NUCLEOTIDES METABOLISM

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- **Outline of the lectures**
- **Classification and nomenclature of nucleotides**
- **Functions of nucleotides**
- ***De novo synthesis of purine nucleotides .***
- **“Salvage” pathway of nucleotide synthesis.**
- **Breakdown of purine nucleotides and excretion of final products**
- **Hyperuricemia and gout**
- **synthesis of pyrimidine nucleotides**
- **Breakdons of pyrimidine nucleotides and excretion**
- **Orotic aciduria**

Metabolism

The chemical processes that occur within a living organism in order to maintain life.

Oxford Dictionary

It is came from Greek metabolē ‘change’

Two kinds of metabolism are often distinguished:

- **constructive metabolism, the synthesis of the proteins, carbohydrates, and fats which form tissue and store energy**
- **destructive metabolism, the breakdown of complex substances and the consequent production of energy and waste substance**

- Nucleotides are the Building Blocks of Nucleic Acids

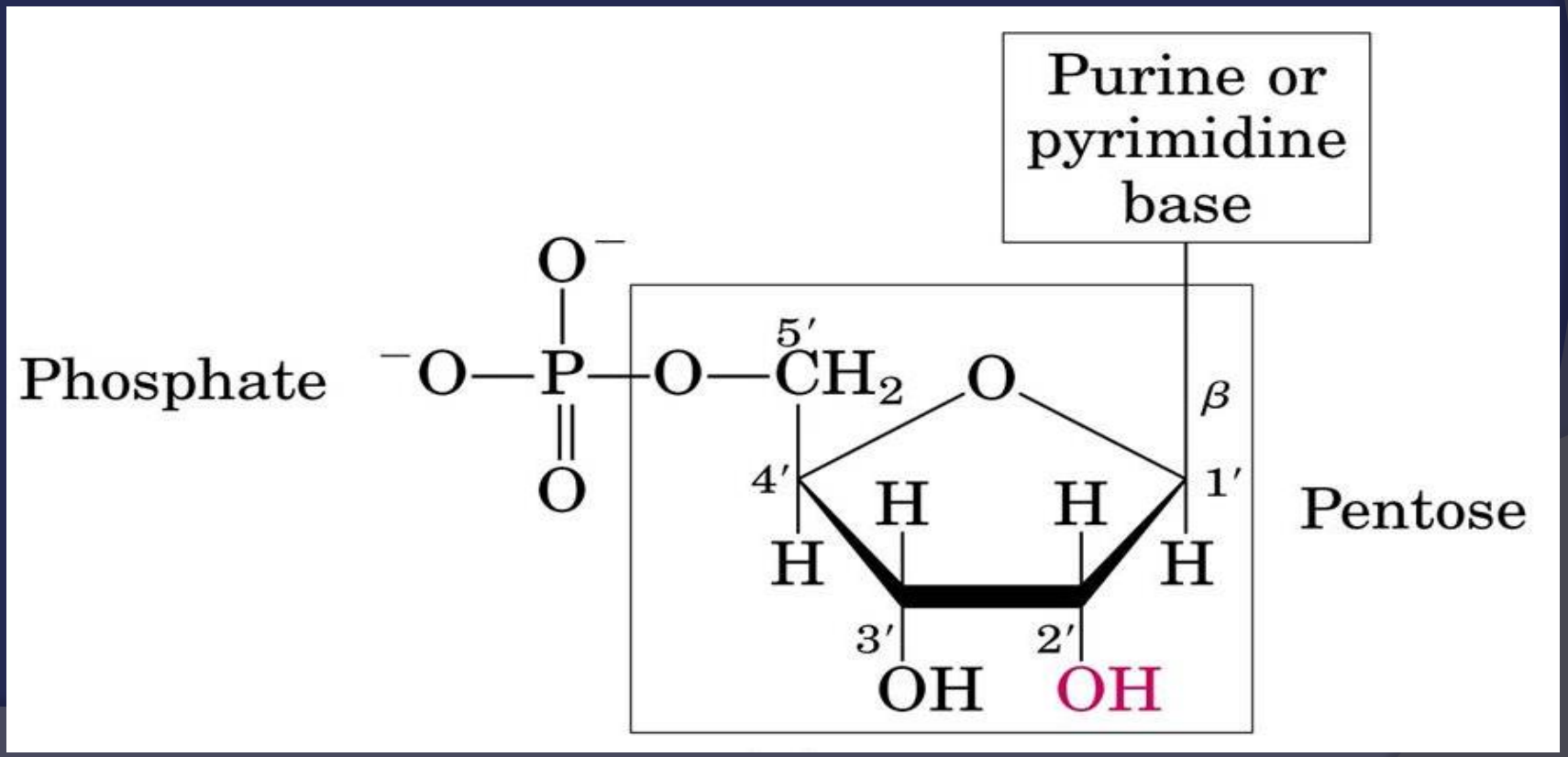
Functions of nucleotides

- Precursors of nucleic acids.
- Energy carriers (ATP and GTP).
- Components of coenzymes (NAD+, FAD).
- Metabolic regulators (cAMP).
- Activators of substrates (UDP-glucose).

Nucleotides structure

The nucleotide has three characteristic components

- Nitrogenous base
- Pentose sugar
- Phosphate



Nitrogenous Bases

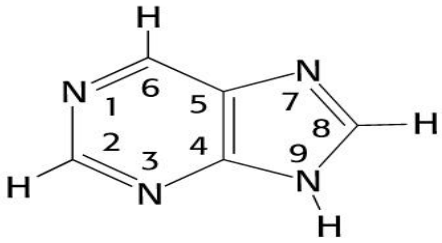
Nitrogenous base: derivatives of Purines and pyrimidines

Purines: Consist of a six-member and a five-member nitrogen-containing ring, fused together; contain (adenine, guanine, hypoxanthine and xanthine).

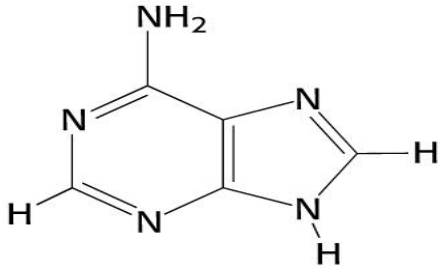
Pyrimidines: Consist of six-member nitrogen-containing ring

DNA and RNA contain the same purine bases and the pyrimidine base **Cytosine** But **Thymine** found only in DNA and **Uracil** found only in RNA

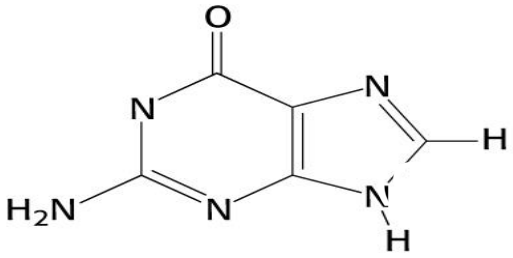
PURINES



Purine

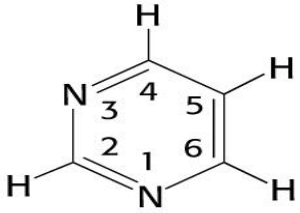


Adenine

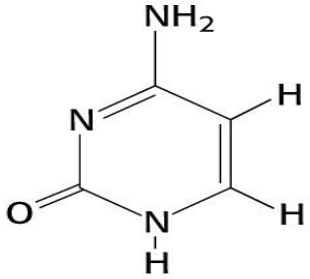


Guanine

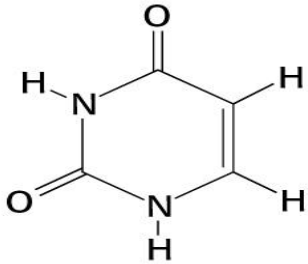
PYRIMIDINES



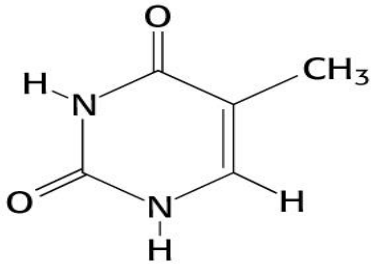
Pyrimidine



Cytosine



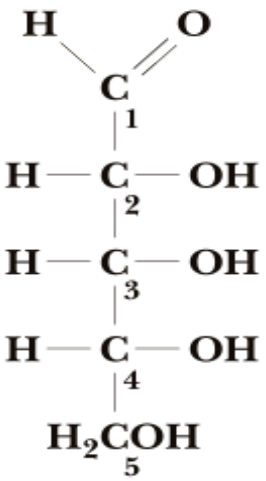
Uracil



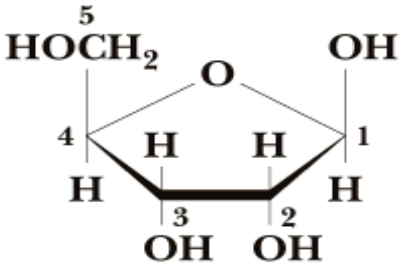
Thymine

Pentoses of Nucleotides

- D-ribose (in RNA)
- 2-deoxy-D-ribose (in DNA)
- The difference - 2'-OH vs 2'-H
- This difference affects secondary structure and stability

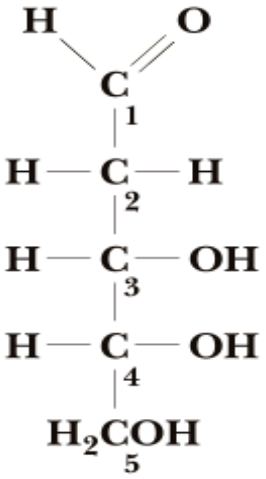


D-Ribose

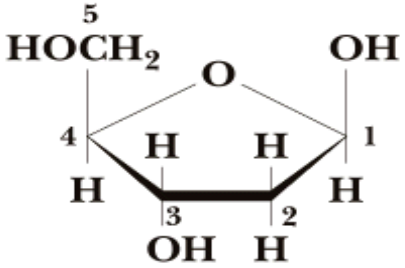


Furanose form of D-Ribose

β-D-Ribofuranose



D-2-Deoxyribose

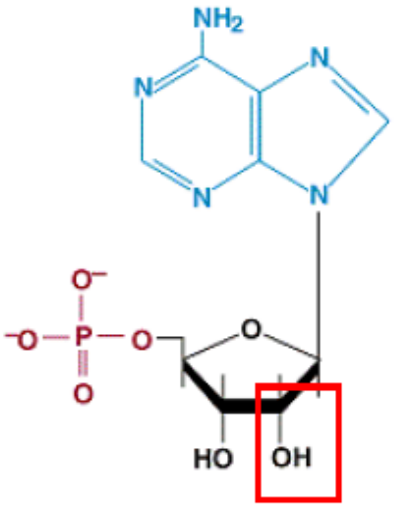


Furanose form of D-2-Deoxyribose

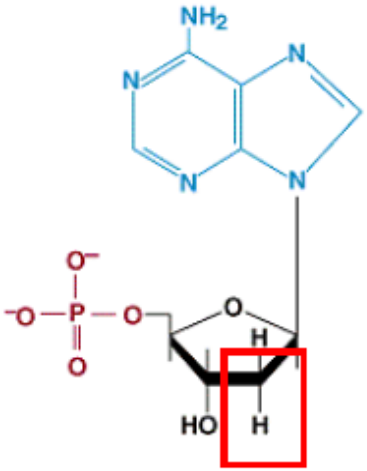
β-D-2-Deoxyribofuranose

Ribonucleotides Deoxiribonucleotides

- These are ribose-containing nucleotides

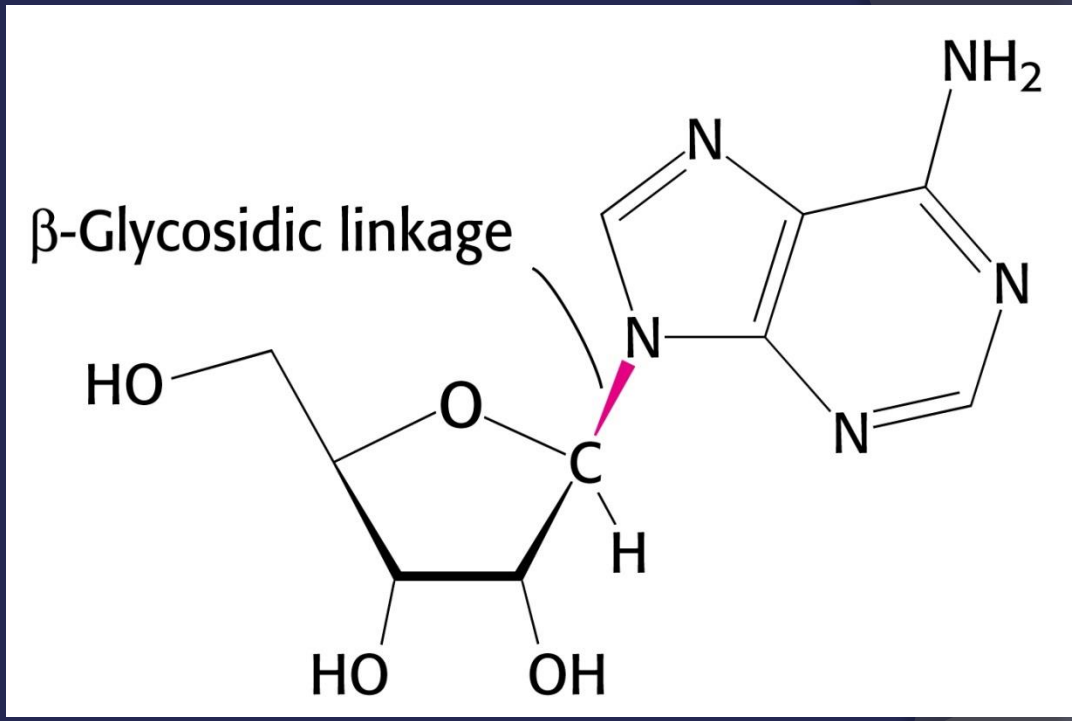


- These are deoxyribose-containing nucleotides

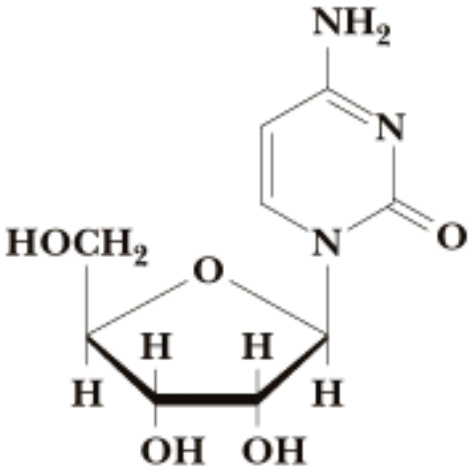


Bases are attached by b-N- glycosidic linkages to 1 carbon of pentose sugar – (Nucleoside)

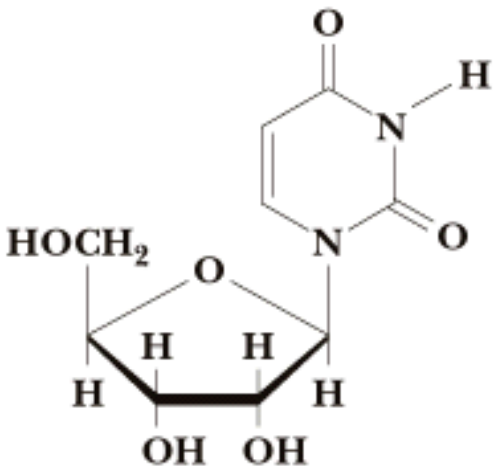
- Base is linked via a b-N-glycosidic bond
- The carbon of the glycosidic bond is anomeric
- Named by adding -idine to the root name of a pyrimidine or -osine to the root name of a purine
- Sugars make nucleosides more water-soluble than free bases



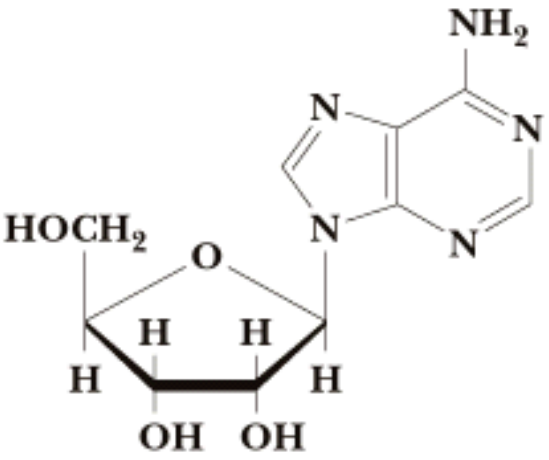
Nucleosides



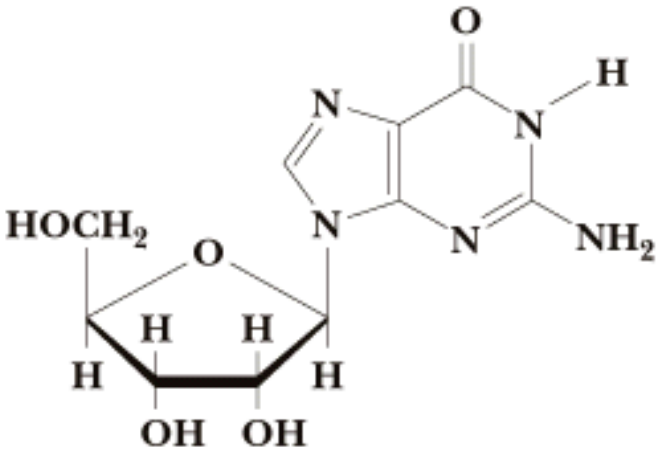
Cytidine



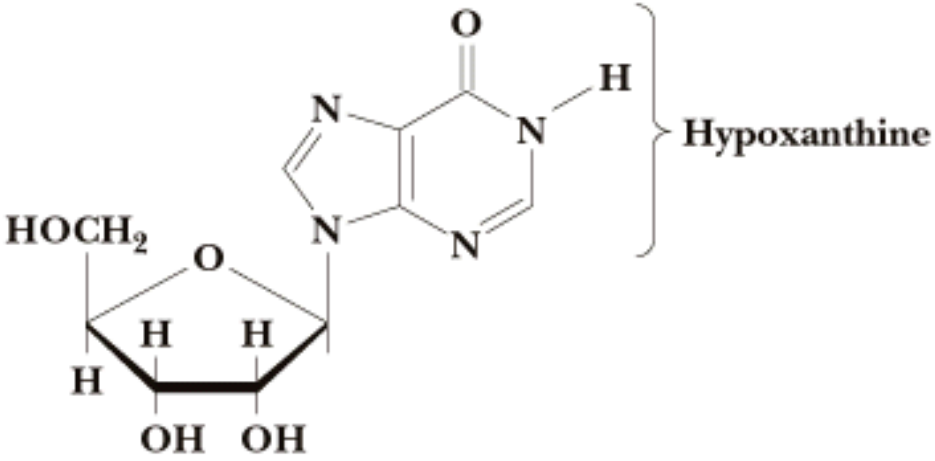
Uridine



Adenosine



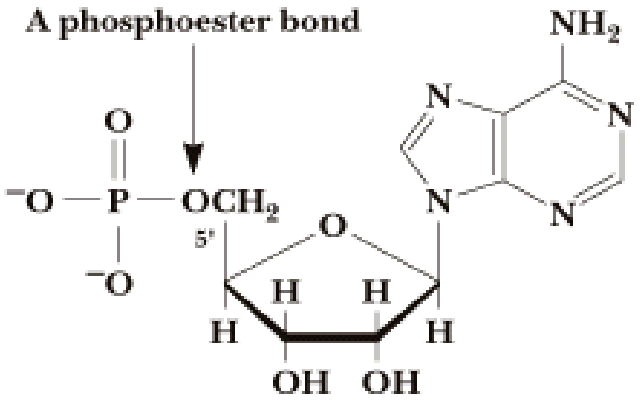
Guanosine



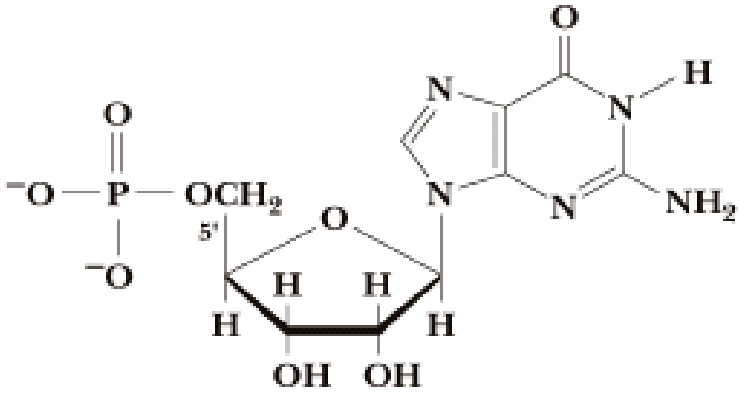
Inosine, an uncommon nucleoside

Nucleotides

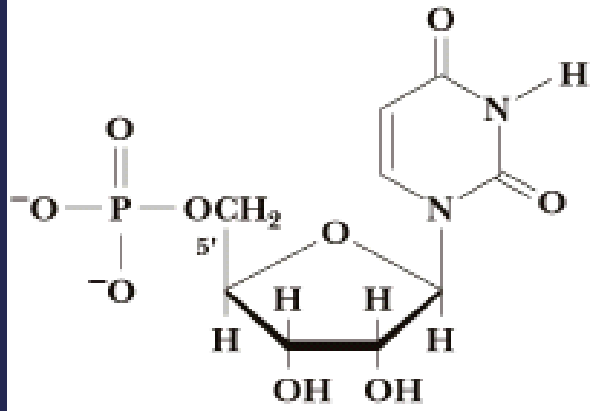
- **Phosphate ester of nucleosides**



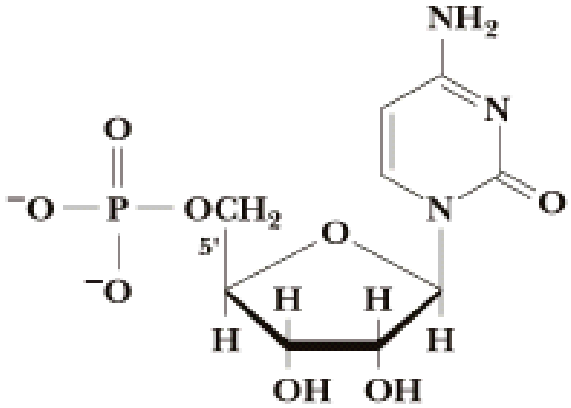
Adenosine 5'-monophosphate
(or AMP or adenylic acid)



Guanosine 5'-monophosphate
(or GMP or guanylic acid)



Uridine 5'-monophosphate
(or UMP or uridylic acid)



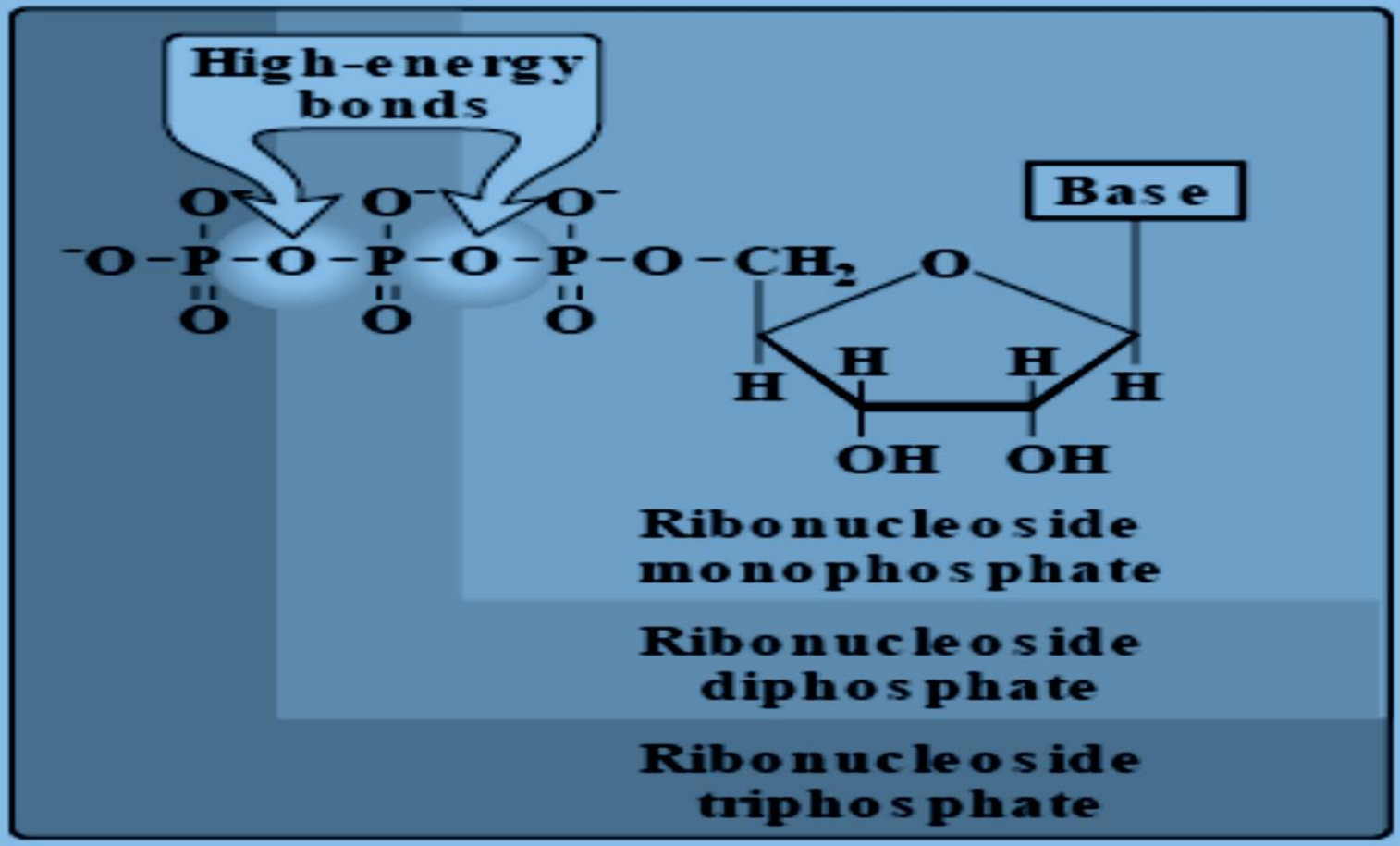
Cytidine 5'-monophosphate
(or CMP or cytidylic acid)

Classification of nucleosides and nucleotides

1. According to the type of N-base either Purines or Pyrimidines

2. According to the type of pentose

3. According to the number of phosphate groups

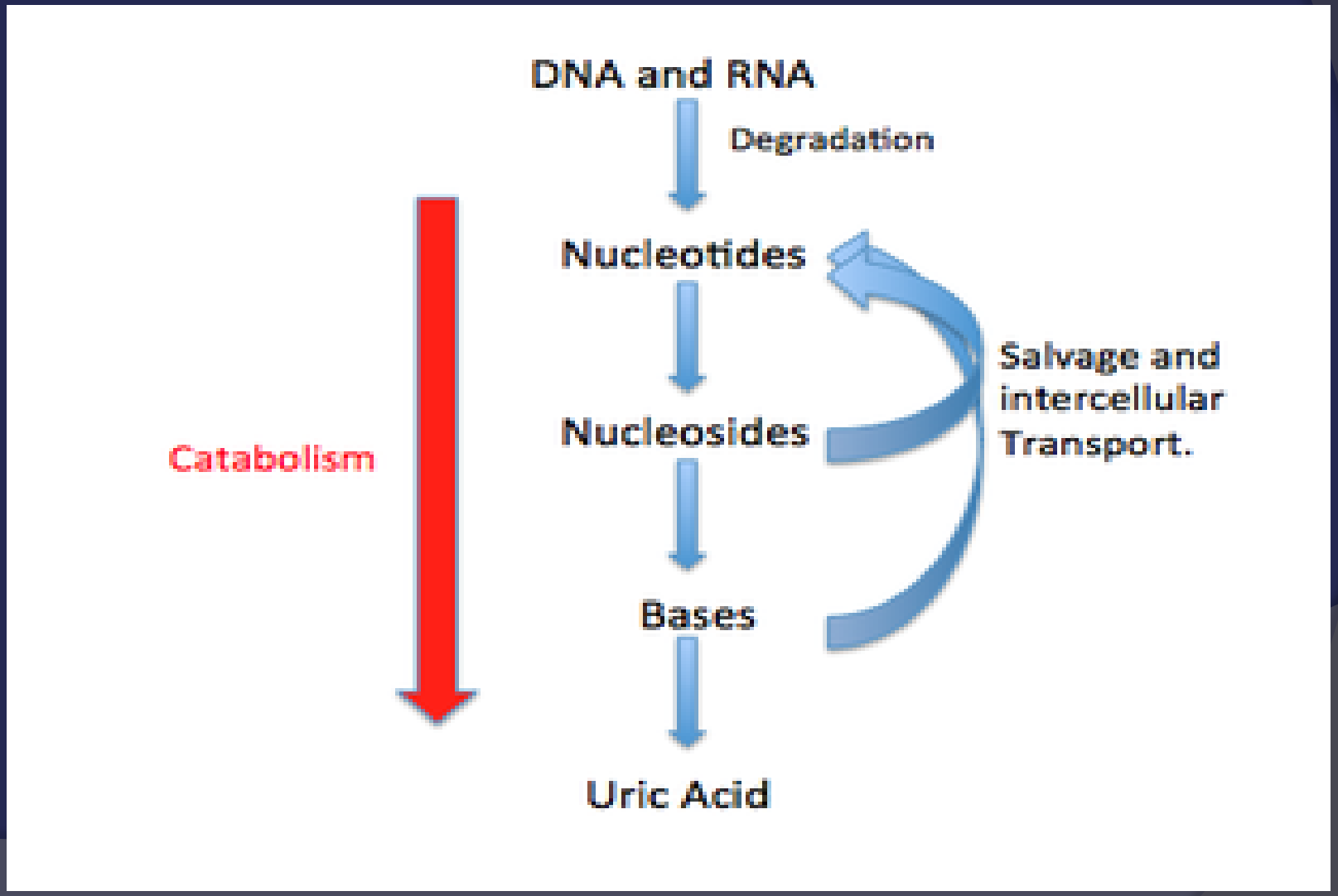


The second and third phosphates are each connected to the nucleotide by a “high-energy” bond. [Note: The phosphate groups are responsible for the negative charges associated with nucleotides and cause DNA and RNA to be referred to as “nucleic acids.”]

Nucleoside Triphosphates	Names of Components	
	Bases	Nucleosides
Ribonucleotides		
Adenosine triphosphate (ATP)	Adenine	Adenosine
Guanosine triphosphate (GTP)	Guanine	Guanosine
Cytidine triphosphate (CTP)	Cytosine	Cytidine
Uridine triphosphate (UTP)	Uracil	Uridine
Deoxyribonucleotides		
Deoxyadenosine triphosphate (dATP)	Adenine	Deoxyadenosine
Deoxyguanosine triphosphate (dGTP)	Guanine	Deoxyguanosine
Deoxycytidine triphosphate (dCTP)	Cytosine	Deoxycytidine
Deoxythymidine triphosphate (dTTP)	Thymine	Deoxythymidine

Sources of nucleotide:

- They are produced from N- bases (these come from the diet and from partly degraded nucleotides)
- synthesis of nucleotides from basic metabolites.



Thank You