Molecular Biology course

Aims of the course

1- Understand the structure, function and regulation of genetic materials

2- Be familiar with the basic techniques of Molecular Biology

3- Define applications of molecular biology in life sciences

Course Content

Week 1: Structure of DNA and RNA
Organization of genetic material in eukaryotes and prokaryotes

Week 2: DNA replication

Week 3: Transcription

Week 4: Translation

Week 5: Enzymes in Molecular Biology

In this lecture

- What is Molecular Biology
- History of DNA discovery
- Chemical structure of DNA
- Chemical structure of RNA
- Physical structure of DNA
- Genome organization in eukaryotes
- Genome organization in prokaryotes

What is Molecular Biology

Studying Molecular Biology is based on

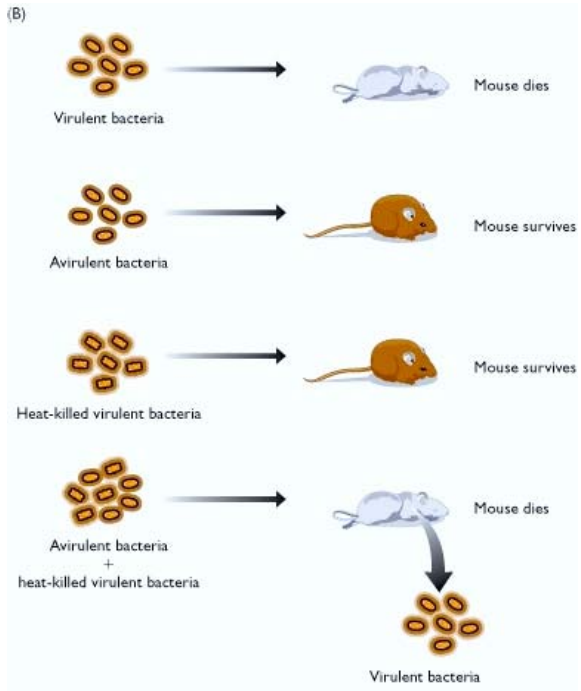
Biochemistry, Microbiology, and Genetics

Why is Molecular Biology

Discovery of genetic material

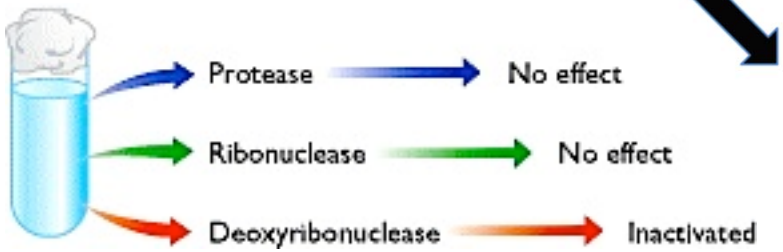
Friedrich Miescher:1869
First extracts of DNA

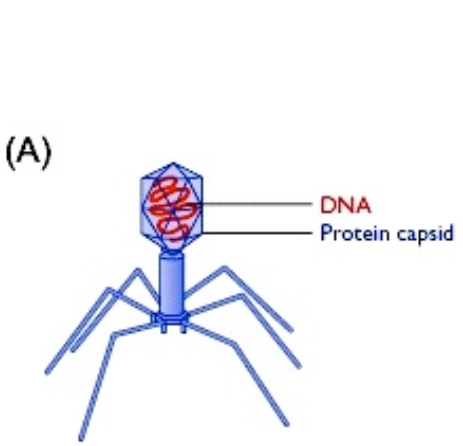
Walter Sutton: 1903
Inheritance pattern of genes paralleled behavior of chromosomes

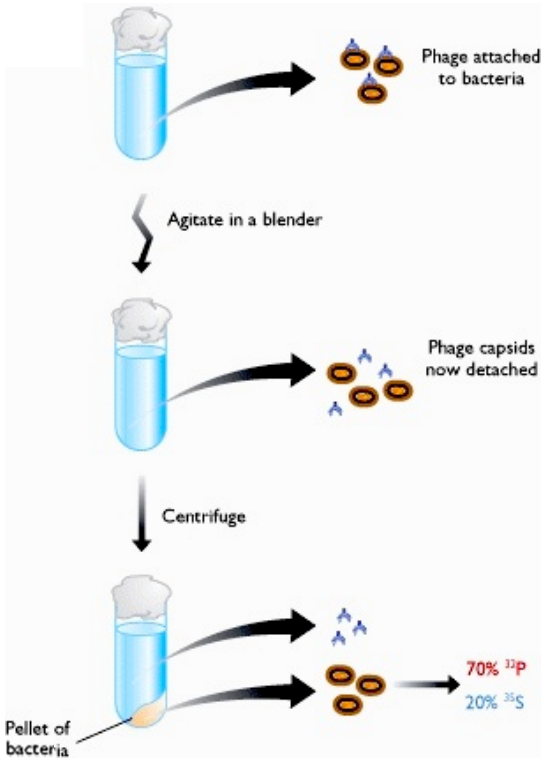


Griffith's experiments 1923

Avery et al experiments 1944



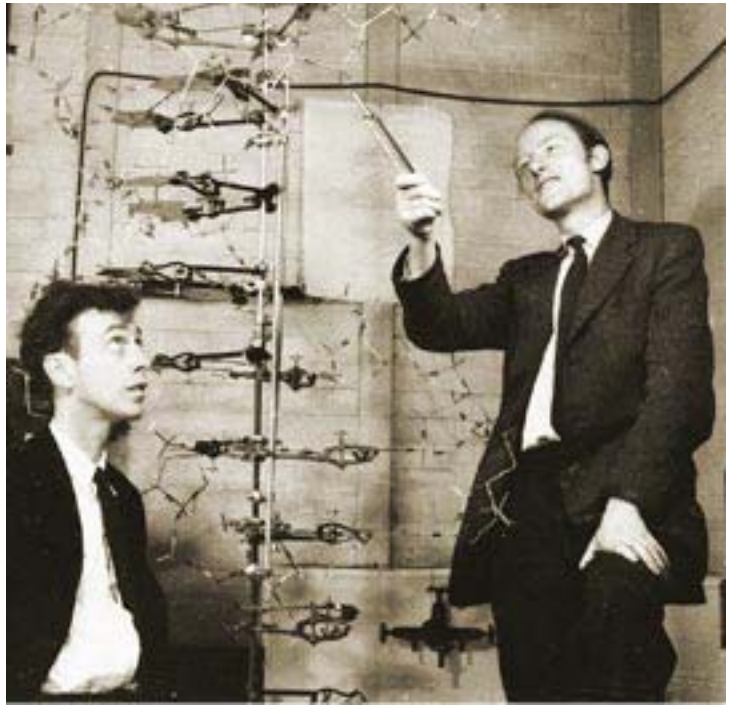




1952
Hershey & Chase's experiments

Structure of DNA

DNA is a double helix

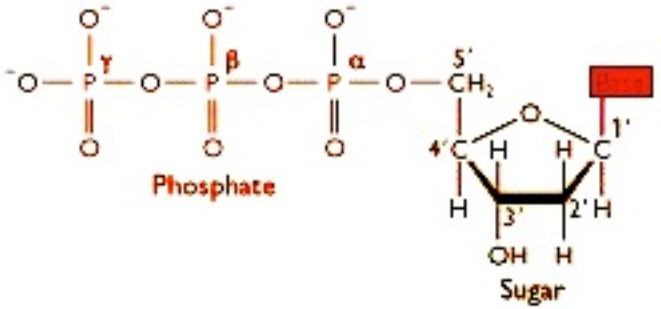


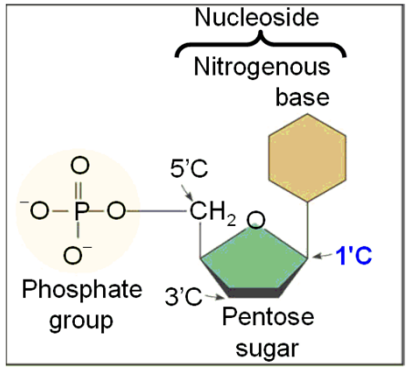
1953
Watson & Crick

Chemical Structure of DNA

(A) A nucleotide

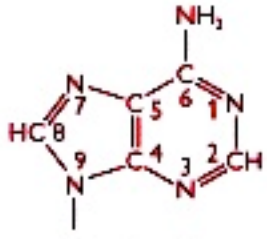
DNA is a polymer consisting of units called ***nucleotides***

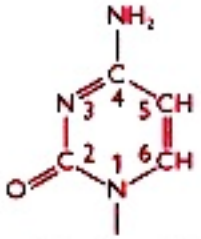


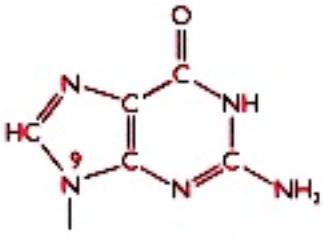


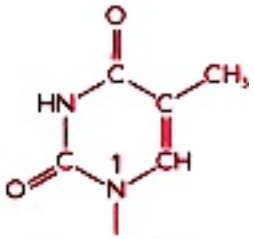
Nucleotide

(B) The four bases in DNA


Adenine (A)


Cytosine (C)

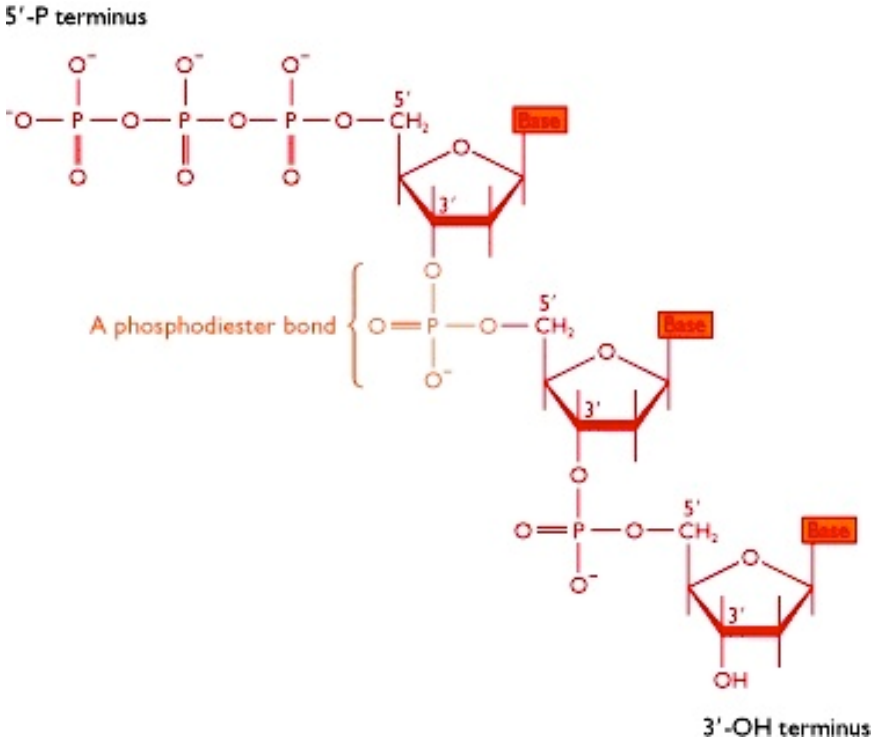

Guanine (G)


Thymine (T)

A, G -- purines

T, C -- pyrmidine

2'-deoxyadenosine-5'-triphosphate (dATP)	A
2'-deoxycytidine-5'-triphosphate (dCTP)	C
2'-deoxyguanosine-5'-triphosphate (dGTP)	G
2'-deoxythymidine-5'-triphosphate (dTTP)	T

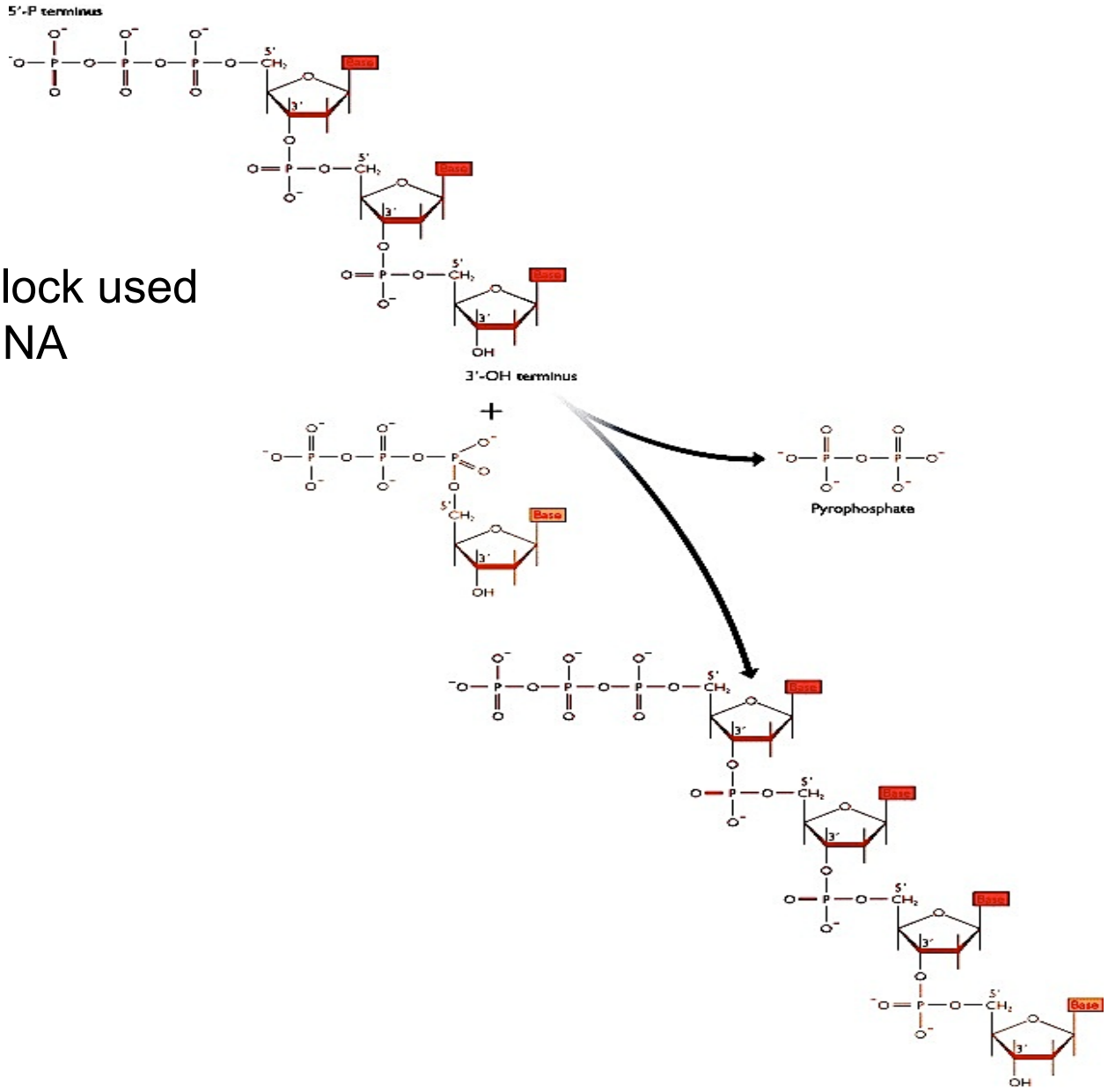


The polynucleotide polymer has a ***chemical direction***

DNA polynucleotide is always written in direction from ***5' to 3' ends***

Polymerization of DNA

dNTPs are the building block used by the cell to synthesis DNA



Chemical Structure of RNA

1- Contains Ribose sugar instead of deoxyribose

2- Contains Uracil instead of Thymidine

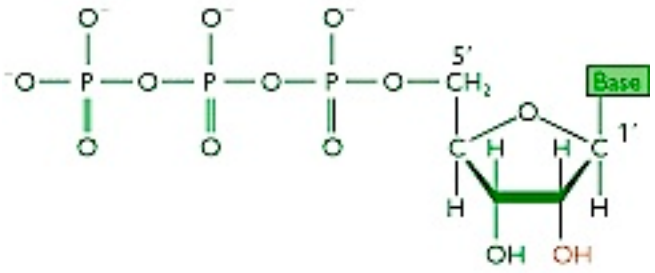
Adenosine-5'-triphosphate (ATP)	A
Guanosine-5'-triphosphate (GTP)	G
Cytidine-5'-triphosphate (CTP)	C
Uridine-5'-triphosphate (UTP)	U

3- Single stranded molecule

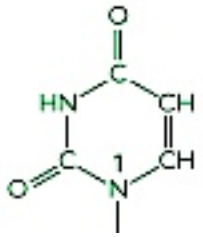
4- Less stable than DNA

5- Shorter than DNA

(A) A ribonucleotide



(B) Uracil



Physical Structure of DNA

DNA is a double helix

Evidences:

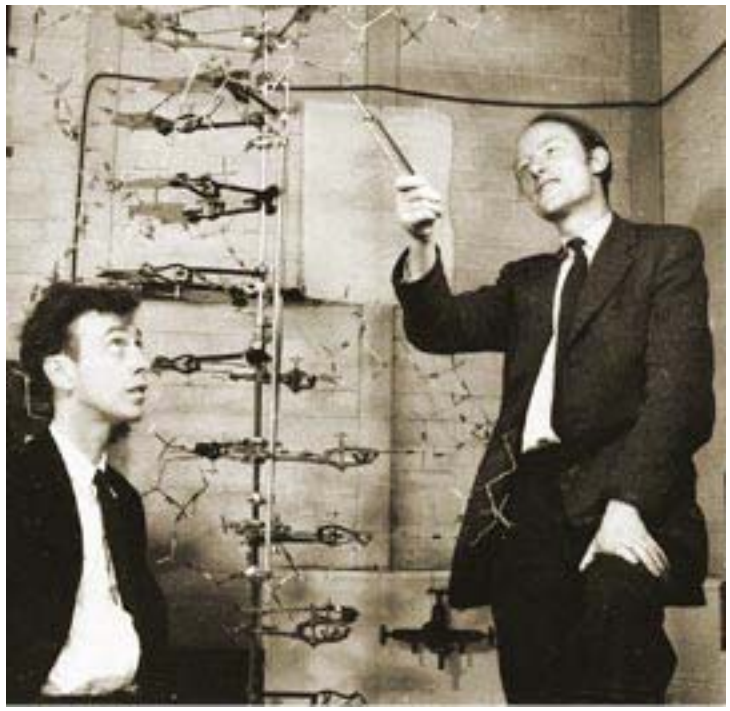
1- Biophysical data

2- X-ray diffraction pattern

3- The base ratios

A/T ratio = 1
G/C ratio = 1

4- Model building



1953
Watson & Crick

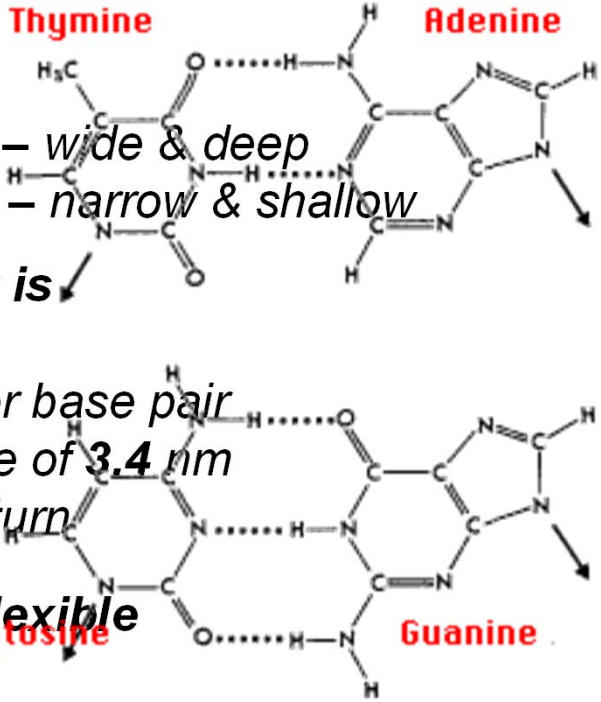
Key features of DNA double helix

1- Double helix is right handed

2- The two strands are complementary to each other

3- The two strands run in opposite directions

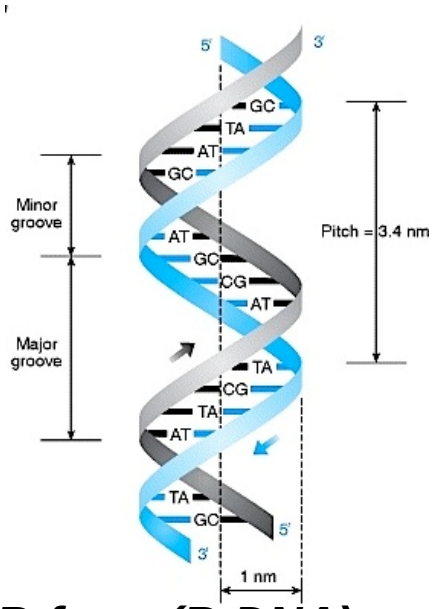
4- The double helix is stabilized by:
- ***a- base pairing***
- ***b- base stacking***



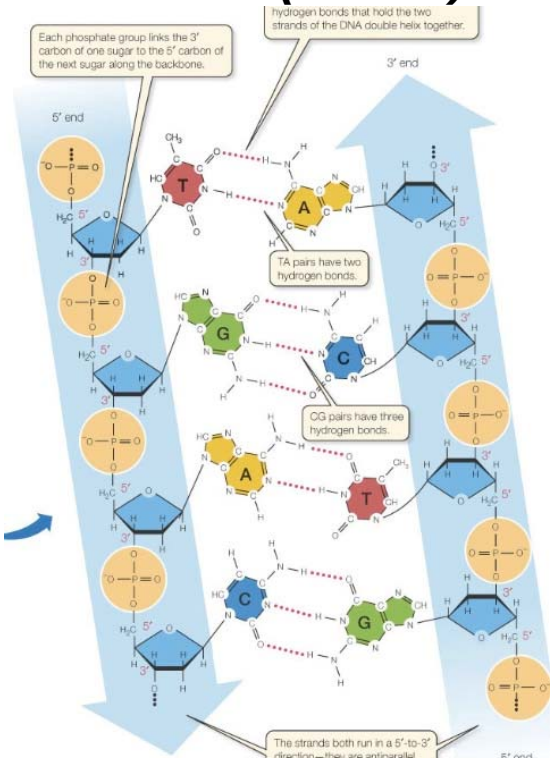
5- Contains:
- ***a- major grooves –*** *wide & deep*
- ***b- minor grooves –*** *narrow & shallow*

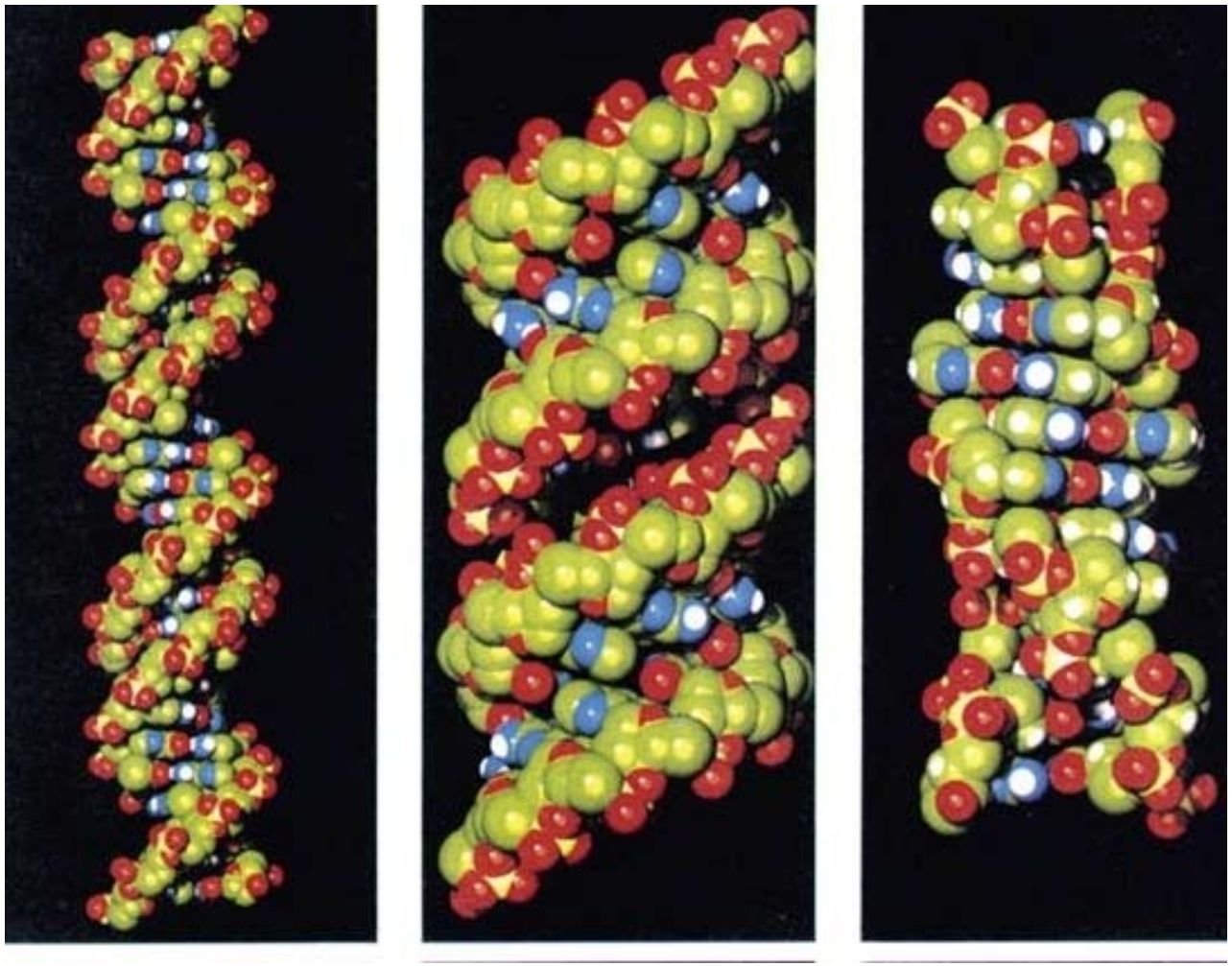
6- The double helix is
- *diameter* ***2.37*** *nm*
- *rise of* ***0.34*** *nm per base pair*
- *pitch (one turn) rise of* ***3.4*** *nm*
- ***10*** *base pairs per turn*

7- Double helix is flexible



B-form (B-DNA)





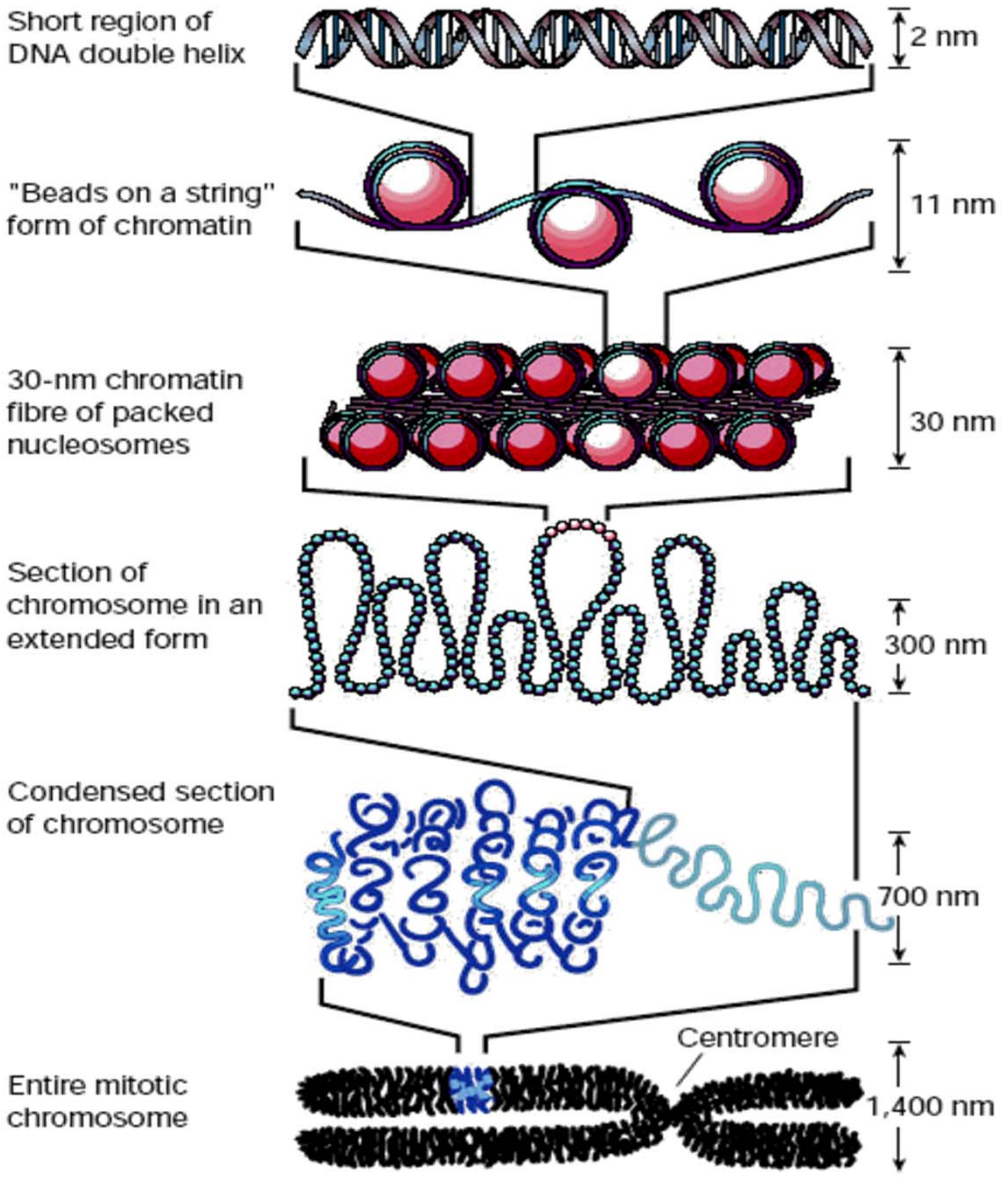
B-DNA ***A-DNA*** ***Z-DNA***

The DNA content of the cell is called **Genome**

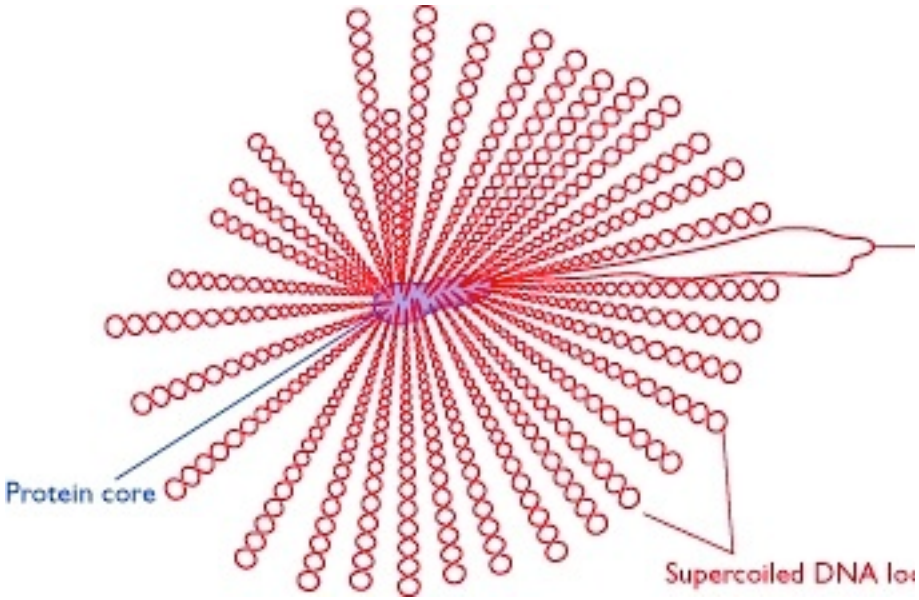
1- Nuclear genome

2- Mitochondrial genome

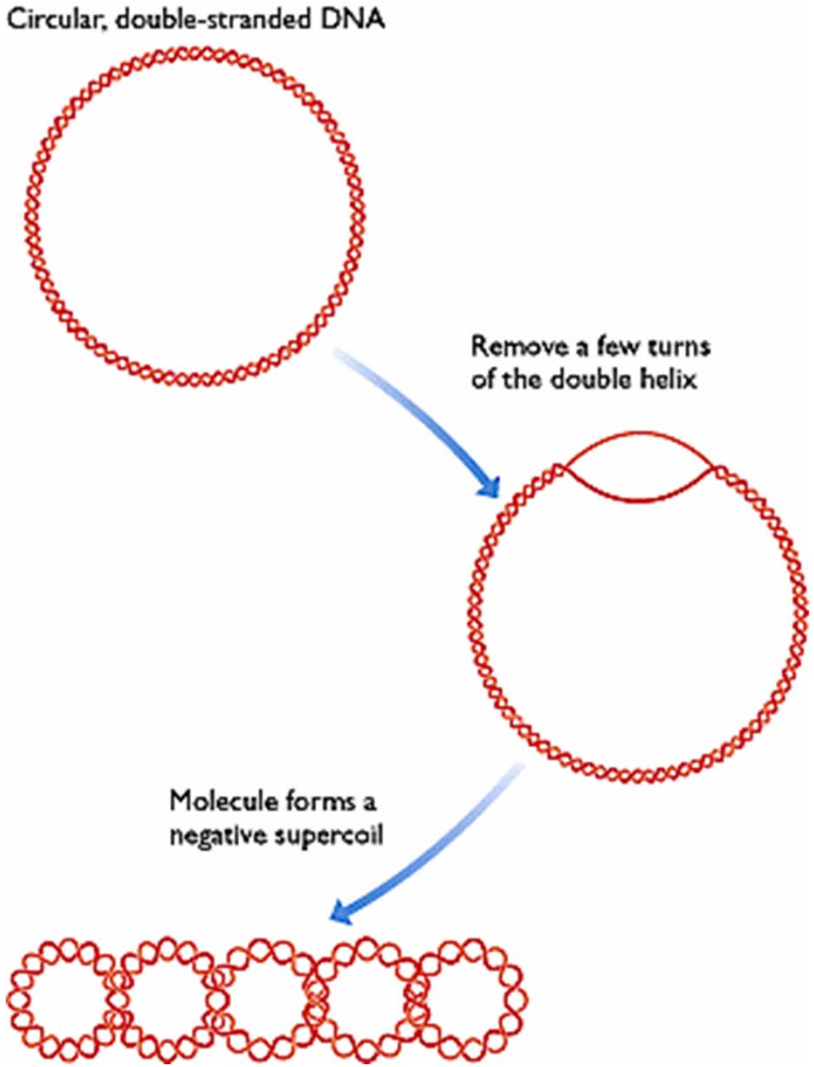
3- Chloroplast genome



DNA Structure in prokaryotes



Nucleoid structure



Bacterial DNA

Questions