

Nucleosides, nucleotides, nucleic acids

- Nucleic acids:

1., deoxyribonucleic acid (DNA)

Function: stores the genetic information

2., ribonucleic acid (RNA) :

Function: protein synthesis

- The flow of genetic information:



- Nucleic acids are polymers, composed of Nucleotides.

Nucleotides have 3 components:

1., **sugar** (pentose): ribose in RNA,

deoxyribose in DNA

the difference is on the 2' carbon atom!

Five-carbon sugars

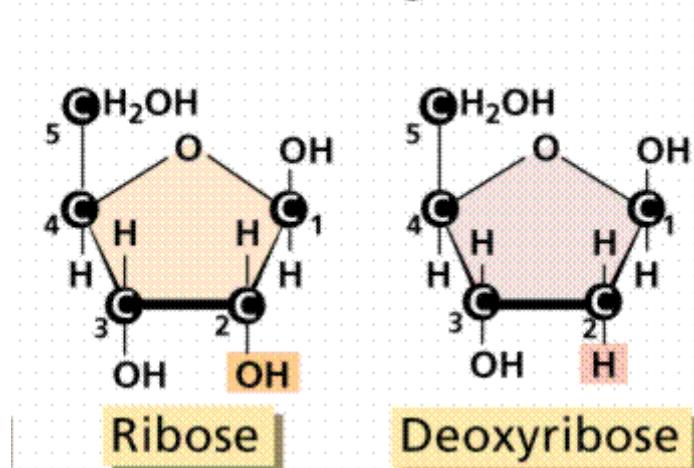


Figure: Purves et al., Life: The Science of Biology, 4th Edition

2., **nitrogenous base**

- Purines (double-ring) : Adenine(A) and Guanine(G)

- Pyrimidines (single-ring): Cytosine(C), Thymine(T) and Uracil(U)

In DNA: A, G, C, T

In RNA: A, G, C, U

3., **Phosphate** (1,2, or 3)

The sugar and base combined are called nucleosides:

- **Ribonucleosides**: Adenosine, Guanosine, Cytidine, Uridine

- **Deoxyribonucleosides**: Deoxyadenosine, Deoxyguanosine, Deoxycytidine, and Deoxythymidine

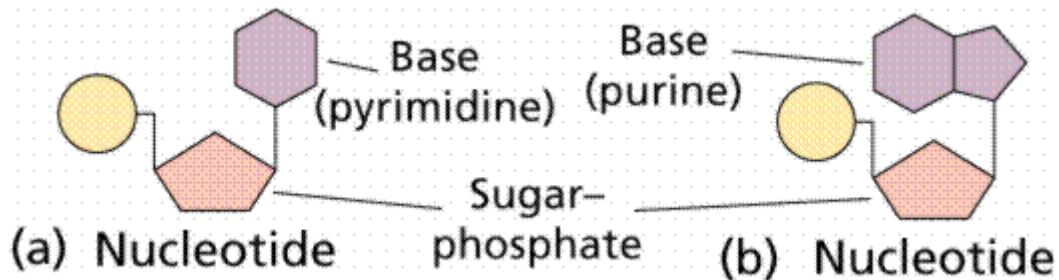


Figure: Purves et al., Life: The Science of Biology, 4th Edition

Nucleotides also play a role in metabolism, energy transfer. E.g.: ATP, NADH, Coenzyme A.

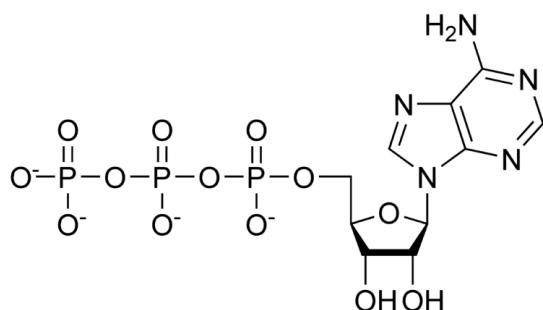
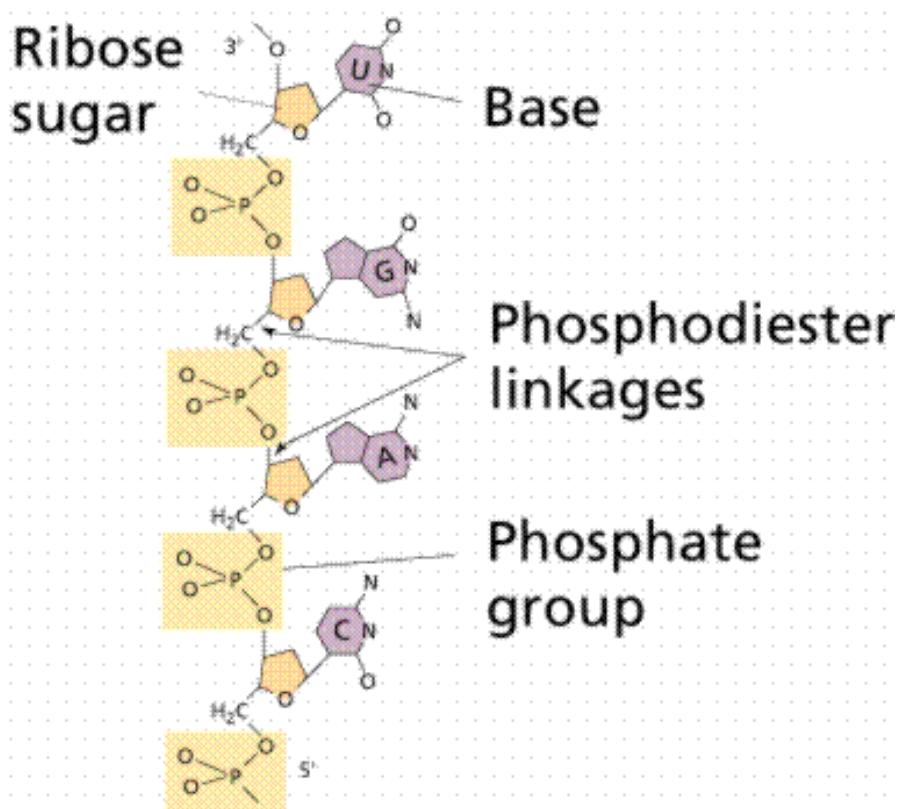


Figure: structure of Adenosine –triphosphate (ATP). It is the “energy currency” of the cell. The hydrolysis of the high-energy bonds between the phosphates provides energy.

- The structure of nucleic acids:

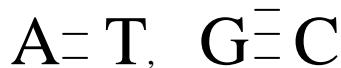
The nucleotides are connected by a 3'-5' **phosphodiester bond** to form a **strand**.

Figure: structure of a single-stranded RNA molecule. There is a 3' and a 5' end of the molecule.



Purves et al., Life: The Science of Biology, 4th Edition

- The structure of DNA: two strands combine to form a **double-stranded** molecule, the two strands are connected by **hydrogenbonds** between the bases (**complementary base-pairing**):



The two **complementary** strands run **antiparalel** (the 5'-3' ends are opposite), they form a **double helix**.

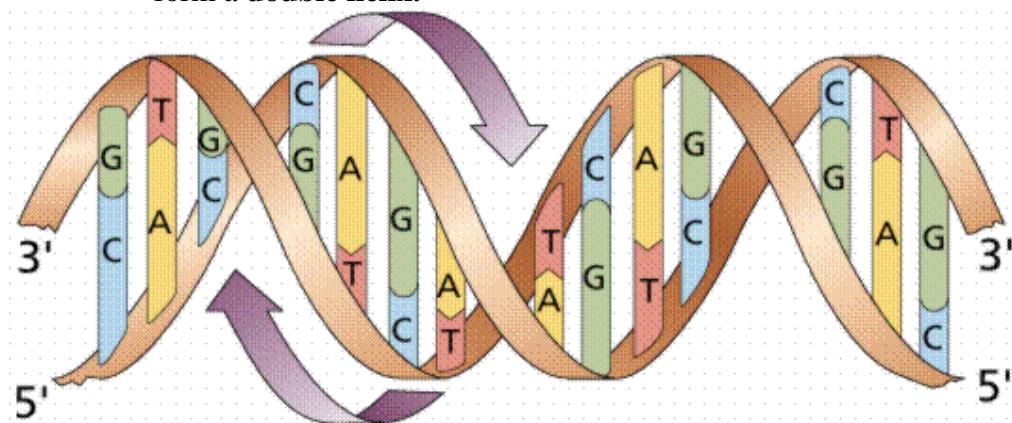


Figure: The DNA double helix.

Purves et al.,
Life: The
Science of
Biology, 4th
Edition:

The **nucleotide sequence (=base sequence)** carries the genetic information, this information will be translated into amino-acid sequence during protein synthesis.

- Types and structure of RNA:

- messenger RNA = **mRNA**: carries the information from the DNA to the site of protein synthesis. Single stranded.
- ribosomal RNA = **rRNA** : components of the ribosome, which is the site of protein synthesis (translation). rRNA forms self-complementary double-stranded regions (in RNA there is Uracil instead of Thymine as a base, it forms double hydrogen bonds with Adenine).
- transfer RNA = **tRNA** : it carries the amino acids to the site of protein synthesis, has an **adapter** role.

Figure: The structure of tRNA. It has self-complementary double-stranded regions, with 3 loops, and an amino acid binding site.

