CYTOLOGY

Premed 2018 - JU

◉ Sheet ○ Slides

Number

1 (Molecular Bio)

Done by:

Lana Mango

Corrected by:

Odai Bani-Monia

Doctor

مأمون أهرام

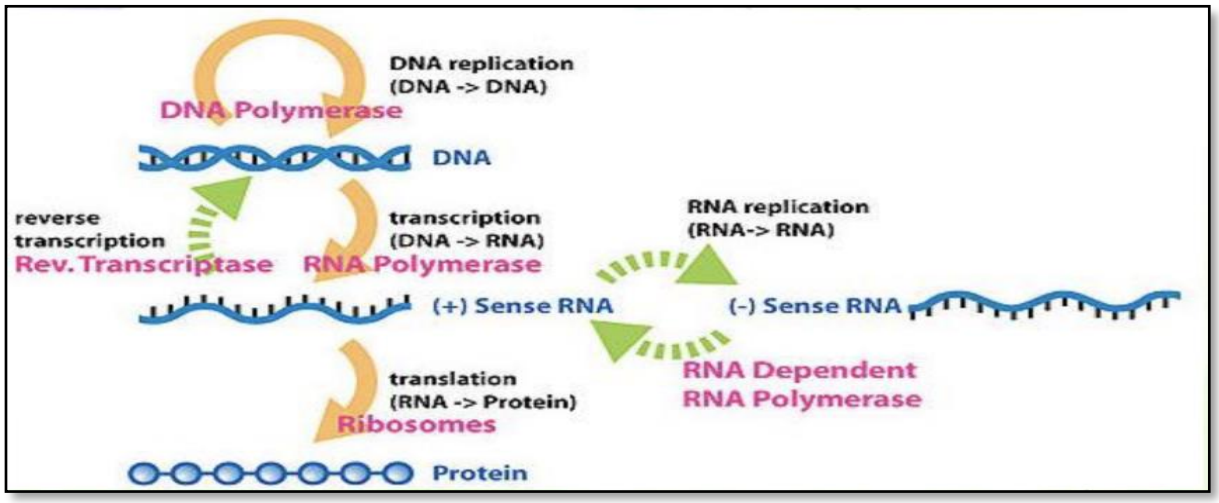
DNA STRUCTURE AND BASIC APPLICATION:

Important things to keep in mind:

SHEETS AND SLIDES, and that BOTH are enough for the final.

- **Molecular Biology:** Biochemistry of DNA and RNA and deals with nucleotides

- **Central Dogma/Molecular Dogma** العقيدة/ الفكرة الأساسية States the following processes:
  1. Transcription: DNA is used to make RNA using **RNA polymerase**
  2. Translation: RNA is used for protein synthesis
  3. DNA Replication: DNA can be used to make more copies of itself using **DNA polymerase.**



- **Later on, they discovered that**
  - RNA can be used to make DNA through Reverse Transcription using **Reverse Transcriptase**

  - RNA can undergo Replication, to make more copies of itself using **RNA Polymerase** (In RNA viruses)
    1. Viruses get the RNA into our cells
    2. DNA is produced by reverse transcription of the RNA
    3. DNA will interfere with our DNA: The cell becomes **Hostage** to the virus
    4. Viral DNA is replicated and is used to produce more viruses

5. Viral DNA is transcribed using our cell's mechanism to produce RNA
6. RNA is replicated and is used to produce the viral coat or body of the virus
7. The body of the virus is packaged and used to destroy our cells or infect them. **(RNA Virus example: HIV)**

NOTE: Proteins **CANNOT** produce RNA. There is no such thing as Reverse Translation

❖ **Macromolecules:**

- Carbohydrates
- Proteins
- Nucleic Acids
- Lipids

POLYMERS

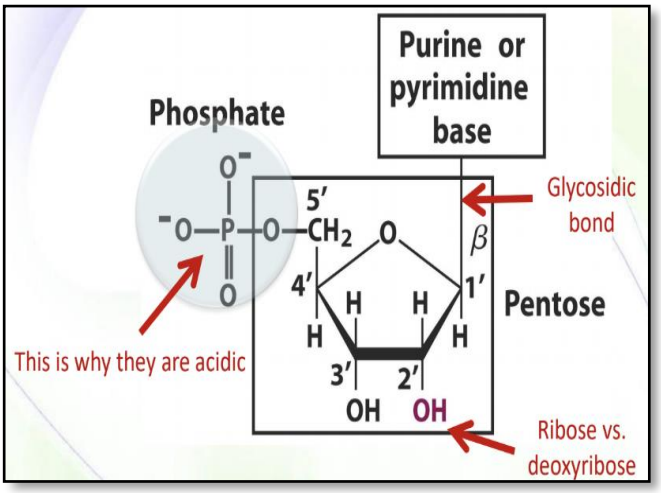
❖ **Nucleic Acids: (RNA and DNA):** It is one of four macromolecules

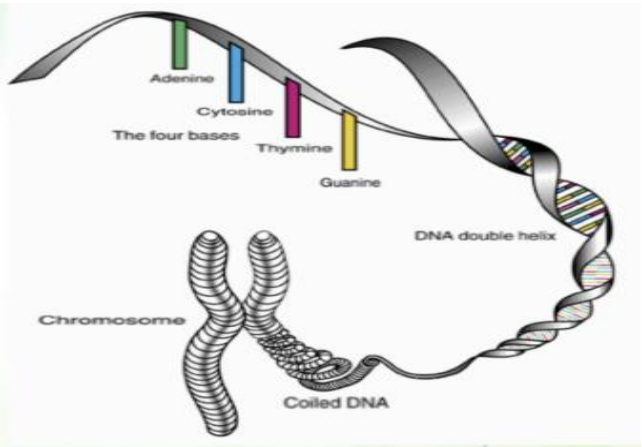
primary structure of nucleic acids: linear polymers of nucleotides(monomers) bound to each other via **phosphodiester bonds.**

These monomers are: **Nucleotides**

Nucleotides are made of three components:

1. **Sugar:** 5 carbon sugar, called **Pentose,** most commonly known as Ribose
2. **Nitrogenous base:** (Situated on 1' of Pentose sugar by forming a glycosidic bond with the pentose sugar)
3. **Phosphate group: (**Situated on 5' of Pentose sugar) **Nucleotide can have more than one phosphate group attached to it**





-DNA is coiled to form Chromosomes

- **Difference between DNA and RNA:**
  1. **DNA consists of Deoxyribose sugar, while RNA consists of the sugar Ribose.**

     How can we tell?
     On carbon 2', notice that Ribose will have an OH group, while Deoxyribose will have an H group, with **no oxygen** as in Ribose.

  2. **DNA** has thymine and does not have Uracil. **RNA** Has Uracil but does not have thymine

- **Where does DNA get its overall negative charge from?**
  DNA is negatively charge due to the large number of Phosphate groups situated on carbon number 5 (5') of the sugar.
  Although DNA and RNA are stable, these negative charges lead to large repulsive forces.

  How can we stabilize RNA and DNA if the negative charges are making them unstable?
  By masking the negative charge using positively charged ions

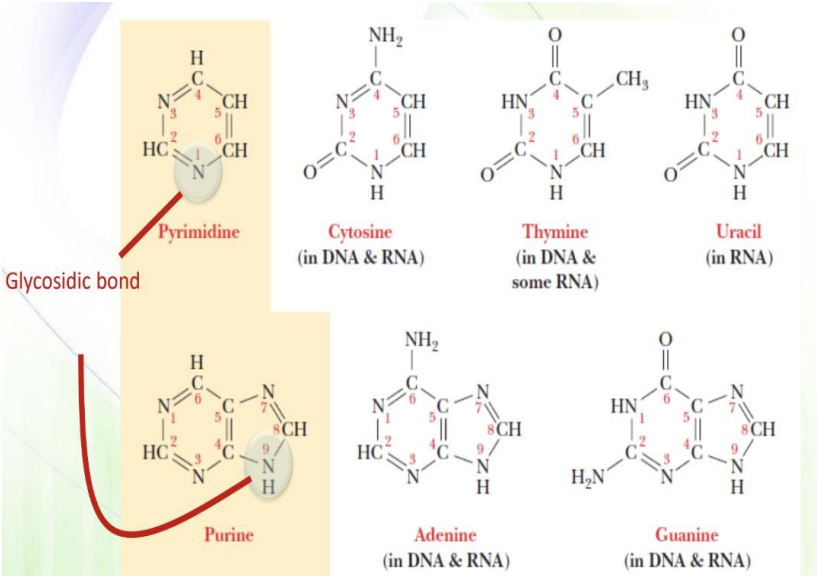
  Thus, positively charged ions (Na+ or Mg2+) and peptides with positively charged side chains can associate with DNA, making it more stable.

  Eukaryotic DNA, for example, **histones** are positively charged proteins since they are made of positively charged amino acids (Arginine and **Lysine**).

  DNA is complexed with histones in the cell nucleus.

  Note: They are called nucleic acids for their large negative charge.

- **Two types of Nitrogenous bases:**
  1. **Purines:**
     Double ring structures
     Forms glycosidic bond with pentose on Carbon number 9
  2. **Pyrimidines**
     Single ring structures
     Forms glycosidic bond with pentose on Carbon number 1



NOTE: You won't be asked to differentiate between different nitrogenous bases and their structures. The professor will not include such questions.

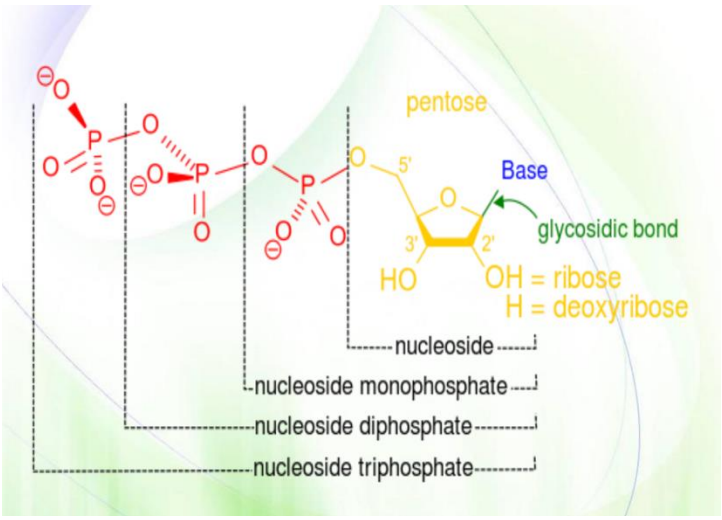
***NOTE*:** (Use the " ' "for numbering carbons of the sugar, to differentiate between the carbons of the nitrogenous base and the carbons of the sugar)

For example: Carbon 5 of the sugar is numbered as **5'**, while Carbon 5 of nitrogenous base is numbered as **5**.

- **Nucleotides VS Nucleosides**

Nucleoside: Pentose sugar and the base**. Ex: Adenosine**

Nucleotide: Pentose sugar, the base AND the phosphate group. (Or can be named starting with "Nucleoside" and ending it and indicating the number of PO_3 groups)
Ex: Adenosine diphosphate

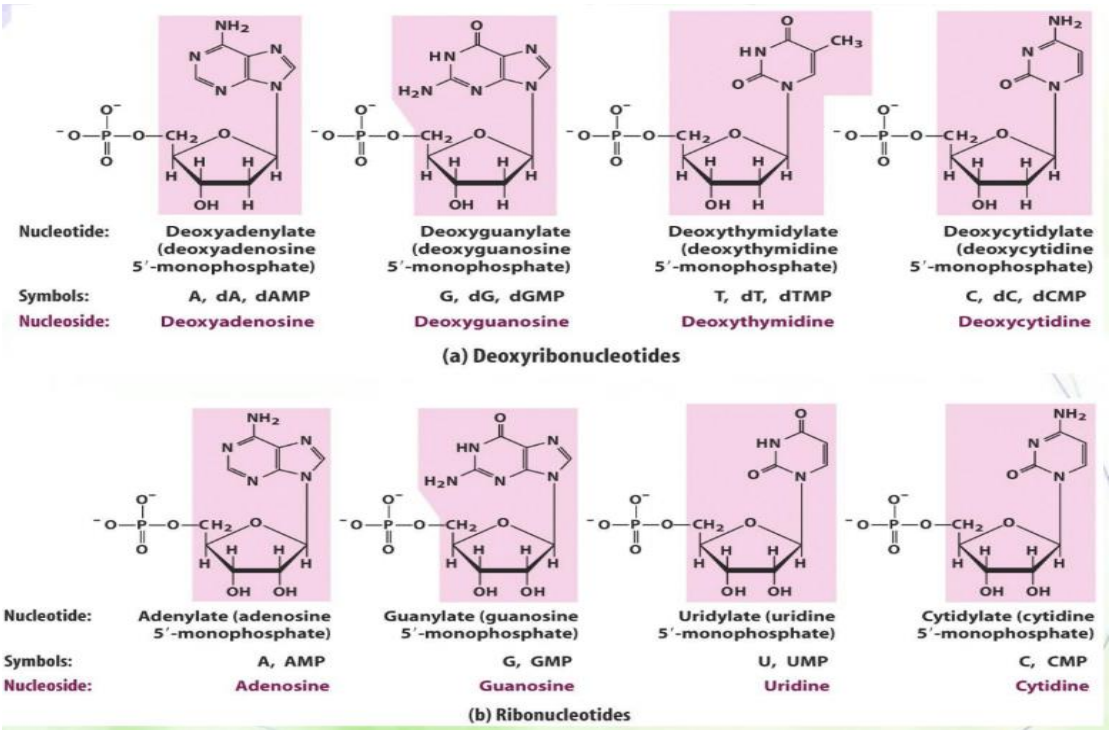


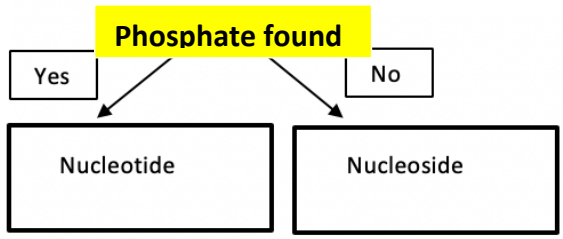
Special naming for monophosphates: (For simpler naming)

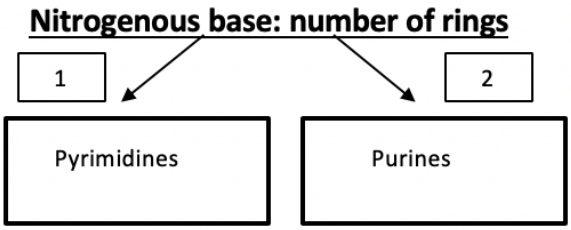
Using (-ylate) that the nucleotide has ONE phosphate group

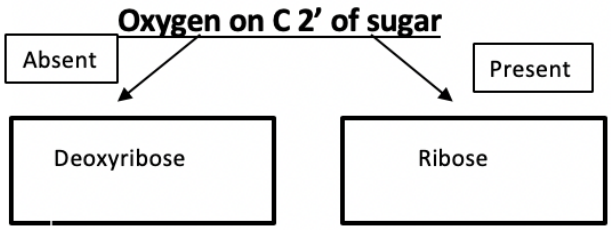
- Adenosine monophosphate= Adenylate
- Guanosine monophosphate= Guanylate

❖ So , the part (-Sine) indicate that this molecule is **Nucleoside**





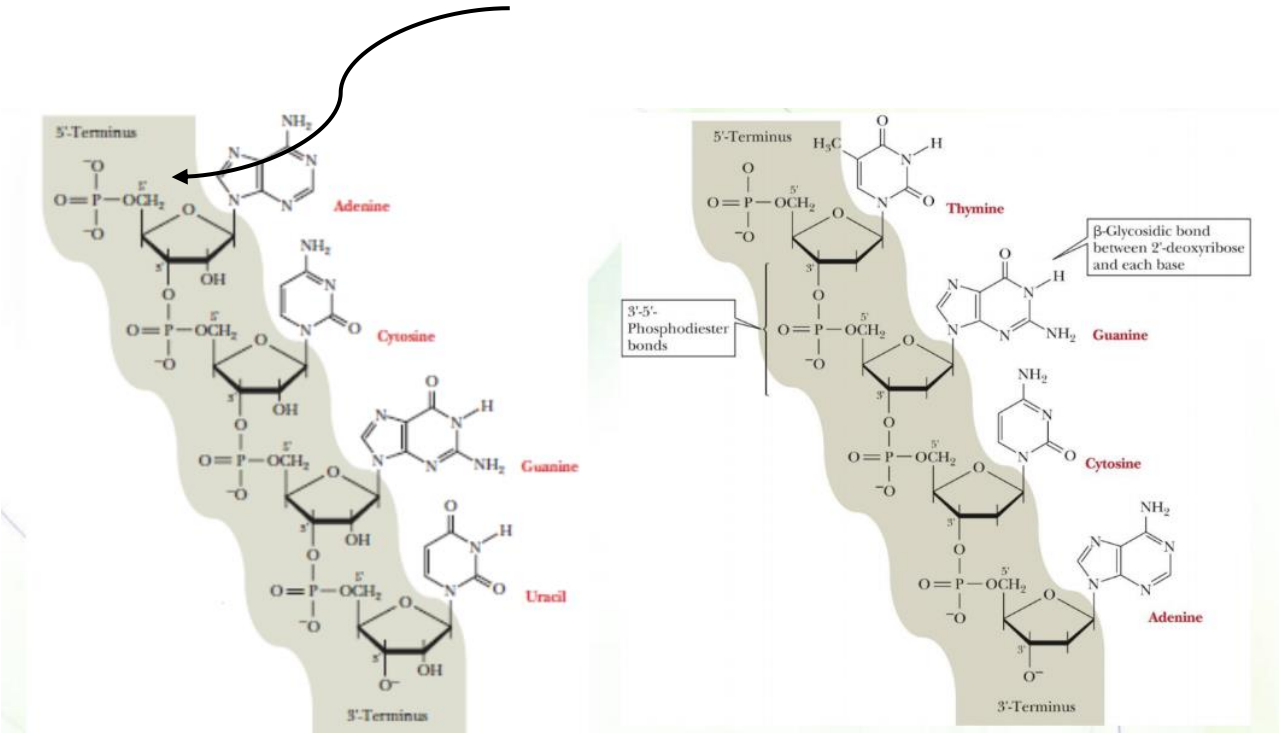




- **Nucleic Acid Polymers**

  Polymerization occurs when nucleotides join together to form phosphodiester bonds. (Bond forms between carbon 3' of sugar of the nucleotide and the phosphate group on 5' of the next nucleotide)

  - Direction of polymerization is always from **5'→ 3'**
  - When we want to add more nucleotides we add them to the **3' end.**
  - The phosphate group on the 5' of the first nucleotide in the sequence of nucleotides remains untouched.



Good Luck ☺