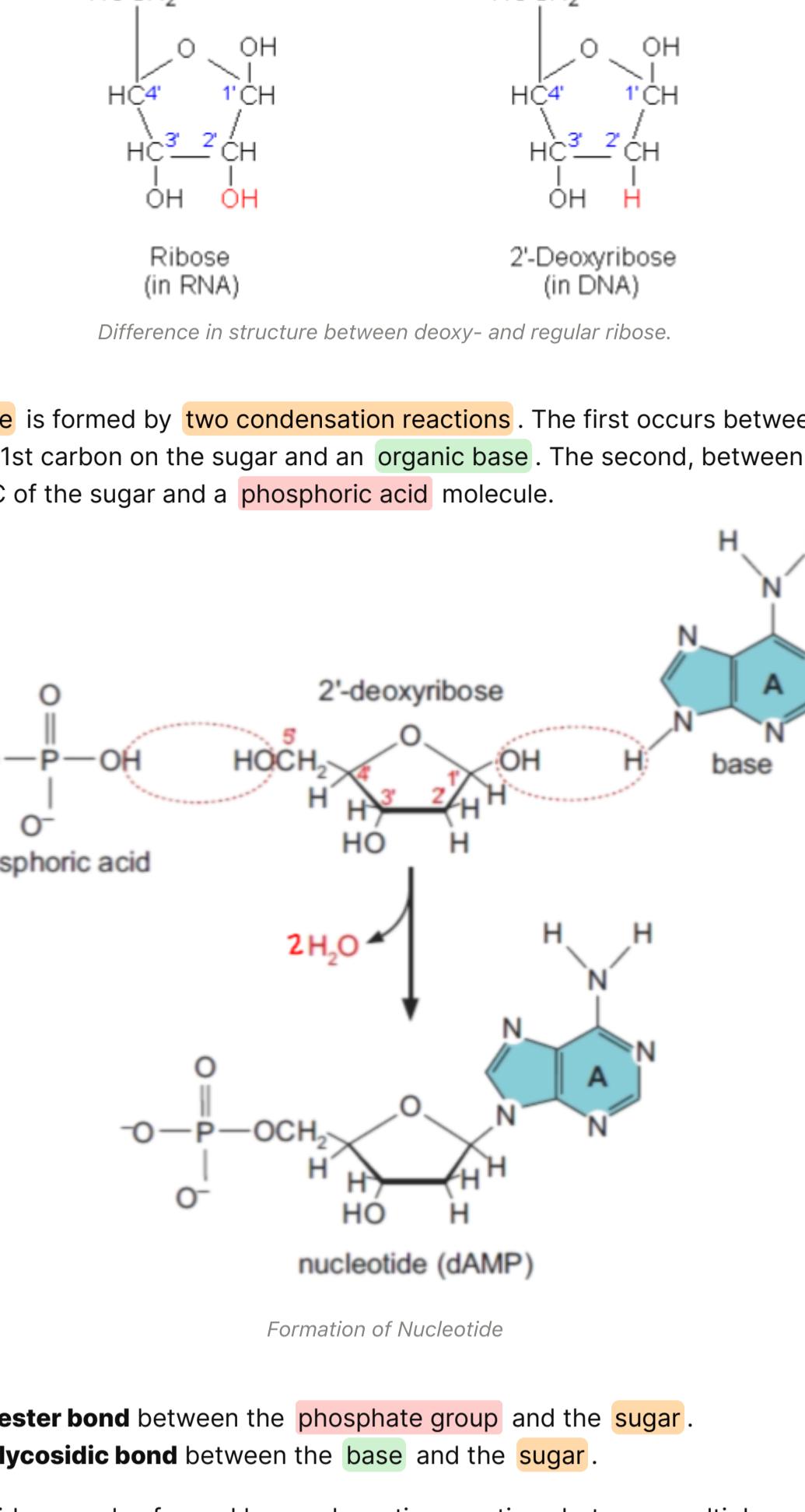


3.1.5 - DNA structure

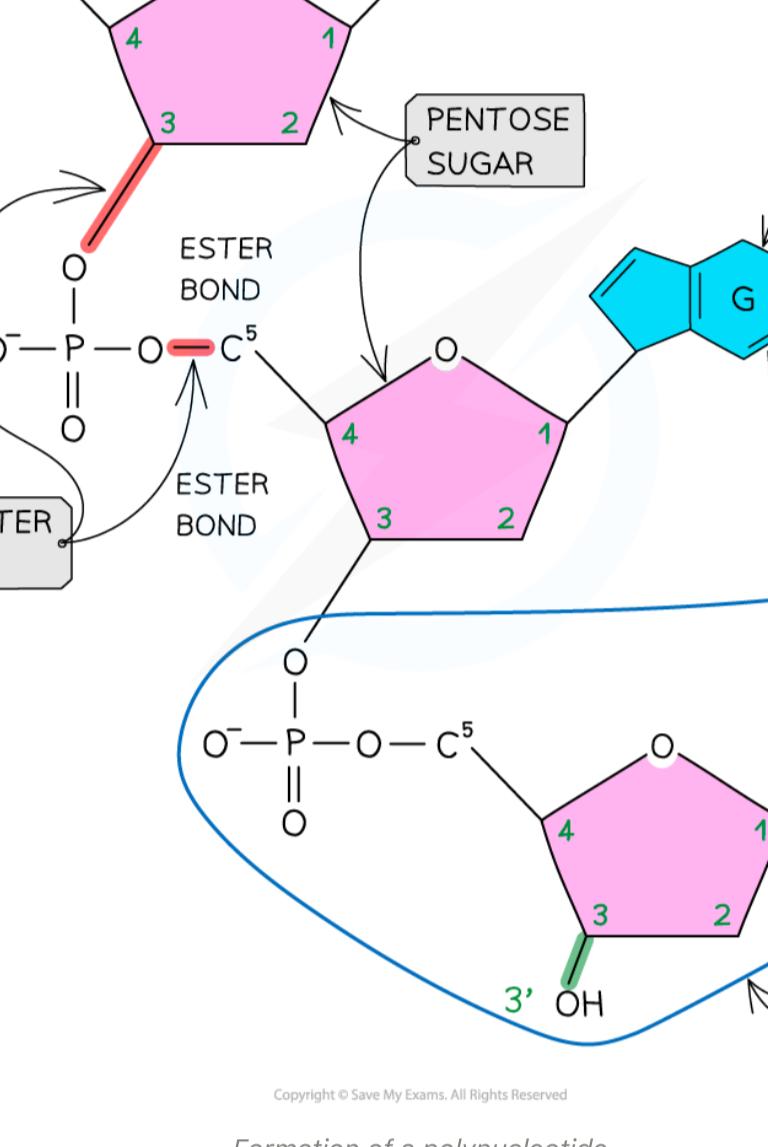
[Specification](#)

Nucleotides

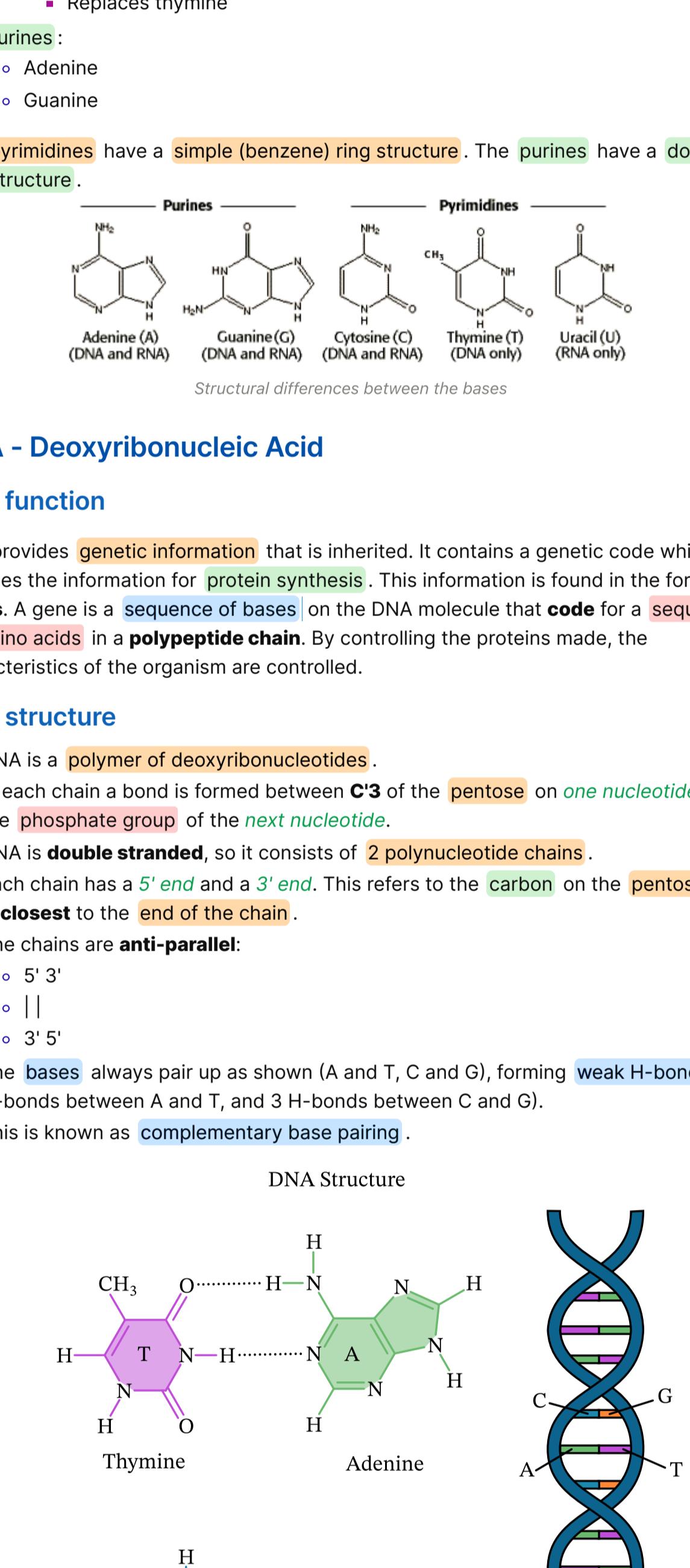
Nucleotides are made up of a phosphate, a pentose sugar, and an organic nitrogenous base. DNA and RNA are polynucleotides.



The pentose sugar can be a ribose ($C_5H_{10}O_5$) in RNA or a deoxyribose ($C_5H_{10}O_4 H-2'$) in DNA.

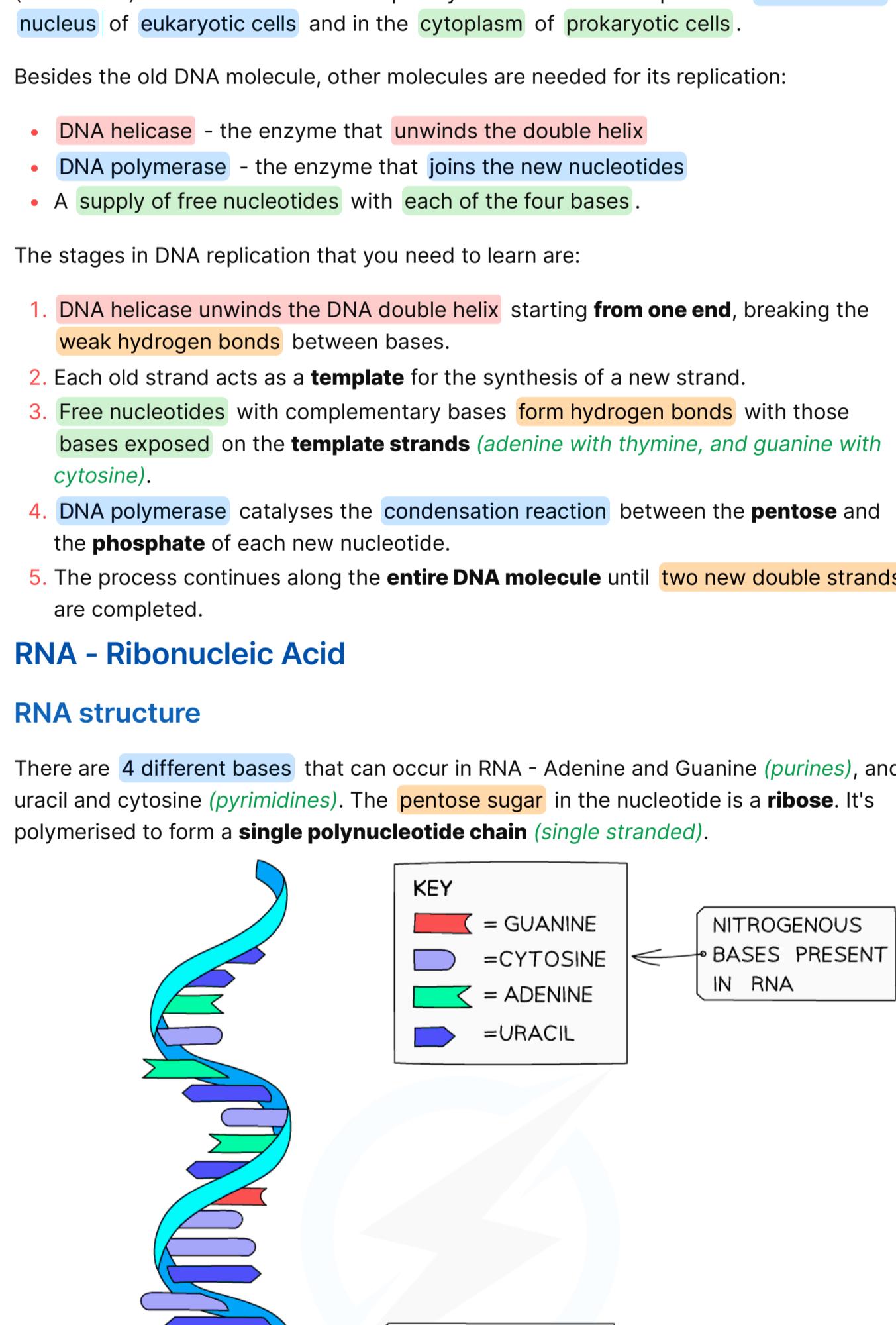


A nucleotide is formed by two condensation reactions. The first occurs between the OH on the 1st carbon on the sugar and an organic base. The second, between the OH on the 5th C of the sugar and a phosphoric acid molecule.



There is an ester bond between the phosphate group and the sugar. There is a glycosidic bond between the base and the sugar.

Polynucleotides are also formed by condensation reactions between multiple nucleotide monomers. The phosphate group of one nucleotides forms a phosphodiester bond to the pentose sugar of another nucleotide.

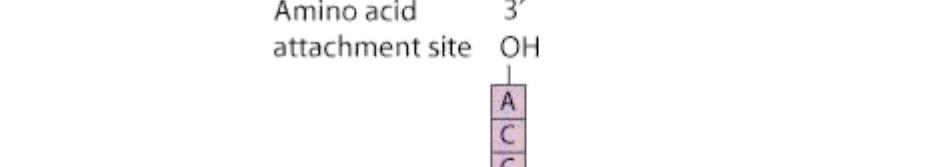


Organic Base

There are 5 types of organic bases that occur in DNA/RNA:

- Pyrimidines:
 - O
 - Thymine
 - Only found in DNA
 - (Uracil)
 - Only found in RNA
 - Replaces thymine
- Purines:
 - Adenine
 - Guanine

The pyrimidines have a simple (benzene) ring structure. The purines have a double ring structure.



DNA - Deoxyribonucleic Acid

DNA function

DNA provides genetic information that is inherited. It contains a genetic code which provides the information for protein synthesis. This information is found in the form of genes. A gene is a sequence of bases on the DNA molecule that code for a sequence of amino acids in a polypeptide chain. By controlling the proteins made, the characteristics of the organism are controlled.

DNA structure

- DNA is a polymer of deoxyribonucleotides.
- In each chain a bond is formed between C3 of the pentose on one nucleotide and the phosphate group of the next nucleotide.
- DNA is double stranded, so it consists of 2 polynucleotide chains.
- Each chain has a 5' end and a 3' end. This refers to the carbon on the pentose that is closest to the end of the chain.
- The chains are anti-parallel:
 - 5' 3'
 - ||
 - 3' 5'
- The bases always pair up as shown (A and T, C and G), forming weak H-bonds (2 H-bonds between A and T, and 3 H-bonds between C and G).
- This is known as complementary base pairing.

3.1.5.2 DNA Replication

DNA replication is called semi-conservative replication because half of the molecule (one strand) is used to make one completely new strand. DNA replication occurs in the nucleus of eukaryotic cells and in the cytoplasm of prokaryotic cells.

Besides the old DNA molecule, other molecules are needed for its replication:

- DNA helicase - the enzyme that unwinds the double helix.
- DNA polymerase - the enzyme that joins the new nucleotides.
- A supply of free nucleotides with each of the four bases.

The stages in DNA replication that you need to learn are:

- DNA helicase unwinds the DNA double helix starting from one end, breaking the weak hydrogen bonds between bases.
- Each old strand acts as a template for the synthesis of a new strand.
- Free nucleotides with complementary bases form hydrogen bonds with those bases exposed on the template strands (adenine with thymine, and guanine with cytosine).
- DNA polymerase catalyses the condensation reaction between the pentose and the phosphate of each new nucleotide.
- The process continues along the entire DNA molecule until two new double strands are completed.

RNA - Ribonucleic Acid

RNA structure

There are 4 different bases that can occur in RNA - Adenine and Guanine (purines), and uracil and cytosine (pyrimidines). The pentose sugar in the nucleotide is a ribose. It's polymerised to form a single polynucleotide chain (single stranded).

3 types of RNA

- Messenger RNA (mRNA)
 - Formed in the nucleus.
 - Single chain twisted into a helix.
 - Length and base sequence varies.
 - Carries instructions from DNA to ribosomes.
 - Short life, degradation after used by ribosome for translation.
- Ribosomal RNA (rRNA)
 - Made in the nucleolus.
 - Forms over half the mass of ribosomes (on which proteins are made).
- Transfer RNA (tRNA)
 - Single chain folded into a clover shape.
 - Many different types of tRNA.
 - Structure always similar but the 3 bases on the anticodon varies.
 - Picks up amino acids and takes them to the ribosome.
 - Found in the cytoplasm.

