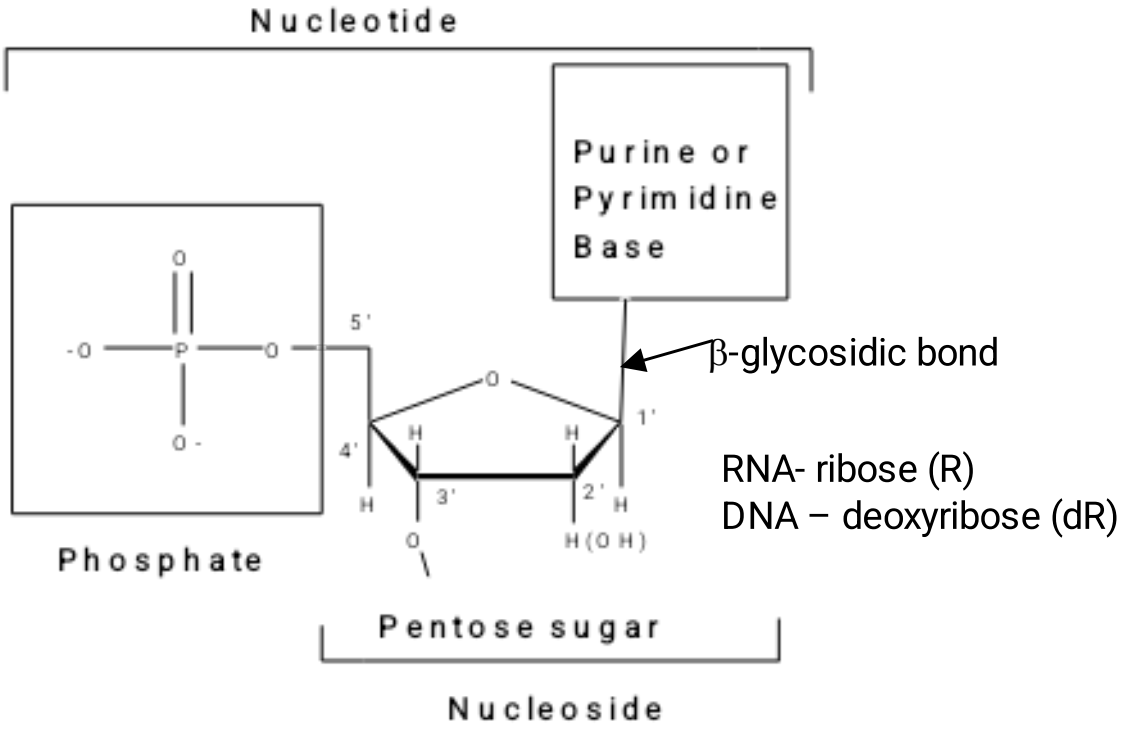
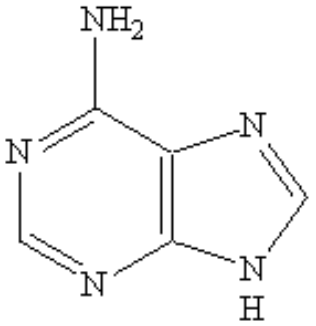
# Nucleic acid Bases
# Nucleoside
# Nucleotide
# DNA/RNA

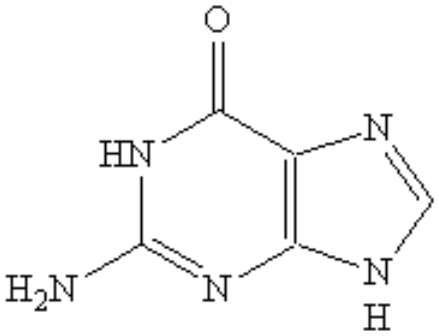

Nucleotide
Purine or
Pyrimidine
Base
β-glycosidic bond
RNA- ribose (R)
DNA – deoxyribose (dR)
Phosphate
Pentose sugar
Nucleoside

# Nucleic Acid Bases

## Purines

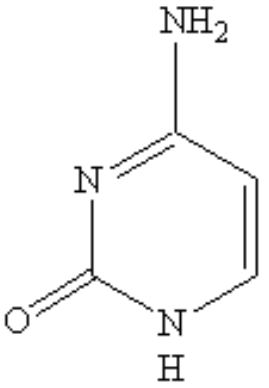



Adenine (A)

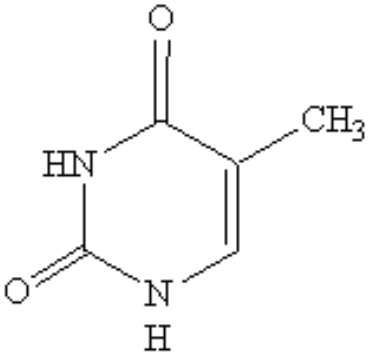



Guanine (G)

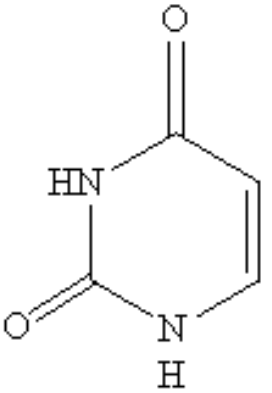
## Pyrimidines




Cytosine (C)



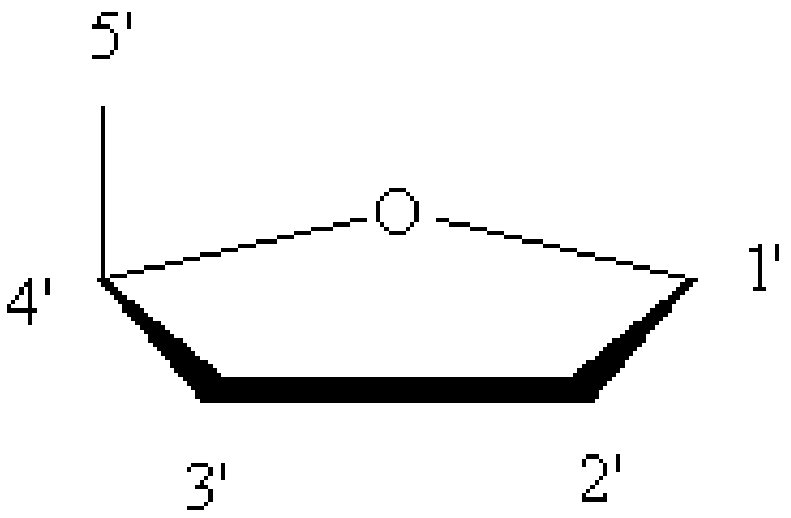

Thymine (T)
(5-methyluracil)




Uracil (U)

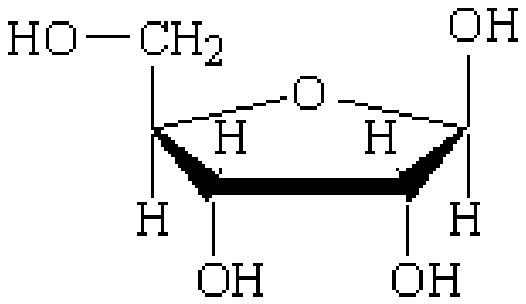
# Sugars

- Pentoses (5-C sugars)
- Numbering of sugars is “primed”

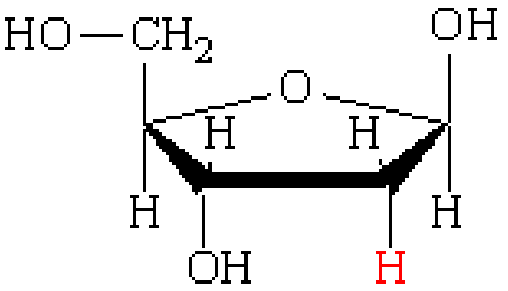


# Sugars

## D-Ribose and 2’-Deoxyribose




D-Ribose




2'-Deoxyribose

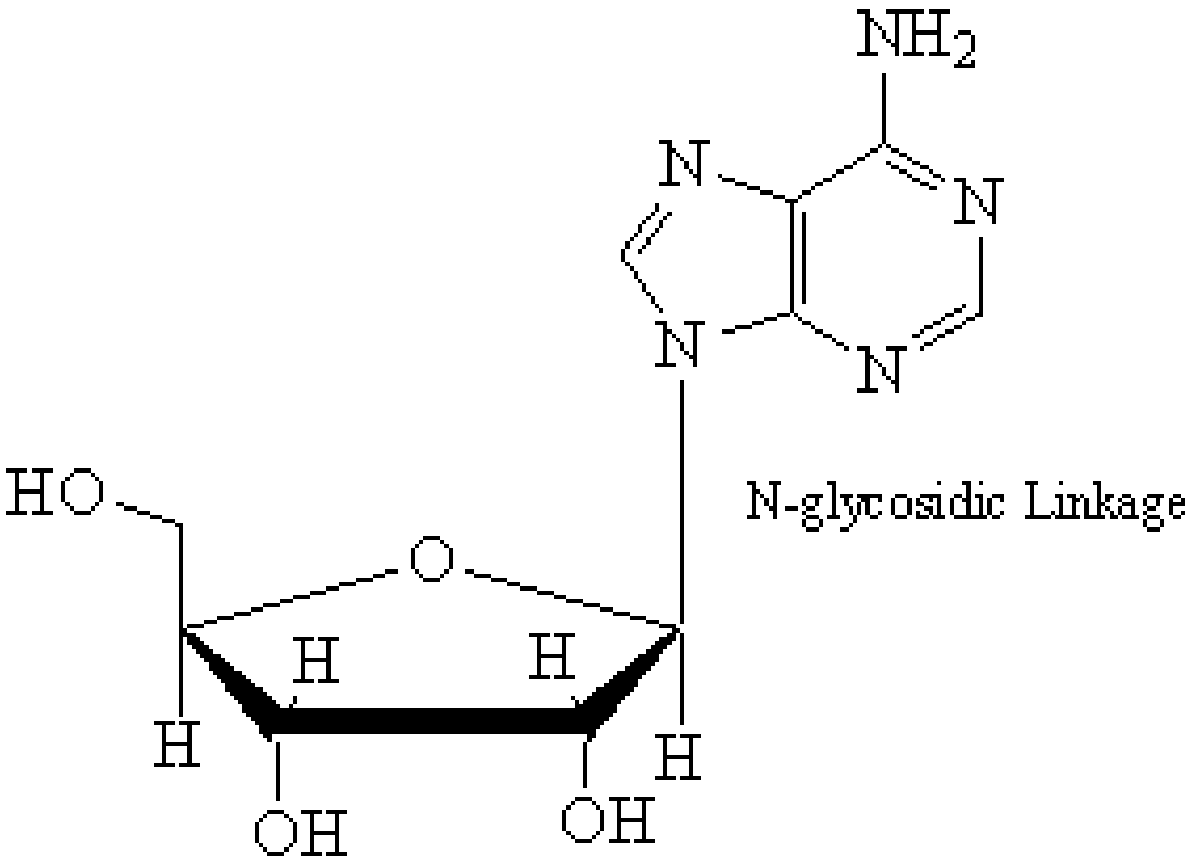
*Lacks a 2’-OH group

# Nucleosides

- Result from linking one of the sugars with a purine or pyrimidine base through an N-glycosidic linkage

  - Purines bond to the C1’ carbon of the sugar at their N9 atoms
  - Pyrimidines bond to the C1’ carbon of the sugar at their N1 atoms

# Nucleosides



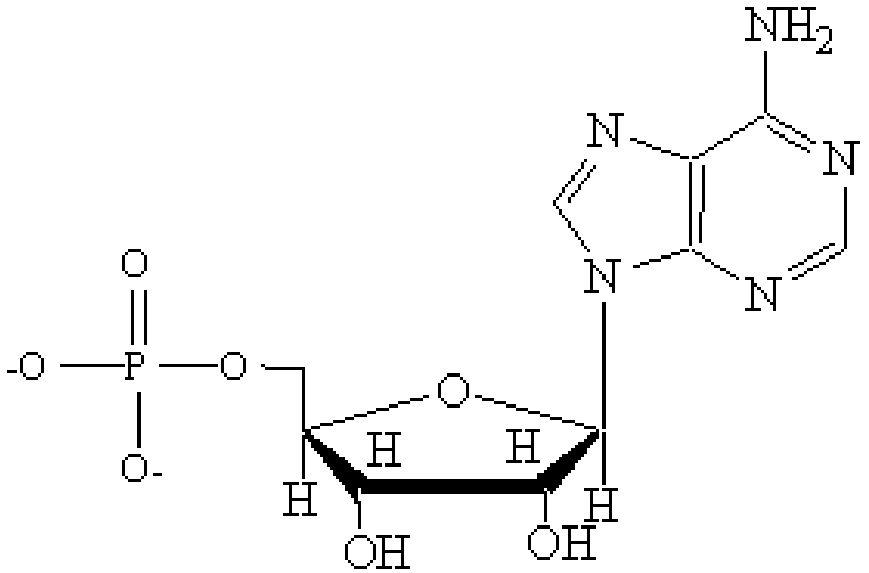

**Adenosine**

# Phosphate Groups

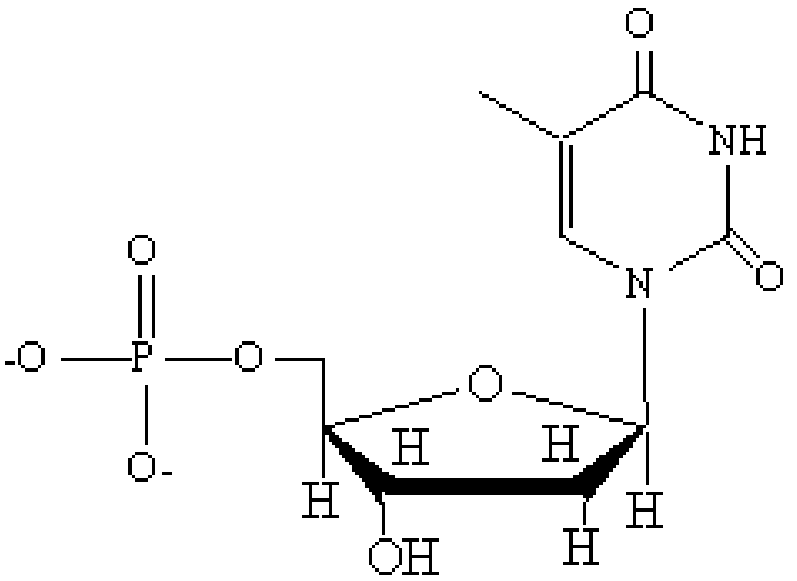
- Mono-, di- or triphosphates
- Phosphates can be bonded to either C3 or C5 atoms of the sugar

# Nucleotides

- Result from linking one or more phosphates with a nucleoside onto the 5’ end of the molecule through esterification



Adenosine Monophosphate (AMP)
(a ribonucleotide)



2'-Deoxythymidine Monophosphate
(a deoxyribonucleotide)

# Nucleotides

- RNA (ribonucleic acid) is a polymer of ribonucleotides
- DNA (deoxyribonucleic acid) is a polymer of deoxyribonucleotides
- Both deoxy- and ribonucleotides contain Adenine, Guanine and Cytosine
  - Ribonucleotides contain Uracil
  - Deoxyribonucleotides contain Thymine

# Nucleotides

- Monomers for nucleic acid polymers
- Nucleoside Triphosphates are important energy carriers (ATP, GTP)
- Important components of coenzymes
  - FAD, $NAD^+$ and Coenzyme A

# Biological functions of nucleotides

1. Building blocks of nucleic acids (DNA and RNA).
2. Involved in energy storage, muscle contraction, active transport, maintenance of ion gradients.
3. Activated intermediates in biosynthesis (e.g. UDP-glucose, S-adenosylmethionine).
4. Components of coenzymes ($NAD^+$, $NADP^+$, FAD, FMN, and CoA)
5. Metabolic regulators:

a. Second messengers (cAMP, cGMP)

b. Phosphate donors in signal transduction (ATP)

c. Regulation of some enzymes *via* adenylation and uridylylation

# Naming Conventions

- Nucleosides:
  - Purine nucleosides end in “-sine”
    - Adenosine, Guanosine
  - Pyrimidine nucleosides end in “-dine”
    - Thymidine, Cytidine, Uridine
- Nucleotides:
  - Start with the nucleoside name from above and add “mono-”, “di-”, or “triphosphate”
    - Adenosine Monophosphate, Cytidine Triphosphate, Deoxythymidine Diphosphate

# HYDROLYSIS OF NUCLEIC ACIDS

Hydrolysis of Nucleic acids by selective methods can be achieved chemically or enzymatically. **Chemical method of hydrolysis:**

**ACID HYDROLYSIS:** RNA is relatively resistant to the effects of dilute acid, but gentle treatment of DNA with 1mM HCl leads to hydrolysis of purine glycosidic bonds and the loss of purine bases from the DNA without affecting the pyrimidine deoxyribose bonds or the phosphodiester bonds of the backbone. At other chemical conditions, selective removal of pyrimidine bases occurs. In most cases, both Nucleic acids can be hydrolysed to their constituent bases by the treatment with 72% perchloric acid ($HClO_4^-$) for 1hour. The resulting nucleic acid derivative which is devoid of purine bases is called **APURINIC ACID;** while that devoid of pyrimidine bases is called **APYRIMIDINIC ACID**

**ALKALI HYDROLYSIS**: DNA is not susceptible to alkaline hydrolysis. On the other hand, RNA is alkali labile and is readily hydrolyzed by dilute sodium hydroxide.

**Enzymatic hydrolysis of Nucleic acids:** Enzymes that hydrolyse nucleic acids are called **NUCLEASES**. Some nucleases can hydrolyse linkages between 2 adjacent nucleotides at internal positions in the DNA or RNA strand and proceed stepwise from that end. Such nucleases are **called ENDONUCLEASES. Another class of nucleases can hydrolyse only the terminal nucleotide linkage, some at the 5' and others at the 3' end; these are called EXONUCLEASES.**

DNases (deoxyribonucleases) acts only on DNA RNases(ribonucleases) are specific for RNA.