



# 3<sup>rd</sup> lecture of molecular biology

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DNA & RNA as Macromolecules

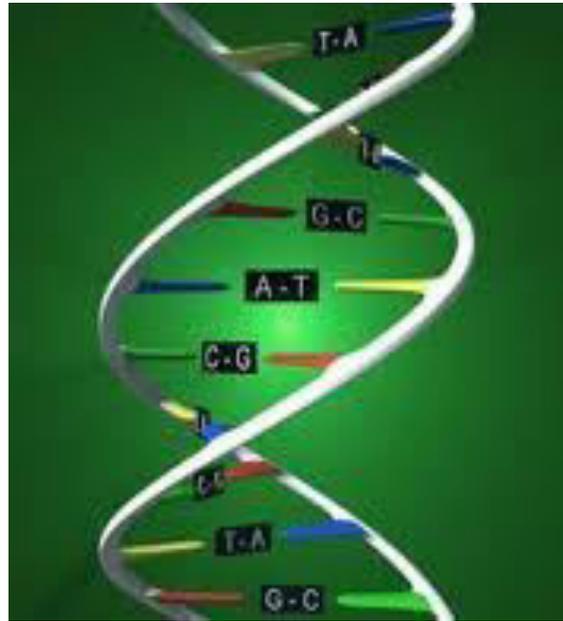
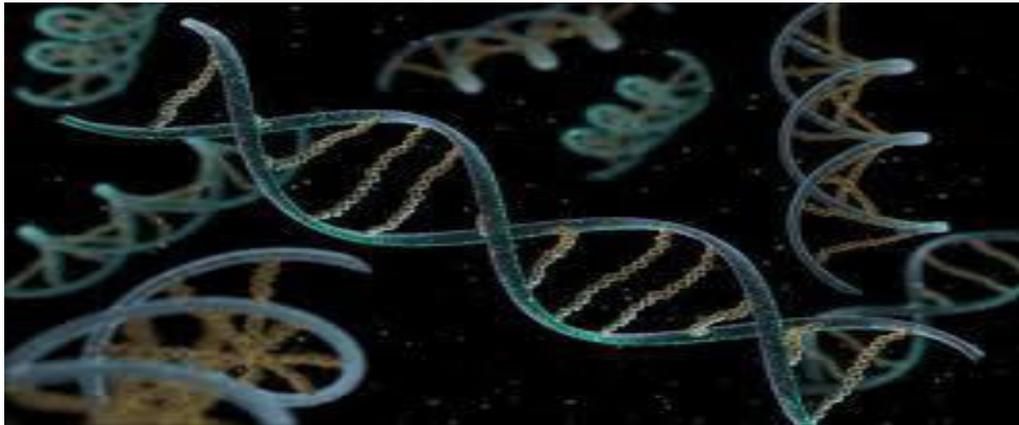
Basic structure and roles

# Type of Macromolecules الجزيئات العملاقة

- Nucleic acid :including DNA {Deoxribonucleic acid} & RNA { Ribonucleic acid}.
- Proteins
- Polysaccharid

## THE NUCLEIC ACIDS :

- DNA is the most important molecule in living cells and contains all the information that the cell need to live and to propagate itself .with RNA they maintain the cell through Gene expression. Nearly all of the DNA present in eukaryotic cells can be found in the cell nucleus but it is present in cytoplasm in bacteria.

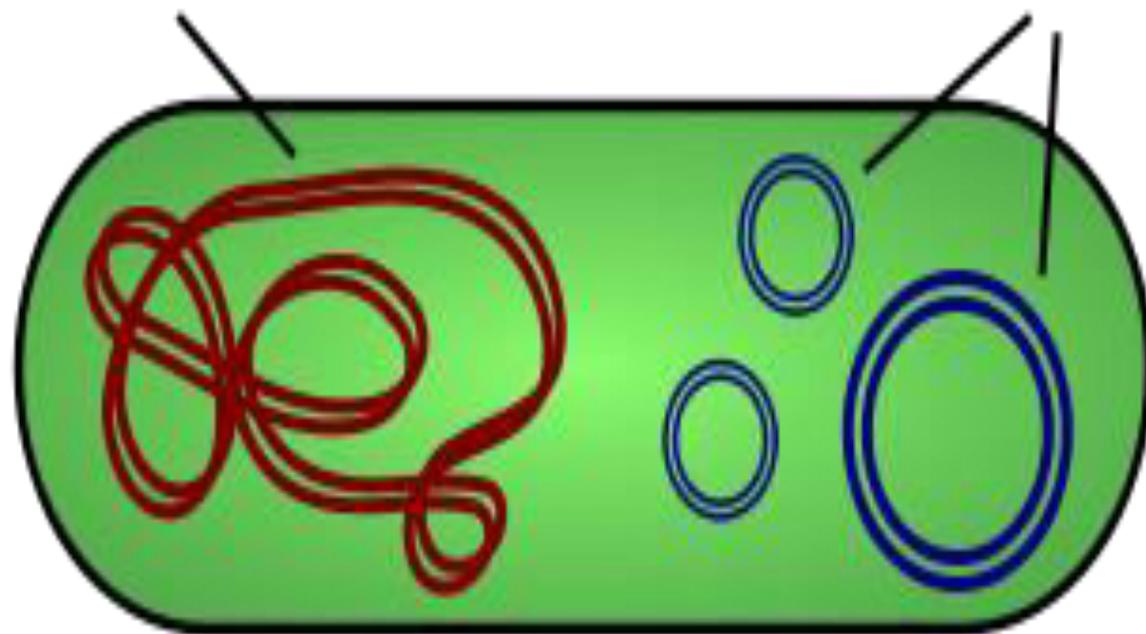


## Other type of DNA rather than chromosomal DNA

- **Plasmid DNA** :It is a double stranded super helix DNA (extra chromosomal genetic material) usually found in bacterial cytoplasm .plasmid are not confined to bacteria but they have been isolated from yeast, protozoa and plants
- **Mitochondrial DNA (mtDNA or mDNA)** is the DNA located in organelles called mitochondria, structures within eukaryotic cells that convert chemical energy from food into a form that cells can use, adenosine triphosphate (ATP).In humans, mitochondrial DNA can be assessed as the smallest chromosome coding for only 37 genes and containing only about 16,600 base pairs. Human mitochondrial DNA was the first significant part of the human genome to be sequenced.
- **Chloroplast DNA**: present inside chloroplast responsible for its activity

Bacterial DNA

Plasmids



## Basic structure of DNA

A Nucleic Acid is a polymer consisting from nucleotides (the main structural units in nucleic acid) each nucleotide has the 3 following components:

- ① Cyclic five carbon sugar called ribose (in RNA) and as it devoid hydroxyl group attached to carbon no. 2 DNA structure thus it called deoxyribose,
- ② Nitrogen base the purine {adenine A and guanine G} and pyrimidine {cytosine C, thymine T and uracile U} .the first type consist from 2 rings while second type contain only one ring .
- ③ A phosphate group (phosphoric acid) attached to the 5 carbon atom of the sugar by a phosphoester linkage .this phosphate group is responsible for the strong negative charge of nucleic acid

5 Nitrogen base :the blue nitrogen atom represent the place where the sugar attached to the nitrogen base

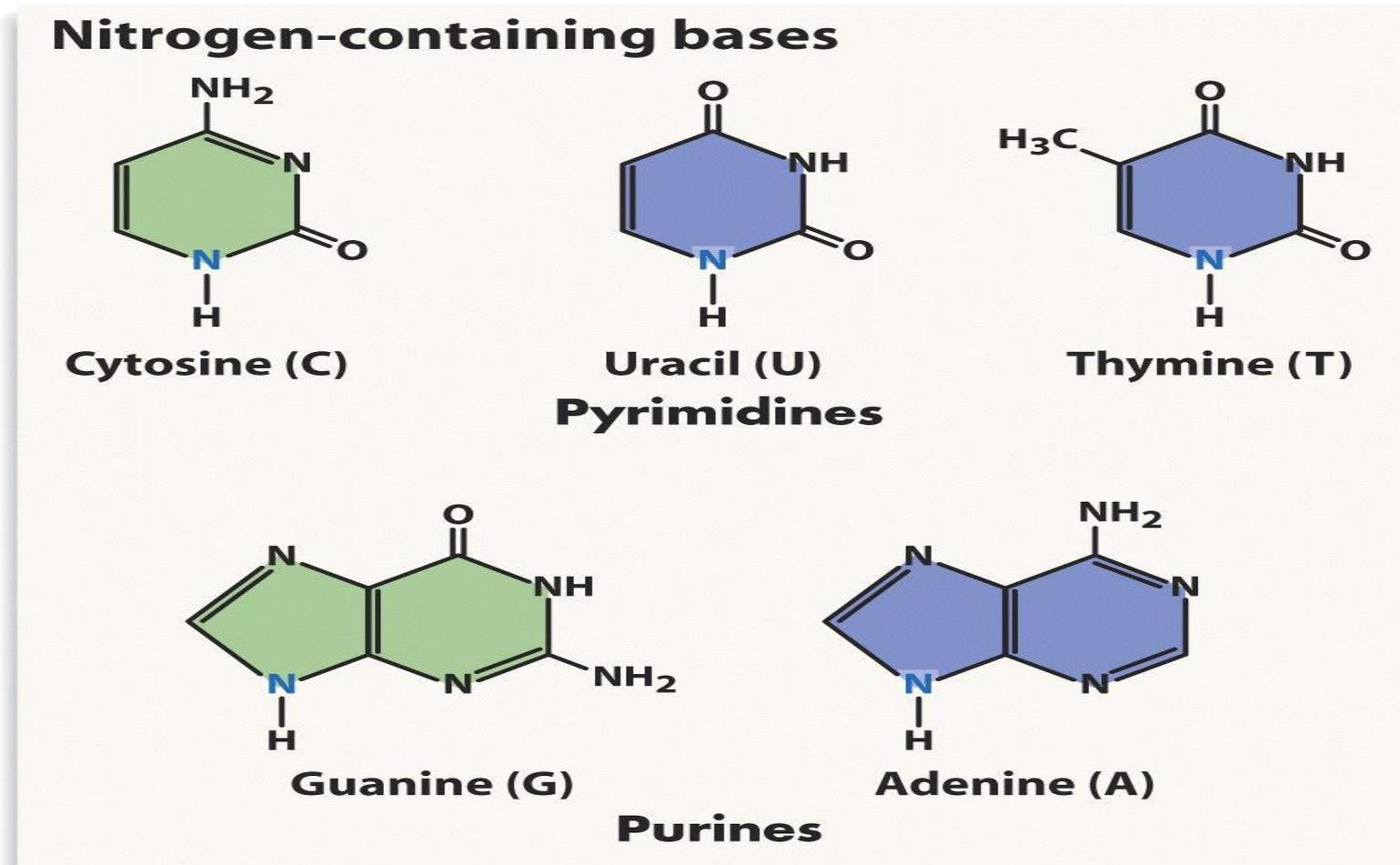
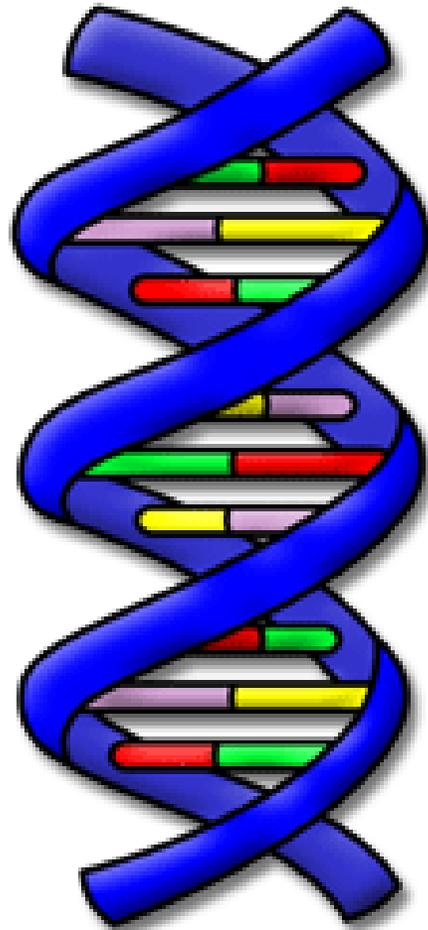


Figure 4-1c Biological Science, 2/e

Nitrogen base in DNA : A T G C without U (Uracile only in RNA) .the back bone is the sugar- phosphate



**DNA**

**Adenine**

**Thymine**

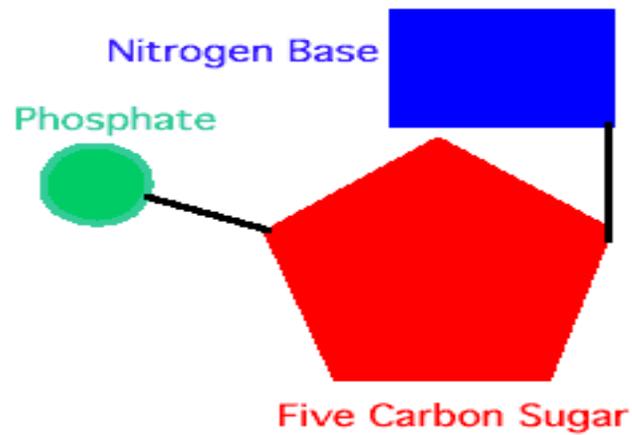
**Guanine**

**Cytosine**

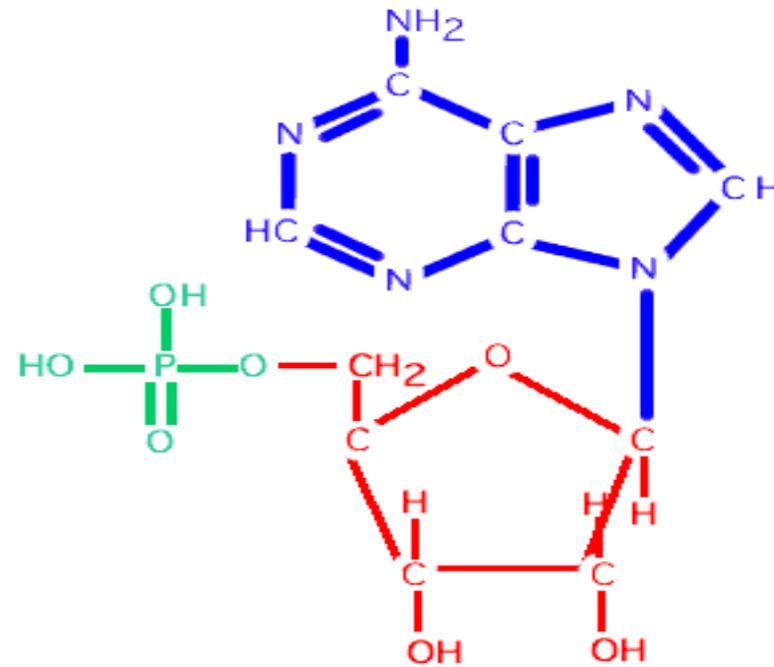
**Sugar +  
Phosphate!**

N base +sugar→ Nucleoside via N-glycosylic bond  
N base +sugar+ phosphate group→Nucleotide

### Basic Nucleotide Structure



### Example



Adenosine 5' phosphoric acid

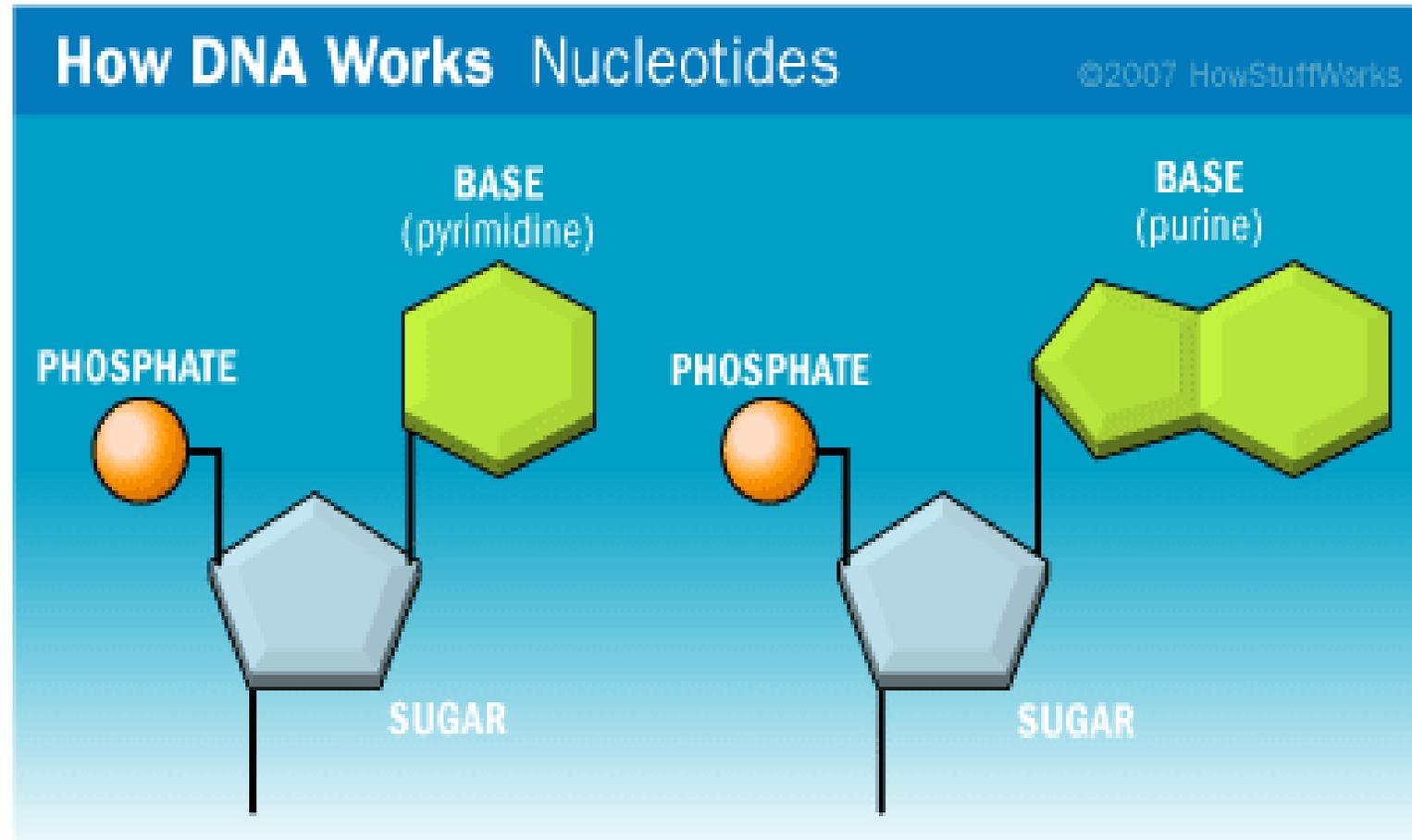
According to nitrogen base type the nucleotide is named

<u>N.B</u>	<u>Nucleoside</u>	<u>Nucleotide</u>
1-Adenine	Deoxyadenosine	Deoxyadenylic acid (d AMP)
2-Cytosine	Deoxycytidine	Deoxycytidylic (d CMP)
3-Guanine	Deoxyguanosine	Deoxyguanylic (d GMP)
4-Thymine	Deoxythymidine	Deoxythymidylic (d TMP)
5- Uracil	Uridine	Uridylic acid

For the phosphate group:

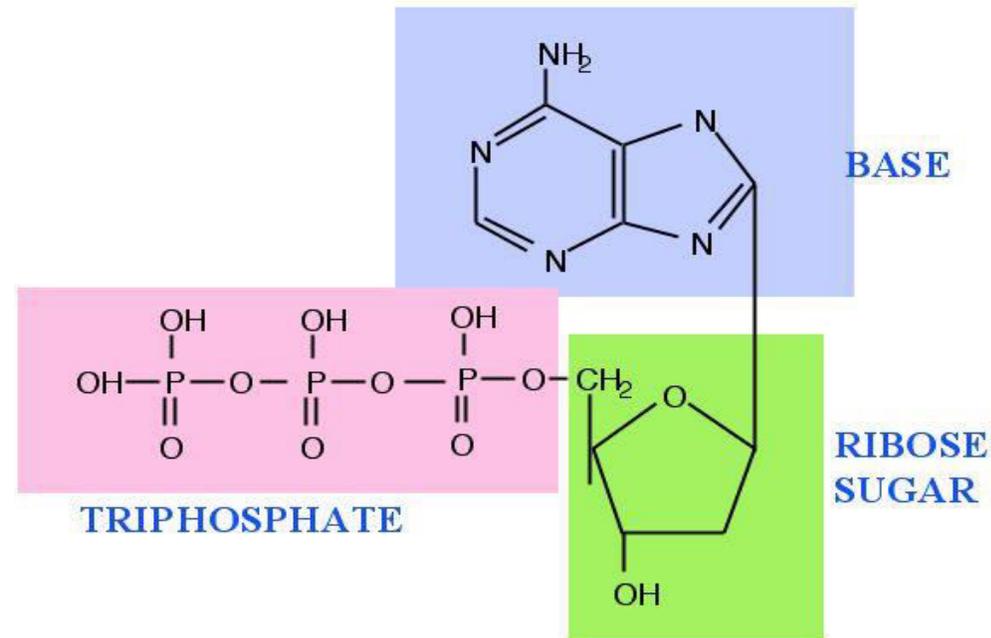
Usually the nucleotide come with 3 phosphate group ( $\alpha$   $\beta$   $\gamma$ ) when it bind to DNA strand it will lose two groups (pyrophosphate) leaving only one group  $\alpha$  attached to the helix .  
The attachment only from one side (the 3' OH free end)

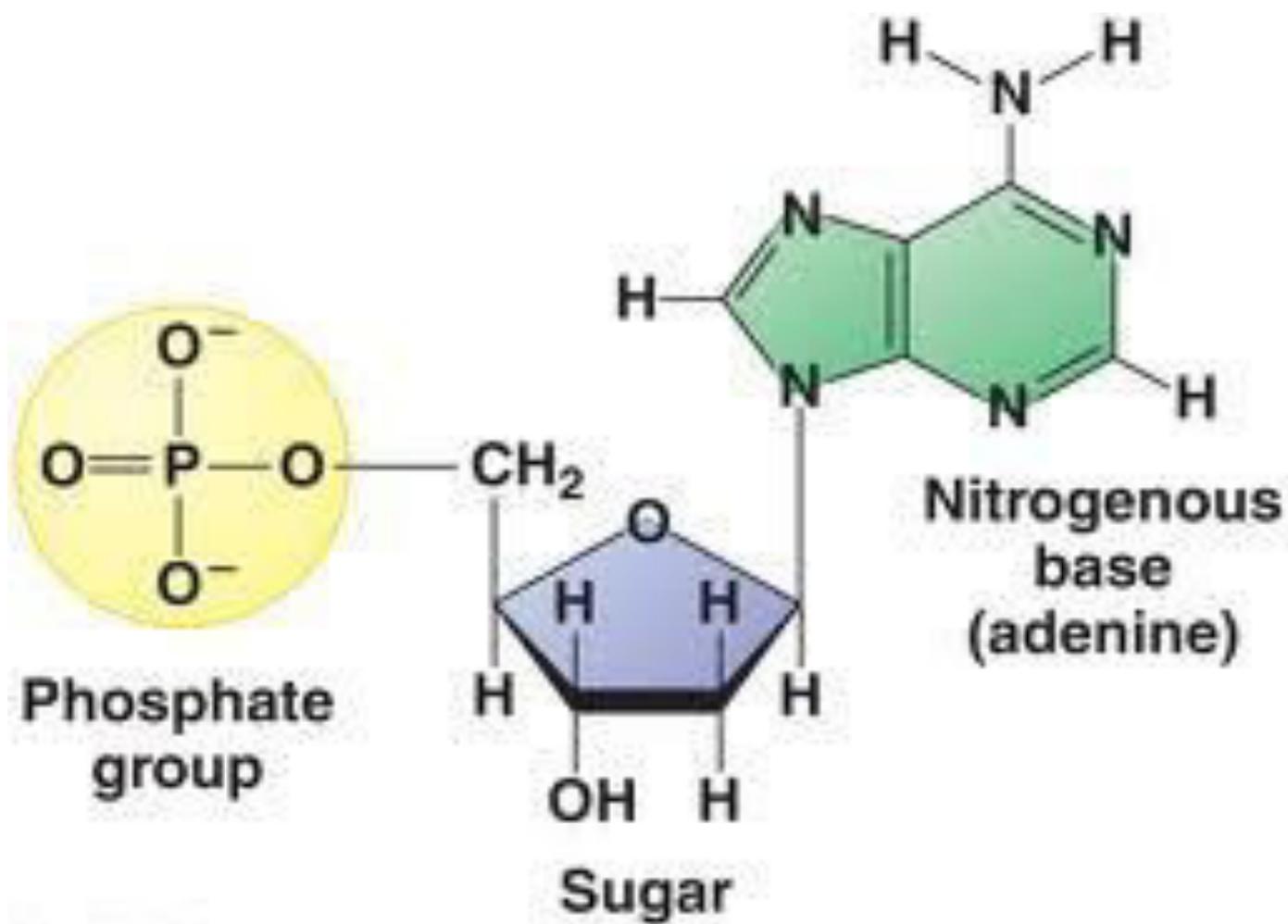
# Nucleotides the basic unit in nucleic acid



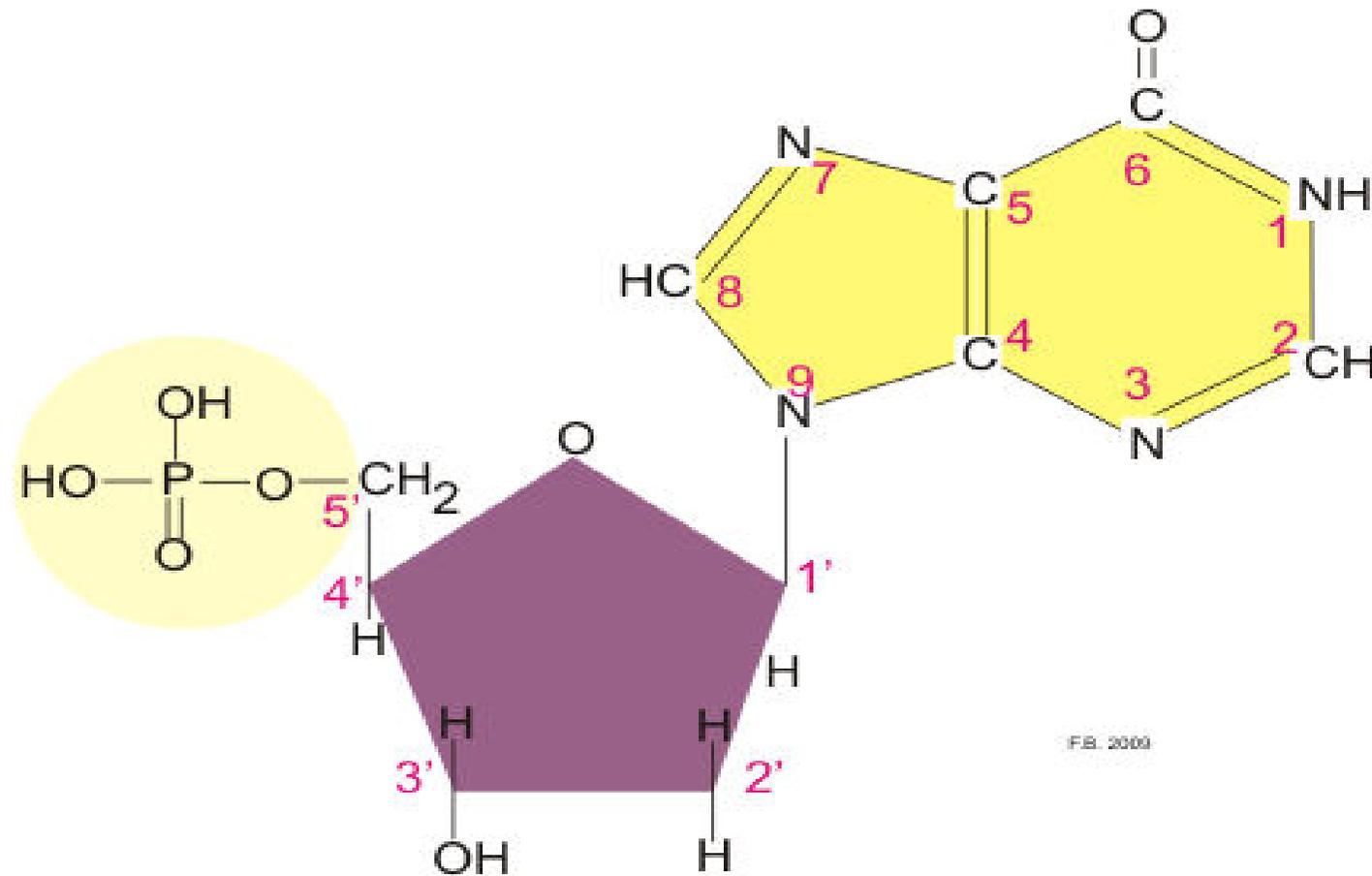
The bond between base and sugar is N-glycosidic bond  
the bond between sugar and phosphate is ester bond  
the bond between 2 bases is hydrogen bond

## NUCLEOTIDE





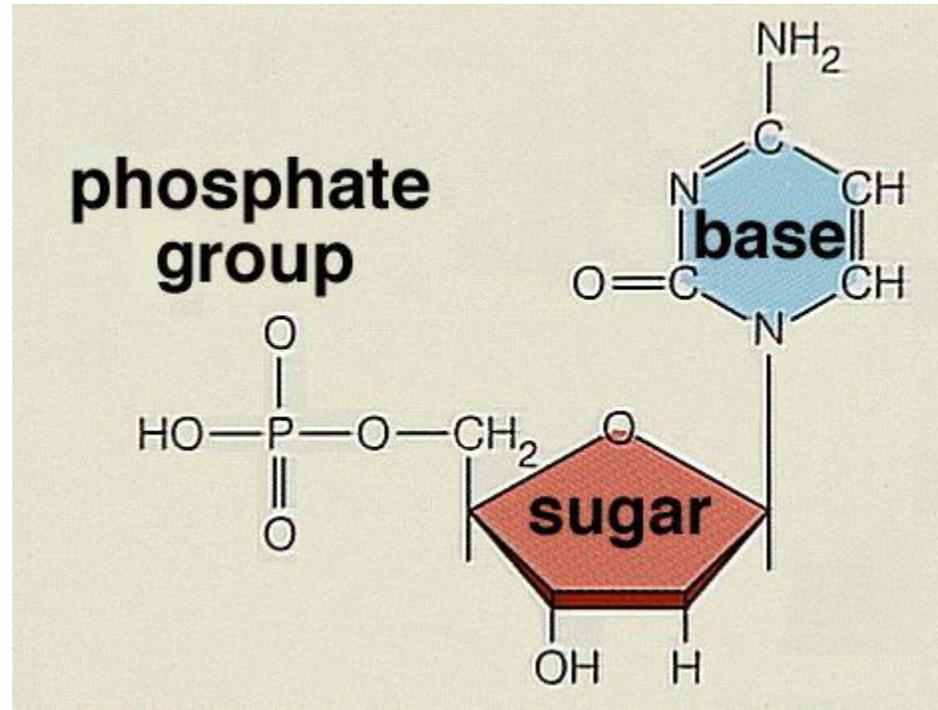
Carbon no:1 in Sugar attached to nitrogen NO. 9 in case of purine



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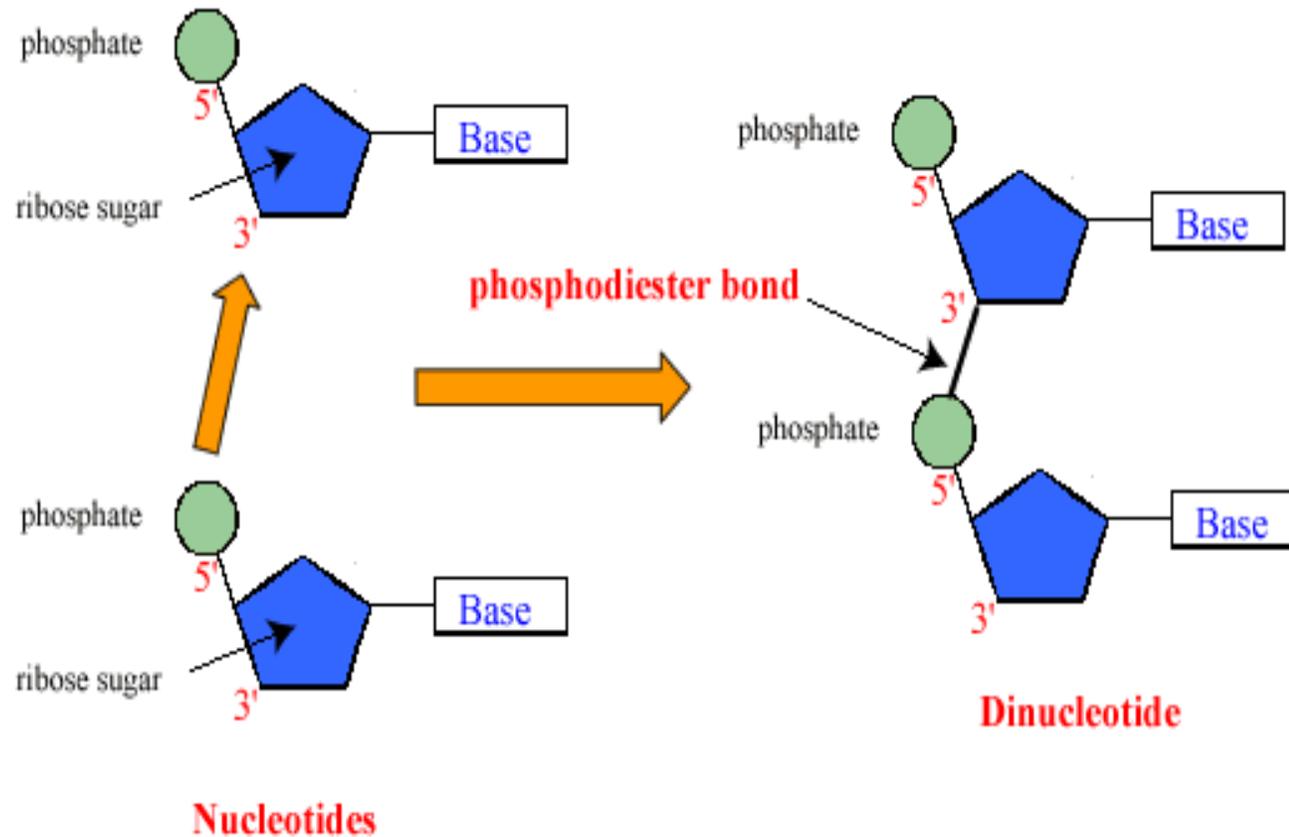
Deoxyribose Nucleodide Guanine

Carbone no:1 in Sugar attached with nitrogen N0.1 in case of pyrimidine

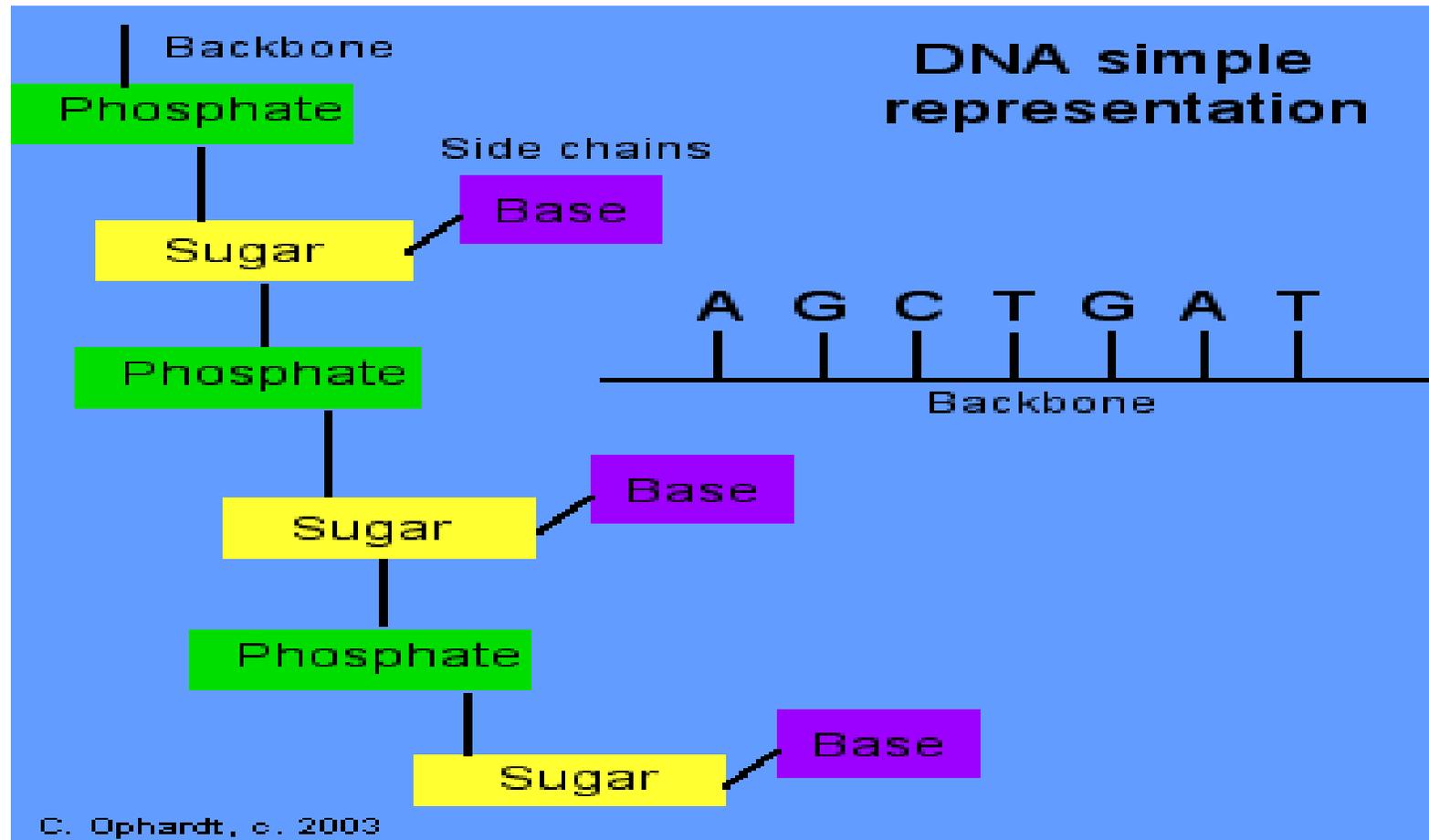


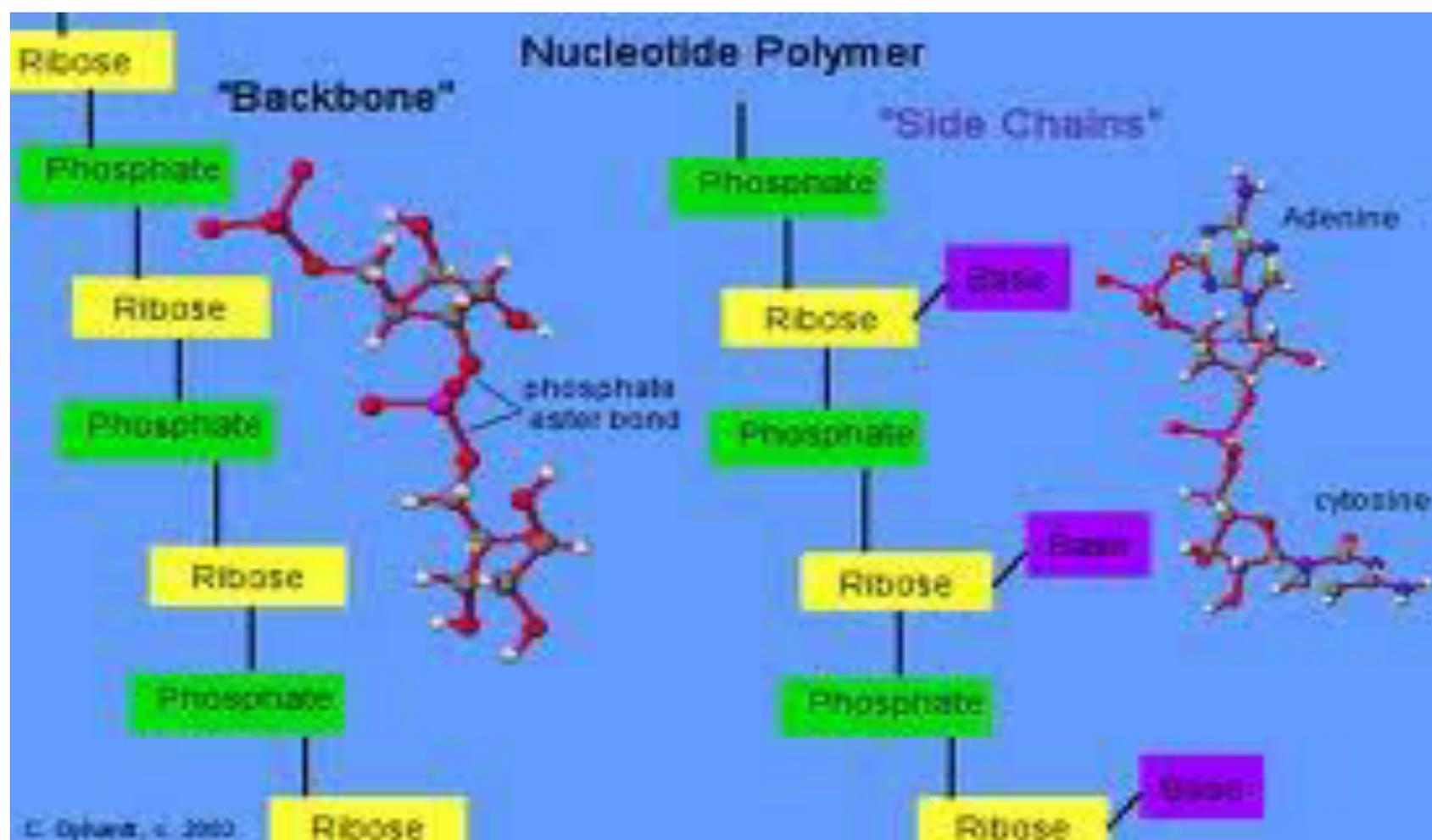
The attachment always occur from 3' end ,the bond between 2 adjacent nucleotide is called 3' 5' phosphodiester bond

### Polynucleotide formation

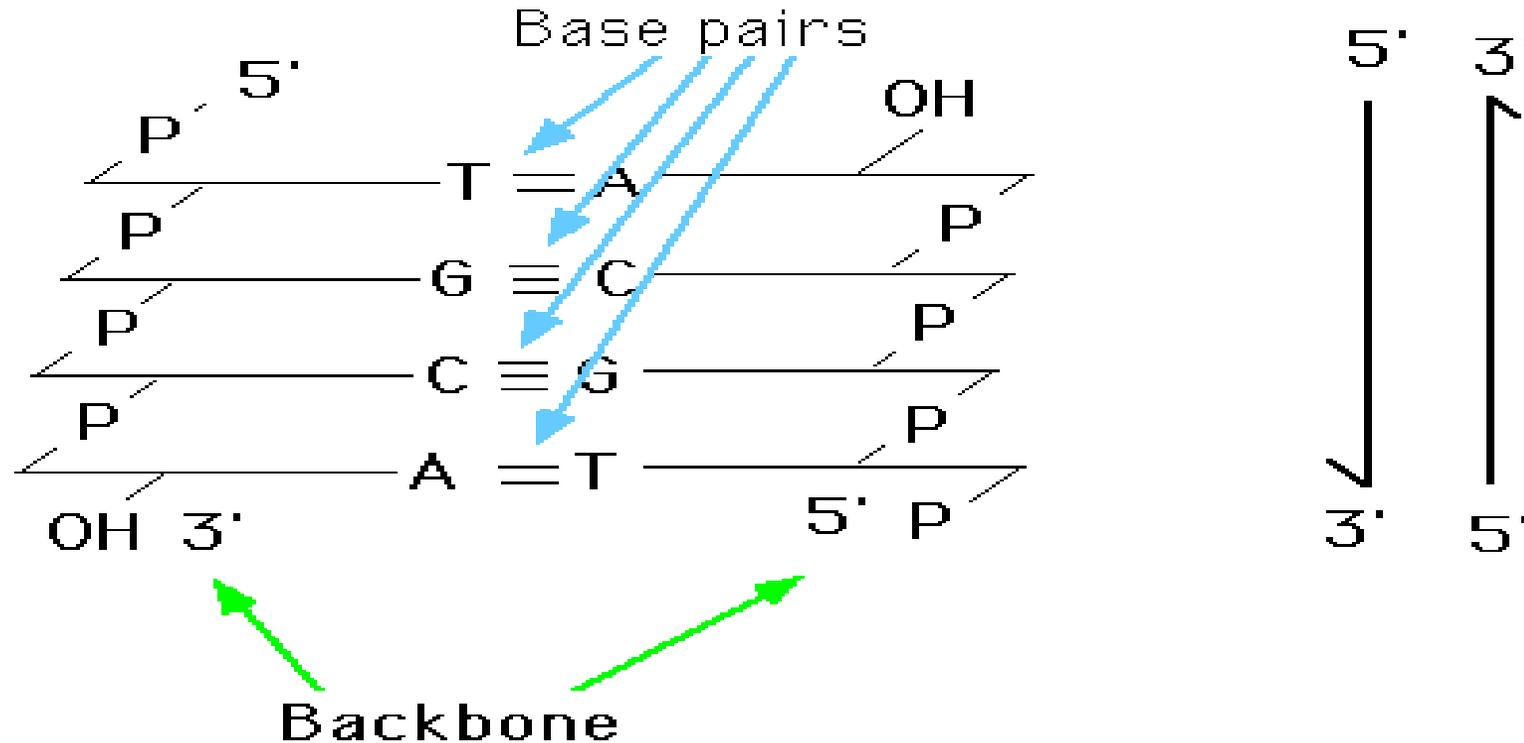


The primary structure of DNA represent one single strand ,not branched, result from binding polymer of nucleotides between the 3' OH free end of the upper sugar with the 5' P end (Pe phosphate) of the following nucleotide

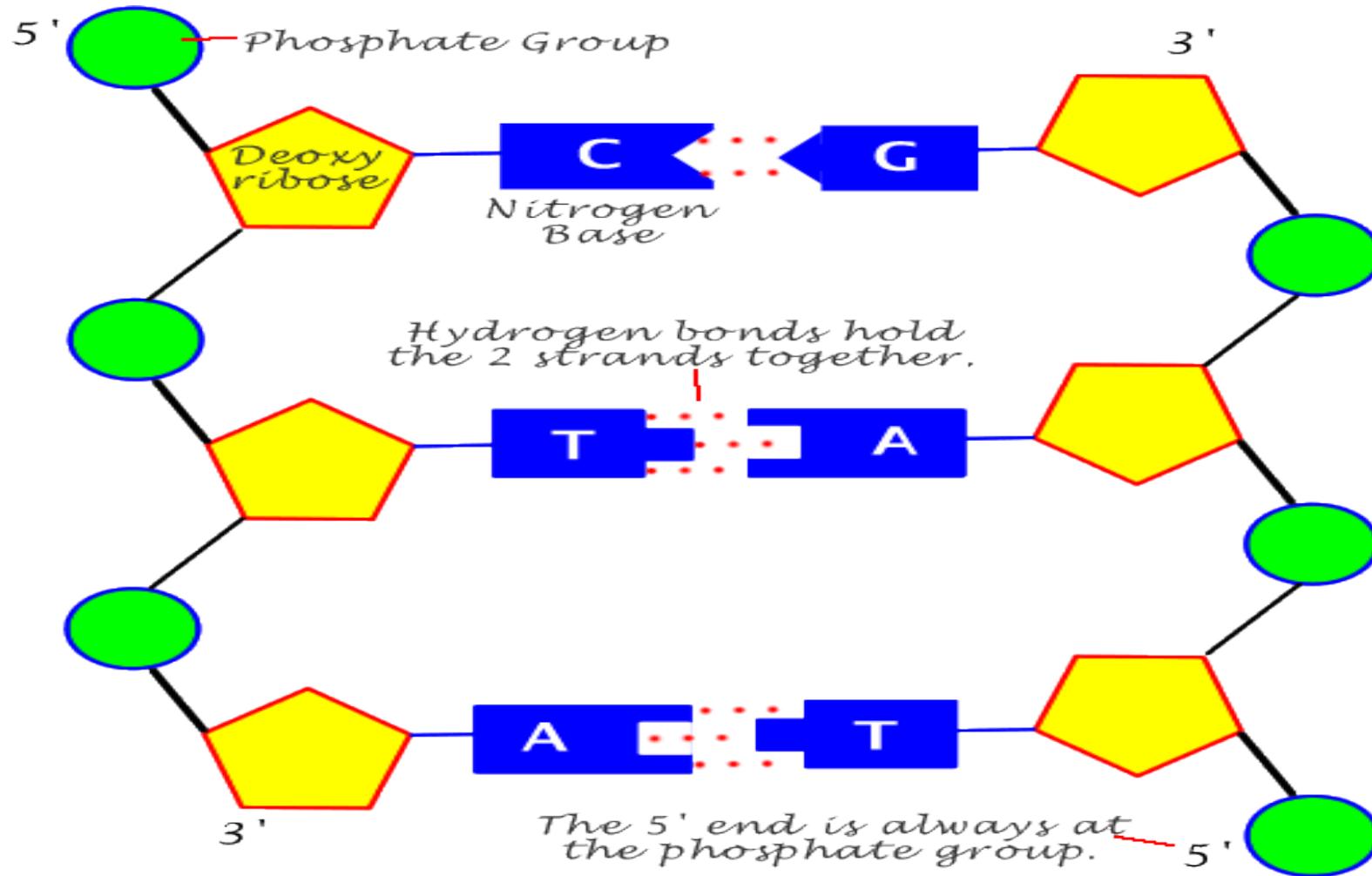




The secondary structure of DNA represent by binding two single strand via hydrogen bond  $A=T$  and  $G\equiv C$  .the two strand are anti parallel to each (opposite direction )that is to say 3'end face the 5' end twisted together .



## Formation of double helix



Binding two strand to form double strand

