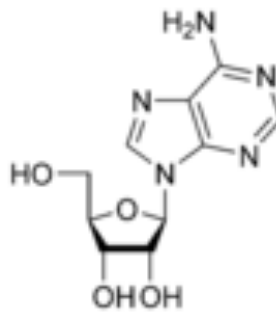


# Knowing Nucleic Acids

**Definition:** Nucleic acids are chains of nucleotides that are biological molecules essential for known forms of life, including deoxyribonucleic acid (DNA) and ribonucleic acid (RNA)

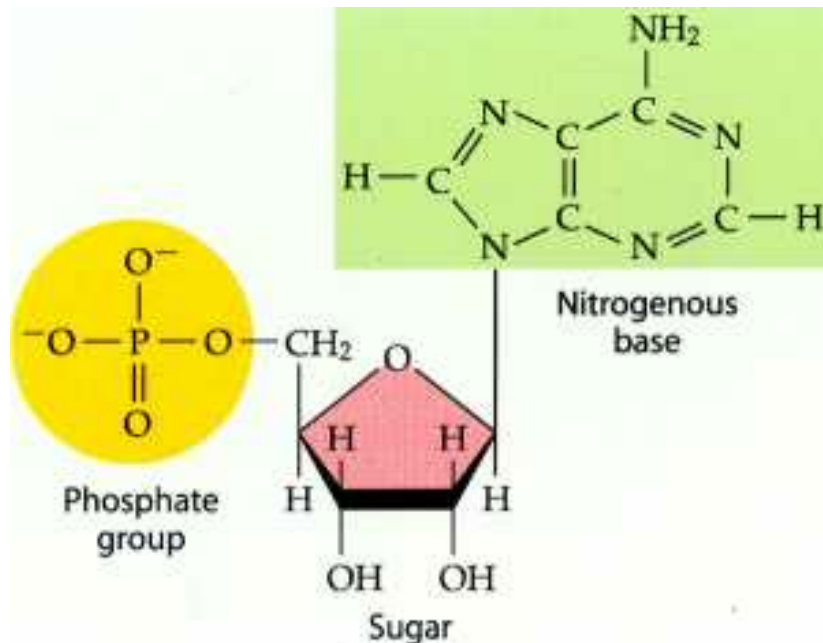
- **Nucleoside:** consists of a nucleobase attached to a ribose or deoxyribose sugar (carbohydrate)

Example: Adenosine



- **Nucleotide:** nucleoside with a phosphate on 3' of 5' carbon

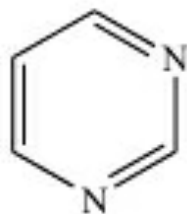
Example:



**Components of Nucleotides:** Each nucleotide consists of three components: a pyrimidine and purine nucleobase, a pentose sugar (furanose), and a phosphate group.

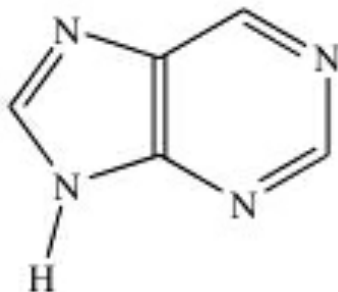
- **Pyrimidine:** A six-membered aromatic heterocycle with nitrogen atoms at positions 1 and 3. Cytosine (C), Thymine (T) *DNA*, and Uracil (U) *RNA* are all examples of pyrimidines.

General pyrimidine structure:



- **Purine:** A fused, bicyclic aromatic heterocycle of the general structure that includes both a 5-membered ring and a 6-membered ring. Adenine (A) and Guanine (G) are purines.

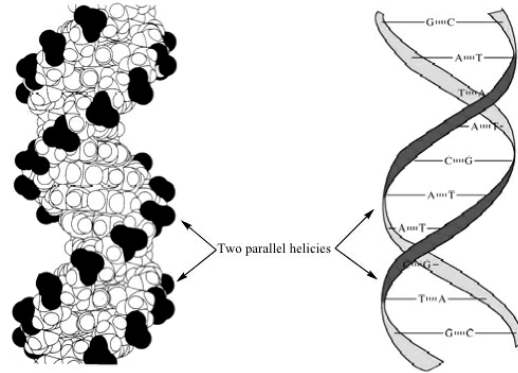
General purine structure:



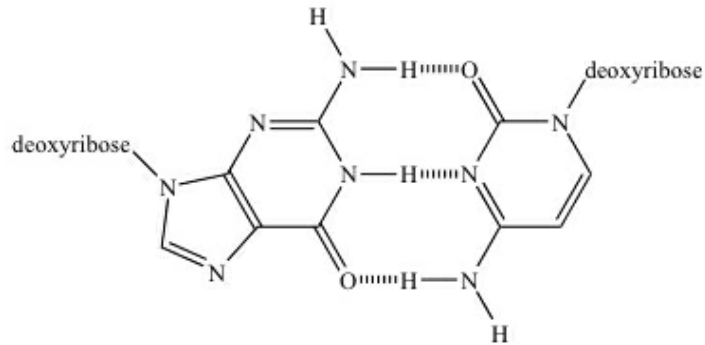
**DNA Structure:** DNA has three levels of structure—>

- **Primary structure:** the nucleotide sequence
  - Similar to primary structure of proteins that is the amino acid sequence
- **Secondary structure:** the three-dimensional structure of biopolymer segments and is a result of hydrogen bonds

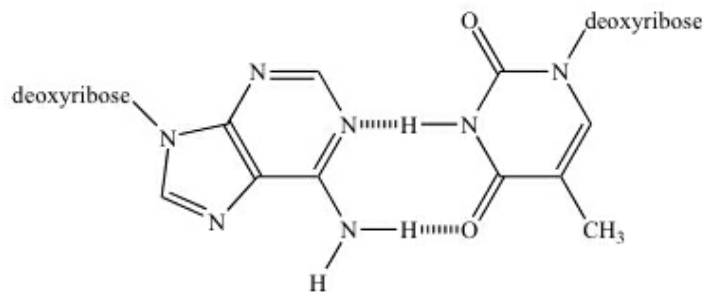
- Hydrogen bonds allow for the robustness and stability of DNA to protect the genetic information, but allow it to easily “unzip” for replication
- Phosphate carbohydrate backbone strands are antiparallel; 3’ and 5’ end run in opposite directions
- Forms the **double helix structure**—>2 parallel, intertwined helices



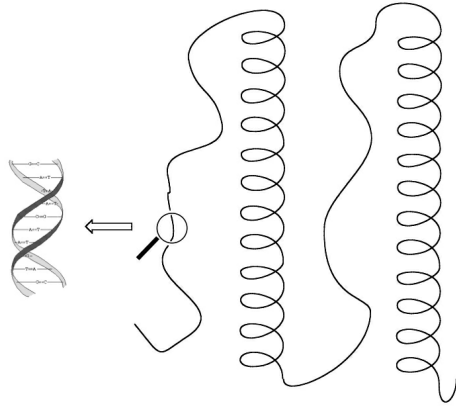
- Guanine pairs with Cytosine (G-C) with three hydrogen bonds in a 1:1 ratio:



- Adenine pairs with Thymine (A-T) with two hydrogen bonds in a 1:1 ratio:



- **Tertiary structure:** the supercoiling of DNA

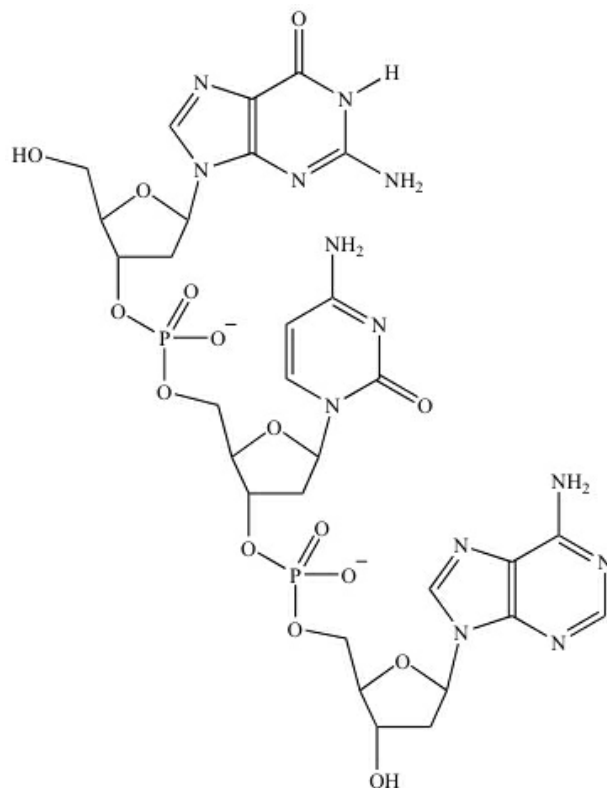


**Similarities and Differences of nucleobases:**

	Cytosine (C)	Thymine (T)	Uracil (U)	Adenine (A)	Guanine (G)
Six-membered ring	X	X	X	X	X
Five-membered ring				X	X
1,3 Nitrogen	X	X	X	X	X
1 pi bond in ring		X	X		
2 pi bonds in ring	X				X
3 pi bonds in ring				X	
Amine	X			X	X
Amide	X	X (2)	X (2)		X
NH <sub>2</sub>	X			X	X
Methyl (CH <sub>3</sub> )		X			

**Patterns for Primary Structure:**

- Repeating base linkage order: A-T-G-C
- Linked in beta configuration for the anomeric carbon where the primary alcohol attached to the furanose and the primary alcohol is on the same face of ribose Phosphates all on the same side
- Furanoses link phosphodiester and nucleobases



### References:

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