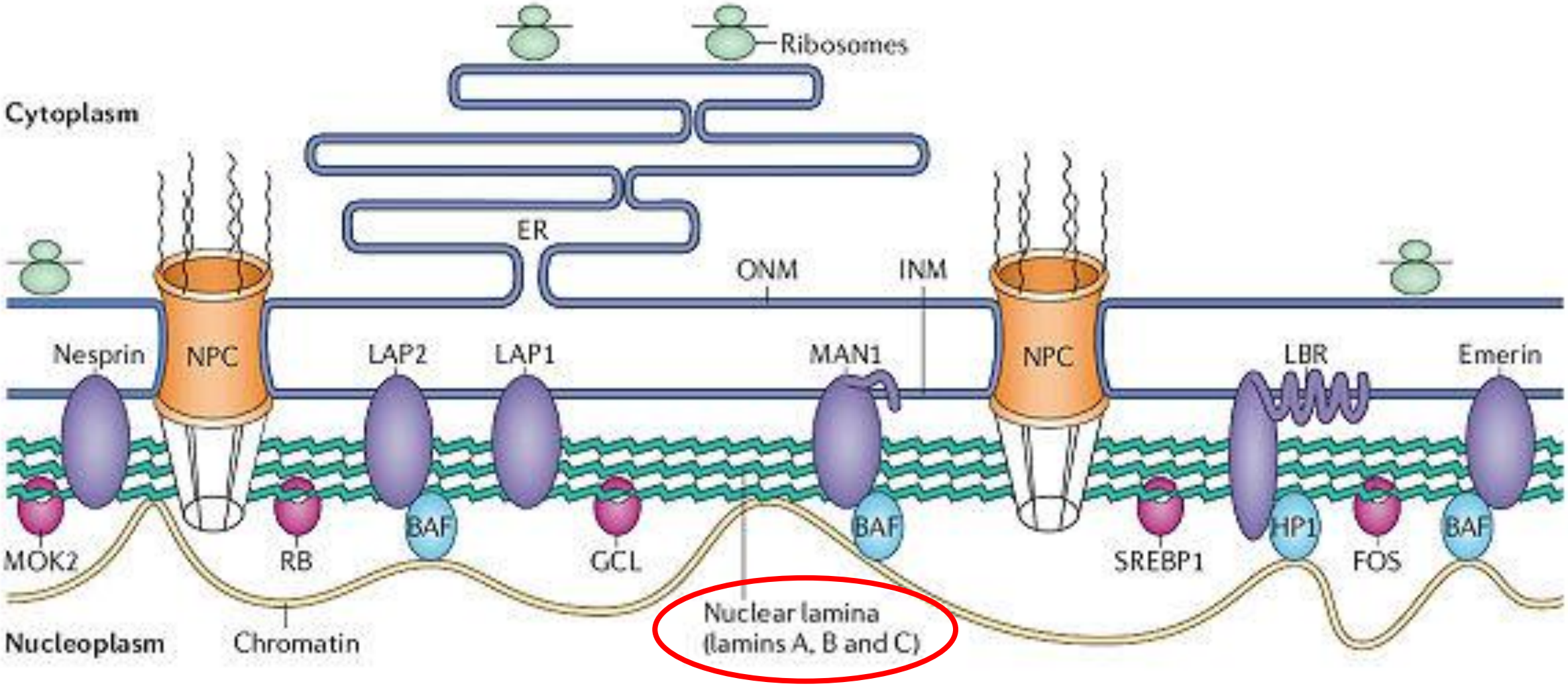
Nuclear lamina

- The nuclear lamins are critically important for the structural properties of the nucleus.
- Nuclear lamina is a filamentous layer located between the inner nuclear membrane (INM) and peripheral heterochromatin.
- It contains three major structurally related polypeptides . These proteins are named nuclear lamins A, B, and C according to their molecular weights.
- Further biochemical characterization and cDNA cloning of the nuclear lamins classifies them as type V intermediate filament proteins.
- The lamina is comprised of a complex meshwork of proteins closely associated with the INM and attached to the periphery of NPCs and to chromatin
- The nuclear lamina is an essential component of metazoan cells.
- the nuclear lamina provide structural support and integrity to the nucleus,
- The nuclear lamina has roles in nuclear integrity, mitosis, DNA replication, signaling, regulation of transcription, and genome organization.
- The nuclear lamina plays an important role in the regulation of gene expression through a number of different mechanisms. These include modulation of gene expression by virtue of chromatin organization and chromosome positioning within the nucleus
- The nuclear lamina provides an anchor point for linking chromatin to the nuclear envelope.


Ribosomes
Cytoplasm
ER
ONM
INM
Nesprin
NPC
LAP2
LAP1
MAN1
NPC
LBR
Emerin
MOK2
RB
BAF
GCL
BAF
SREBP1
HP1
FOS
BAF
Nuclear lamina
(lamins A, B and C)
Nucleoplasm
Chromatin

Chromatin

- In eukaryotic cells the genetic material is organized into a complex structure composed of DNA and proteins and localized in a specialized compartment, the nucleus, called **chromatin**
- Chromosome and chromatin are basically same thing, the only difference chromatin is less condensed and extended DNA while chromosomes are highly condensed DNA
- The fundamental unit of chromatin, termed the **nucleosome,** composed of DNA and histone proteins.
- Chromatin has been divided into:
  - **euchromatin** and
  - **heterochromatin**.

Chromatin and Condensed Chromosome Structure

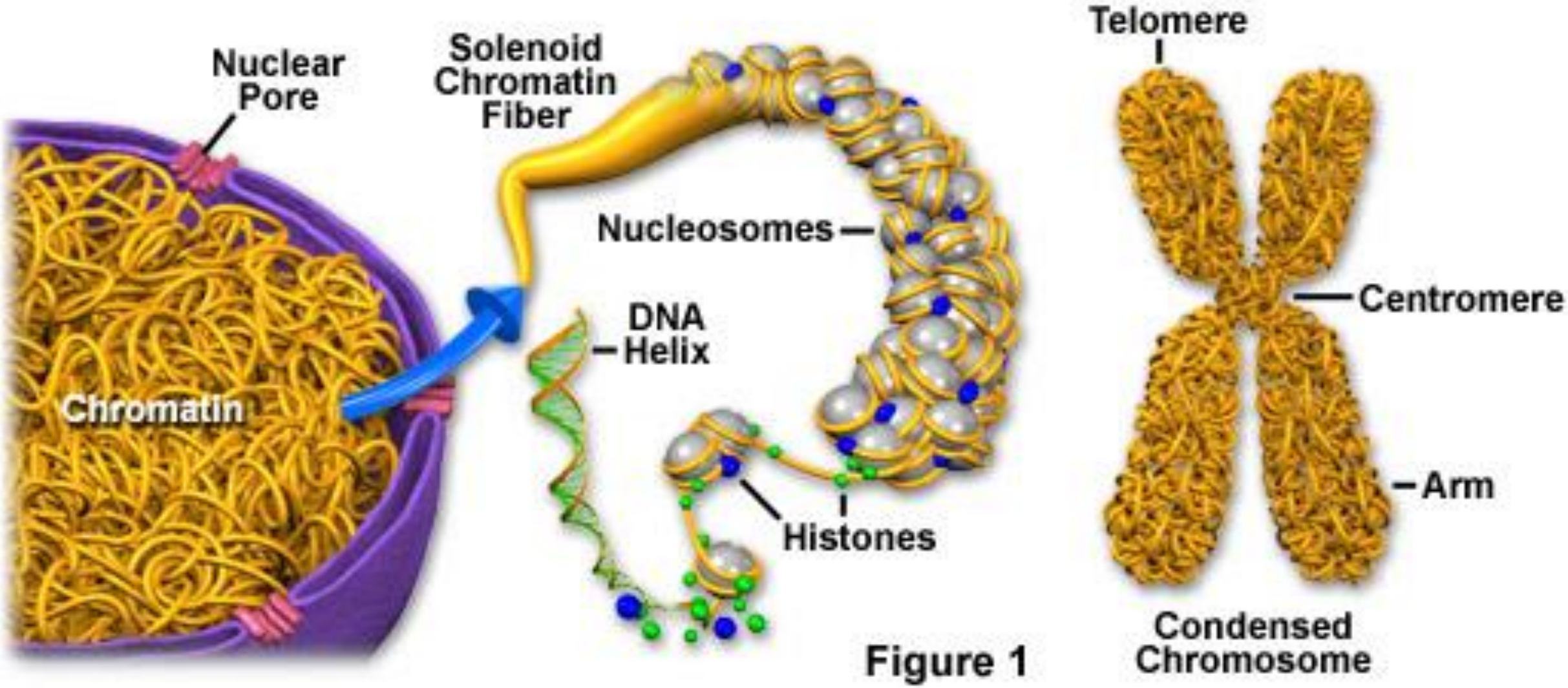
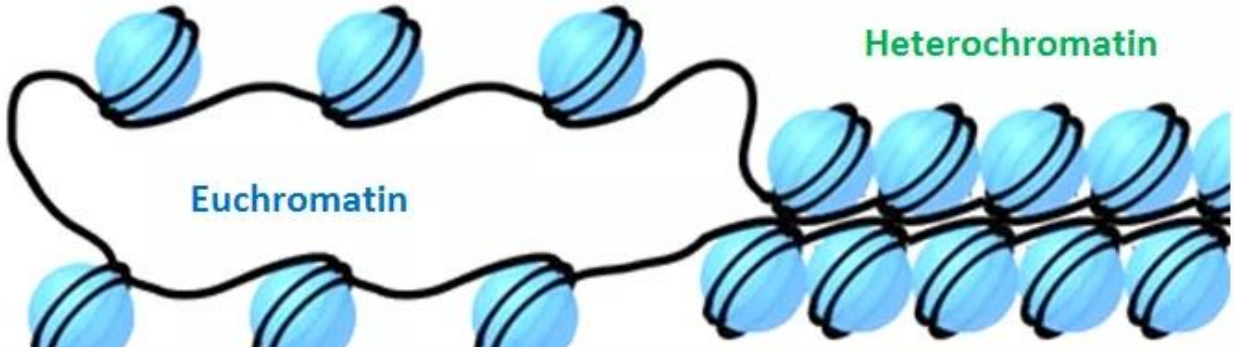


Figure 1

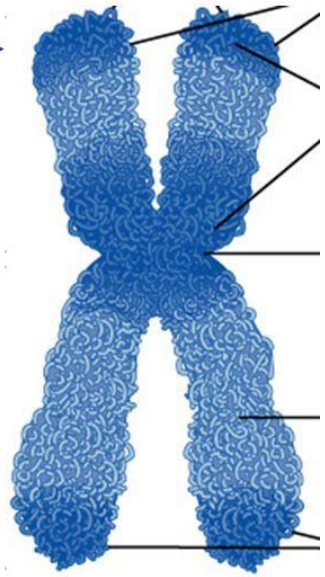
Heterochromatin and euchromatin

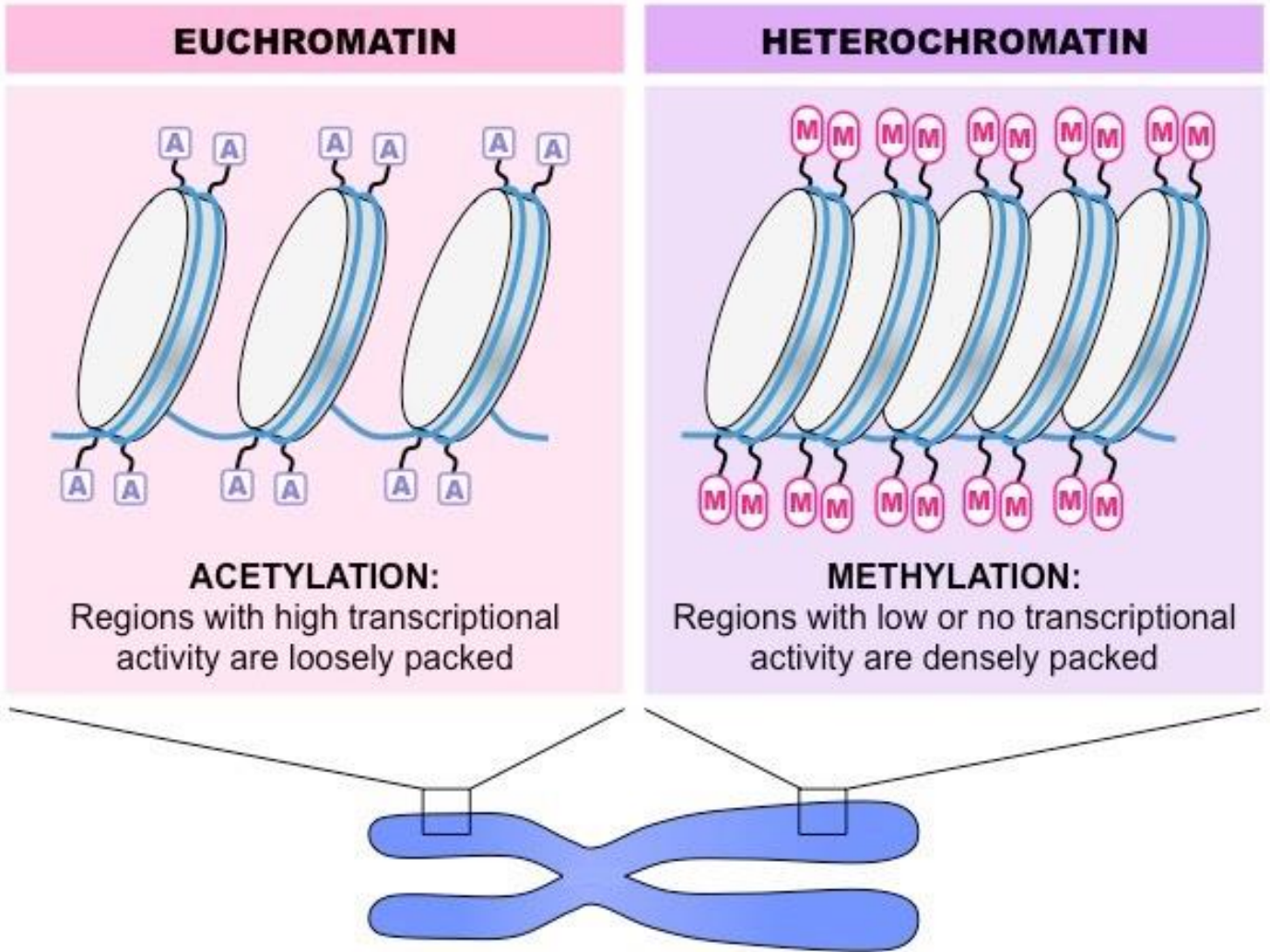
- In the eukaryotic genome, DNA associates with proteins to form densely packed chromatin, a highly coiled and compact structure.
- The two types of chromatin, heterochromatin and euchromatin, are functionally and structurally distinct regions of the genome.
- Heterochromatin is densely packed and inaccessible to transcription factors so it is rendered transcriptionally silent (Richards and Elgin 2002).
- Euchromatin, on the other hand, is less condensed, more accessible, and therefore transcriptionally active (Hennig 1999).



Chromosome Parts:

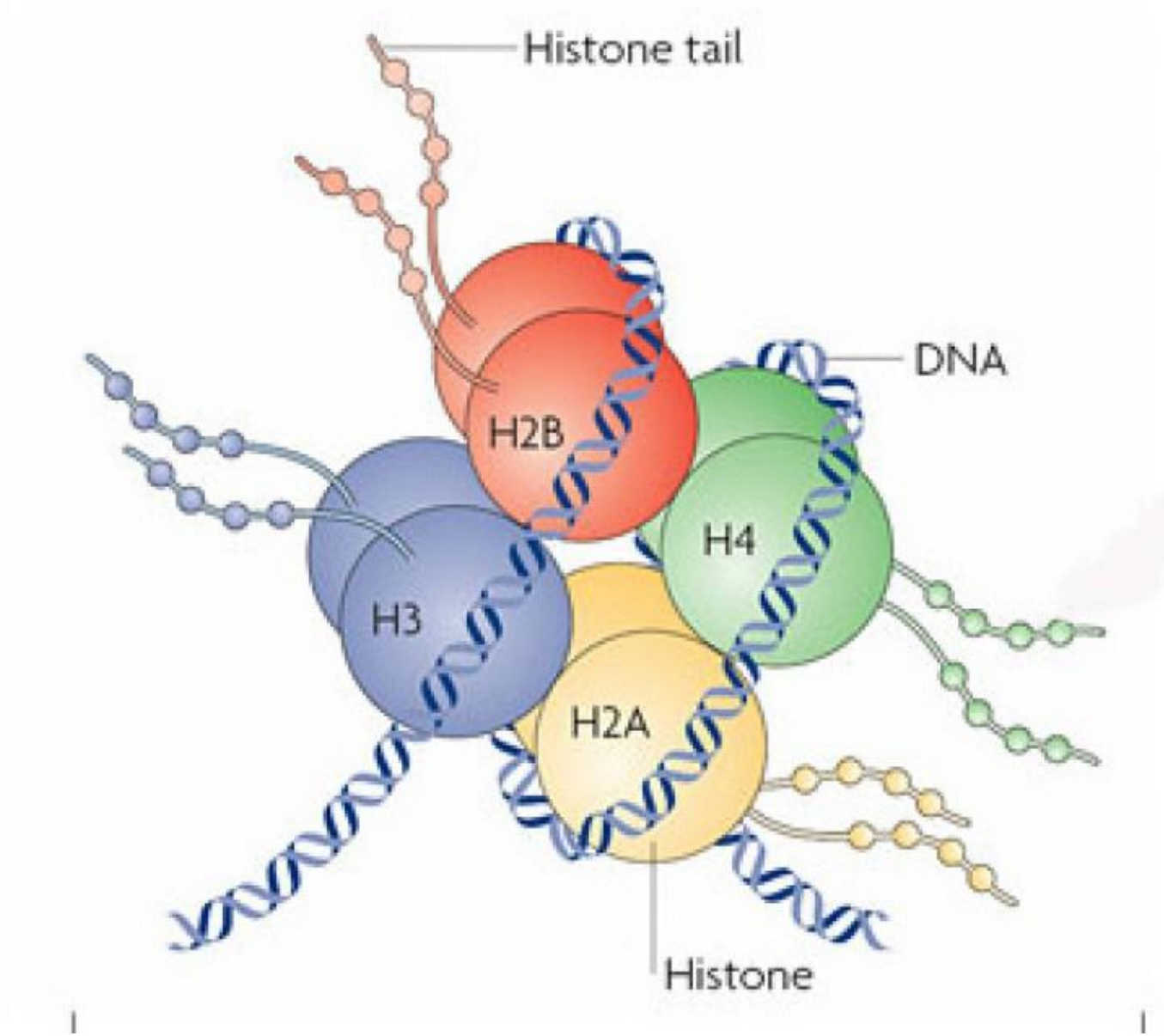
- Heterochromatin:
  - More condensed
  - Silenced genes (methylated)
  - Gene poor (high AT content)
  - Stains darker
- Euchromatin:
  - Less condensed
  - Gene expressing
  - Gene rich (higher GC content)
  - Stains lighter





Nucleosome

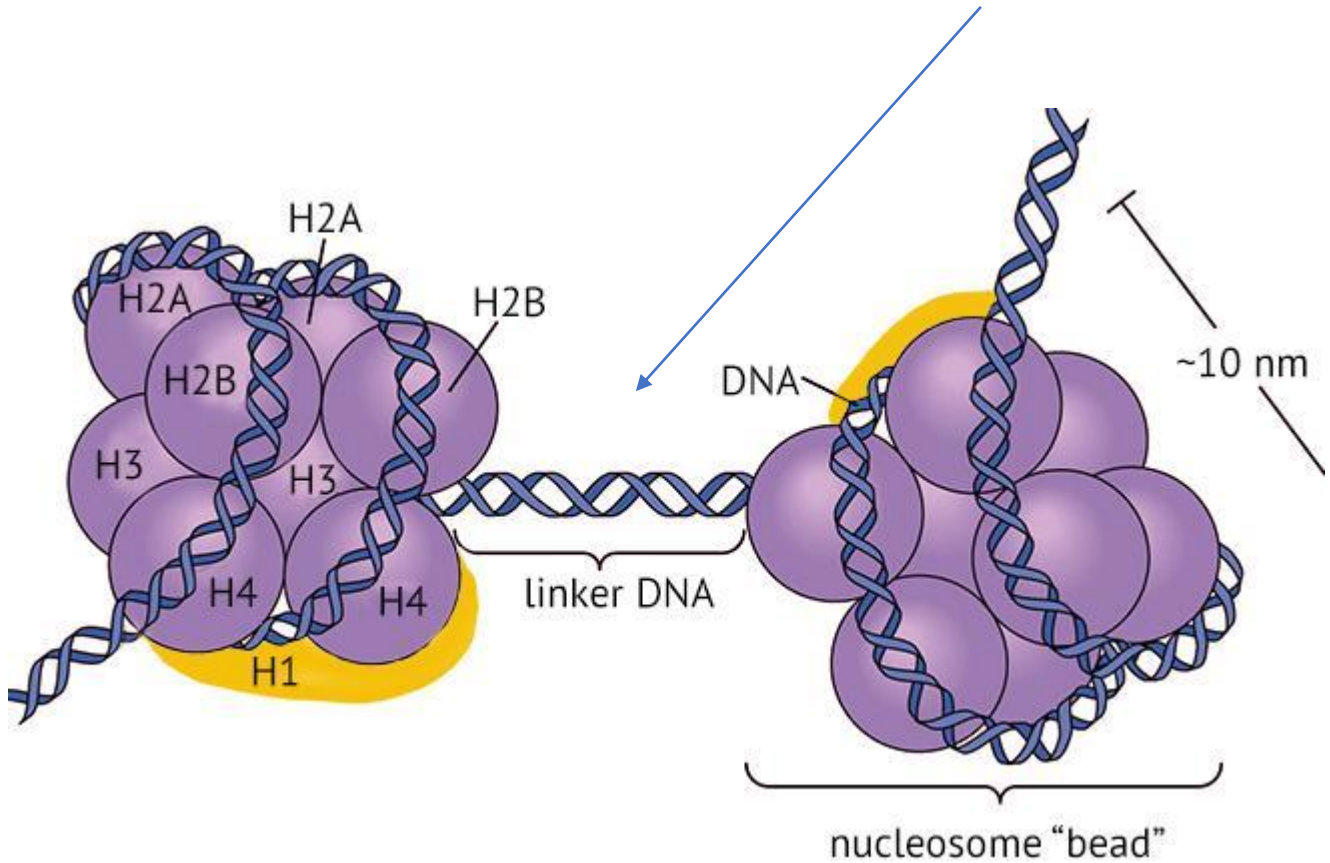
- A nucleosome is a section of DNA that is wrapped around a core of proteins.
- Inside the nucleus, DNA forms a complex with proteins called chromatin, which allows the DNA to be condensed into a smaller volume.
- When the chromatin is extended and viewed under a microscope, the structure resembles beads on a string.
- Each of these tiny beads is a called a nucleosome and has a diameter of approximately 11 nm.
- The nucleosome is the fundamental subunit of chromatin.
- Each nucleosome is composed of a little less than two turns of DNA wrapped around a set of eight proteins called histones, which are known as a histone octamer.
- Each histone octamer is composed of two copies each of the histone proteins H2A, H2B, H3, and H4.
- The chain of nucleosomes is then compacted further and forms a highly organized complex of DNA and protein called a chromosome.



- Nucleosome: a section of DNA that is wrapped around a core of proteins

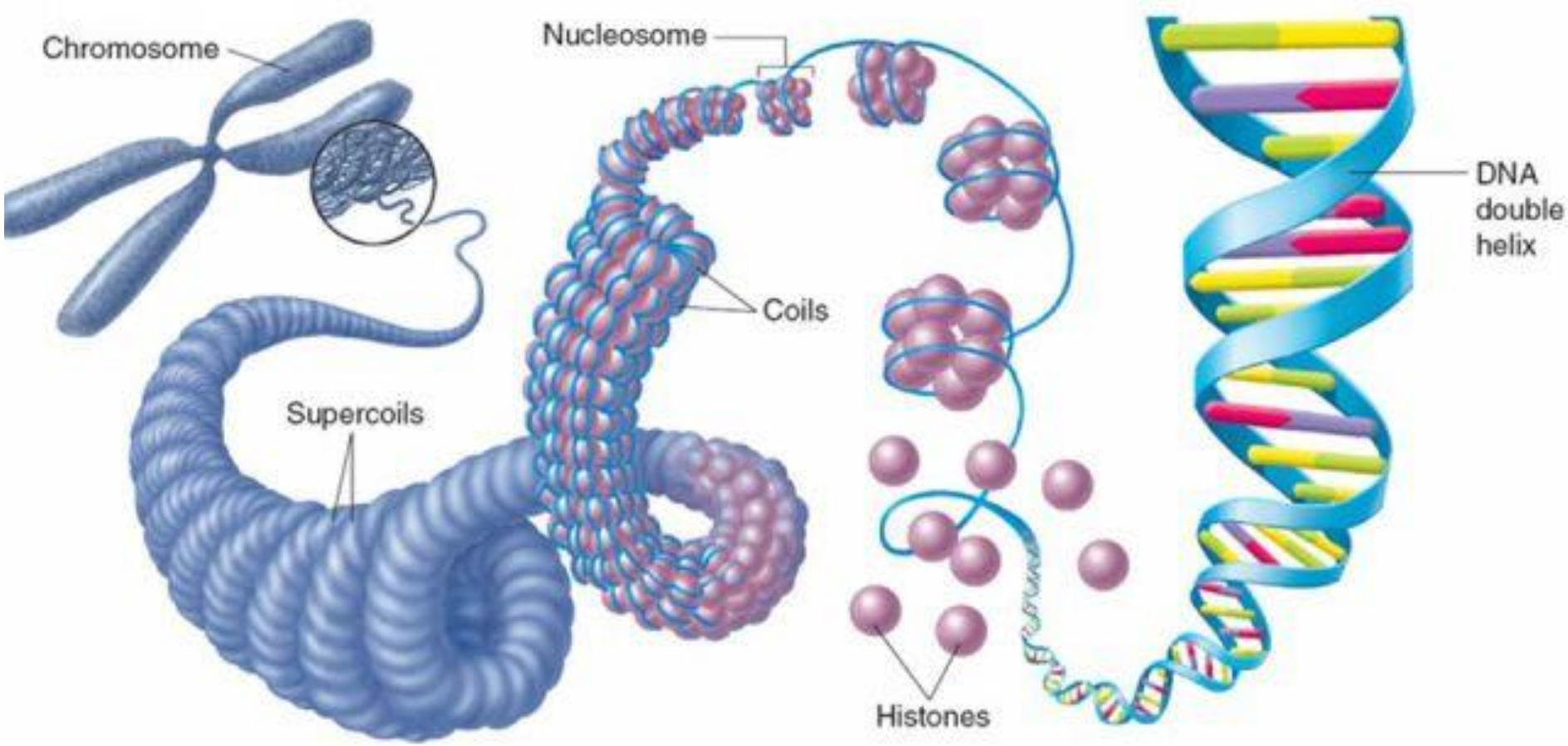
Nucleosome

- Two nucleosome beads attached with each other through linker region



DNA and Chromosomes

- Eukaryotic Chromosome Structure



DNA

+histone
protein core

Nucleosome

Chromatin