

Structure of DNA

The **DNA** (deoxyribonucleic acid) molecule is made up of *two polynucleotide chains*. The chains are **antiparallel** – to each other - one chain has the direction of phosphodiester bonds **5' » 3'** and the other **3' » 5'** – we are talking about the 3' or 5' end. An **-OH** group is attached to the 3' end, while a **phosphate** group is attached to the 5' end.

General characteristics

The structure is made up of three components – **sugar, phosphate, base**. The sugar component consists of the five-carbon sugar **2-deoxy-D-ribose** (oxygen is missing in the 2' position of DNA compared to normal ribose). **Purine** derivatives (*Adenine, Guanine*) and **pyrimidine derivatives** (*Cytosine, Thymine*) are represented as **nitrogenous bases** in DNA. Bonding interactions occur between N-bases of opposite strands.

The law of complementarity

Only 2 specific N-bases are always bound together (always 1 pyrimidine base and 1 purine base), namely:

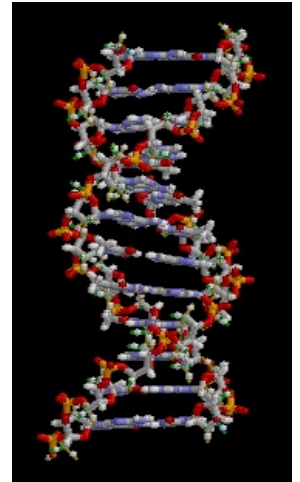
- **A - T** (connected by 2 hydrogen bonds);
- **C - G** (connected by 3 hydrogen bonds).

In addition, **van der Waals forces** (stabilization) act between neighboring bases.

So the equation applied:

$$\frac{A + C}{T + G} = 1$$

Both **polynucleotide strands** (*primary structure of DNA*) create the most common right-handed helix known as **double helix** (*secondary structure of DNA*) → the most frequently occurring form is the **B-form** of DNA = *right-handed*. DNA molecules can still occur in the *right-handed* form **A** and in the *left-handed* form **Z**. The transition between individual forms is possible based on a change in physical and chemical conditions.



DNA animation - The Spatial Structure of DNA

Types of DNA

1. Nuclear (chromosomal)

From a functional point of view, **these are**:

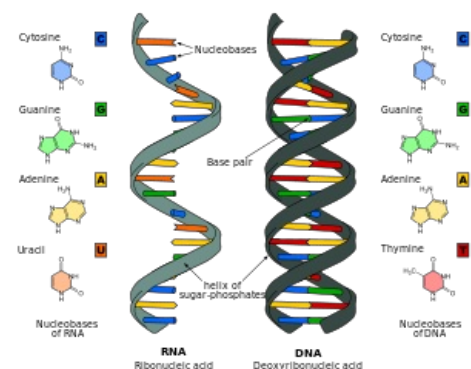
1. DNA that encodes the sequence of amino acids in a polypeptide or some RNA.
2. DNA, which has a control and management function.
3. Special types of DNA have specific functions in chromosomes e.g., in the area of centromere and telomeres.
4. DNA, the function of which we do not yet know anything about.

In eukaryotes, approximately 60% of DNA consists of **unique** (or low-repetition) sequences – this includes, for example, *genes encoding polypeptides* or similar non-functional *pseudogenes*. Others represented are **repetitive sequences**.

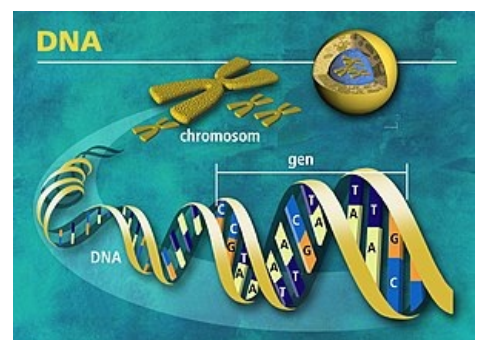
We divide them into:

1. *moderately repetitive* sequence – number of copies in the genome 10^3 – 10^5 (this includes, for example, genes for rRNA and histone-type proteins);
2. *highly repetitive* sequence – on the order of 10^6 copies / genome.

Repetitive sequences can be scattered throughout the genome. Long repetitive sequences are referred to as **LINES** (Long Interspersed Nuclear Elements). Short repetitive sequences are referred to as **SINES** (Short Interspersed Nuclear Elements). Most SINES are derived from *tRNA genes* → their formation is explained by reposition (transposition) from RNA by reverse transcriptase. The so-called **Alu-sequences**, are specific for primates, where almost every 4kb section of human DNA contains this



Difference DNA RNA-EN

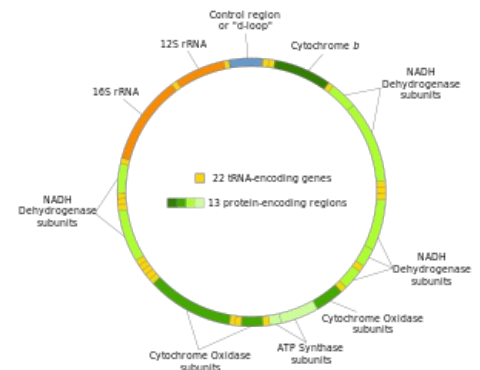


DNA molekula života - český

sequence - their origin is 7SL DNA. Another possibility is the so-called **tandem repetitive sequences**, where the individual repetitions are one after the other - e.g.: genes for rRNA or so-called satellite DNA.

2. Extrachromosomal

In humans, it is found in the **mitochondria**. The arrangement of the mitochondrial genome is different from the nuclear genome of a eukaryotic cell, but it is similar to the arrangement of the genome in prokaryotes. DNA has a **circular** arrangement in mitochondria. In humans, it is 16.6 kb in size. In the human genome, a total of **37 genes** code - of which 24 genes are involved in the proteosynthetic apparatus of mitochondria - 16S and 23S genes for rRNA, 22 genes for tRNA. The rest are involved in the enzymatic equipment of mitochondria. Most genes are coded on the **H** (heavy) strand of DNA. The information is quite strongly compressed, it **does not contain introns!** Other differences include that it has **4 triplets different** in meaning from those in the nuclear genome, there are also differences in **initiation and termination**.



Mitochondrial DNA en

Links

related articles

- DNA
 - DNA replication
 - Transcription
 - Posttranscriptional modifications
 - Transcription factors
 - Translation
 - Post-translational modifications
- Repetitive sequences in the human genome

Source

- ŠTEFÁNEK, Jiří. *Medicine, diseases, studies at the 1st Faculty of Medicine, UK* [online]. [cit. 11. 2. 2010]. <<http://www.stefajir.cz>>.
- ALBERTS, B – BRAY, D – JOHNSON, A. *Basics of cell biology*. 2. edition. Espero Publishing, 2005. ISBN 80-902906-2-0.