

DNA and RNA

DNA Replication

DNA Transcription

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Module 9 / **Backbone**

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Identify a phosphodiester bond.

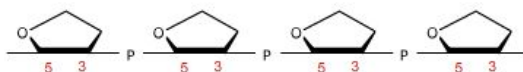
Describe 3 common structural characteristics of DNA/RNA polymer backbones.

Explain the major difference between the DNA and RNA backbone structures.

Give two examples of bioselectivity in the formation of the RNA or DNA backbone.

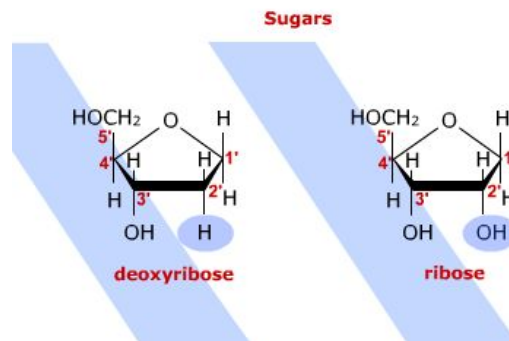
The Backbone

Both DNA and RNA are linear polymers. The components of the backbone of the [polymer](#) include a set of [furanose](#) sugars linked together by bridging phosphate molecules in a synthesis between the 3 position of one furanose and the 5 position of the next furanose. This linkage is made through condensation synthesis formation of ester bonds by a bridging phosphate molecule between two hydroxyl groups, one on each furanose ring. The resulting polymer is a string of furanose molecules linked by phosphodiester bonds and having the 5 position exposed on one end of the polymer and the 3 position exposed on the other end of the molecule.

Polymer

The major difference in the polymer backbones between DNA and RNA is the sugar used in the formation of the polymer. In DNA (**D**eoxyribo**N**ucleic Acid) the sugar is the aldose deoxyribose with a hydrogen replacing the hydroxyl at the 2 position of ribose, a furanose. In RNA (**R**ibo**N**ucleic Acid), the sugar is the monosaccharide ribose in the furanose conformation.

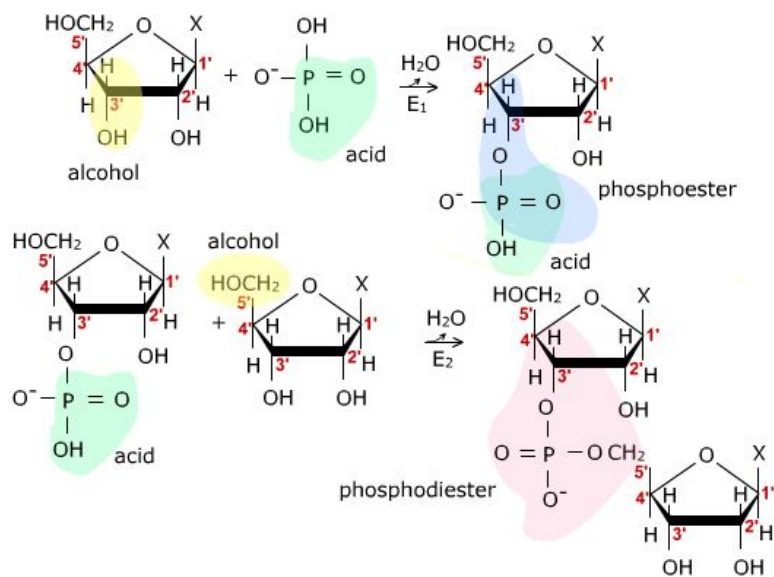
The numbering of the positions on the sugar furanose rings of DNA and RNA follow a convention that uses ' (prime) to denote the sugar positions. Thus the ribose has X connected to the 1' position and hydroxyl groups on the 2', 3' and 5' positions. Using this nomenclature, deoxyribose is formally called 2'-deoxyribose (2 prime deoxyribose) to denote the loss of the hydroxyl at the 2' position of ribose.



Furanose Sugars

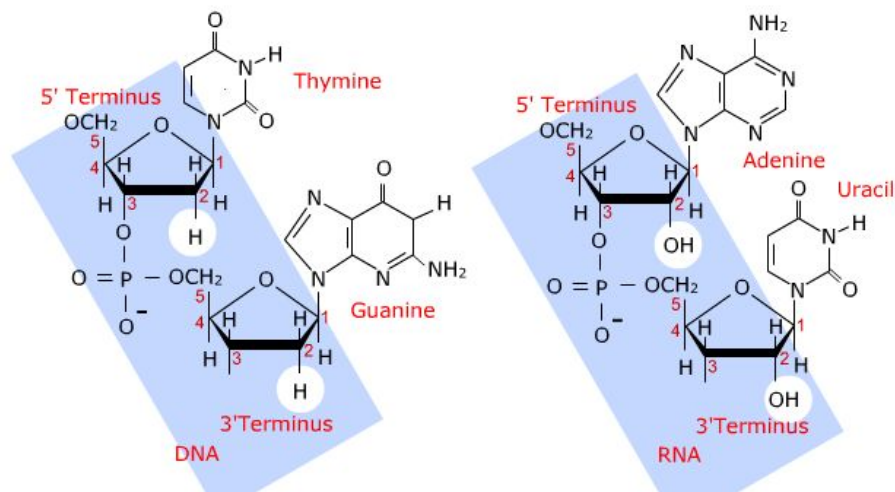
And, the resulting phosphodiester link is between the 3' position of one furanose and the 5' position on the second furanose.

Formation of phosphodiester Bonds



Condensation synthesis of the phosphodiester bond between the 3' position of one ribose and the 5' position of the second ribose.

The images below show the backbone structures for both DNA and RNA.



Phosphodiester linked sugar-phosphate-sugar backbone

did I get this

Can you identify two processes in the formation of the RNA and DNA backbones that illustrate bioselectivity?

Submit and Compare

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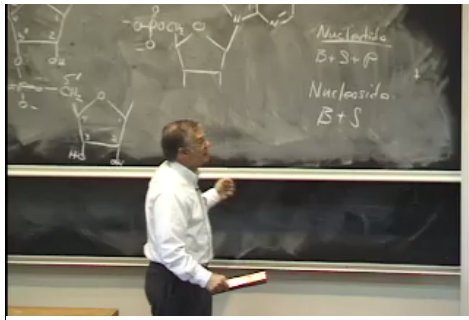
The synthesis of the backbones illustrated above is directed by specific enzymes that restrict the possible structures to links between the 3' position and the 5' position of the sugars with a bridging phosphate and to selected sugars with specific inclusion of either ribose or 2'-deoxyribose.

The following is a list of structural characteristics of the DNA/RNA polymer backbone.

- Phosphate-ribose(deoxyribose)-phosphate-ribose(deoxyribose)sequence
- Linked by Phosphodiester covalent bonds
- 3' position on one ribose(deoxyribose) linked to 5' position of adjacent ribose(deoxyribose) through phosphodiester bridge
- chain has 3' end and 5' end

In the structure above the X represents the bases that distinguish the units of the backbone from each other in much the same way that the 20 naturally occurring side chains on a common backbone distinguish the units of a polypeptide (protein) structure. These bases will be explored in the following sections.

The following is a video in which Dr. Brown explains the structure and formation of DNA and RNA backbones.



0:00



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