

Biologie moléculaire végétale

Semestre : 6 Unité d'enseignement : UEF2 (O/P) Matière : Biologie moléculaire végétale Crédits :4

Coefficient :2 Objectifs de l'enseignement Ce module permet aux étudiants de posséder des connaissances de base sur biologie moléculaire végétale. Connaissances préalables recommandées : Biologie végétale, génétique, biochimie, physiologie et multiplication végétale. Contenu de la matière :

I- Biologie moléculaire végétale

1-Acides nucléiques

1.1 ADN (structure, fonction et propriétés)

1.2 ARN (structure, fonction et propriétés)

2-Biosynthèses des protéines

2.1 Traduction

2.2 Code génétique

2.3 Régulation

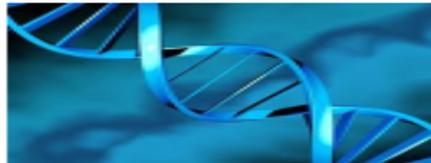
3- Régulation de l'expression génétique

INTRODUCTION

Plant molecular biology studies the molecular mechanisms that control the functioning, development, and adaptation of plants. It relies on the analysis of DNA, RNA, proteins, and their regulation in plant cells.

Components involve in molecular biology

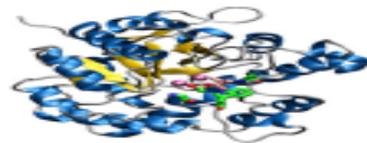
DNA



RNA



Protein



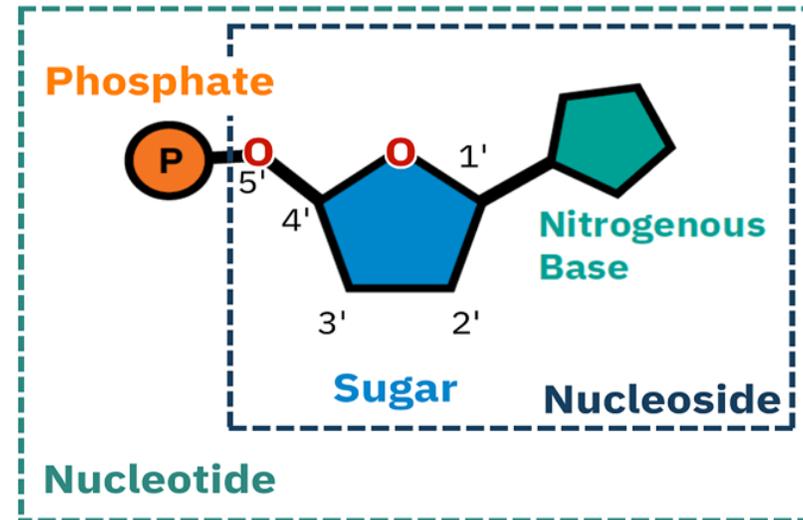
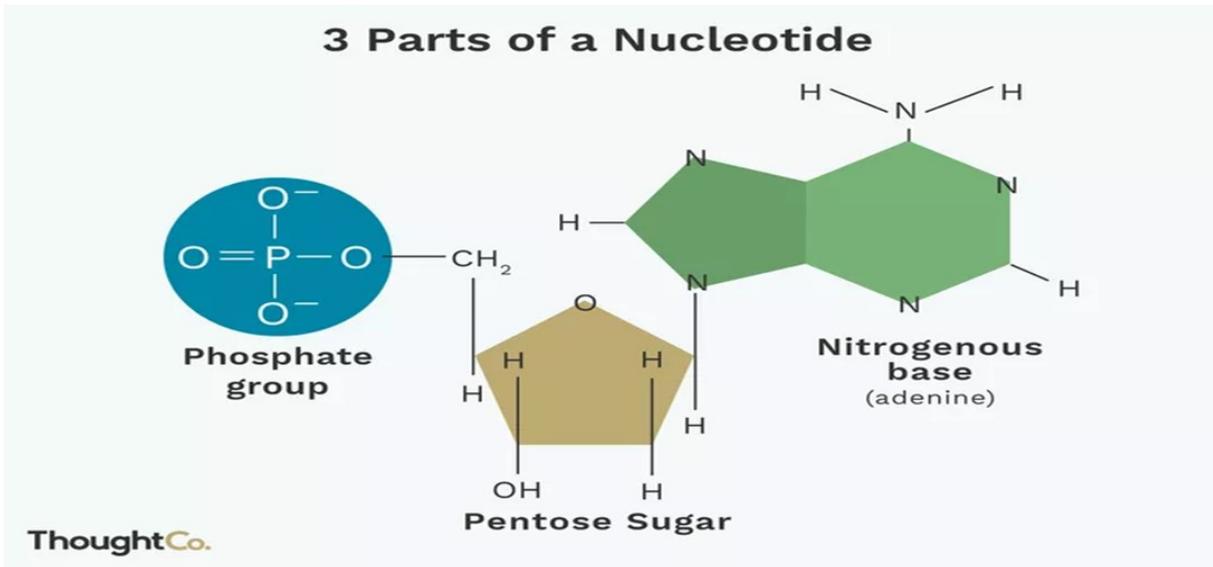
I. Nucleic Acids

Nucleic acids are macromolecules essential for the storage, transmission, and expression of genetic information in plants. They primarily include DNA and RNA.

DNA and RNA are large molecules whose structural unit is the nucleotide.

1. Composition of Nucleic Acids

1,1, Nucleotides and Nucleoside



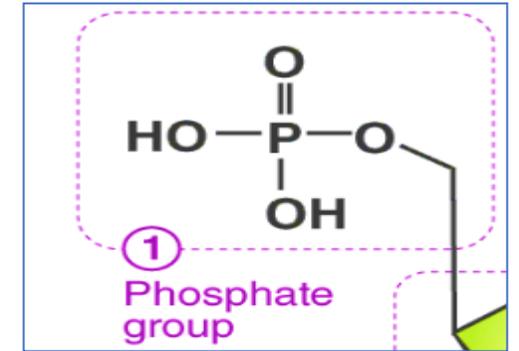
Difference between Nucleotide and Nucleoside:

Nucleotides are the basic components of nucleic acids. This compound comprises a phosphate group, a sugar molecule, and a nitrogenous base. On the other hand, nucleosides lack the phosphate group and are made entirely of sugar and nitrogenous bases. Nucleotides are essential in genetic information storage and transmission.

What Are the 3 Parts of a Nucleotide? How Are They Connected?

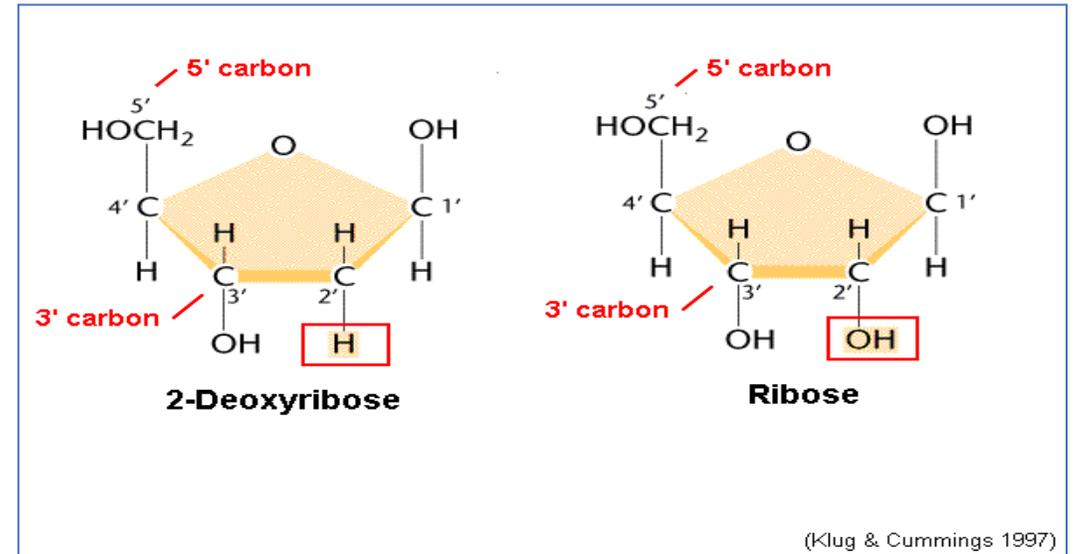
A nucleotide has three parts:

1, Inorganic phosphate is a stable ion formed from phosphoric acid (H_3PO_4). It is often written as Pi. The phosphate group bonds to the 5-carbon of the sugar and links nucleotides together.



2. Sugar: A nucleotide comprises a pentose sugar. DNA (**Deoxyribonucleic acid**) contains **deoxyribose sugar** and RNA (**Ribonucleic acid**) contains a **ribose sugar**.

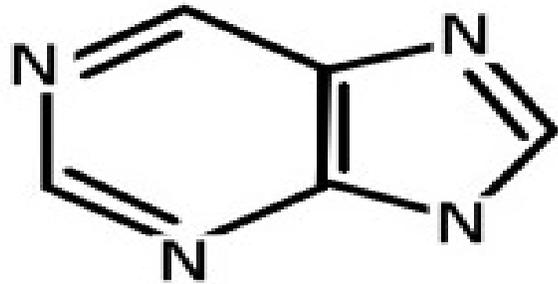
Ribose is a single-ring pentose [5-Carbon] sugar. The numbering of the carbon atoms runs clockwise, following organic chemistry rules. Note the absence of the hydroxyl (-OH) group on the 2' carbon in the deoxy-ribose sugar in DNA as compared with the ribose sugar in RNA.



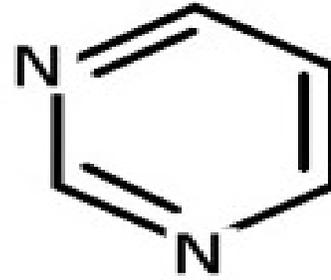
3, Nitrogenous Base:

These Nitrogenous bases are organic compounds in heterocyclic form, rich in nitrogen. Also, other elements present in purines and pyrimidines are carbon, hydrogen, and oxygen. The two bases of nucleotides can be single-ringed or double-ringed.

- Purines are large and have double-ringed.
- pyrimidines have a single ring.



Purine Rings

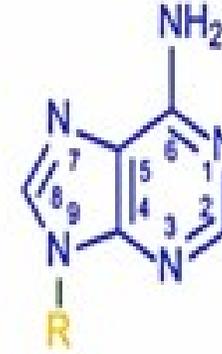


Pyrimidine Ring

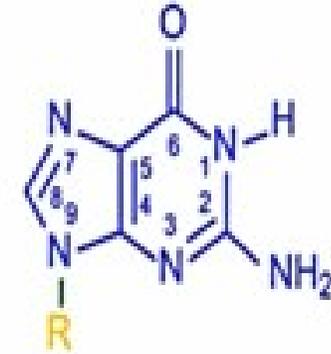
A/ There are two purine bases: adenine and guanine.

- Adenine consists of a purine ring with carbon 6 substituted by an amine group. It is the only nucleic acid base whose formula does not contain an oxygen atom.
- Guanine consists of a purine ring with carbon 2 substituted by an amine group and carbon 6 substituted by a ketone group.

Structures of Nitrogenous Bases



Adenine



Guanine

B/There are three pyrimidine bases: cytosine, uracil, and thymine.

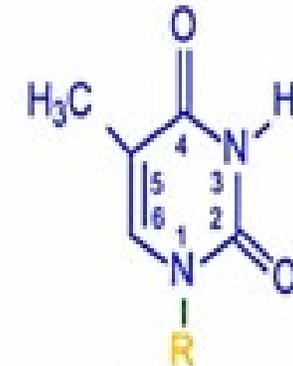
- Cytosine consists of a pyrimidine ring in which carbon 4 is substituted with an amine group and carbon 2 with a ketone group.
- Uracil consists of a pyrimidine ring in which carbons 2 and 4 bear ketone groups.
- Thymine also consists of a pyrimidine ring in which carbons 2 and 4 bear ketone groups, but in which carbon 5 is substituted with a methyl group.



Cytosine



Uracil

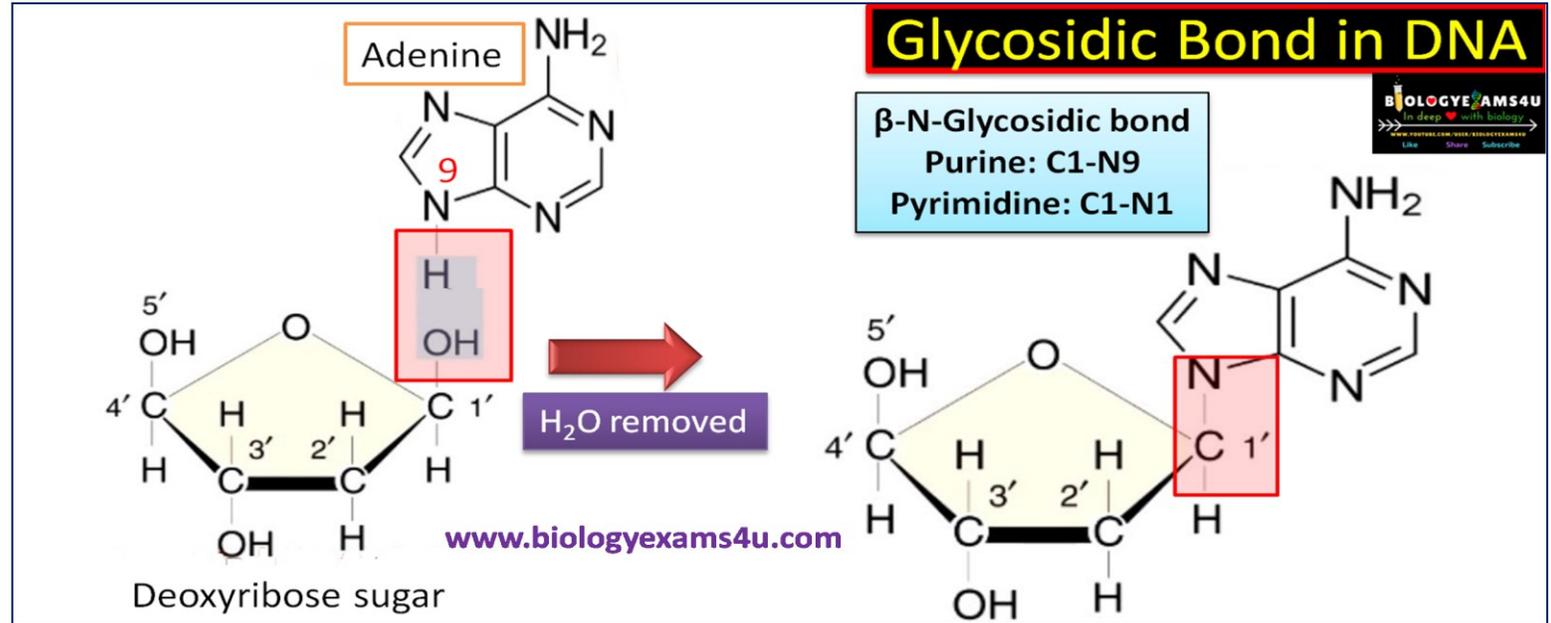


Thymine

The three elements constituting the nucleotide are combined

1, The bond between sugar and nitrogenous base: formation of the nucleoside

The association between the sugar and the nitrogenous base is ensured by an N-glycosidic bond, resulting in the formation of a compound called a nucleoside. This bond occurs between carbon 1' of the ribose and nitrogen 1 of the pyrimidine base or nitrogen 9 of the purine base.



The names of nucleosides are those of the root of the nitrogenous base to which is added the ending "idine" for pyrimidines (Cytidine, Thymidine, Uridine)

and "osine" for purines (Adenosine and Guanosine).

1. Pentose sugar

2. Nitrogenous bases (A,G,C,U,T)

- Adenine + sugar = Adenosine
- Guanine + sugar = Guanosine
- Cytosine + sugar = Cytidine
- Uracil + sugar = Uridine
- Thymine + sugar = Thymidine

2, Bonding between phosphoric acid and sugar: formation of the nucleotide

Nucleotides result from the phosphorylation of an OH group of the sugar in a nucleoside.

The bond between the sugar and phosphoric acid is an ester bond; this bond is formed by the elimination of a water molecule between an OH of the phosphoric acid and a H of the alcohol function, (OH) on the 5' carbon of the pentose.

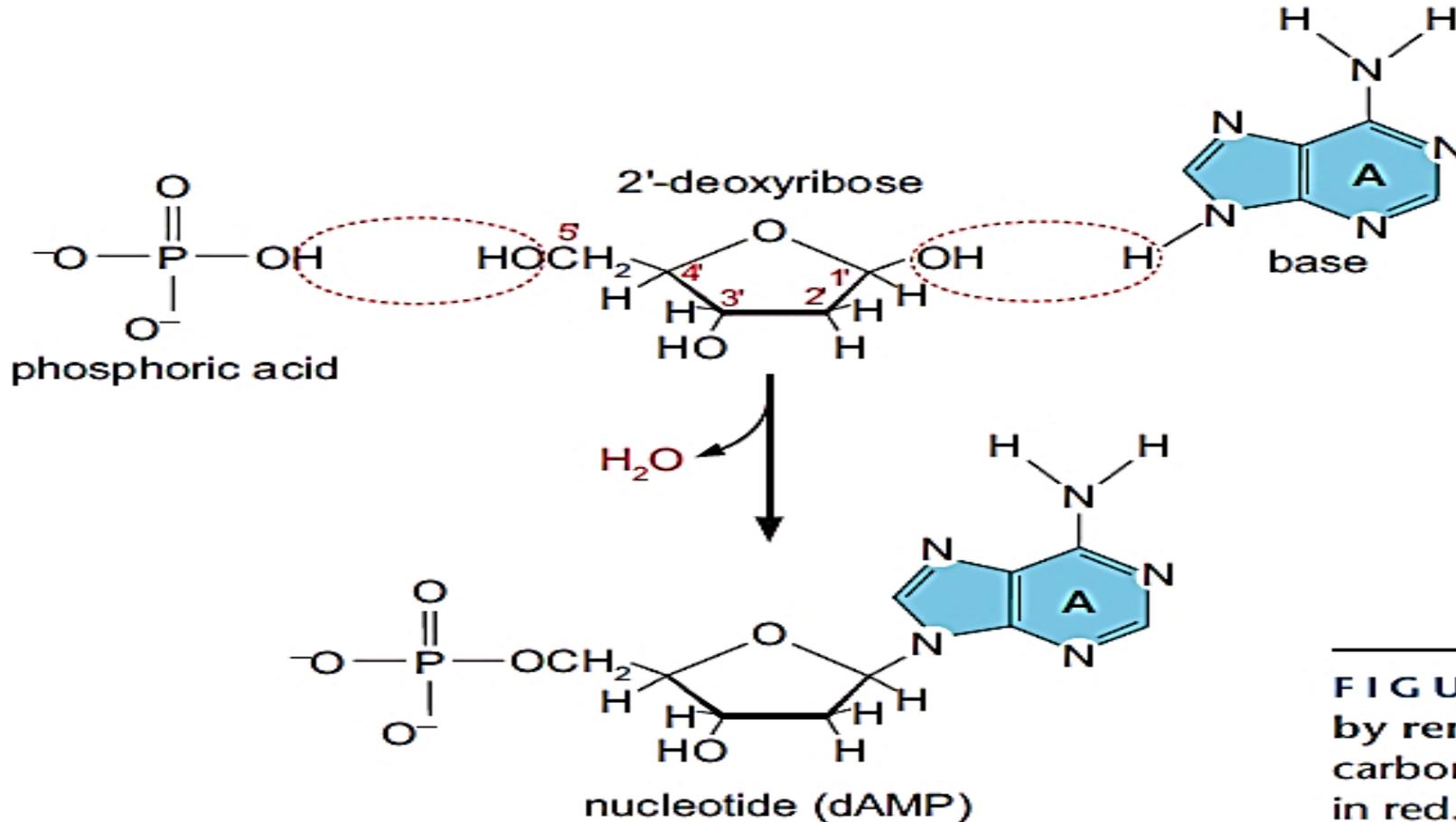
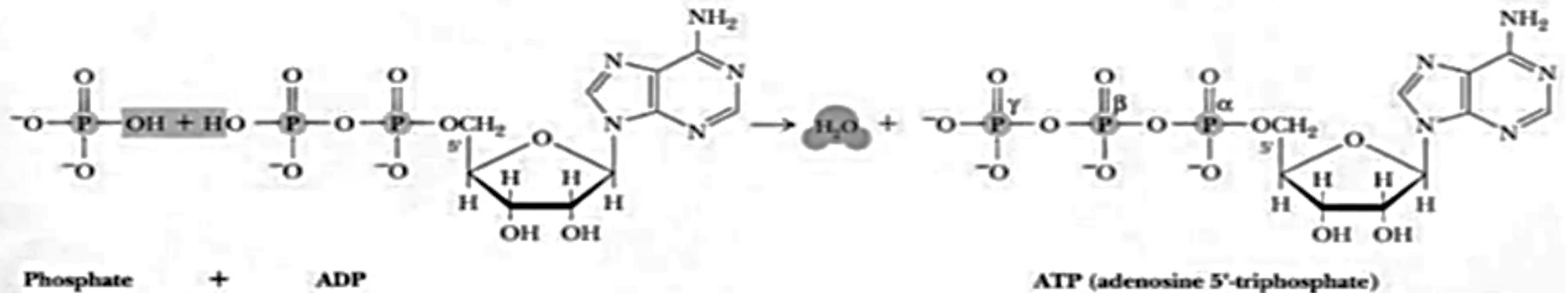
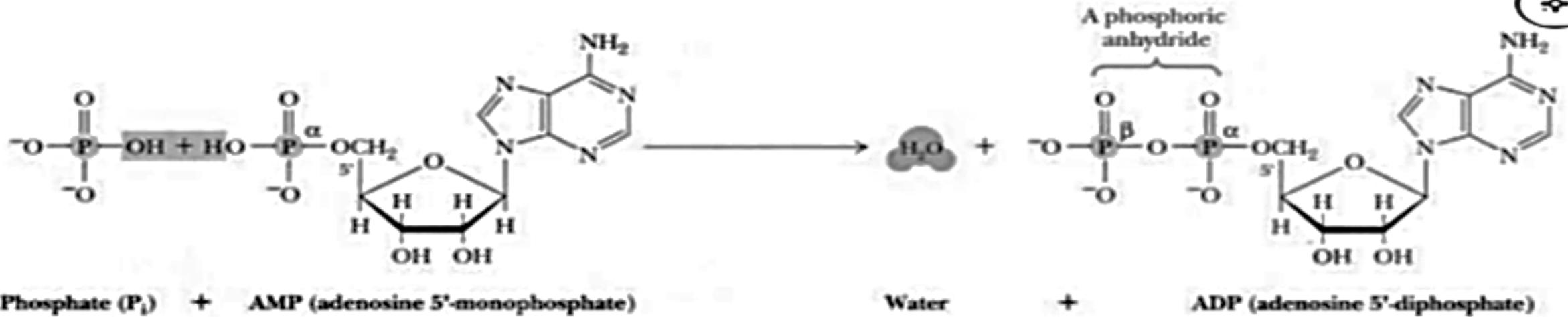


FIGURE 4-2 Formation of nucleotide by removal of water. The numbers of the carbon atoms in 2'-deoxyribose are labeled in red.

Within the cell, nucleotides can exist as nucleoside bisphosphates and nucleoside triphosphates, but the cell uses only nucleoside triphosphates during nucleic acid synthesis due to their higher energy content.

Nucleoside diphosphates & triphosphates





Nucleotide Name Table

	Purines			Pyrimidines	
	Adenine (A)	Guanine (G)	Cytosine (C)	Thymine (T)	Uracil (U)
Nucleotides in DNA	deoxyadenylate	deoxyguanylate	deoxycytidylate	deoxythymidylate or thymidylate	
Nucleotides in RNA	adenylate	guanylate	cytidylate		uridylate

Abbreviations

Nucleoside monophosphates	AMP	GMP	CMP	TMP	UMP
Nucleoside diphosphates	ADP	GDP	CDP	TDP	UDP
Nucleoside triphosphates	ATP	GTP	CTP	TTP	UTP

For deoxynucleotides add 'd' in front of the above three.

e.g., AMP is a ribonucleotide, dAMP is a deoxyribonucleotide, hence

dAMP	dGMP	dCMP	dTMP
dADP	dGDP	dCDP	dTDP
dATP	dGTP	dCTP	dTTP

Table 12–1 Nucleotide and nucleic acid nomenclature

Base	Nucleoside*	Nucleotide†	Nucleic acid
<i>Purines</i>			
Adenine	Adenosine	Adenylate	RNA
	Deoxyadenosine	Deoxyadenylate	DNA
Guanine	Guanosine	Guanylate	RNA
	Deoxyguanosine	Deoxyguanylate	DNA
<i>Pyrimidines</i>			
Cytosine	Cytidine	Cytidylate	RNA
	Deoxycytidine	Deoxycytidylate	DNA
Thymine	Thymidine or deoxythymidine	Thymidylate or deoxythymidylate	DNA
Uracil	Uridine	Uridylate	RNA

