



# ***Genetics***

***Subject : Genetics***

***Lec no : 3 (record 2 part 2)***

***Done By : Mahmoud Al Qusairi***

وَقُلْ رَبِّ زِدْنِي عِلْمًا

تجدون في guidance مادة الباثو على موقع النادي :



شرح المادة كاملة

يوجد شرح للمادة كاملة من أرشيف دفعة آخر مع العلم ان الوحدة الثالثة كانت تعطينا من قبل الدكتور عادة

شرح الفريق العلمي

شرح قديم للفريق العلمي

PATHO - SCIENTIFIC TEAM

تقارير

تقارير تفصي آثر و وريد قويات جدا

يمكن الاستفادة من تقارير الدم السابقة

ATHAR PATHOLOGY NOTES

VEIN PATHO NOTES

QUIZZES

كوييزات للدكاترة

للاوصول الى guidance الباثو و تقارير  
المادة كاملة :



كل اعمال الفريق العلمي تنشر على قناة  
التيليجرام



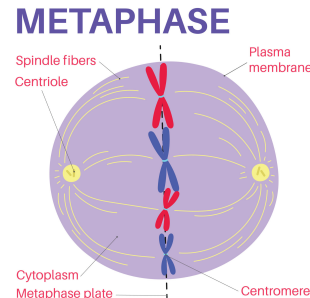
## • Chromatin

replication of DNA

• The simplest form of chromatin is present in non dividing eukaryotic cells, when chromosomes are not sufficiently condensed to be visible by light microscope.

• Chromosomes are normally visible under a light microscope only when the cell is undergoing the **metaphase** of cell division, when the chromosome is in its most condensed state.

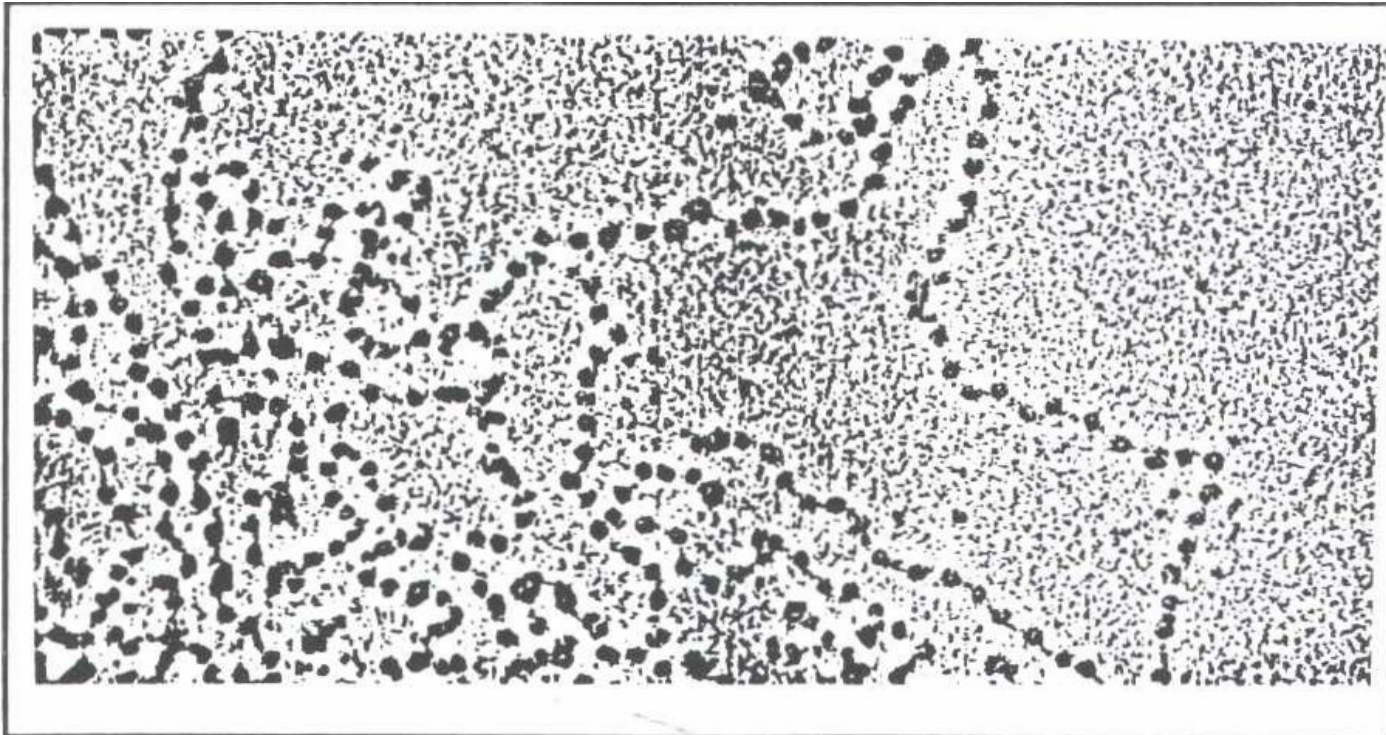
metaphase ← عند انطاف chromosomes في وقت الخلية استعداداً للانقسام.



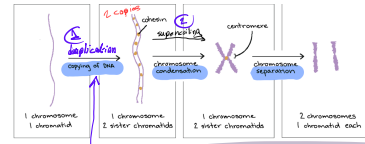
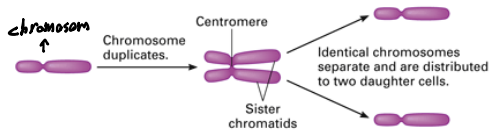


- In electron microscope, chromatin resembles a regularly beaded thread.

*like beads on a string*

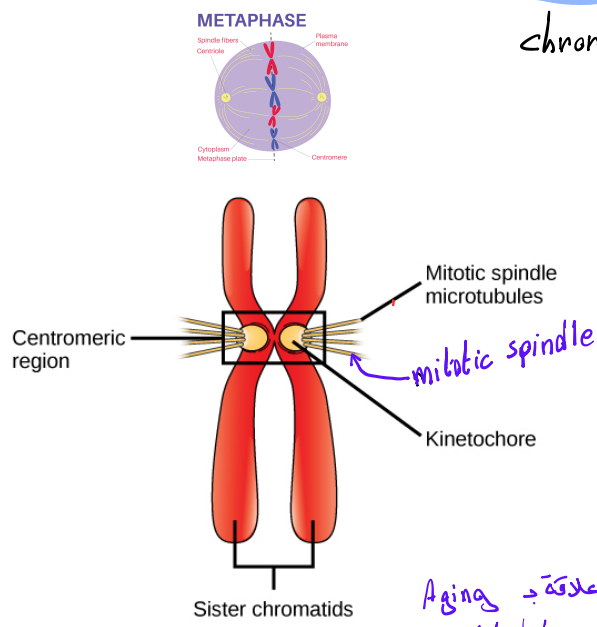


*duplicated chromosome (2 chromatids)*

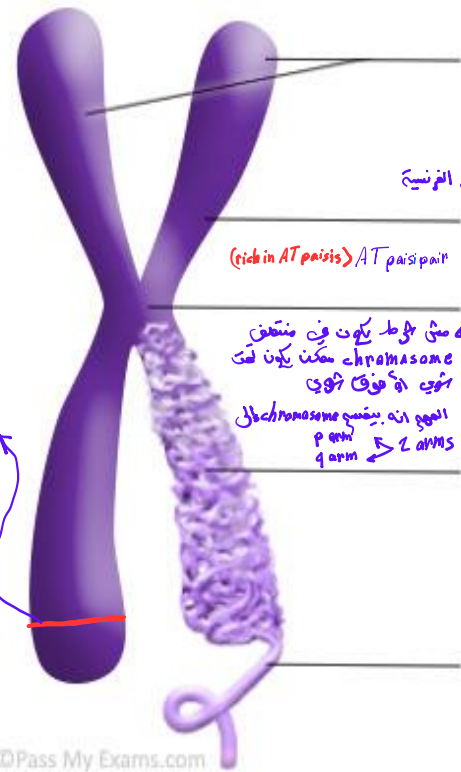


- Before cell division, all DNA molecules are replicated or doubled, the chromatin is **supercoiled** in the form of chromosomes and each chromosome is formed of two identical chromatids.
- A **chromatid** is one of the two **identical halves** of a chromosome that has been **replicated** in preparation for cell division.

← عند فصل chromatids في واحد رح يعطى chromosome



### One Chromosome



**Two Identical Chromatids**

One is an exact copy of the other and each contains one DNA molecule.

**p arm** - short arm structure

**Centromere** - constricted point

of the chromosome

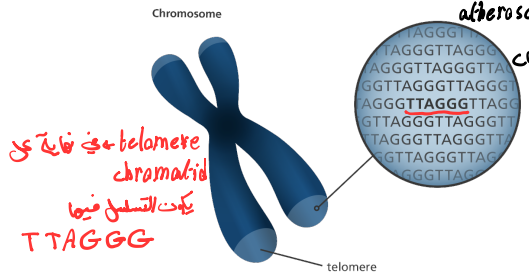
**q arm** - long arm structure

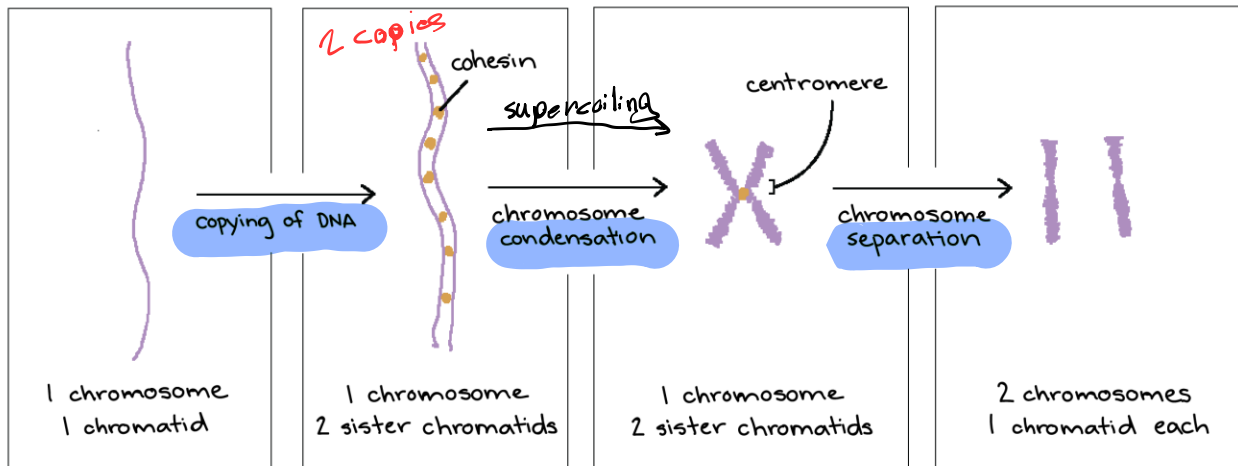
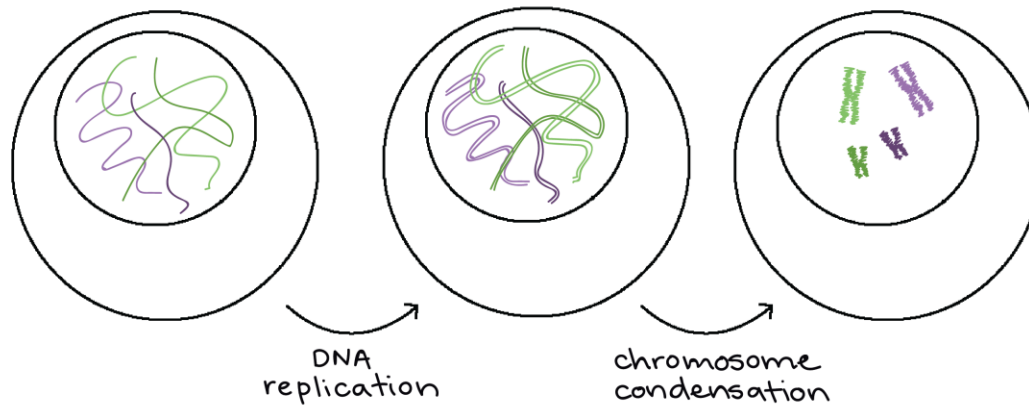
**DNA molecule** - long string like DNA molecule formed into a compact structure by proteins called histones.

AT paisi pair (rich in AT pairs)  
 مكوّنات AT pair في مناطق  
 التي فيها يكون لون chromatosome  
 أزرق أو فوق أزرق  
 المكوّنات الغنية بـ AT  
 p arm → 2 arms  
 q arm

مهمة لأنّها رح يمسك فيها  
 Kinetochore ويعمل proteins  
 منطقة ارتباط spindle  
 التي رح تسحب كل chromatid  
 أثناء division

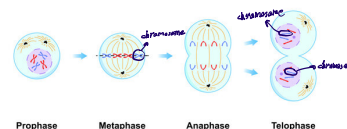
يقال ان له علاقة بـ Aging  
 له علاقة بـ Aging related diseases  
 الزهايمر  
 وله علاقة بـ cancer





As long as the sister chromatids are connected at the centromere, they are still considered to be one chromosome. However, as soon as they are pulled apart during cell division, each is considered a separate chromosome.

Mitosis Phases



\* بسبب أن histone proteins لها شحنة positive و DNA لها شحنة negative ∴ عملية التفاف DNA على proteins تكون أكثر سهولة

## • Each chromatid consists of :

1- A single DNA molecule.

2- Histone proteins: they are **basic proteins** rich in **lysine and arginine** (positively charged), that are united to the **DNA which is acidic** (negatively charged) due to the presence of phosphate groups.

*proteins rich in basic a.a*

*basic a.a*

*(nucleotides في تركيب phosphate) ← phosphoric acid*

■ Five major types of histones (H1, H2A, H2B, H3 and H4) are present in eukaryotic chromosomes.

■ Histones play an important role in DNA supercoiling and regulation of gene expression.

3- Non-histone proteins: include enzymes involved in DNA replication and transcription as well as proteins regulating these two processes.

- The two identical chromatids of each chromosome are connected at the **centromere**, which is rich in A---T and is about 130 bp long. The centromere is connected to specific proteins to form a complex known as **kinetochore**, which is connected to the mitotic spindle.
- Each chromatid has two ends or **telomeres**, that are characterized by the presence of variable repeat number of specific sequence of several kilobases long, which is (TTAGGG)<sub>n</sub> in humans



regulation of gene expression <sup>coiling</sup> ↗ 2 functions ← histone proteins <sup>من التفاف DNA</sup>

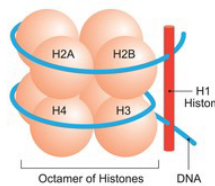
- Each chromatid is formed of many **nucleosomes**.
- Each nucleosome is formed of eight histones (histone octomer or histone core) or two copies of each of H2A, H2B, H3 and H4.
- Around the histone octomer is wrapped 1.75 left-handed turns of DNA (contains average 140 bp).
- Linker or spacer DNA (contains average 60 pb) connects the different nucleosomes like beads on a string. H1 histones are connected to these linker DNA segments.
- Linker histones such as H1 and its isoforms are involved in chromatin compaction and sit at the base of the nucleosome near the DNA entry and exit binding to the linker region of the DNA.

لفة وثلاث أرباع اللفة فيها 140 base pairs

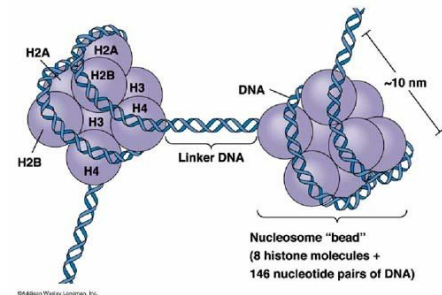
أول level من supercoiling

condensation form هذا غير كافي للمرحلة الأولى إلى بدنا إياه.

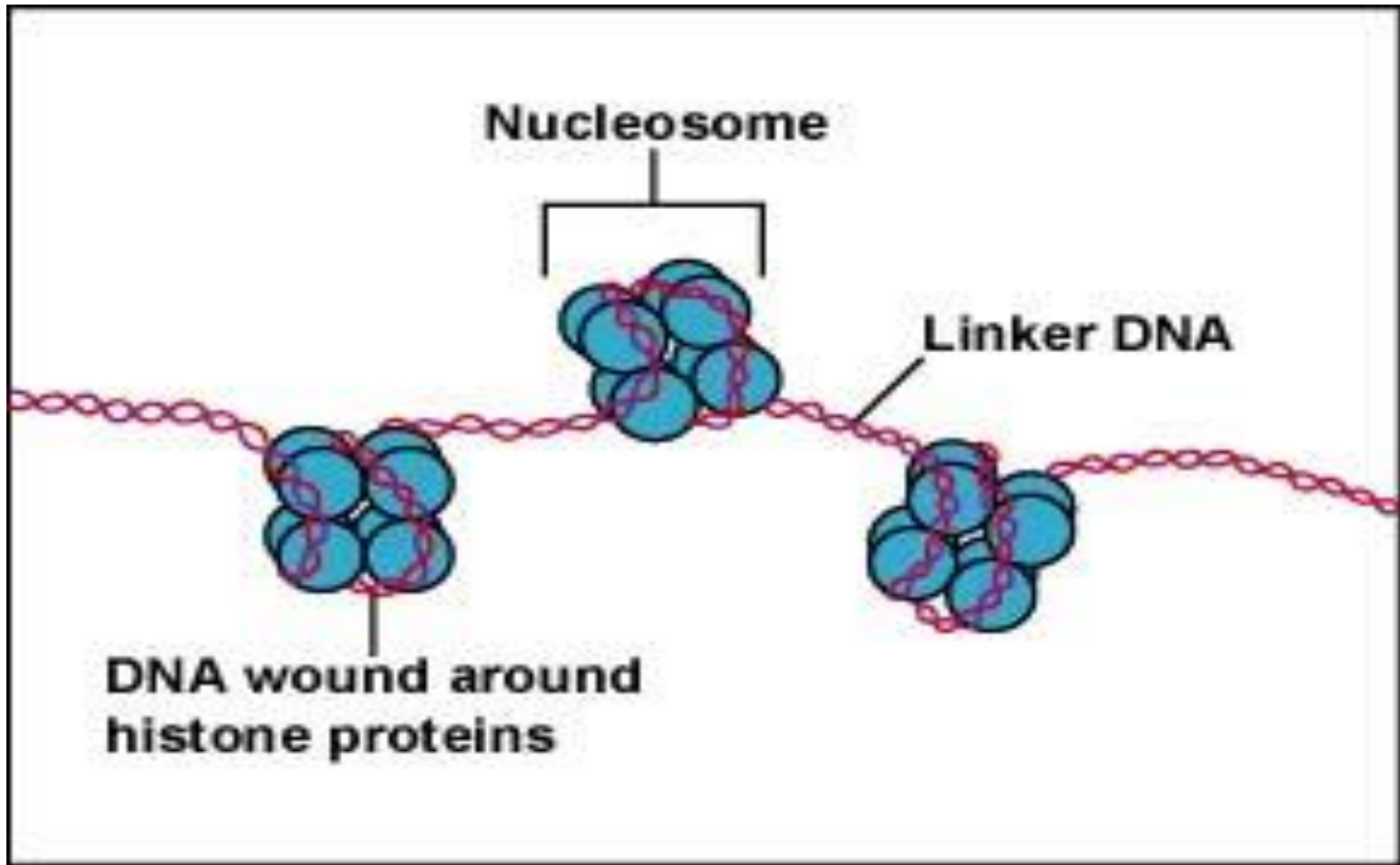
Histone Structure



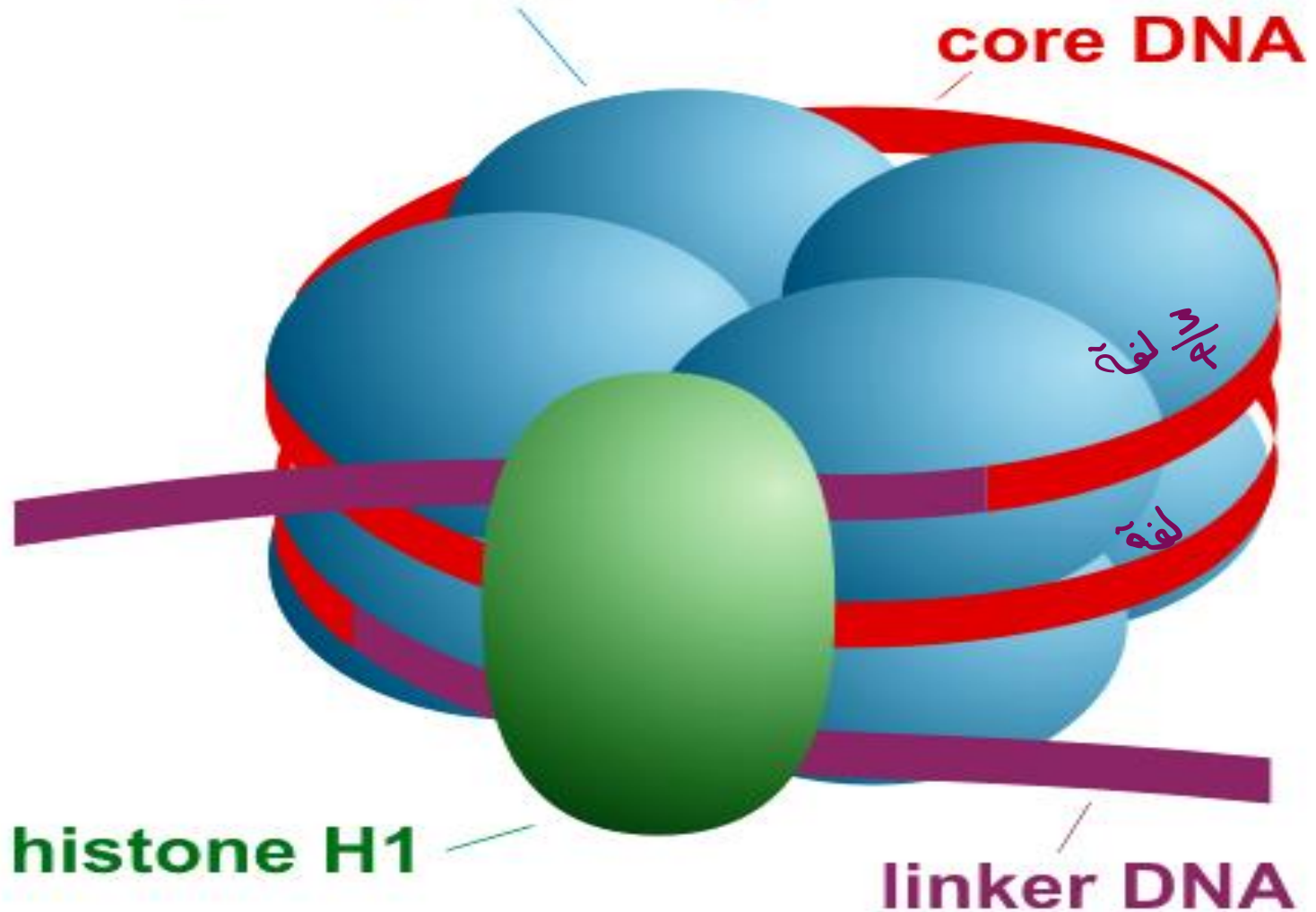
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octamer of core histones:  
H2A, H2B, H3, H4 (each one  $\times 2$ )



سلي هنا

- **Supercoiling of DNA:**

- Supercoiling of DNA is important for its packing within the small nucleus. (in mammalian cells approximately 2 m of linear DNA have to be packed into a nucleus of roughly 10  $\mu\text{m}$  diameter).
- **The first level** of supercoiling (packing ratio of 10) around histone octomer in the form of nucleosomes produces a ten fold shortening of the length of DNA to form **the 10-nm fibril** (10 nm in diameter)



■ **The second level of supercoiling** (packing ratio of 50):

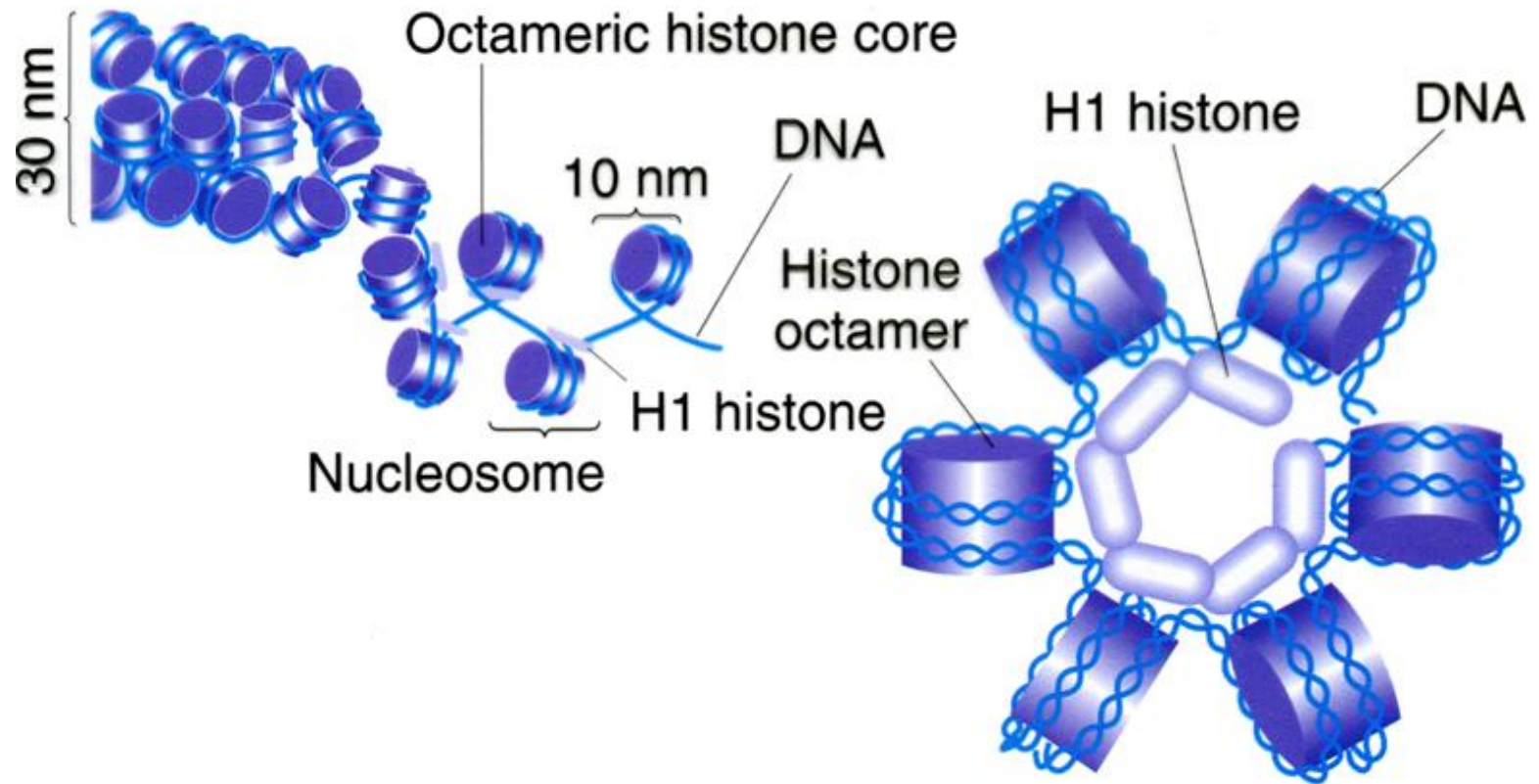
Requires the presence of H1, this leads to 50-fold shortening of the DNA and it looks like a solenoid (cylindrical coil), each turn contains 6 nucleosomes that form the 30-nm fiber (30 nm in diameter).

■ **The third level of supercoiling** (packing ratio of 8000):

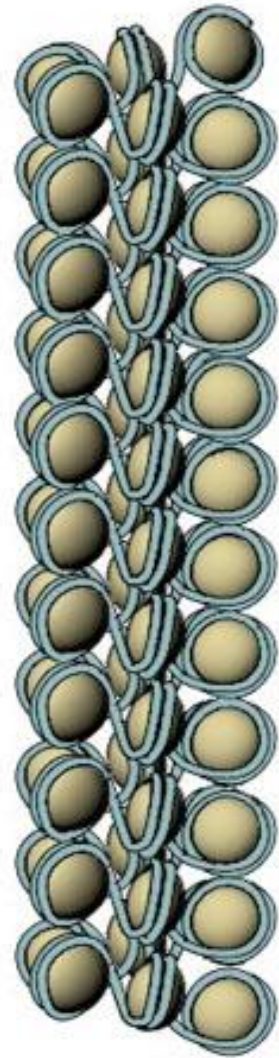
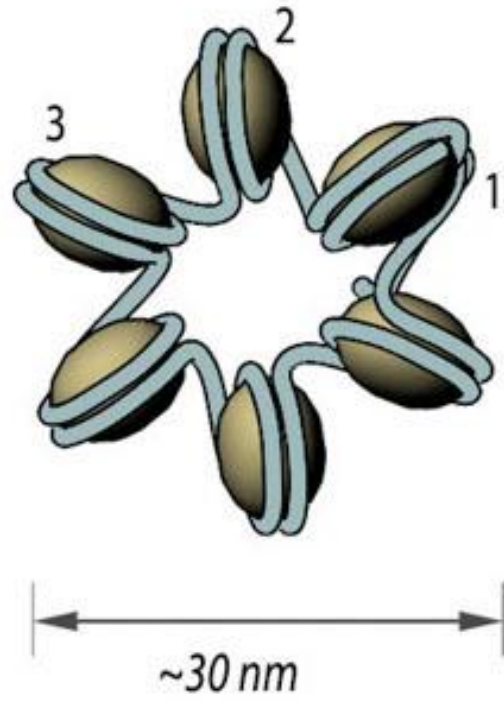
Coiling of the 30nm fiber into twisted-looped structure attached to a protein scaffold in the form of rosettes. Each rosette contains 6 loops.

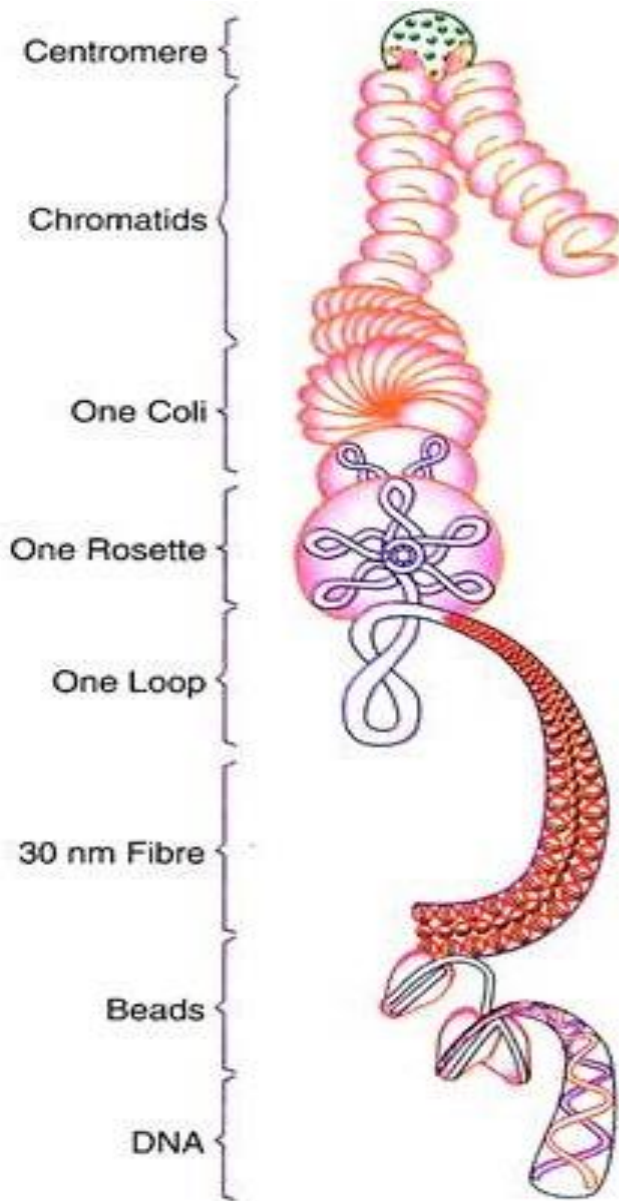
The rosettes are arranged in the form of a coil to form each chromatid, each turn of the coil is composed of about 30 rosettes.

# 30 nm fibers



## A. Solenoid





Packaging of eukaryotic DNA



## Compaction of DNA in a eukaryotic chromosome

