides connected to each other by covalent bonds. It differs from deoxyribonucleic acid ( DNA (nucleic acid) ) by the presence of a hydroxyl group on each pentose (sugar) molecule. Instead of the nucleobase thymine, uracil is used. It is usually single-stranded, sometimes double-stranded. RNA has many functions in the body and many different subtypes are distinguished.

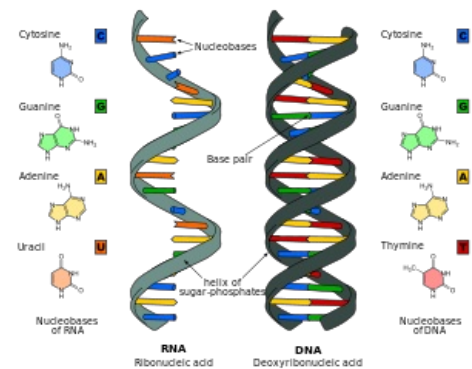
## Basic information

- Its molecule consists of only one polynucleotide strand (however, there are also double-stranded types of RNA, e.g. in some viruses);
- the carbohydrate component consists of the five-carbon sugar D-ribose;
- nitrogenous bases (N-bases) form adenine and guanine (purine bases), cytosine and uracil (instead of thymine, pyrimidine bases);
- all types of RNA are produced by the process of transcription ;
- the secondary structure of individual types of RNA is different, they are generally single-stranded molecules (with the exception of some viral RNAs);
- on this single strand, the formation of a double helix can occur in certain sections, if these sections contain bases complementary to each other.

## Types of RNA

### m-RNA

- Messenger RNA, information RNA, mediator RNA;
- transmits hereditary information, which is stored in a gene and encodes the exact order of AMK in a protein;
- it is created by transcription from DNA and subsequent splicing;
- it is transported from the nucleus to the cytoplasm, where, in conjunction with ribosomes, it participates in protein synthesis ( translation );
- its reverse transcription (reverse transcription) into DNA creates c-DNA ( reverse transcriptase enzyme ).



RNA (left) and DNA (right).

### t-RNA

- Transfer RNA;
- brings amino acids to the right place of the nascent polypeptide - to the proteosynthetic apparatus of the cell ;
- consists of 75 pb;
- it arises from the transcription by polymerase III of genes scattered in different places of the genome;
- signal sequences for transcription are located within the transcribed regions;
- the primary transcript is edited by splicing, where introns are removed;
- tRNA is characterized by a high content of minor bases;
- the classical scheme of the tRNA molecule is considered to be the "trefoil";
- the "stems" of this formation are formed by the bonding of hydrogen bridges based on the principle of base complementarity;
- at the end of CCA 3' is bound by an ester bond carried by Free fatty acids

### 4 loops can be distinguished on the t-RNA molecule

1. **D-loop ;**
  - according to the dihydrouracil content.
2. **Anticodon loop ;**
  - contains a triplet of bases complementary to the codon of the given AMK;
  - enables the inclusion of the AMK-tRNA complex in the correct place during proteosynthesis.
3. **V-loop ;**
  - variable, it differs both in size and in the included bases between tRNA molecules for different AMKs.
4. **Pi-loop ( $\psi$ ) ;**
  - according to pseudo-uridine content.

### r-RNA

- Ribosomal RNA;

- forms the building block of ribosomal subunits;
- we recognize **four different types of r-RNA** :

## 5S rRNA

- composed of 120 nucleotides, it is created by transcription (polymerase III) of genes that are distributed in larger quantities at different places of the genome in the form of tandem repeats separated by untranscribed sequences;
- signal sequences are located within the transcribed regions.

## Genes for 18S rRNA, 5.8S rRNA and 28S rRNA

- they create multiple repeating blocks on chromosomes carrying so-called nucleolar organizers;
- transcription takes place with the help of polymerase I, when a section of approximately 13 kb is transcribed;
- subsequently, splicing occurs, when this very long molecule produces **18S** r-RNA (2300 bp), then **5.8S** r-RNA (156 bp) and **28S** r-RNA (4200 bp);
- 6800 bp, which were transcribed, were not used to build these functional r-RNA molecules;
- 18S rRNA associates with approximately 30 proteins to form a smaller ribosome unit (40S ribosomal unit);
- the large unit of the ribosome (60S) is made up of 5.8S r-RNA, 28S r-RNA and 5S RNA + approximately 50 proteins brought here from another place in an as yet unknown way;
- all types of rRNA based on base complementarity can form quite complicated secondary structures.

## ncRNA

As "non-coding" (meaning "non-protein-coding") RNA ( **ncRNA** ) we refer to all functional **RNA** molecules that are not translated into protein in the process of translation . They generally fall into two categories, distinguishable by size:

### ncRNAs shorter than 200 nucleotides

This group includes, for example:

- **transfer RNA (tRNA)** – RNA involved in the process of translation. We distinguish 49 types/families of tRNA. There are 497 tRNA genes in the nuclear genome (a significant part of them are on chromosomes 1 and 6), the transcription of which is ensured by RNA polymerase III (another 22 tRNAs are encoded by the mitochondrial genome).
- **ribosomal RNA (rRNA)** – forms part of ribosomes, there are 4 distinct types – 5S rRNA, 18S rRNA, 5.8S rRNA and 28S rRNA
- **small nuclear RNA ( *small nuclear RNA* - **snRNA** )** – participates in the so-called splicing process – splicing of hnRNA, cleavage of introns
- **small nucleolar RNA ( *small nucleolar RNA* - **snoRNA** )** – plays an important role in the synthesis and maturation (post-transcriptional chemical modification) of rRNA, snRNA and tRNA. Deletion of a cluster of snoRNAs in the region of chromosome 15q leads to the manifestation of Prader-Willi syndrome
- a number of regulatory RNA types such as:
  - **microRNAs** – participate in the regulation of gene expression – are complementary to certain sections of mRNA, bind to them and thus regulate their translation
  - **small interfering RNA ( *small interfering RNA* - **siRNA** )**
  - **piRNA** (piwi-interacting RNA) – RNA interacting with proteins from the PIWI family.

### ncRNA longer than 200 nucleotides

This group bears the collective designation of **long non-coding RNA - lncRNA**. Probably the best-known representative of lncRNA is the **XIST ( *X Inactivation Specific Transcript* )**(Xq13.2; OMIM: 314670)) gene, which is involved in the process of inactivation of the X chromosome .

## Links

### related articles

- Non-coding RNA
- DNA
- mRNA
- tRNA
- rRNA
- miRNAs

### External links

- RNA (Englishwikipedie)

### Source

- ŠTEFÁNEK, Jiří. *Medicine, diseases, studies at the 1st Faculty of Medicine, UK* [online]. [feeling. 2009]. < <https://www.stefajir.cz/> >.

- ŠIPEK, Antonín. *Genetics* [online]. ©2008. [feeling. 2010-02-11]. < <http://www.genetika-biologie.cz/ribonucleova-kyselina> >.

Kategorie:Genetika Kategorie:Molekulární biologie Kategorie:Biochemie