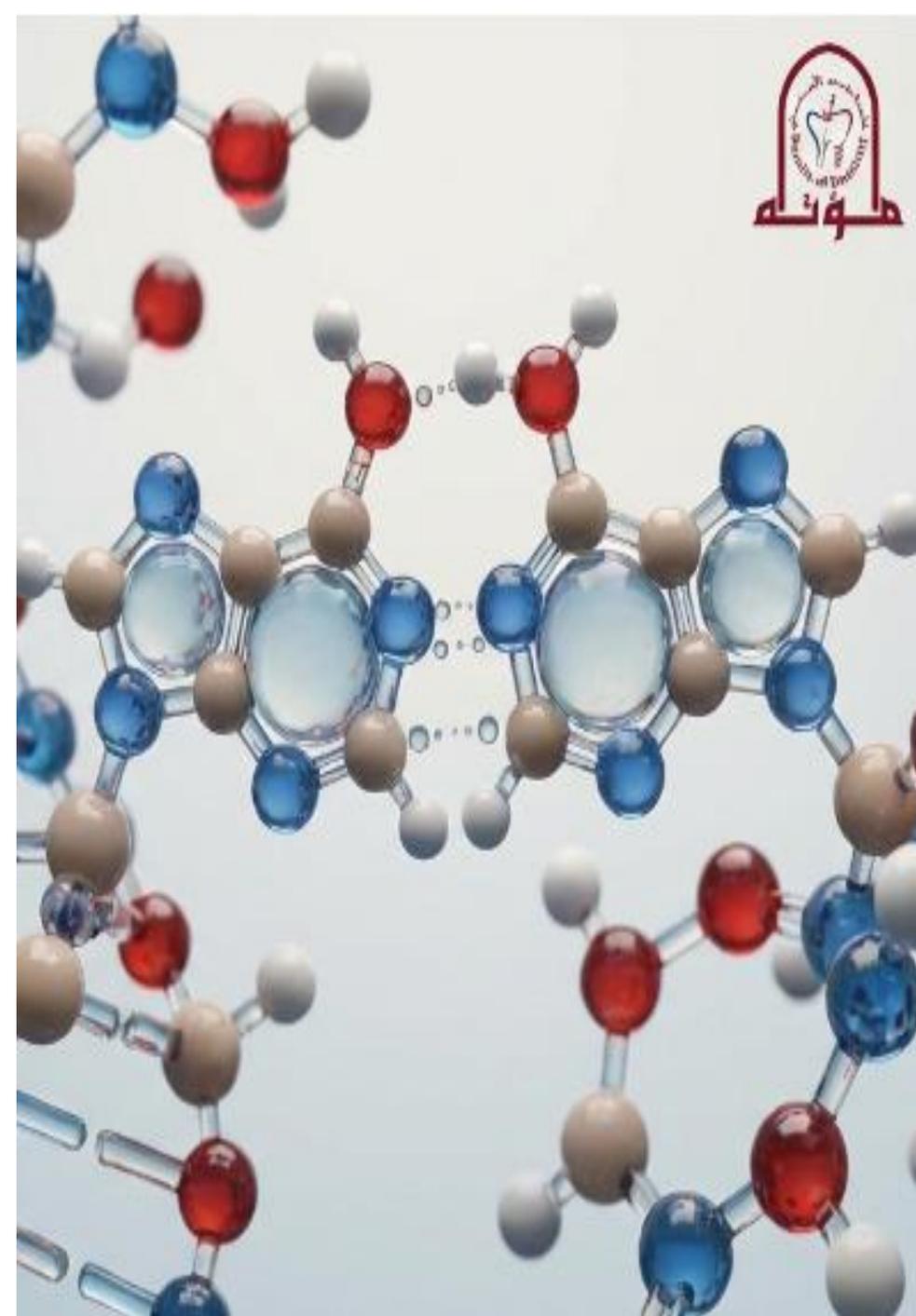


Nucleic acid chemistry



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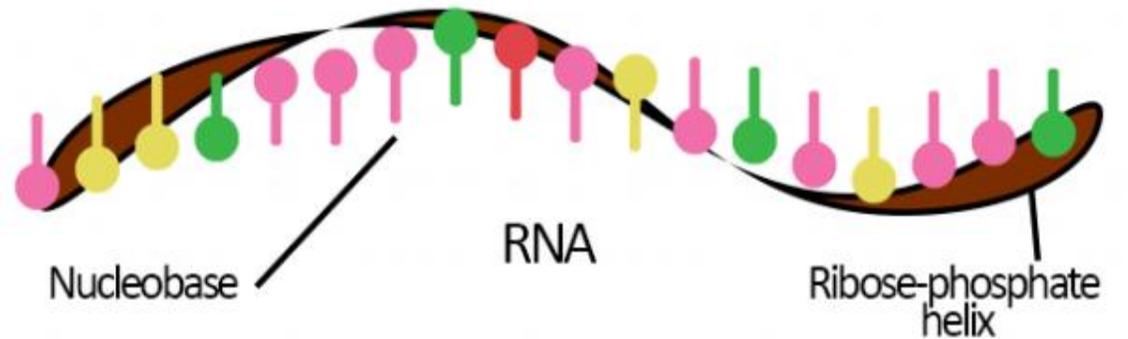
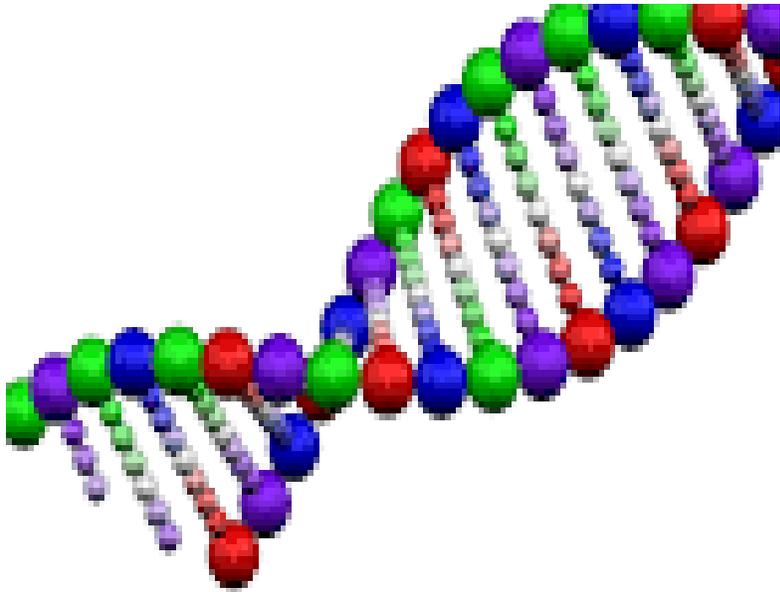
Learning outcomes

By the end of lecture, students should be able to:

- ❖ *Define nucleic acids*
- ❖ *Identify the basic structure of nucleotides and nucleosides*
- ❖ *List nucleotides of biological importance & their functions*

Basic of Nucleic acid structure

Nucleic acids (DNA & RNA) are long chains of repeated subunits (**polymers**) of nucleotides.



Nucleotide Structure

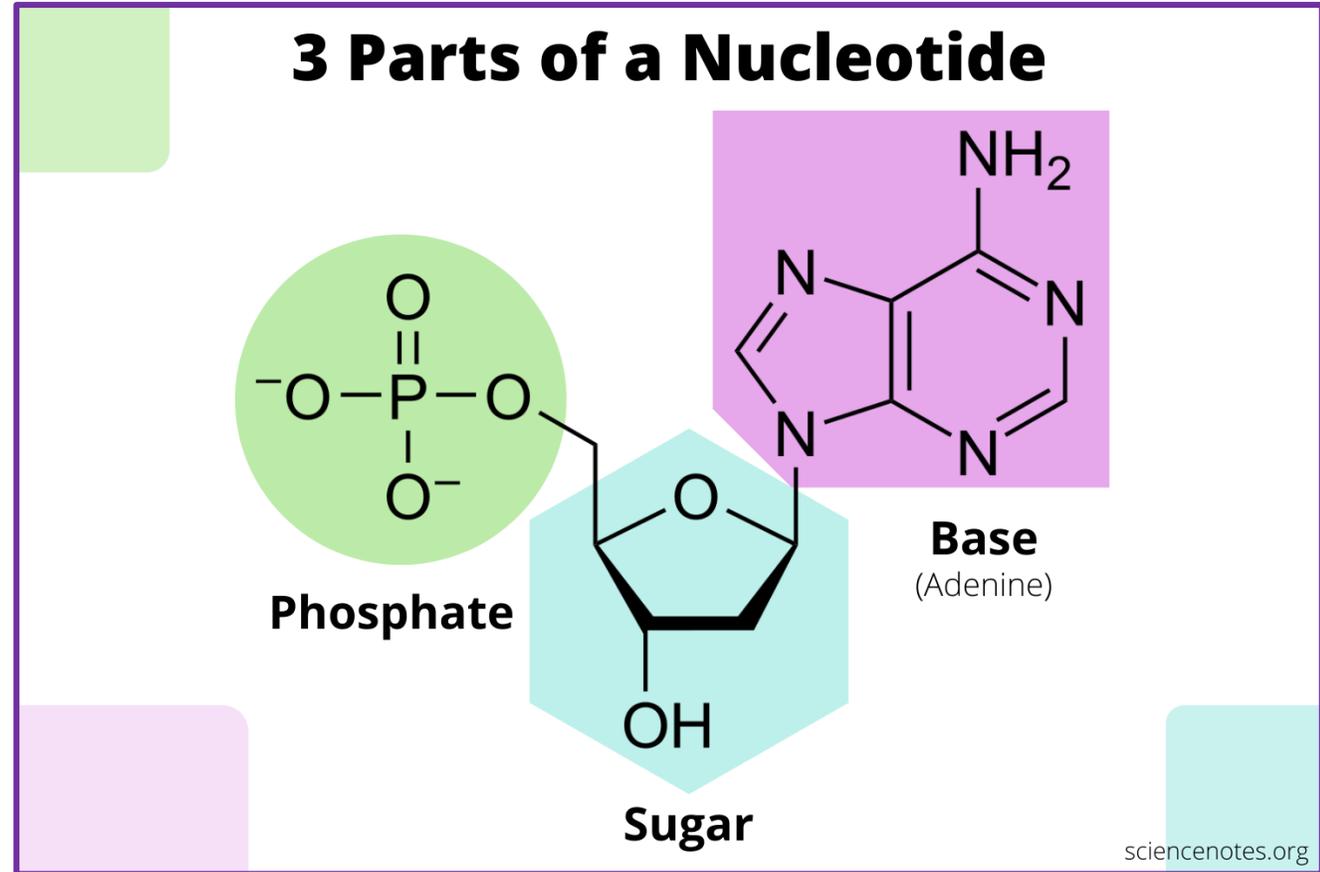
□ A nucleotide consists of

3 components:

1- Nitrogenous base

2- Pentose sugar

3- One or more Phosphate group



1- Nitrogenous Bases

- Purines

(both are in DNA & RNA)

Adenine

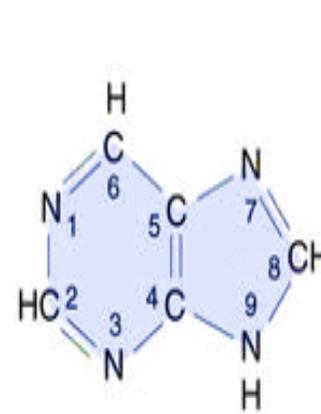
Guanine.

- Pyrimidines:

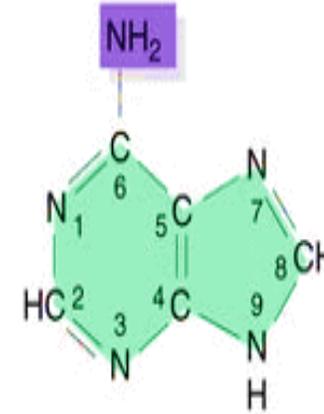
Cytosine (DNA&RNA)

Thymine (DNA)

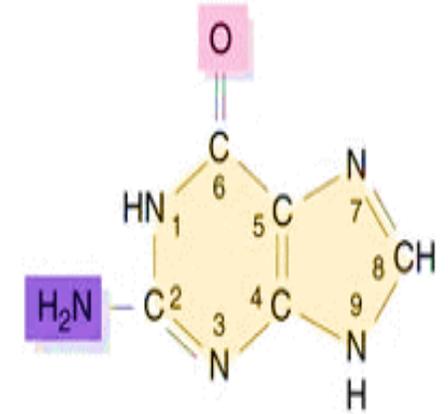
Uracil (RNA)



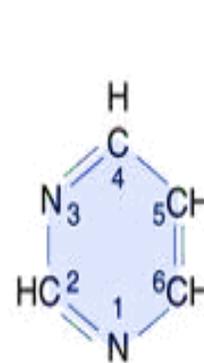
Purine



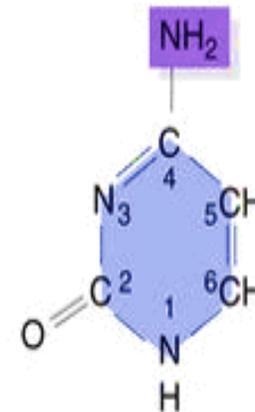
Adenine (A)



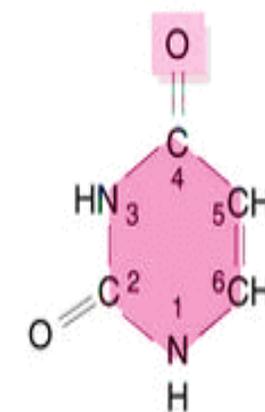
Guanine (G)



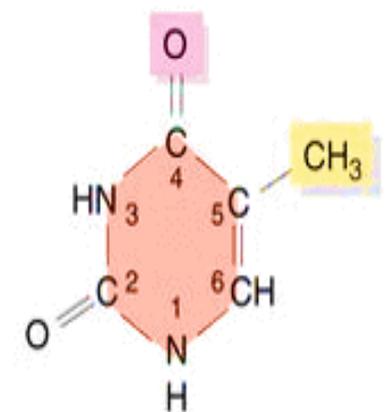
Pyrimidine



Cytosine (C)



Uracil (U)
(found in RNA)

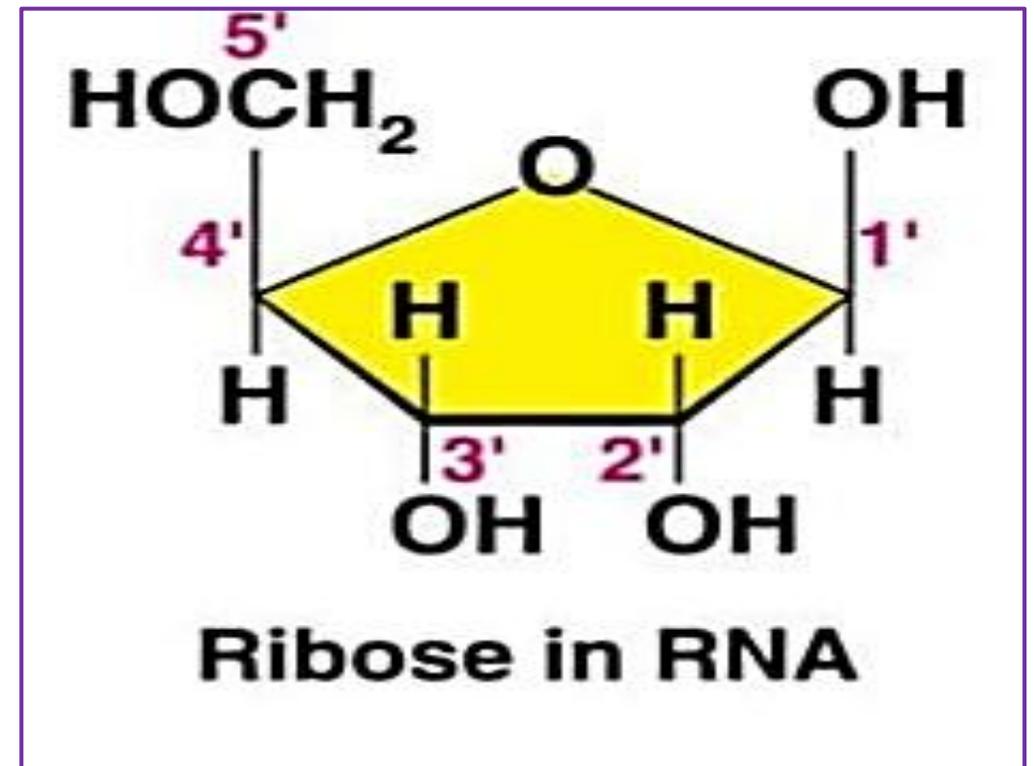
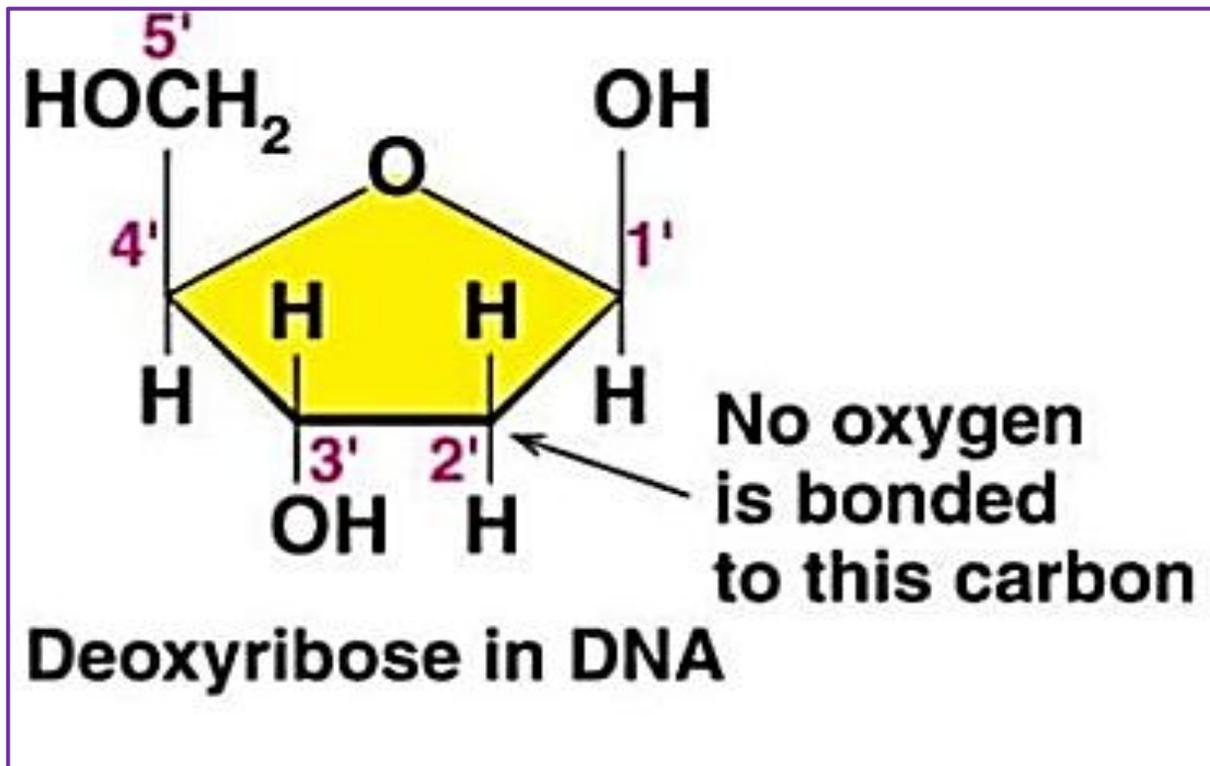


Thymine (T)
(found in DNA)

2- Sugars

Deoxyribose (forming deoxyribonucleotides) in DNA

Ribose (forming ribonucleotides) in RNA

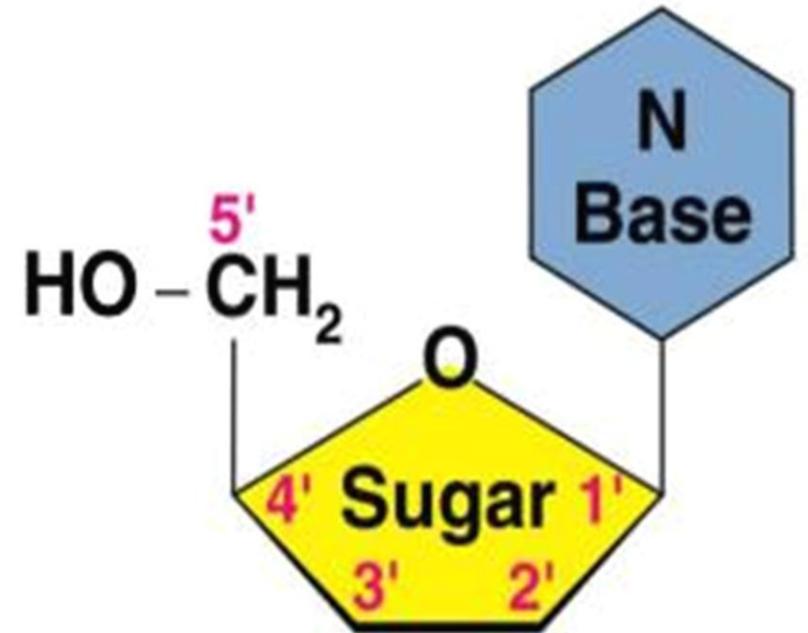


Nucleoside = Sugar + Base

Addition of base to the C1 of the pentose sugar produce **nucleoside**

[Glycosidic bond]

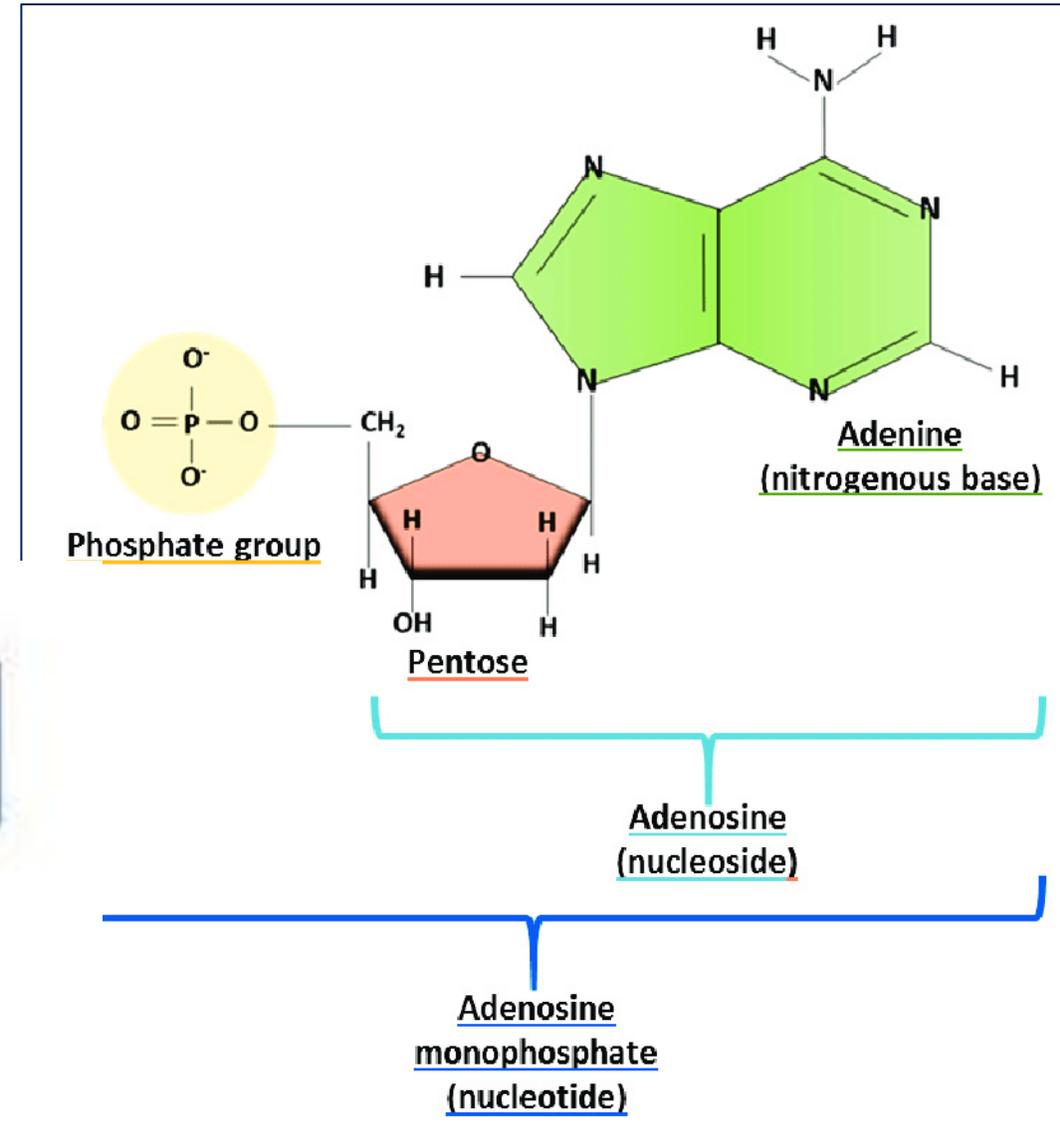
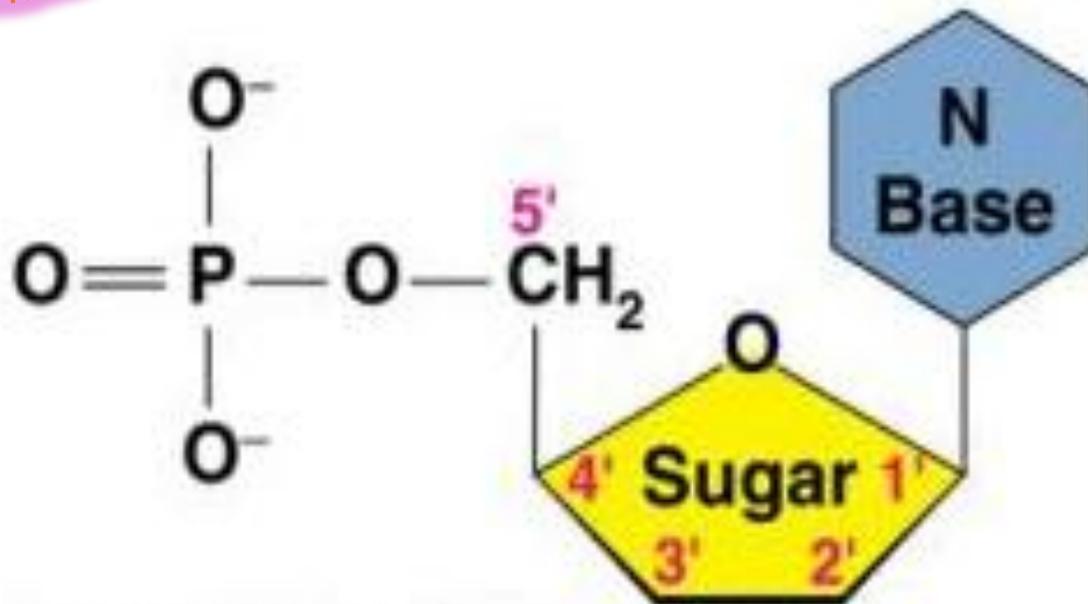
- If ribose (ribonucleoside)
- If deoxyribose (deoxyribonucleoside)



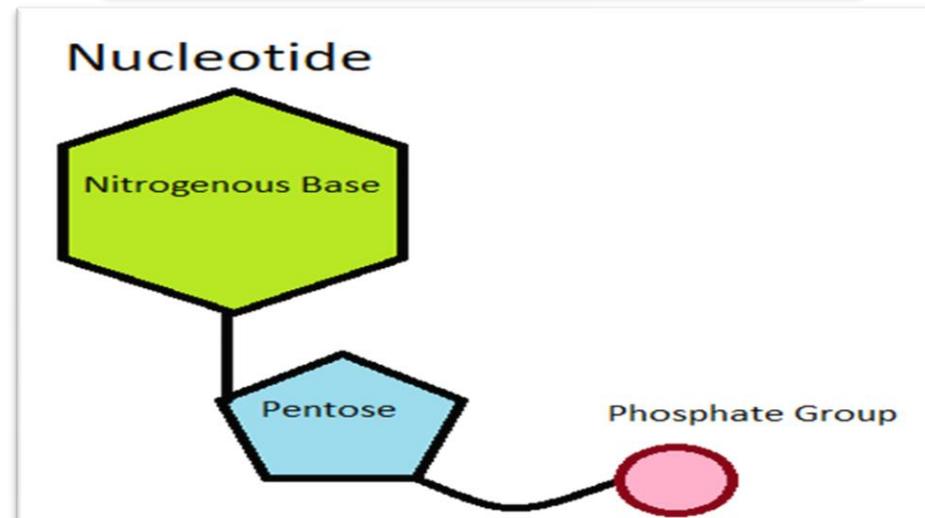
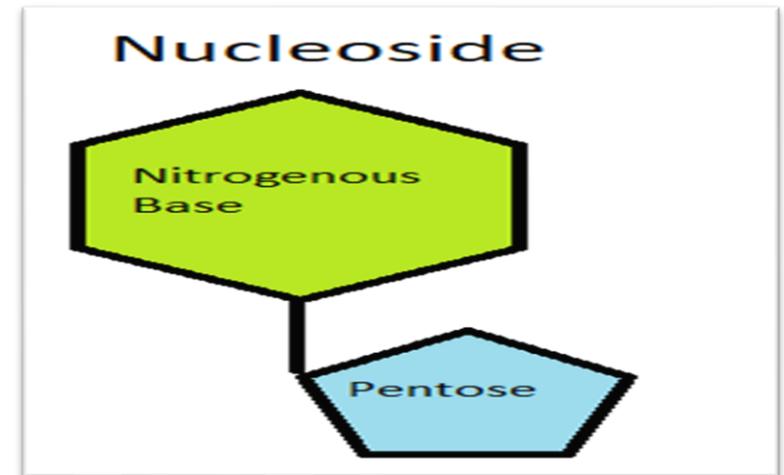
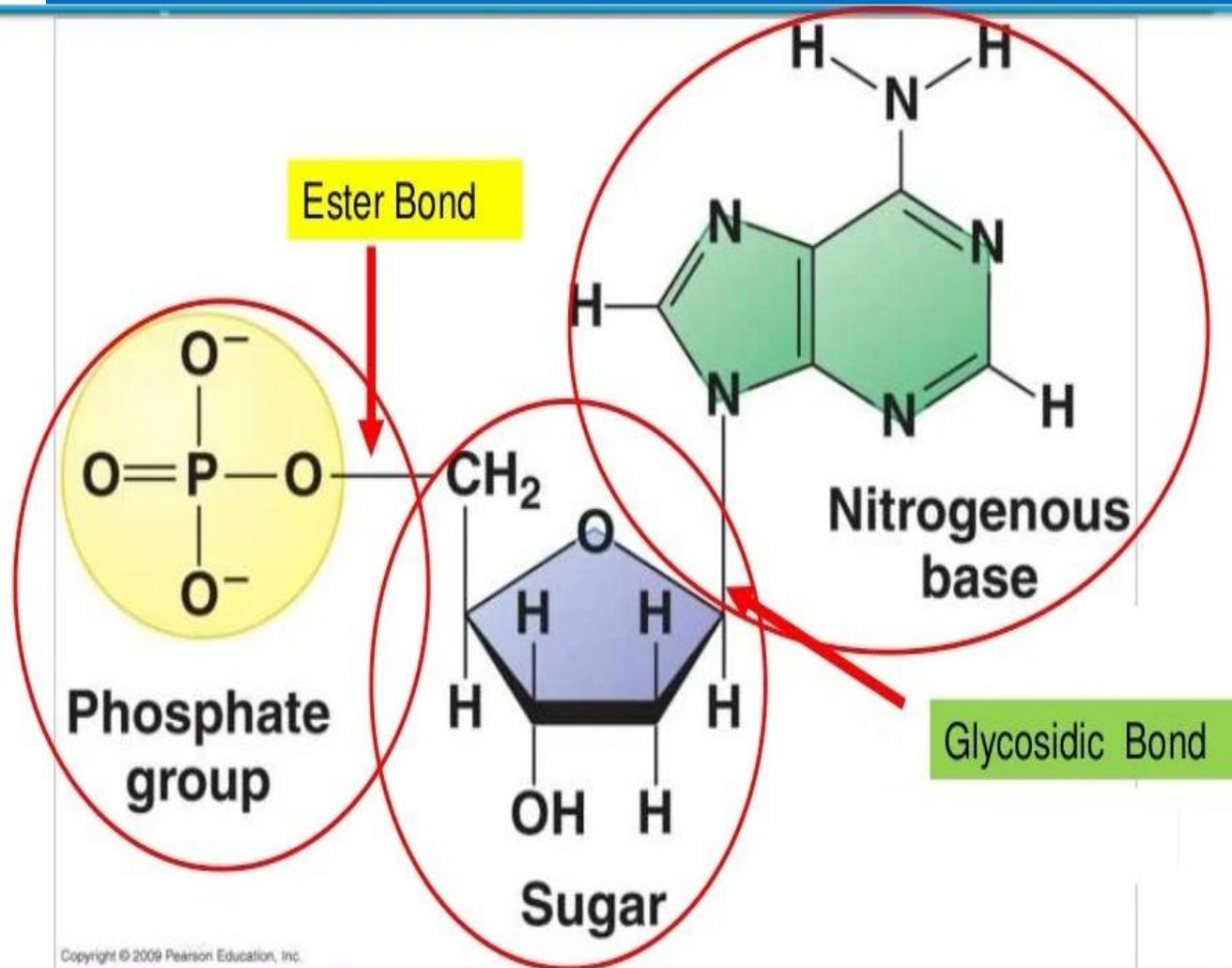
3- Phosphate

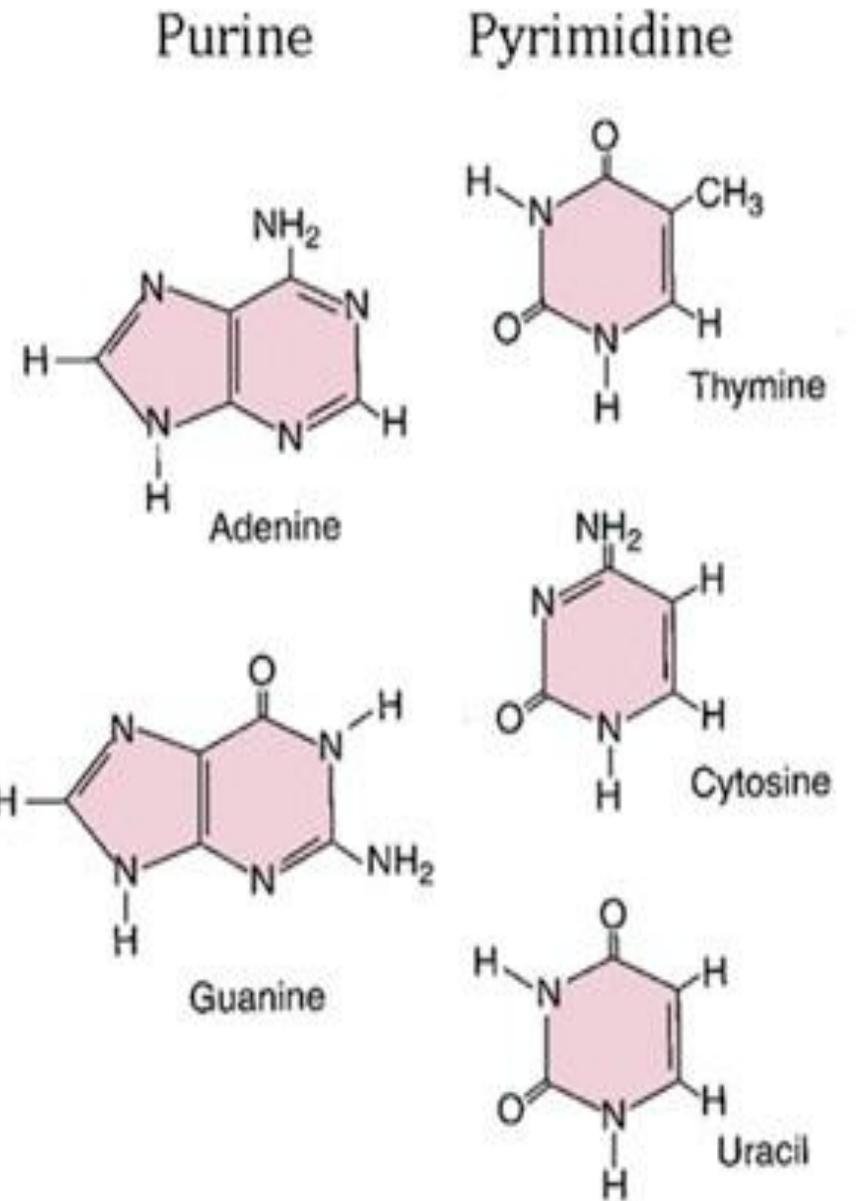
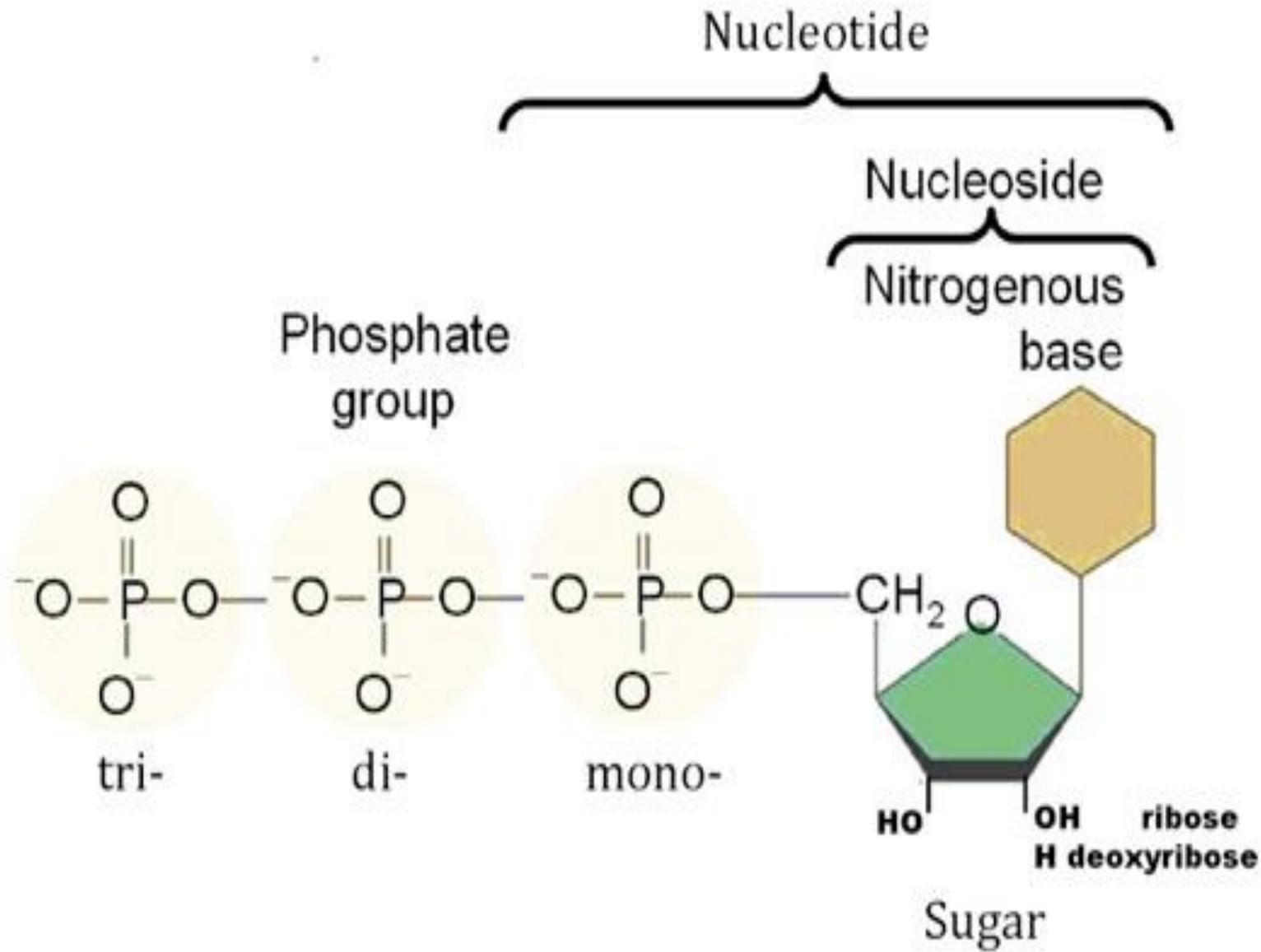
- Phosphate is added C5 to of the pentose
- The phosphate group is attached by

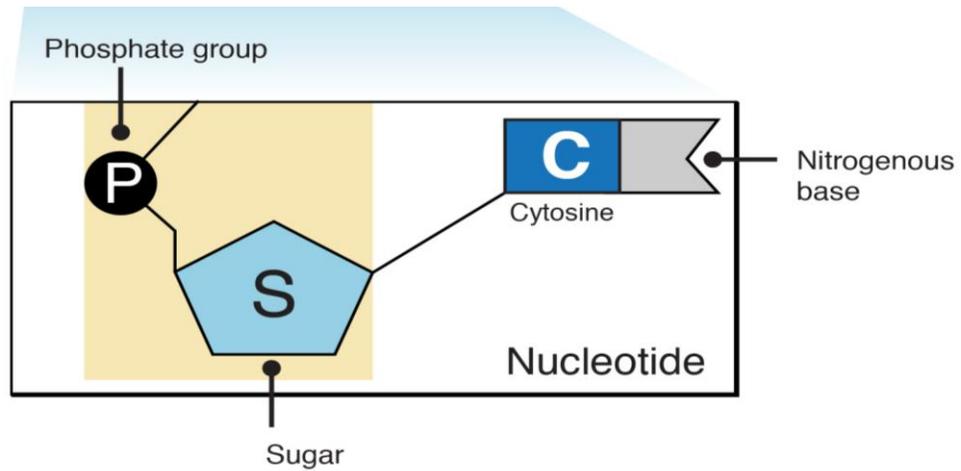
ester bond.



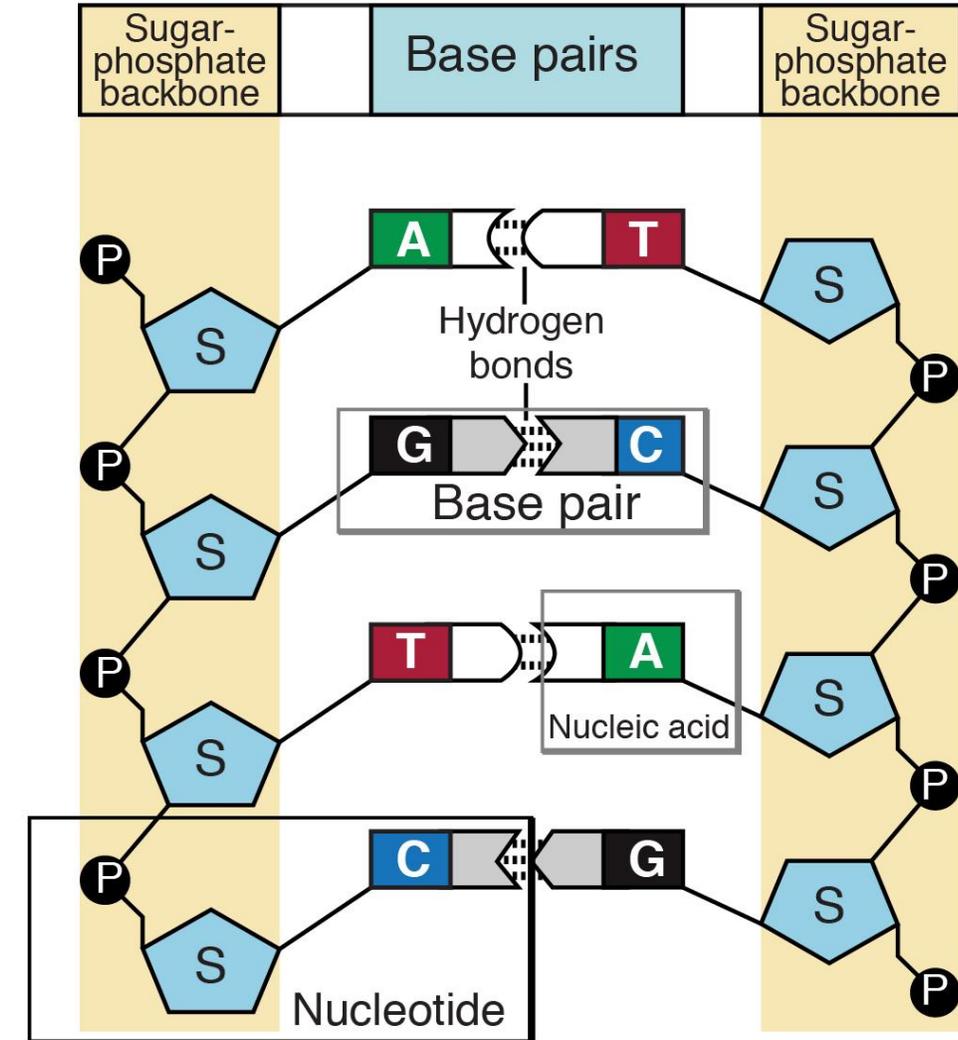
Nucleotide = Nucleoside + Phosphate



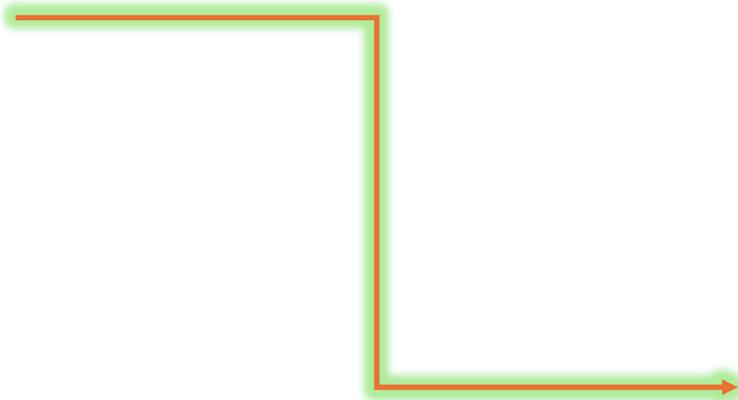




Deoxyribonucleic Acid (DNA)



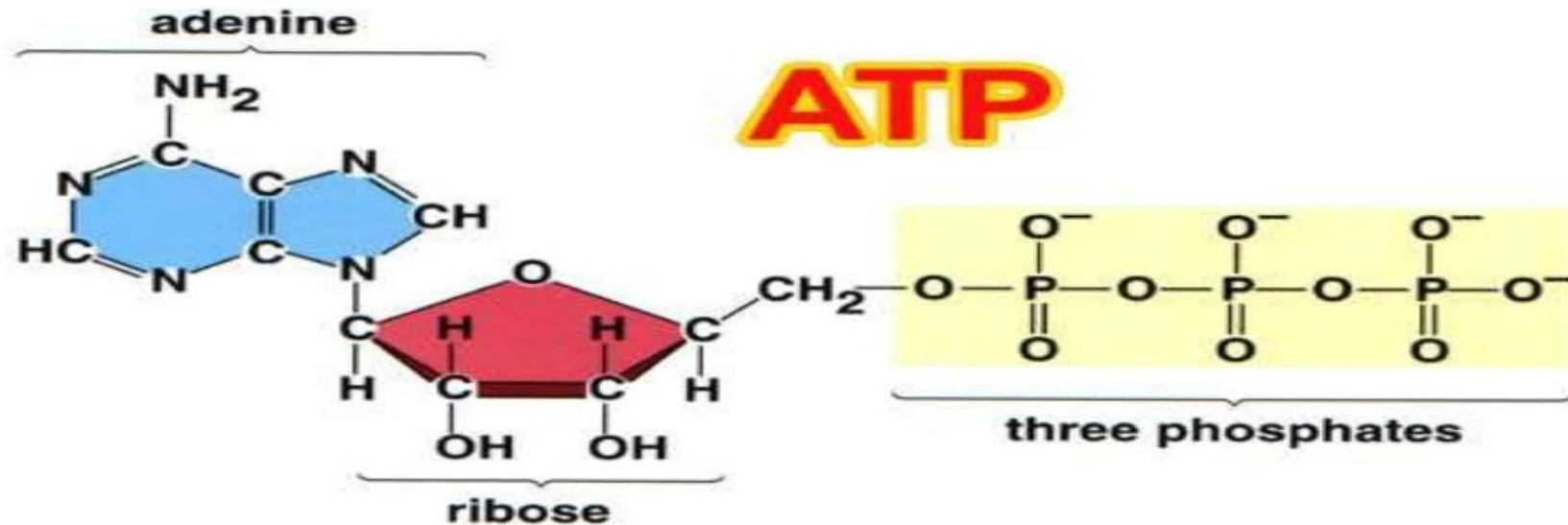
- A** Adenine
- T** Thymine
- C** Cytosine
- G** Guanine



Functions of nucleotides

1- Building blocks of DNA & RNA

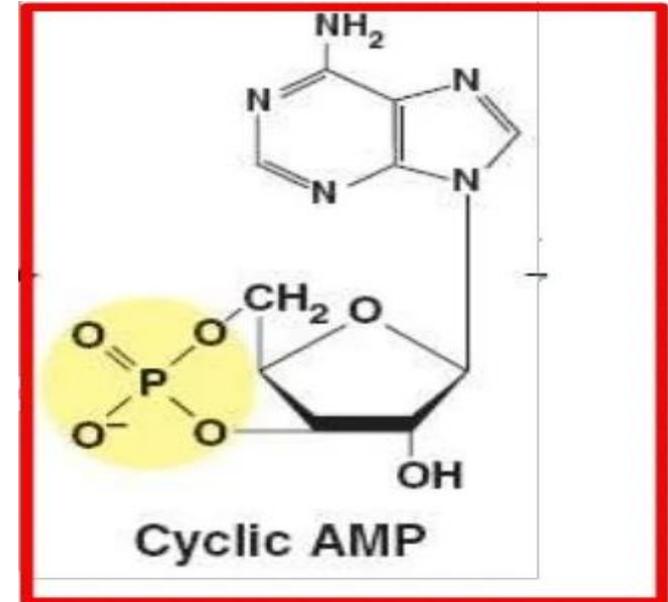
2- Source of energy : ATP ,GTP



Functions of nucleotides

3-Mediate action of hormone : e.g. c.AMP and c.GMP are second messenger

4- Co-enzymes : as NAD, FAD.



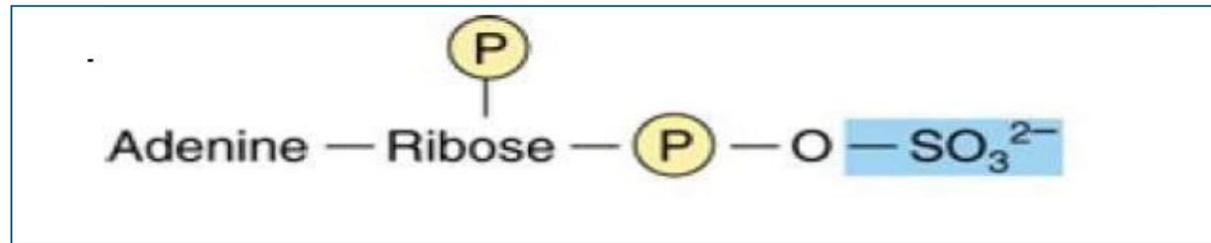
Functions of nucleotides

5-Activation of chemical compounds

- ❖ UDP- glucose ----- synthesis of glycogen.
- ❖ CDP choline, CDP-ethanolamine ----- synthesis of phospholipids.

6- Chemical group donors:

- ❖ PAPS is a **sulfate** donor ----- synthesis of sulfolipids



- ❖ SAM is a **methyl** donor ----- transmethylation reactions

Adenine -ribose -Methionine (-CH₃)

7- Synthetic Analogue:

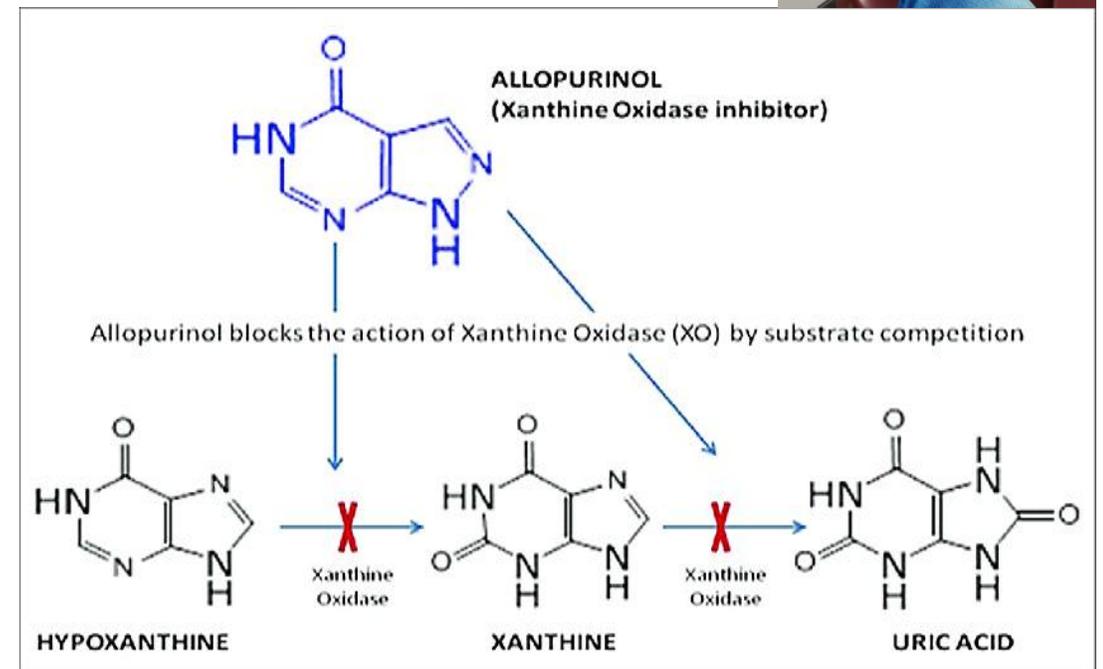
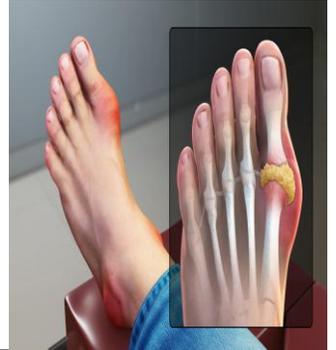
- Nucleotides analogues are prepared by altering the base ring or sugar part.
- Used as drugs in clinical therapy

Treatment of Gout

-Allopurinol (purine analogue) used for treatment of gout

It inhibits xanthine oxidase enzyme

→ Decrease uric acid synthesis



Anti-Tumor (chemotherapy)

- **5-fluorouracil** (pyrimidine analogue)
- **6-mercaptopurine** (purine analogue)

These compounds inhibit the growth of rapidly growing cancer cells by inhibiting the synthesis of DNA & RNA

Case scenario

A 44 years old male patient. He was presented with severe **pain in his right big toe**, with **inflammation** of the joints. He was diagnosed as acute **gouty** arthritis. He had been taking **allopurinol**

1- Explain chemical nature of allopurinol ?

Purine analogue .

2- Explain mechanism of action of allopurinol ?

Inhibit xanthine oxidase → ↓ production of uric acid .





Assessment

Which of the following is considered a nucleoside?

- a) Adenine
- b) Adenine and ribose
- c) Adenine, ribose and one phosphate group
- d) Adenine, ribose and two phosphate group
- e) Adenine, ribose and three phosphate groups.

In nucleotides, phosphate is attached to sugar by:

- a) Salt bond
- b) Hydrogen bond
- c) Ester bond
- d) Glycosidic bond
- e) Ionic bond

Which of the following nucleotide act as second messenger for hormone?

- a) UDP
- b) SAM
- c) PAPS
- d) C.AMP
- e) ATP

