

# Molecular biology – Sheet 1

## Introduction and DNA structure.

Firstly, we have to take a look on 3 related sciences or fields, and know the differences between them:

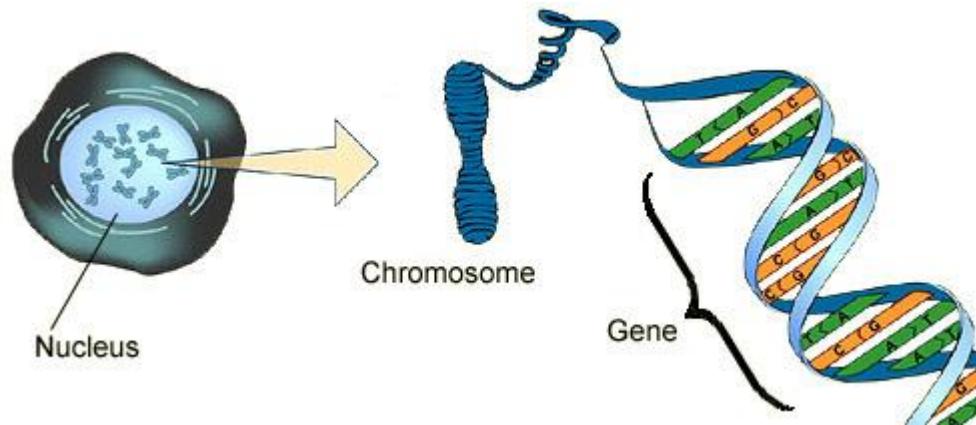
**1- Genetics (or Medical Genetics which we took with Dr. Alkhatib):** The association between certain genetic aberrations or mutations and human diseases. It also studies the patterns of human inheritance.

(**Example:** Thalassemia is an autosomal recessive disorder caused by mutations in alpha globin gene)

**2- Molecular biology:** The biology of the DNA molecule (and associated molecules). It Studies their structure, function, regulation of expression, mutations and genetic engineering. And it's wider than Medical Genetics.

The two sciences (Genetics and Molecular Biology) of course overlap! When we say for example that Thalassemia is caused by a point mutation, we have to know what "point mutation" means. Or when we say that a mutation happens in certain part of DNA (intron, non-coding region, ... etc), we have to be familiar with these parts of DNA.

**3- Cell biology:** The study of the whole cell (containing the nucleus and DNA which is in it).



\*It's sad that we only have just 1 credit hour to study Molecular Biology. Molecular Biology is a rapidly changing science, and the future is for such sciences. It's a very important subject, especially for researches (**example:** Stem cell technology and Gene therapy).

\*\*The reference book is **Mark's Basic Medical Biochemistry** (3<sup>rd</sup> or 4<sup>th</sup> edition). The material is divided into two parts:

**Basic Molecular Biology:**

The basics of the DNA molecule (Structure, Replication, Transcription, Translation, Regulation of gene expression and Molecular biology of cancer).

**Applied Molecular Biology:**

Recombinant DNA technology (Genetics Engineering)

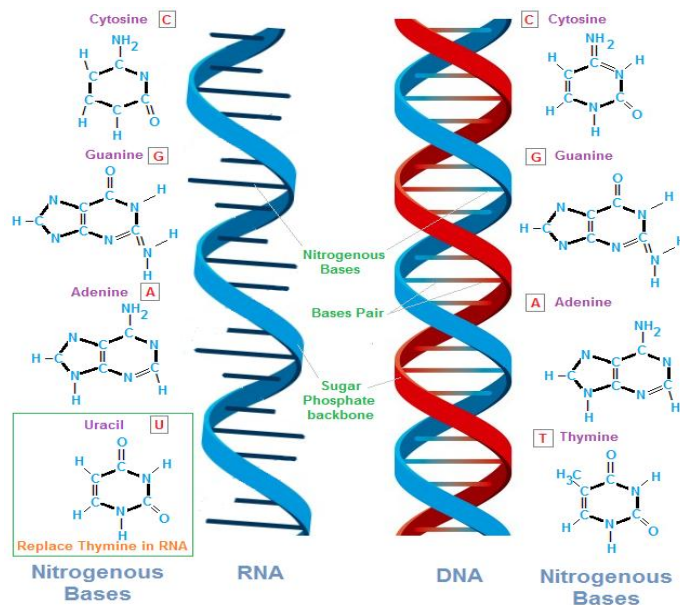
Gene therapy

Cloning (if it was possible for us to take it due to short time).

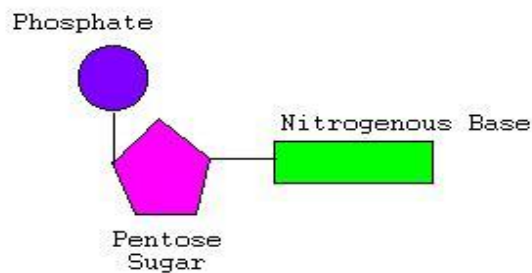
## DNA structure:

### General facts and rules:

- We have two types of genetic material (Nucleic acids) in our cells:
  - 1- DNA (double stranded)
  - 2- RNA (single stranded)



- Nucleic acids' strands are composed of basic units called **"Nucleotides"**.
- **Nucleotides consist of: Phosphate, Sugar (ribose or deoxyribose) and Nitrogenous base.**



- We can differentiate between DNA and RNA by checking the carbon number 2 in the ribose sugar. If it has (OH) then it's RNA. However, if it has just (H)s without oxygen then it's DNA.

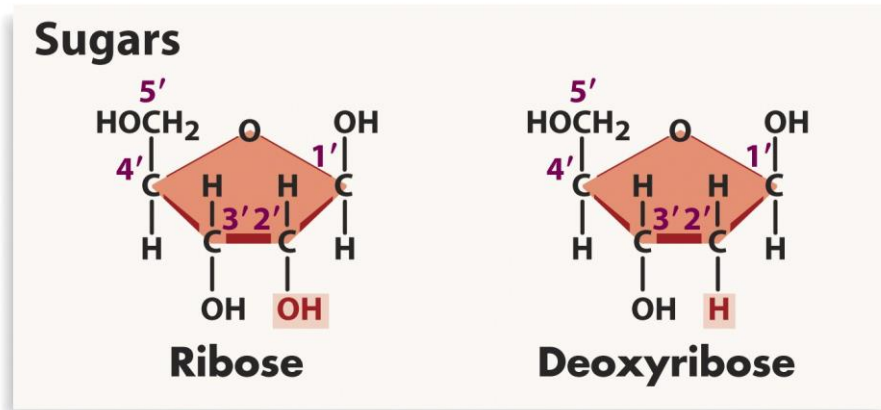
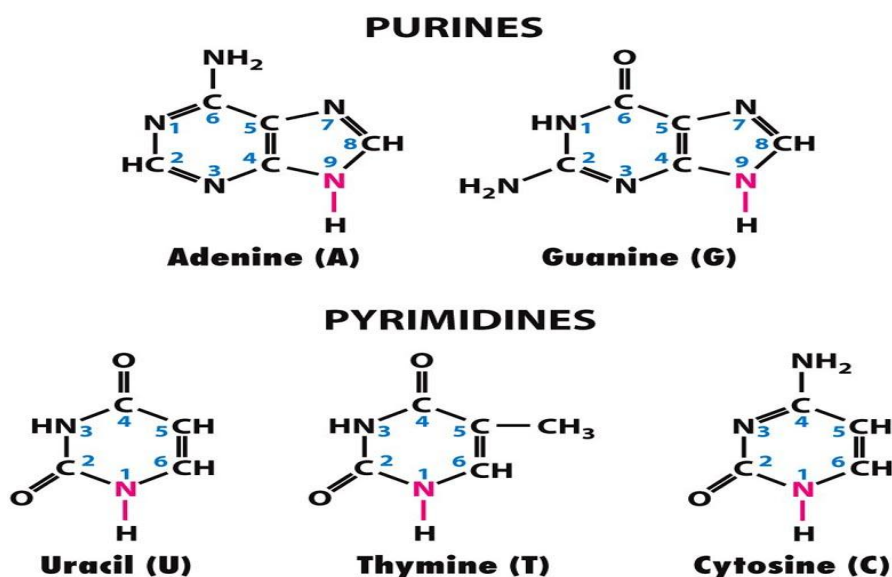


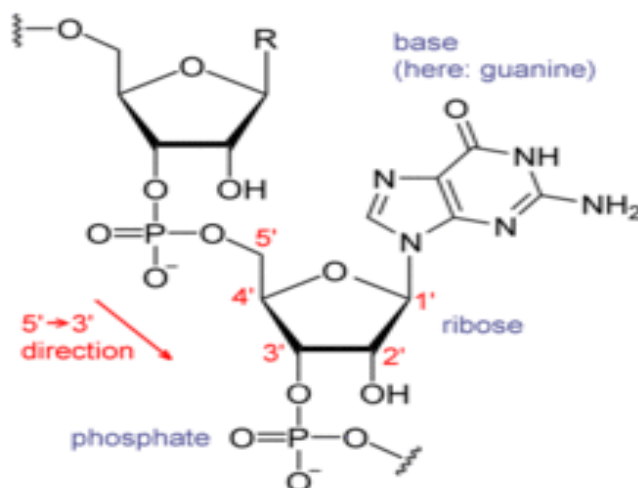
Figure 4-1b Biological Science, 2/e

© 2005 Pearson Prentice Hall, Inc.

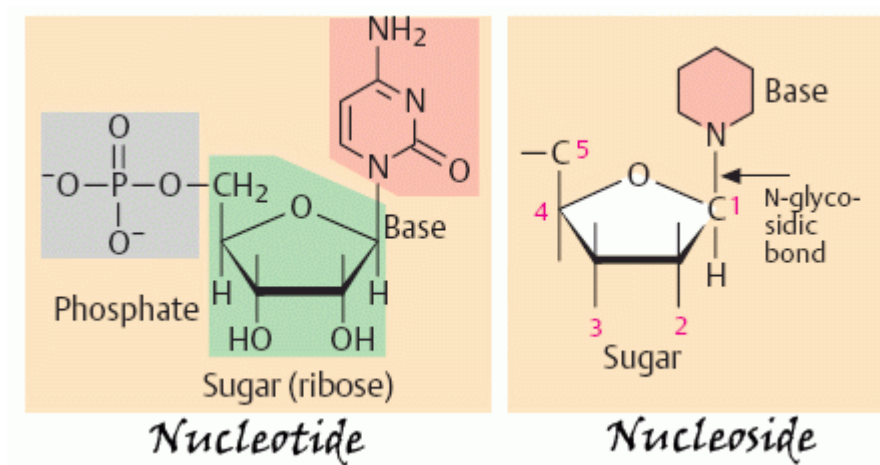
- There are two types of Nitrogenous bases:
  - 1- Purines:** Adenine or Guanine. Every base consists of 2 rings. They differ from each other by the functional groups.
  - 2- Pyrimidines:** Cytosine or Thymine (just in DNA) or Uracil (just in RNA). Every base here consists of just one ring. They differ from each other by the functional groups.



- In nucleotides, **On carbon 1 of the ribose sugar, we find a glycosidic bond with the nitrogenous base.** (with nitrogen number 9 in purines and number 1 in pyrimidines).
- In nucleotides also, **we find an ester bond between carbon number 5 on ribose sugar and a phosphate group or more** (We can link more than one phosphate group to the nucleotide).
- On the other hand, **Nucleotides are bound to each other by a phospho-di-ester bond.**  
**The phosphate group on the following nucleotide binds with the (OH) group on carbon number 3 of the previous nucleotide.**  
 Phospho-di-ester bond = phosphate group with 2 ester bond (with the previous and following nucleotides)
- **The bonds in DNA units are in 5→3 direction (when we want to read it).**  
 So always, first nucleotide of the DNA has a free 5' phosphate group, and last nucleotide has a free 3' OH group)



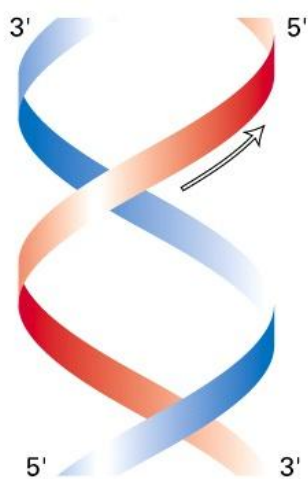
- Backbone of the DNA = phosphate + sugar (because they are always the same). The only changing thing is the nitrogenous base.
- Base + sugar = Nucleoside.
- Base + sugar + phosphate = Nucleotide (phosphate ester of the nucleoside)



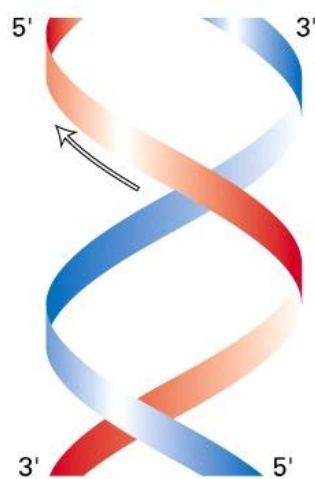
- The phosphate group is what makes the DNA acidic (that's why it's called a nucleic acid).
- The 2 strands of the DNA (since it's a double stranded molecule) bind to each other by hydrogen bonds.
- The 2 strands are complementary regarding the nitrogenous bases (A with T , C with G).



- The 2 strands are anti-parallel. One is called the "sense strand" (the coding one). The other one is called "anti-sense strand" (the template, non-coding). One runs in the 5'→3' direction and the other is in the 3'→5' direction.



Right-handed double helix



Left-handed double helix

- Watson and Crick are the ones who discovered the DNA structure in 1953. And the crystallography for it was made by Rosalind Franklin.

## **The End**

Done by: Majd Sleiti

(And by the way, I advice everyone to attend Dr. Saeed's lectures, since they are the best and most interesting and useful lectures we've ever had in the faculty).

-----

**"Our deepest fear is not that we are inadequate. Our deepest fear is that we are powerful beyond measure. It is our light, not our darkness that most frightens us."**