Welcome to CHEM 373!

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Office Hours:
Monday 1:10-2 pm
Wednesday 9:10-10 am
180-414

Close

0 response submitted

What comes to mind when you think of molecular biology?

Scan the QR or use link to join

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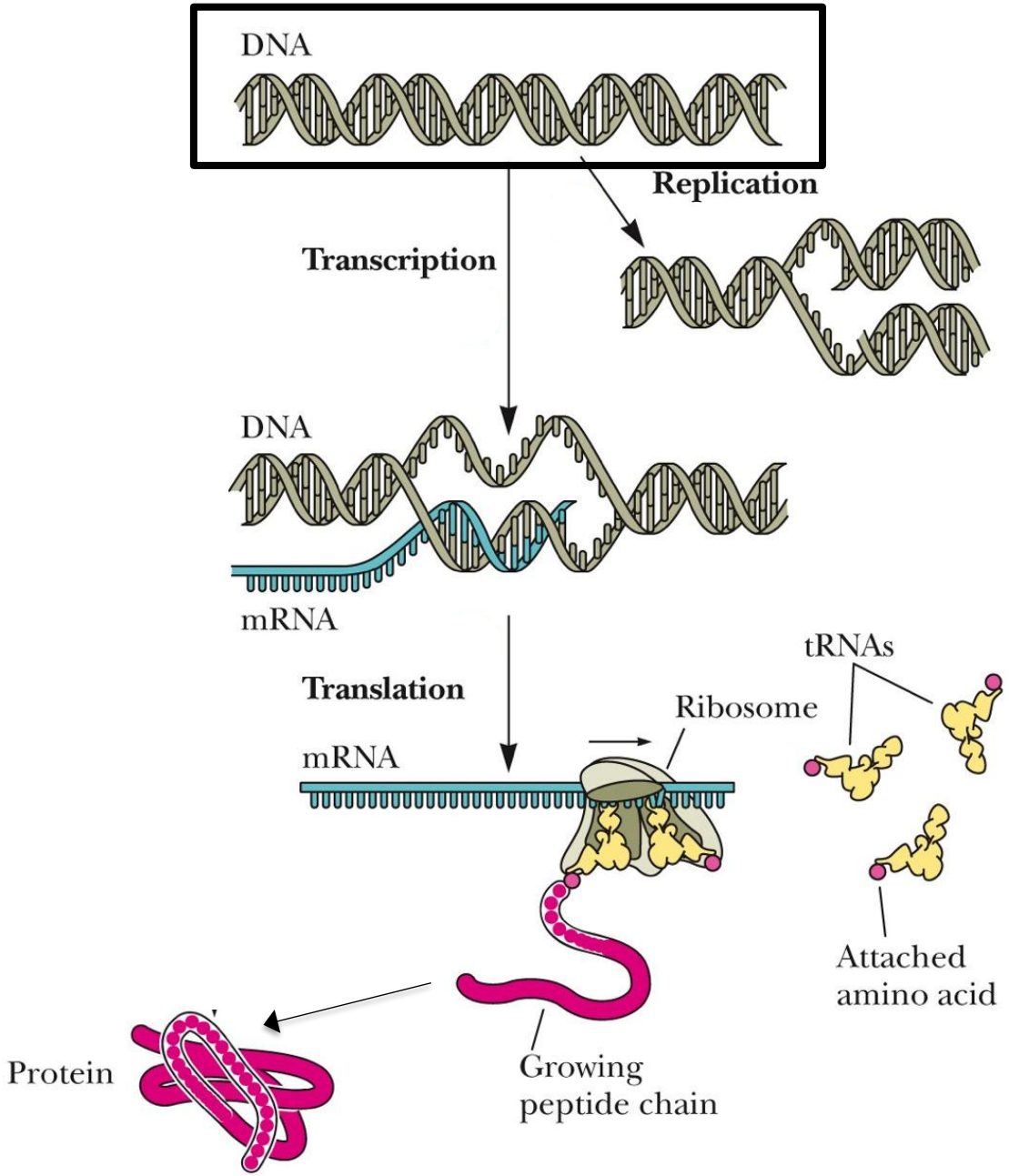
Wordcloud | All responses

1 of 1

The central dogma of molecular biology



Nucleosides and Nucleotides

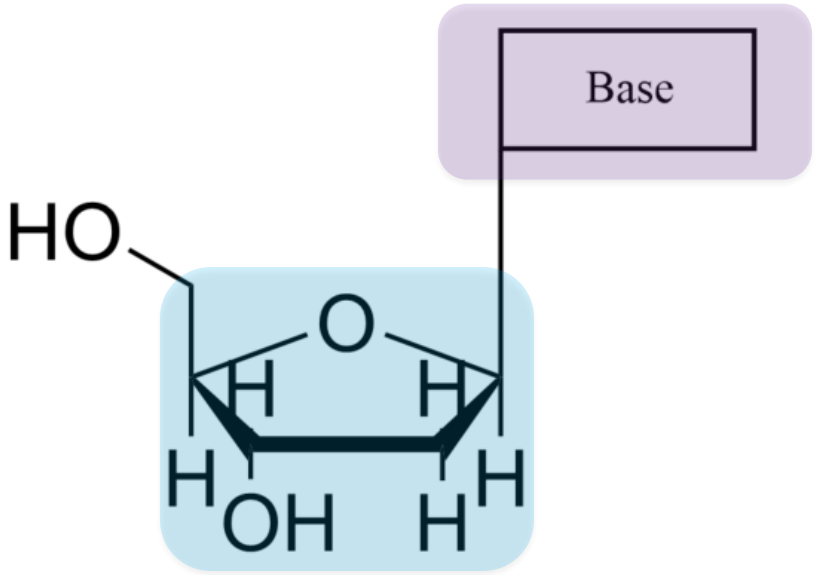
Learning Objectives

1. Be able to draw and identify all nucleic acid bases, and their corresponding nucleotides at pH 7: adenine, guanine, cytosine, uracil, and thymine.

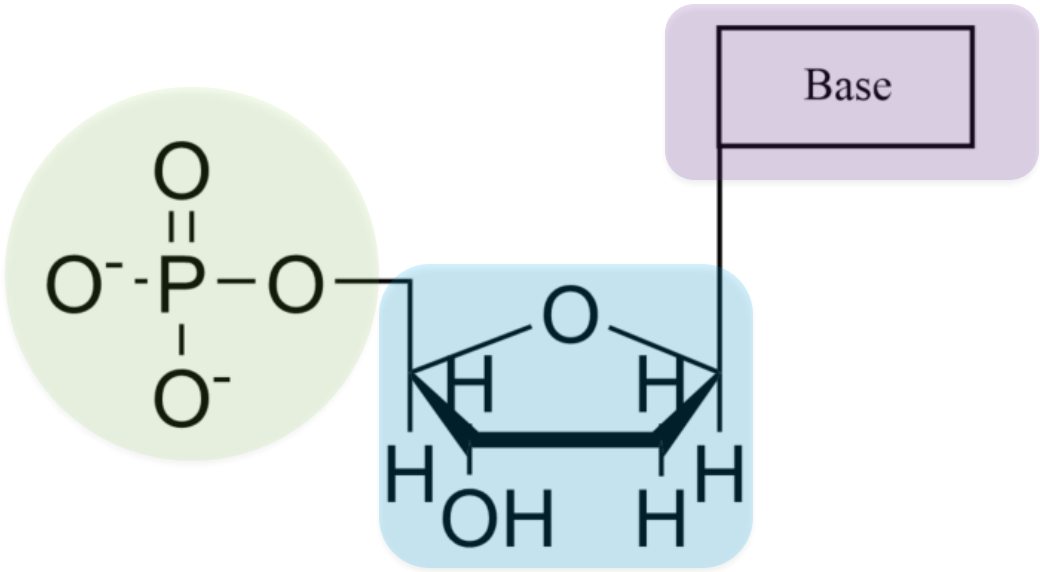
2. Know how nucleic acid bases and phosphate groups are bonded to the pentose sugar.

3. Know the key features of bases that make them the ideal building blocks for nucleic acids.

Nucleosides and nucleotides only differ by the presence of phosphate



Nucleoside



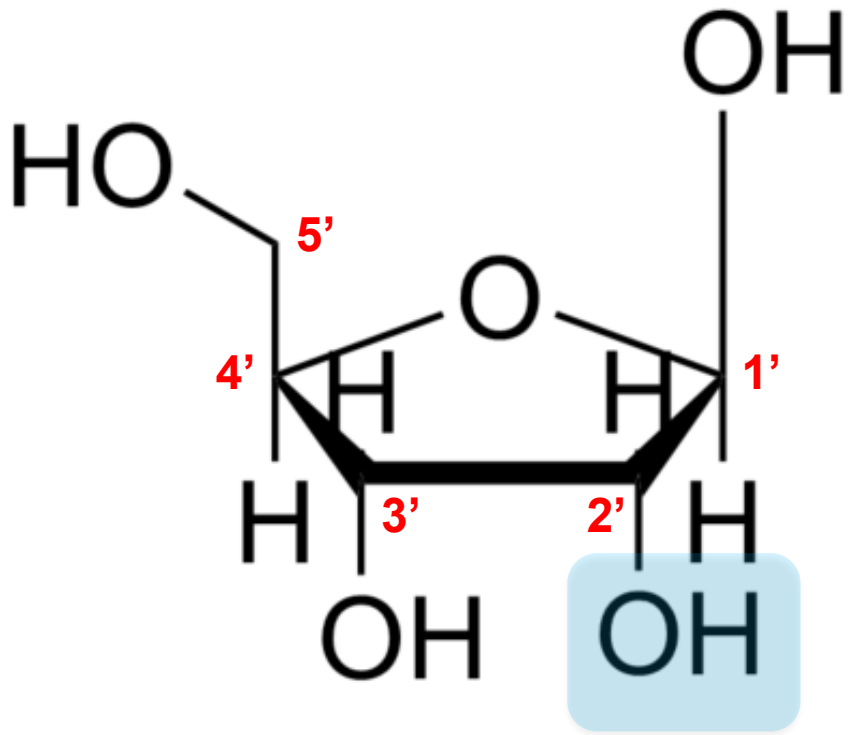
Nucleotide

Pentose Sugar

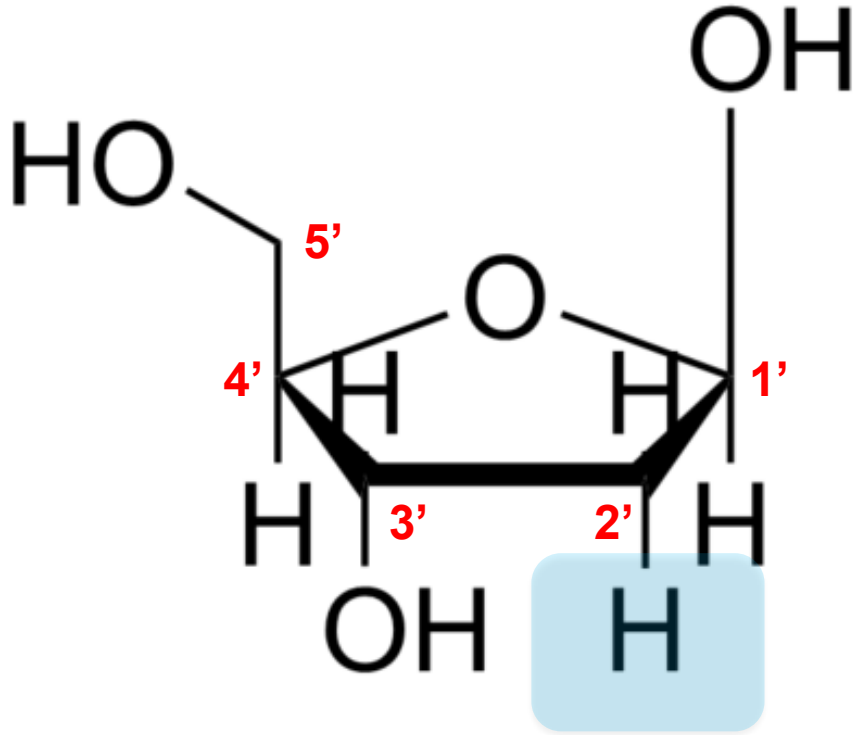
Nitrogenous Base

Phosphate(s)

The **pent**ose sugar exists as ribose or 2’-deoxyribose



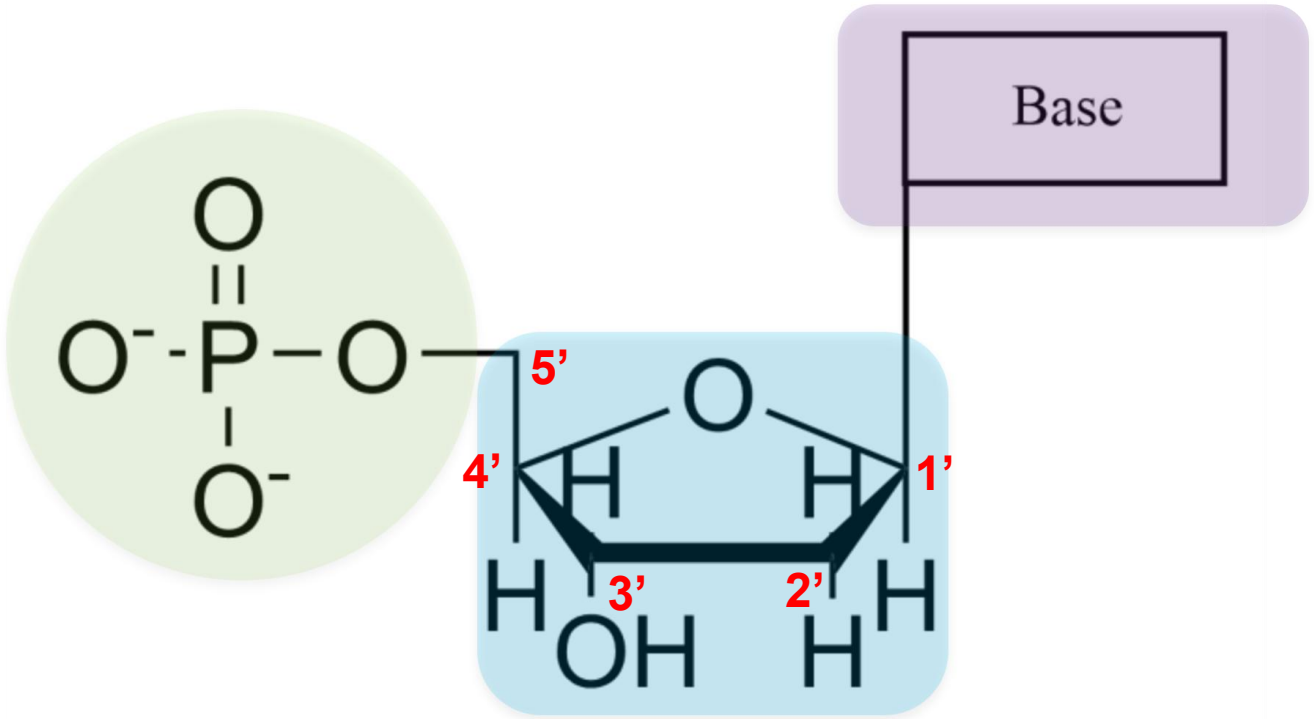
Ribose



2’-Deoxyribose

This is the key distinguishing feature between DNA and RNA!

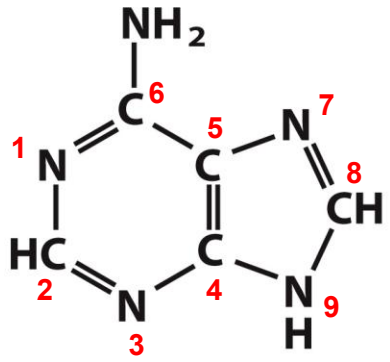
Building a nucleotide



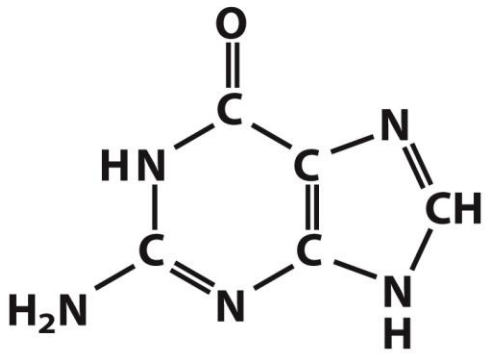
Nucleotide

- Nucleotides will contain phosphate group(s) at C5’
- **Nitrogenous bases will be attached via C1’**

Bases can be categorized into purines and pyrimidines



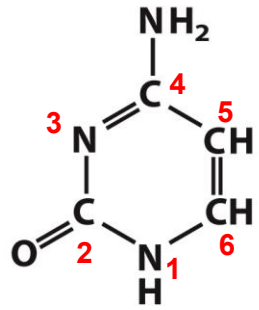
Adenine



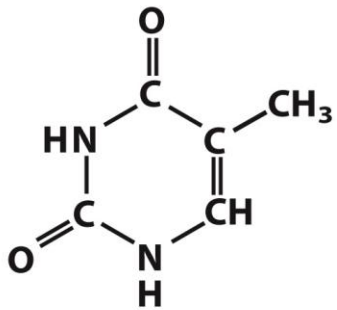
Guanine

A Purines G

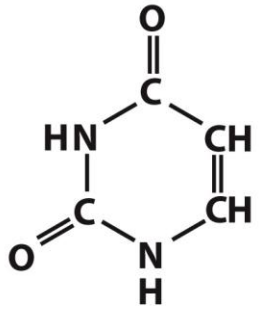
You will need to be able to recognize and draw all of these!



Cytosine



Thymine (DNA)

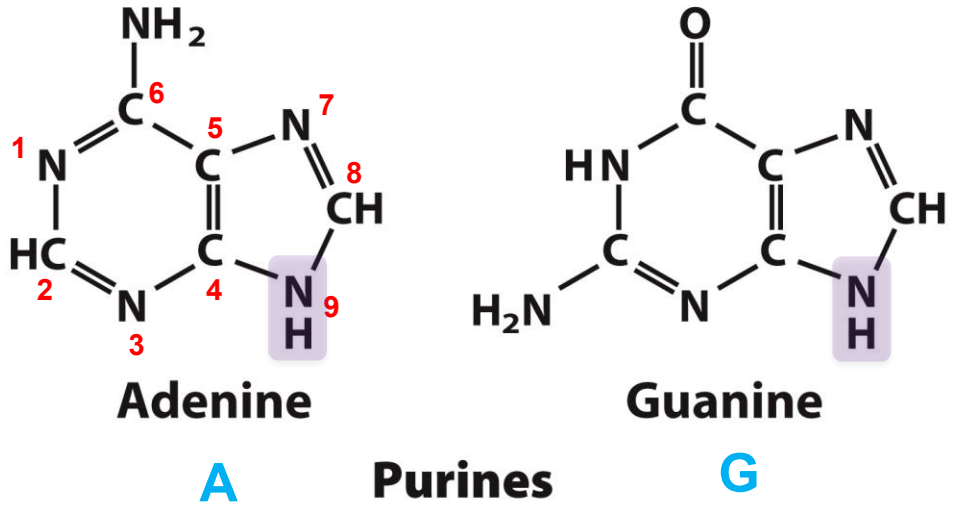


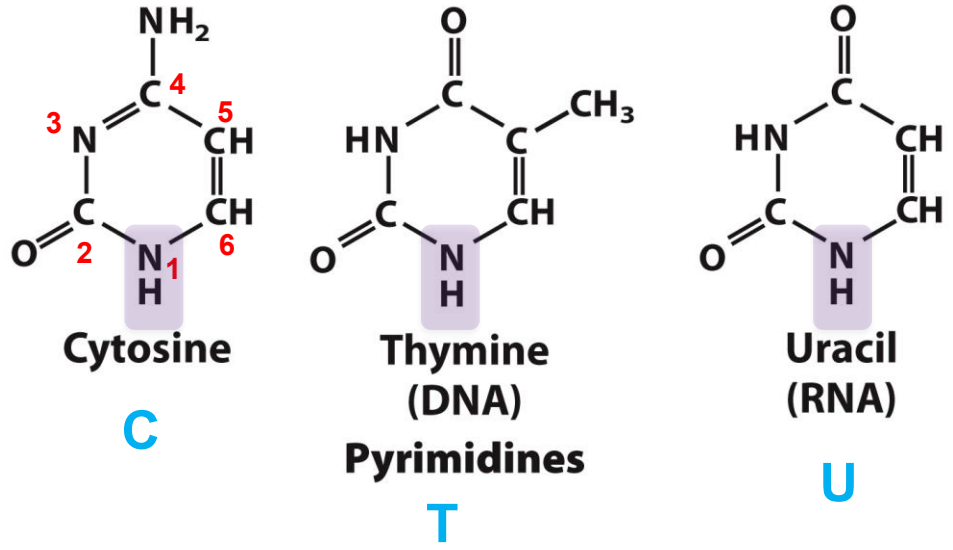
Uracil (RNA)

C Pyrimidines T U

Lehninger Figure 8-2

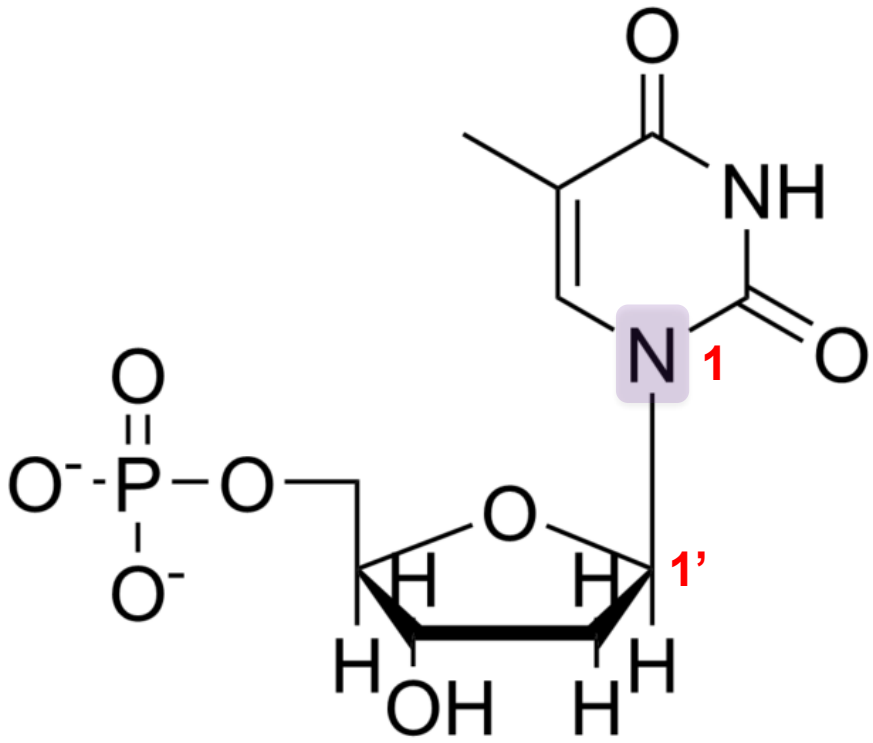
Bases can be categorized into purines and pyrimidines





Purines attach to the sugar via N9

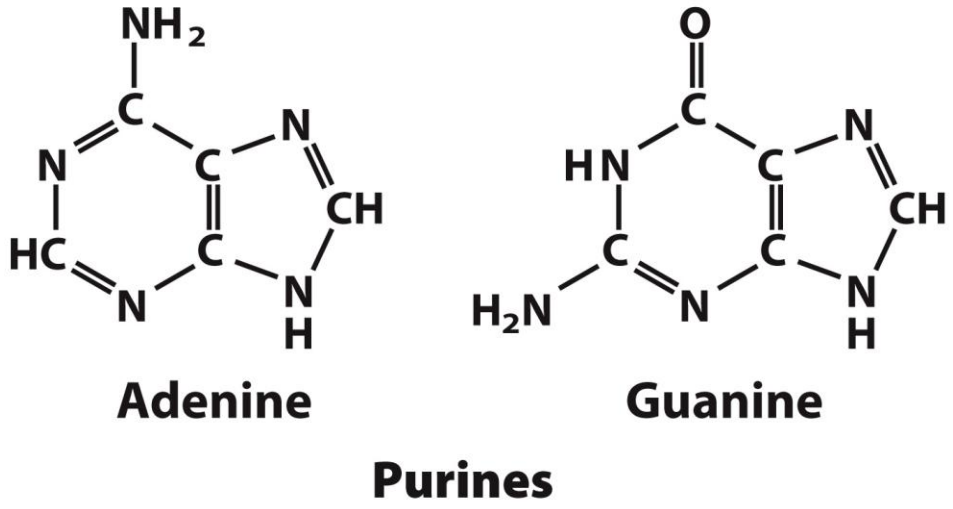
Pyrimidines attach to the sugar via N1



Bases attach to the pentose sugar via an *N-glycosidic bond*

Lehninger Figure 8-2

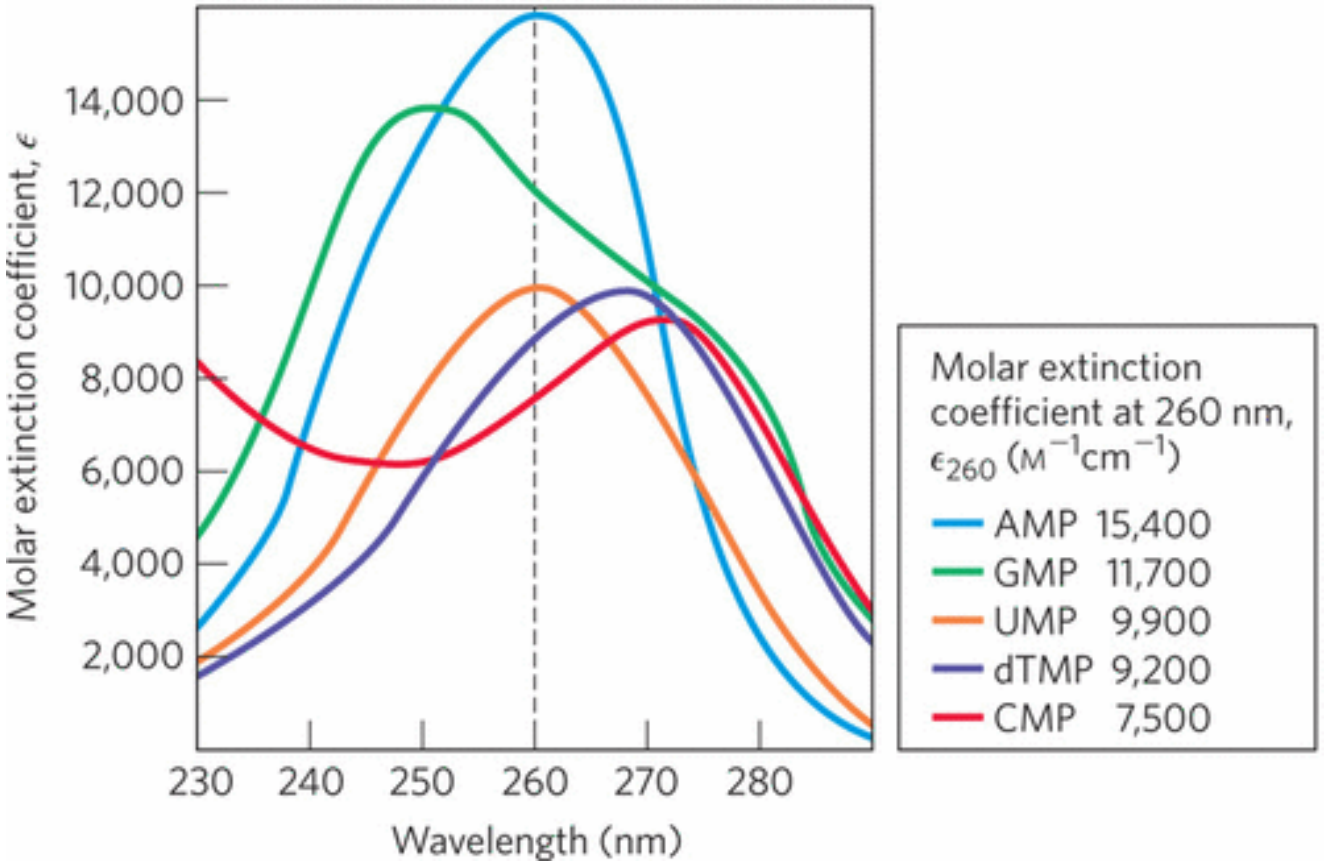
Nitrogenous bases have distinct chemical features



- Aromatic rings
- Ability to hydrogen bond

Lehninger Figure 8-2

Nucleotide bases absorb UV light at 260 nm



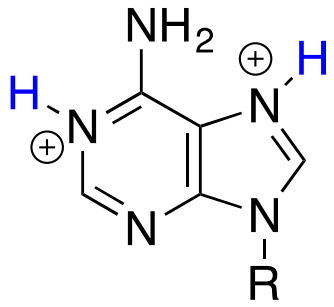
- Aromatic and nearly planar
- Useful for quantification and analysis of purity for nucleic acids (NanoDrop)

Lehninger: Figure 8-10

pKa values of nitrogenous bases

Adenine

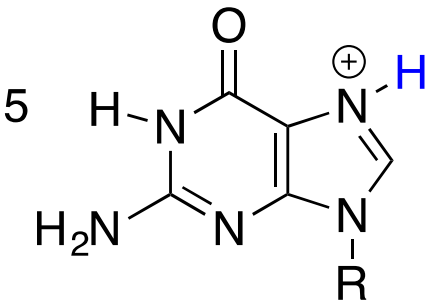
pKa ~3.5



pKa ~2.5

Guanine

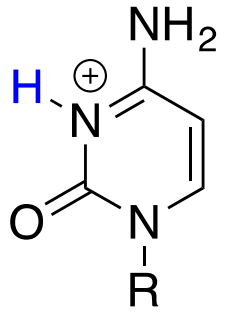
pKa ~9.5



pKa ~2.1

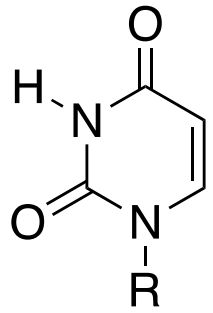
Cytosine

pKa ~4.5



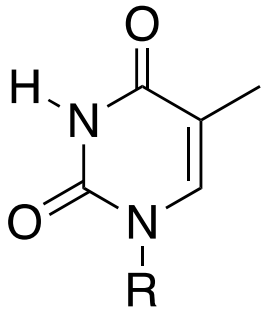
Uracil

pKa ~10.0



Thymine

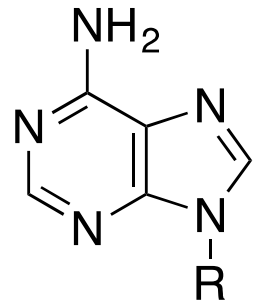
pKa ~9.2



pKa values shown in blue are dissociated at neutral pH (~7)
pKa values that are not shown are not relevant in the aqueous pH range (1-14)

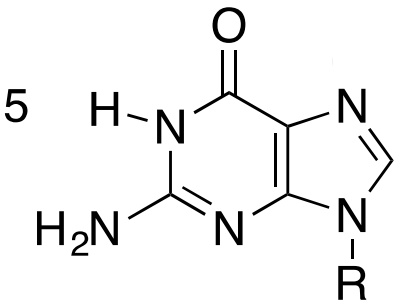
Nitrogenous bases are great at hydrogen bonding

Adenine

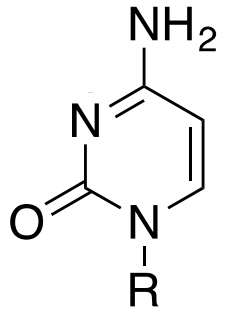


Guanine

pKa ~9.5

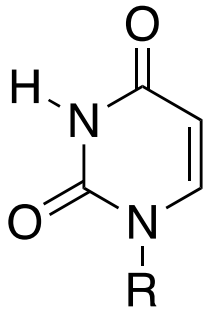


Cytosine



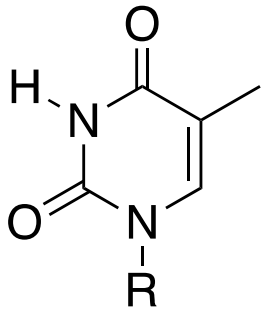
pKa ~10.0

Uracil



pKa ~9.2

Thymine

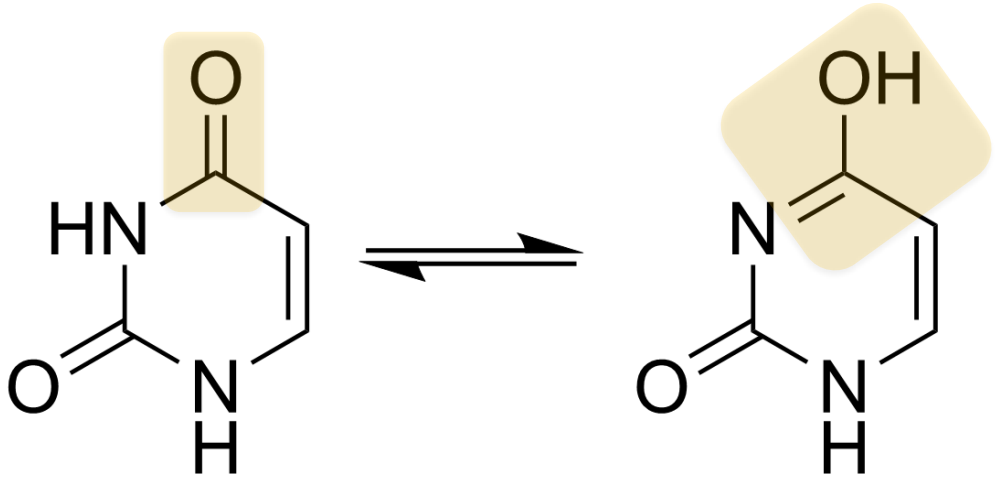


Bases can undergo keto-enol tautomerization

Keto

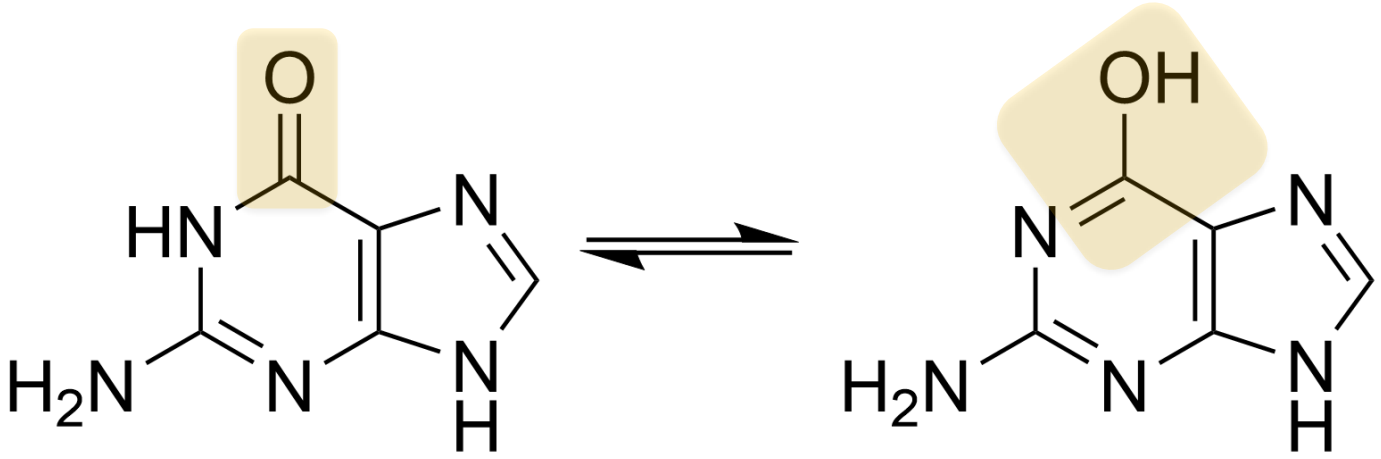
Enol

Pyrimidine

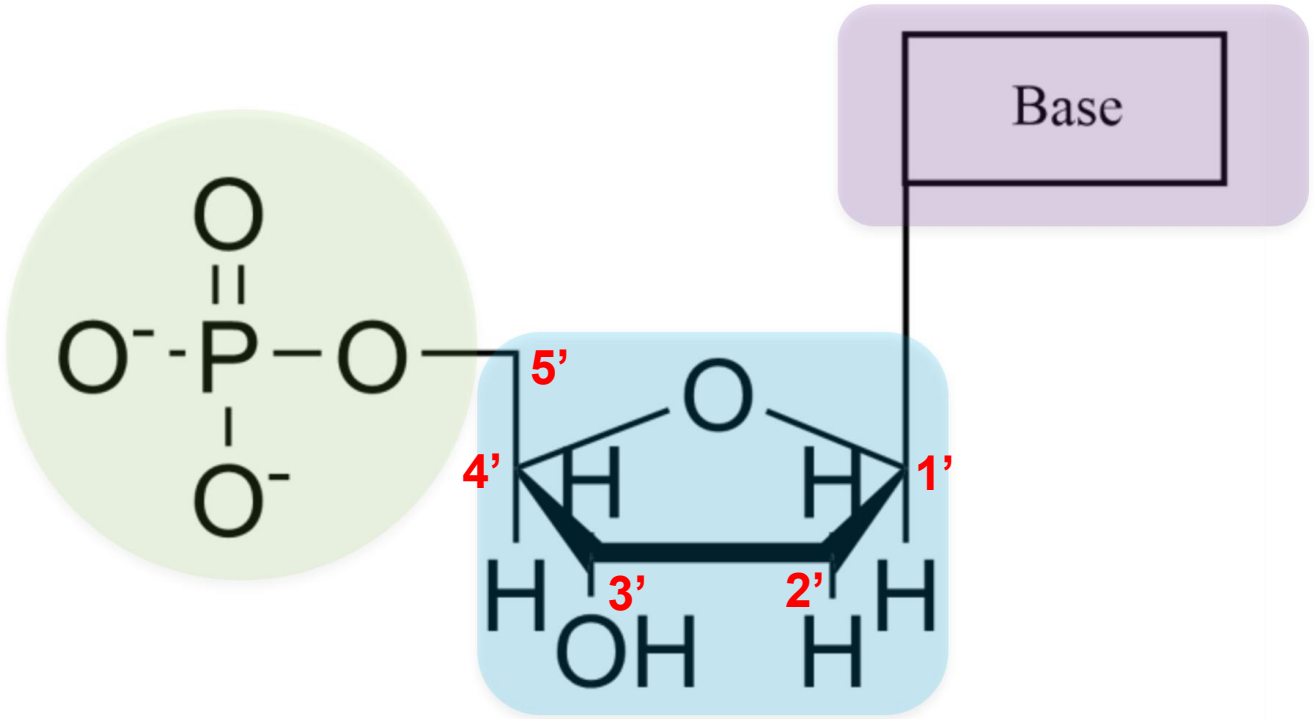


Enol will predominate under non-physiological conditions

Purine



Building a nucleotide



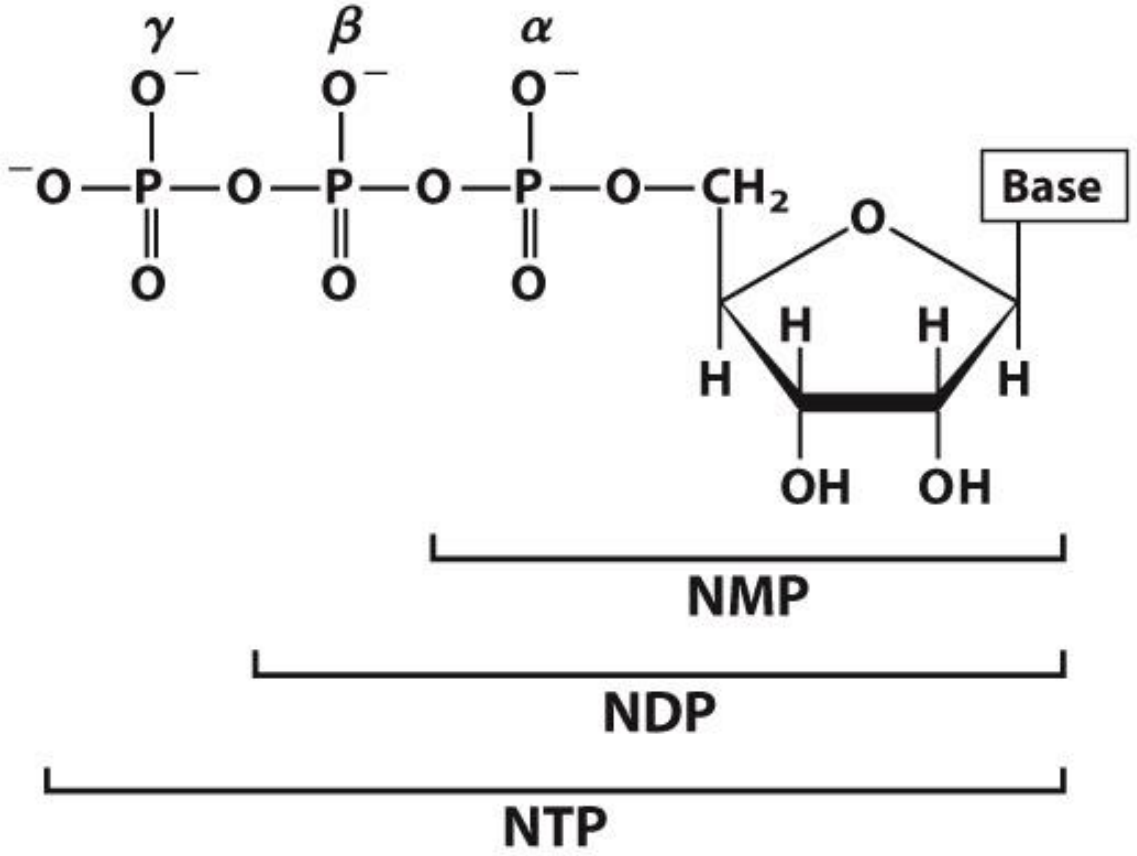
Nucleotide

- **Nucleotides will contain phosphate group(s) at C5’**
- Nitrogenous bases will be attached via C1’

Multiple phosphate groups can be attached to a nucleoside

Abbreviations of ribonucleoside 5′-phosphates			
Base	**Mono-**	**Di-**	**Tri-**
Adenine	AMP	ADP	ATP
Guanine	GMP	GDP	GTP
Cytosine	CMP	CDP	CTP
Uracil	UMP	UDP	UTP

Abbreviations of deoxyribonucleoside 5′-phosphates			
Base	**Mono-**	**Di-**	**Tri-**
Adenine	dAMP	dADP	dATP
Guanine	dGMP	dGDP	dGTP
Cytosine	dCMP	dCDP	dCTP
Thymine	dTMP	dTDP	dTTP



Lehninger: Figure 8-39

Summary of base, nucleoside, and nucleotide names

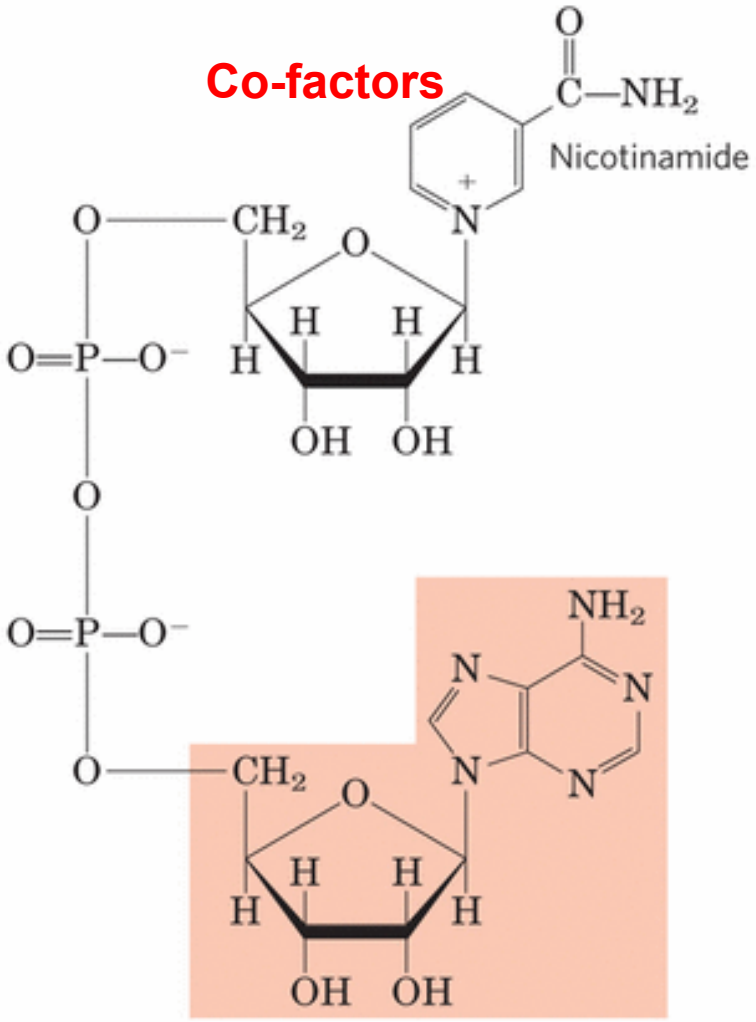
Base	Pentose Sugar	Nucleoside Name	Nucleotide Name (Abbreviation)*
Adenine	Ribose	Adenosine	Adenosine monophosphate (AMP)
	Deoxyribose	Deoxyadenosine	Deoxyadenosine monophosphate (dAMP)
Guanine	Ribose	Guanosine	Guanosine monophosphate (GMP)
	Deoxyribose	Deoxyguanosine	Deoxyguanosine monophosphate (dGMP)
Cytosine	Ribose	Cytidine	Cytidine monophosphate (CMP)
	Deoxyribose	Deoxycytidine	Deoxycytidine monophosphate (dCMP)
Uracil	Ribose	Uridine	Uridine monophosphate (UMP)
Thymine	Deoxyribose	Deoxythymidine	Deoxythymidine monophosphate (dTMP)

*For di- and tri-phosphates, abbreviations are “DP” and “TP”

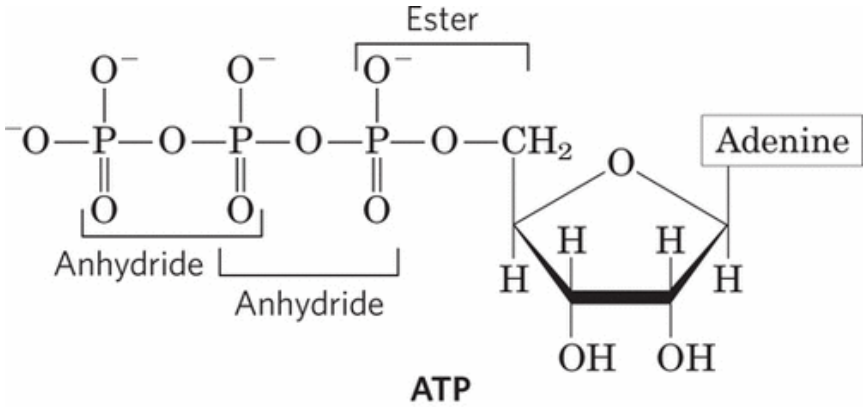
Purine: -osine Pyrimidine: -idine

Other Functions of Nucleotides

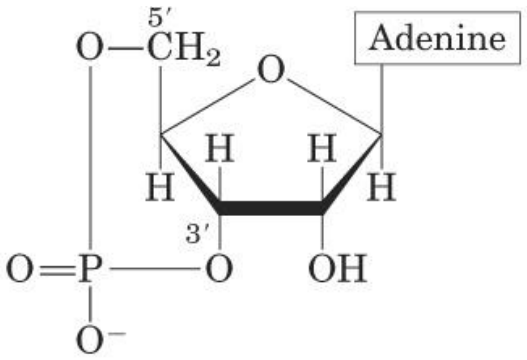
Co-factors



Chemical Energy



Chemical messengers



Close

0 response submitted

Select the nucleotide from the images below.

Scan the QR or use link to join

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Copy link

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1 of 3

Show correct answer

For each of the nitrogenous bases below:

1. Draw a star under the pyrimidine bases and underline the purine bases
2. Write the one letter abbreviation for each base above its structure
3. Circle all of the bases found in DNA