

# MOLECULAR BIOLOGY (1)

❖ **Color coding:**

- **Very important**
- Extra information

“IT IS BETTER TO HAVE A HEART WITHOUT WORDS  
THAT WORDS WITHOUT A HEART” - MAHATMA GANDHI

# OBJECTIVES:

- To learn the central dogma of molecular biology.
- To have an understanding of the composition, types and structure of DNA and RNA.
- To have an idea about the organization of DNA in the chromosome and the role of histone proteins.

# The central dogma of Molecular Biology

## Central of dogma?

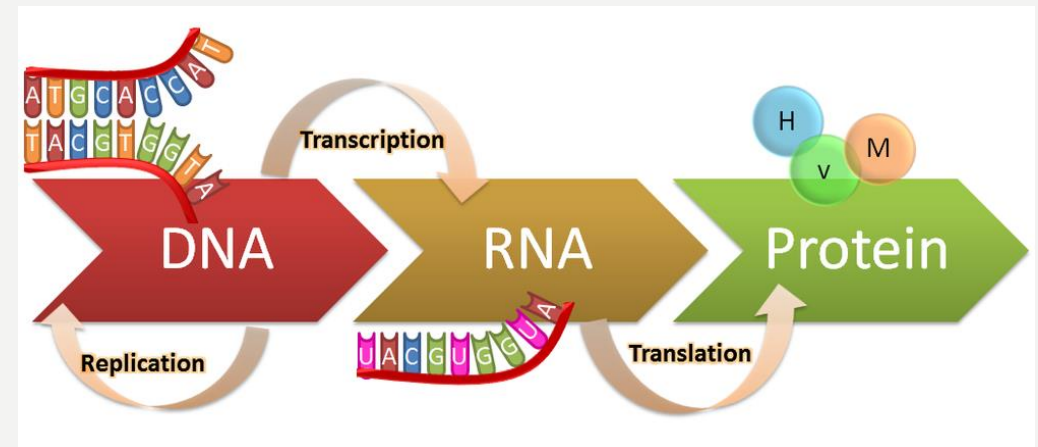
The flow of information from DNA to RNA to Protein.

**Gene:** portion of DNA that transcribed into RNA. .

- human genome contains about 35,000 genes.

## The process of protein formation in the cell :

- a gene  $\xrightarrow{\text{transcribed into}}$  RNA
- RNA  $\xrightarrow{\text{translated into}}$  proteins..



# NUCLEIC ACIDS

DNA  
(Deoxyribonucleic acid).



are

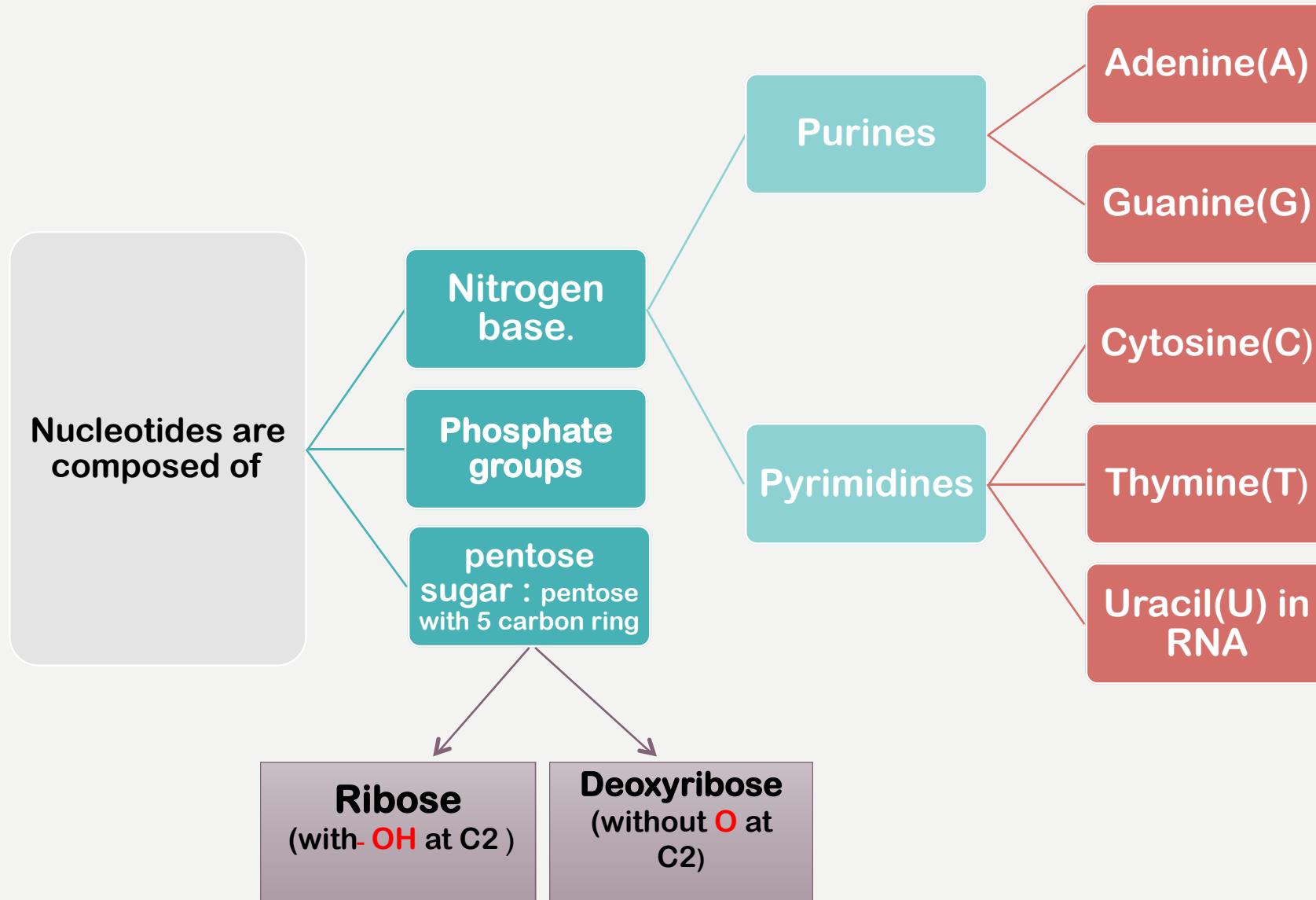
RNA  
(Ribonucleic acid).

## Nucleic acids

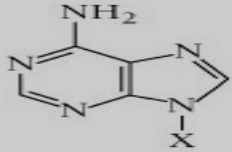
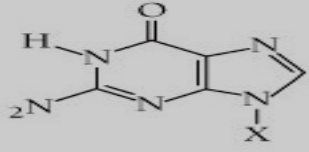
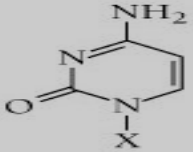
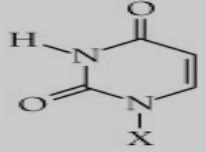
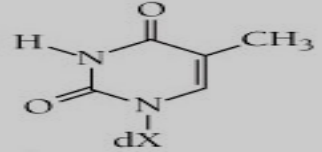
- Required for the storage and expression of genetic information -

# NUCLEOTIDES

Building blocks of nucleic acids are nucleoside triphosphates (**nucleotides**).



# NITROGEN BASES

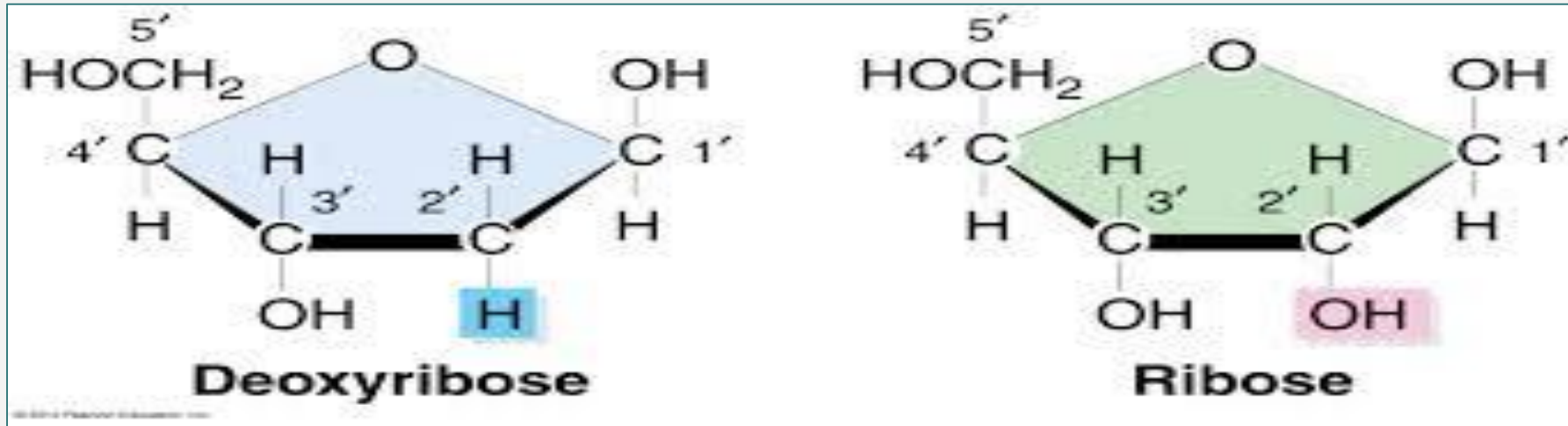
Base Formula	Base (X = H)	Nucleoside (X = ribose <sup>a</sup> )	Nucleotide <sup>b</sup> (X = ribose phosphate <sup>a</sup> )
	Adenine Ade A	Adenosine Ado A	Adenylic acid Adenosine monophosphate AMP
	Guanine Gua G	Guanosine Guo G	Guanylic acid Guanosine monophosphate GMP
	Cytosine Cyt C	Cytidine Cyd C	Cytidylic acid Cytidine monophosphate CMP
	Uracil Ura U	Uridine Urd U	Uridylic acid Uridine monophosphate UMP
	Thymine Thy T	Deoxythymidine dThd dT	Deoxythymidylic acid Deoxythymidine monophosphate dTMP

Purine bases (A, G) have 4 nitrogen atoms.

Pyrimidine bases (T, C, U) have 2 nitrogen atoms

- Nucleoside = nitrogen base + sugar ( ribose ).
- Nucleotide = nitrogen base + sugar ( ribose) + phosphate group (PO<sub>4</sub>)

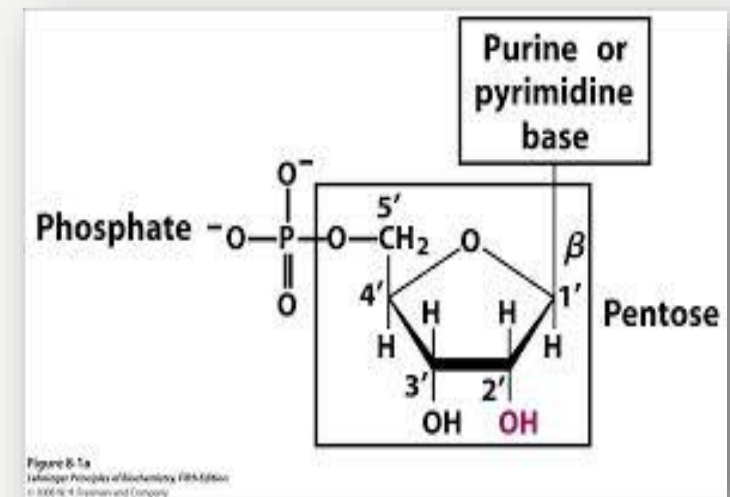
# PENTOSE SUGAR:



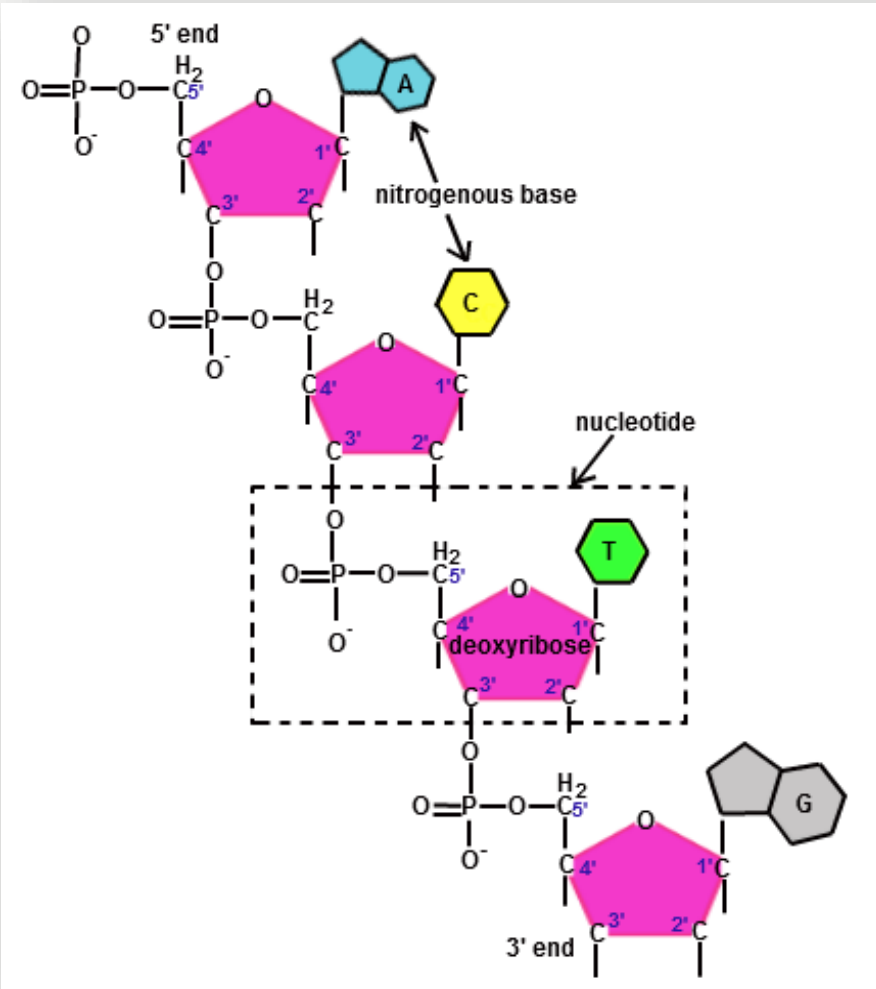
In **DNA**

In **RNA**

- Sugar carbon → number + primed (')
- Nitrogen base atoms → number + **un**primed
- \*The nitrogenous base is bonded to **C1'** of sugar.
- \*The PO<sub>4</sub> group is bonded to **C3'** or **C5'** of sugar.



# CHEMICAL STRUCTURE OF DNA & RNA



- The PO<sub>4</sub> bridges the 3' and 5' positions of ribose sugar.

- The **PO<sub>4</sub>** and sugar bonding is the backbone of DNA structure.

- The linkage between the nucleotides is called phosphodiester bond

\* مهم جدا معرفة اسم الرابطة التي تربط بين النيوكليوتايديز.  
 \* مهم معرفة كل كربون ايش مرتبط فيها .. مثلا النيتروجين البيسسز مرتبطه بكربون رقم ١ -.



## Function of nucleotides

Polymers of nucleotides (as DNA or RNA) store and transfer genetic information.

Free nucleotides and their derivatives perform various metabolic functions not related to genetic information



**Other nucleotides:  
FAD, NAD,  
CoA**

# THE DOUBLE HELIX DNA

**Was determined By:** James watson and Francis crick which commonly known as **\*Watson and crick structure\***

## **Features of Watson and crick DNA Structure:**

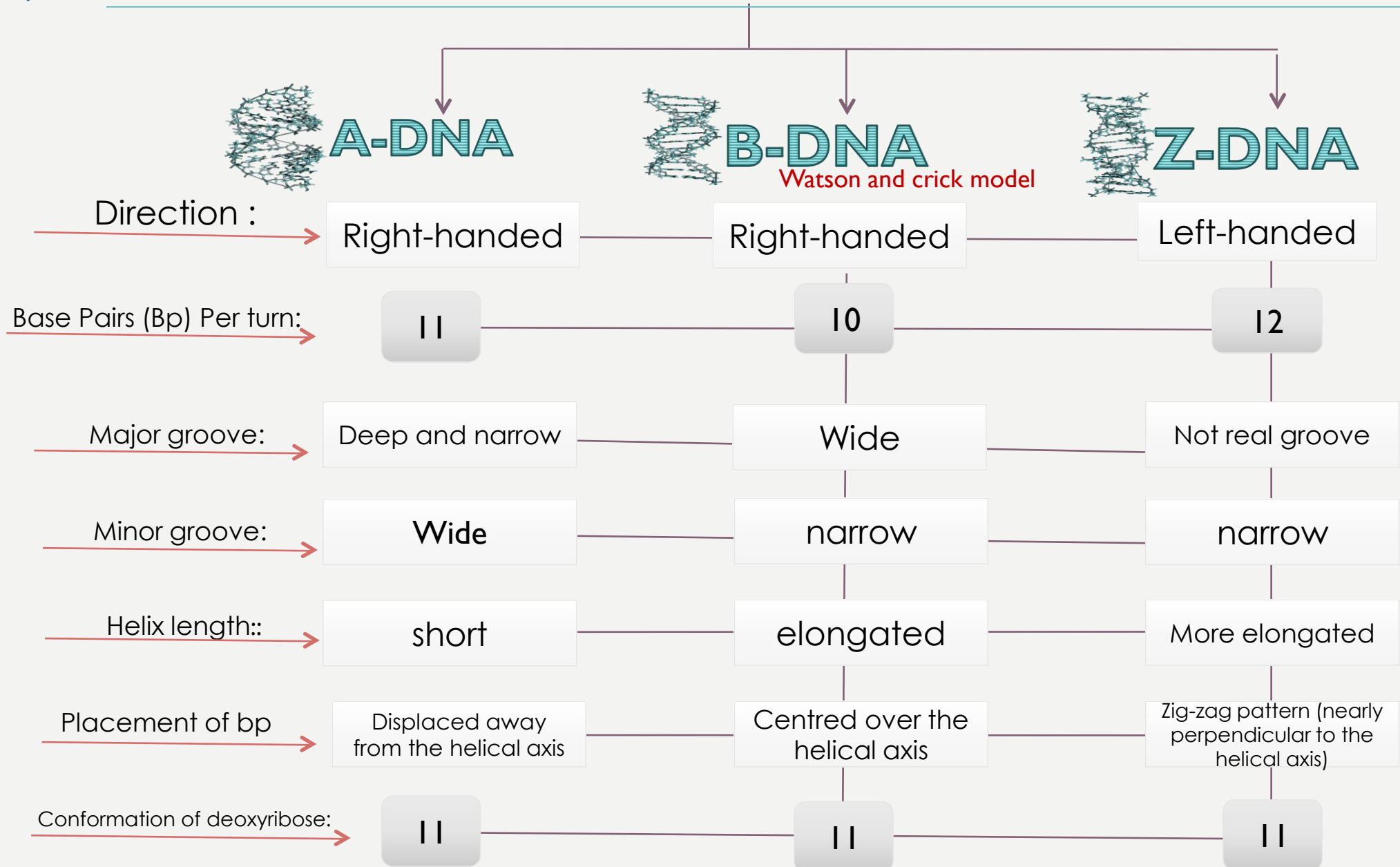
- 1 Two polynucleotides chains wind around a com axis **\*helical axis\*** to form a **\*double helix\***.
- 2 The two strand are **\*anti-parallel\***
- 3 Each helix is **\*Right-handed helix\***.
- 4 Its helix has 10 base pairs per turn.
- 5 Nitrogenous bases are in the center of the double helix .. Sugar-phosphate are on the sides.
- 6 The surface of the double helix contains 2 grooves **\*Minor groove\*** and **\*Major groove\***.
- 7 Each base is **\*hydrogen bonded\*** to a base in the opposite strand to form a base pair (A-T and C-G) .. Known as : **complimentary base pairing**.

Adenine (A) ——— Thyminine (T) ← **Two hydrogen Bond**

Guanine (G) = = = Cytosine (C) ← **Three hydrogen Bond**

**\* In RNA, Thymine is replaced by Uracil (U)\***

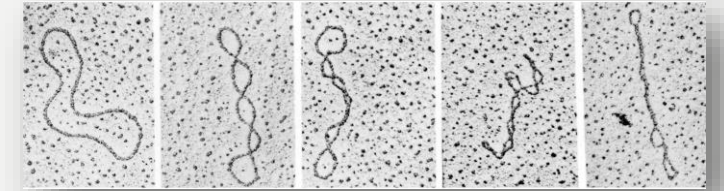
# TYPES OF DNA STRUCTURE



# #DNA SUPERCOILING

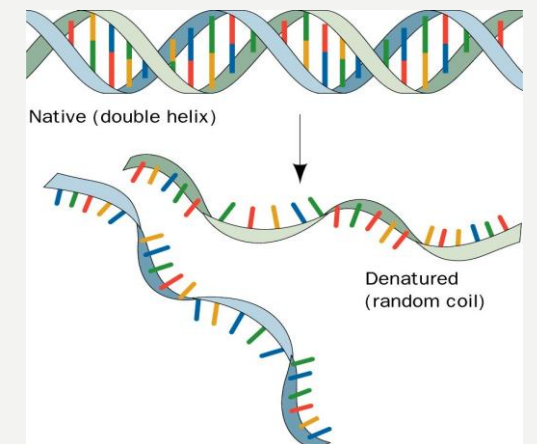
The chromosomes of many bacteria and viruses contain circular DNA which is supercoiled.

- **DNA supercoiling** refers to the over- or under-winding of a DNA strand, and is an expression of the strain on that strand. Supercoiling is important in a number of biological processes, such as compacting DNA.



## #MELTING TEMPERATURE (MT)

- The **temperature** at which the double-stranded DNA is separated into two single strands.
- MT of DNA depends on nitrogenous base content (A-T and G-C). G-C has 3 hydrogen bonds → stronger than A-T.



RNA is : a single-stranded polymer of ribonucleotides.

TYPES OF RNA			
	mRNA	tRNA	rRNA
Full name	Messenger RNA	Transfer RNA	Ribosomal RNA
Function	Transcription process (from DNA to mRNA).	Recognition and transferring. It recognizes amino acids' codons and transfers the selected amino acids to the growing protein chain.	Site of protein synthesis (factory).


# THE DIFFERENCE BETWEEN DNA AND RNA

	DNA	RNA
Stands for	Deoxyribonucleic acid	Ribonucleic acid
Structure	Double stranded. It has two nucleotide strands. (Double helical DNA)	Single stranded. It has one nucleotide stand.
Nitrogenous base (Base pairing)	Adenine links to thymine (A=T) Cytosine links to Guanine (C≡G)	Adenine links to Uracil (A=U) Cytosine links to Guanine (C≡G)
Sugar	pentose with 5 carbon ring Deoxyribose sugar (without O at C <sub>2</sub> )	pentose with 5 carbon ring Ribose sugar (with -OH at C <sub>2</sub> ).
Propagation	DNA is self-replicating	RNA is synthesized from DNA

# HOW DNA IS ORGANIZED IN A CHROMOSOME?

## Important Facts about Chromosomes:

- 1- Each chromosome is a complex of a single linear DNA molecule and protein called **chromatin**.
- 2- The DNA from single 23 human chromosomes have a length of 1 meter.
- 3- 50% of chromatin consists of protein called **Histones**.

- 
- **Major types of histones** : **H1 , H2A , H2B , H3 and H4**.
  - They consist of amino acids that are **positively charged** ( arginine and lysine ).
  - **Importance** : These proteins (+) bind to  $\text{PO}_4(-)$  groups of DNA, stabilizing the structure of chromatin.

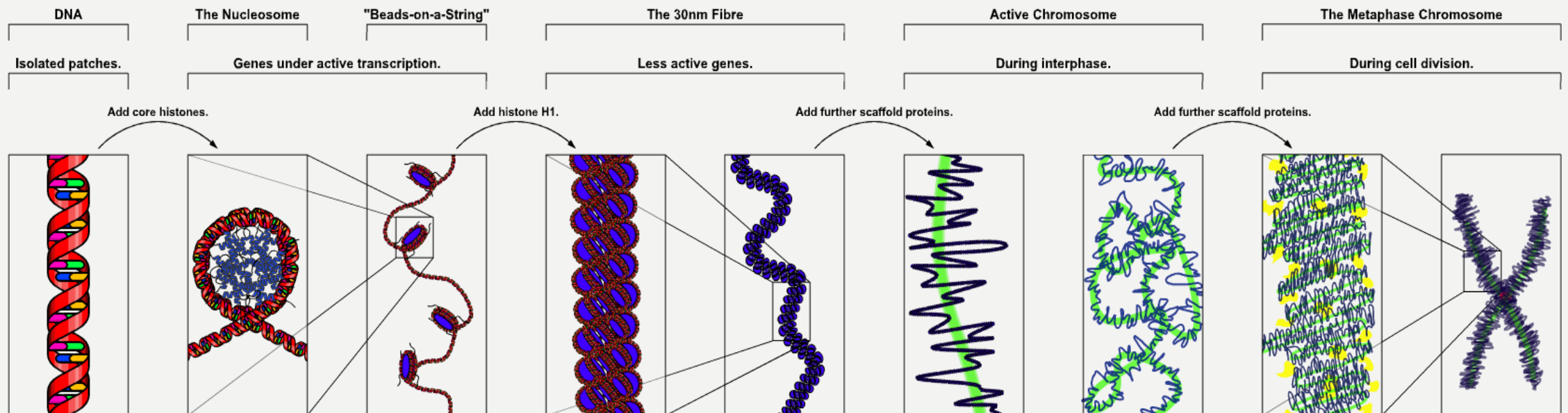
# NUCLEOSOMES:

**Nucleosomes are:** particles consisting of DNA and histones connected by thin strands of naked DNA.

**Nucleosomes consist of:** the histone octamer (eight) and DNA  
 $(H2A)_2(H2B)_2(H3)_2(H4)_2$

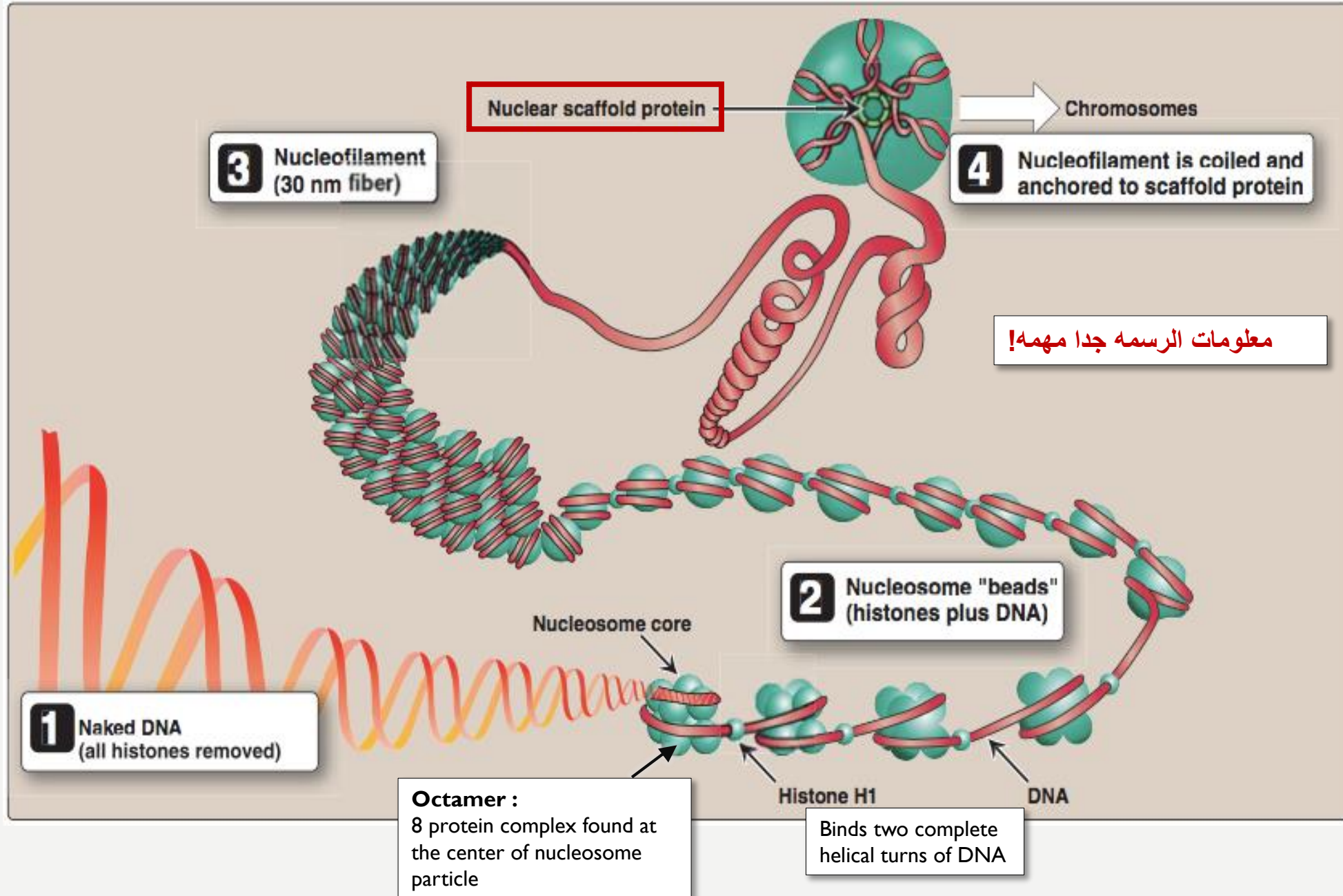
- **H1** binds to 2 complete helical turns of DNA.

هذه الصورة ممكن توضح فكره الباكجنيق:





# DNA PACKAGING



# Videos

- ✓ protein synthesis
- ✓ DNA Double Helix Structure
- ✓ Funny video talks about RNA and compares it with DNA
- ✓ How DNA is organized in a chromosome?
- ✓ How DNA is organized in a chromosome?
- ✓ Nucleosomes
- ✓ DNA packaging
- ✓ DNA packaging

## Boys Team:

- عبدالعزيز المالكي.
- مهند الزهراني.
- أحمد الرويلي .
- محمد الصهيل .
- خالد النعيم .
- إبراهيم الشايع.
- محمد الدغيثر.

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## Girls Team:

- شهد العنزي.
- نوره الرميح .
- بدور جليدان.
- علا النهير.
- أفنان المالكي.
- أمجاد الدهيش.
- دلال الحزيمي.
- فاطمه الدين.
- جواهر الحربي.
- جوهره المالكي.
- خوله العريني.
- لجين السواط.
- منيال باوزير.
- نوره القحطاني.
- رزان السبتي .
- رHF العباد .
- وضحي العتيبي.
- ساره العنزي .