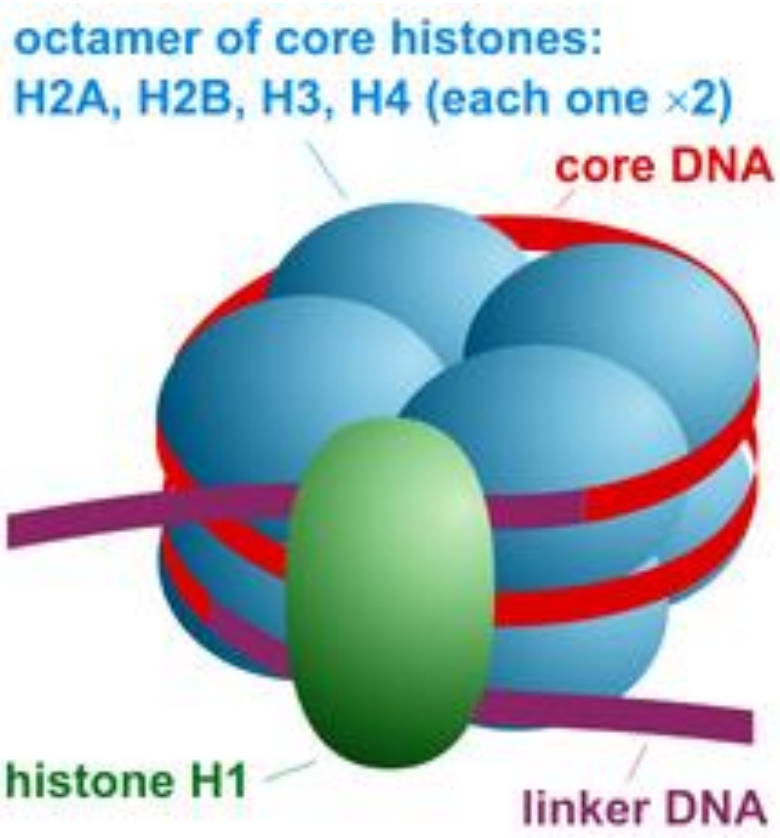
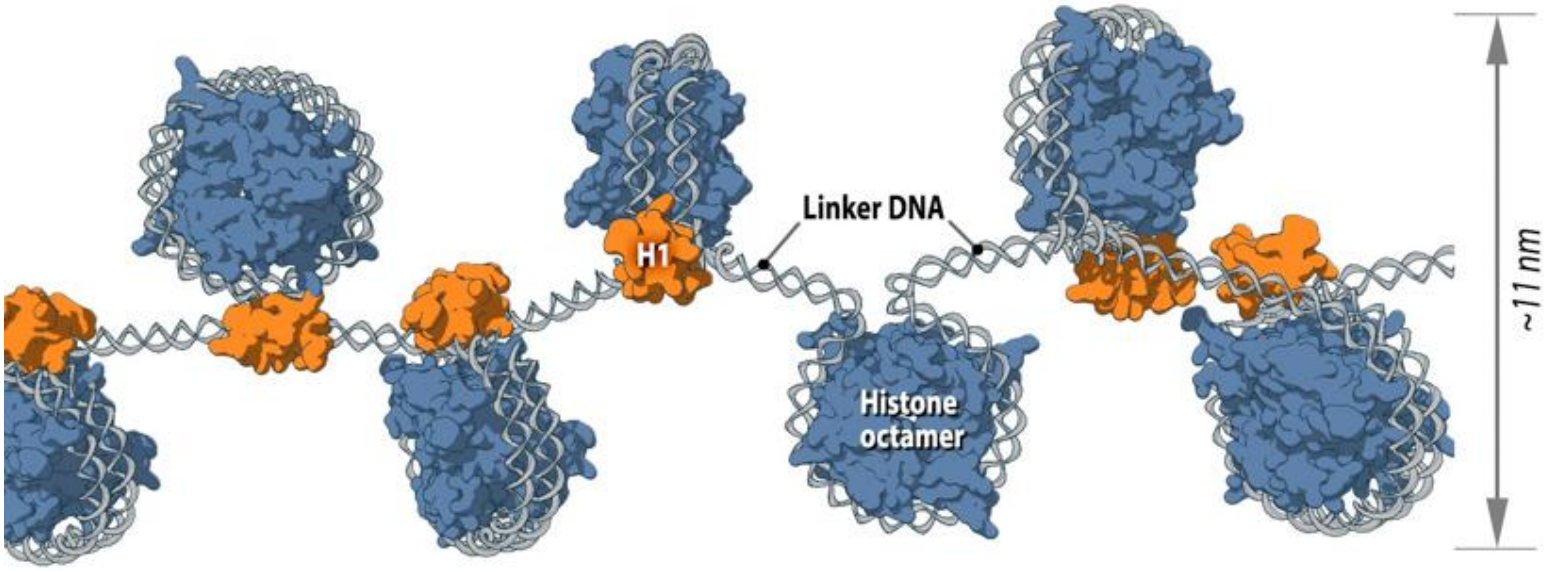
Chromatin structure in eukaryotic cells

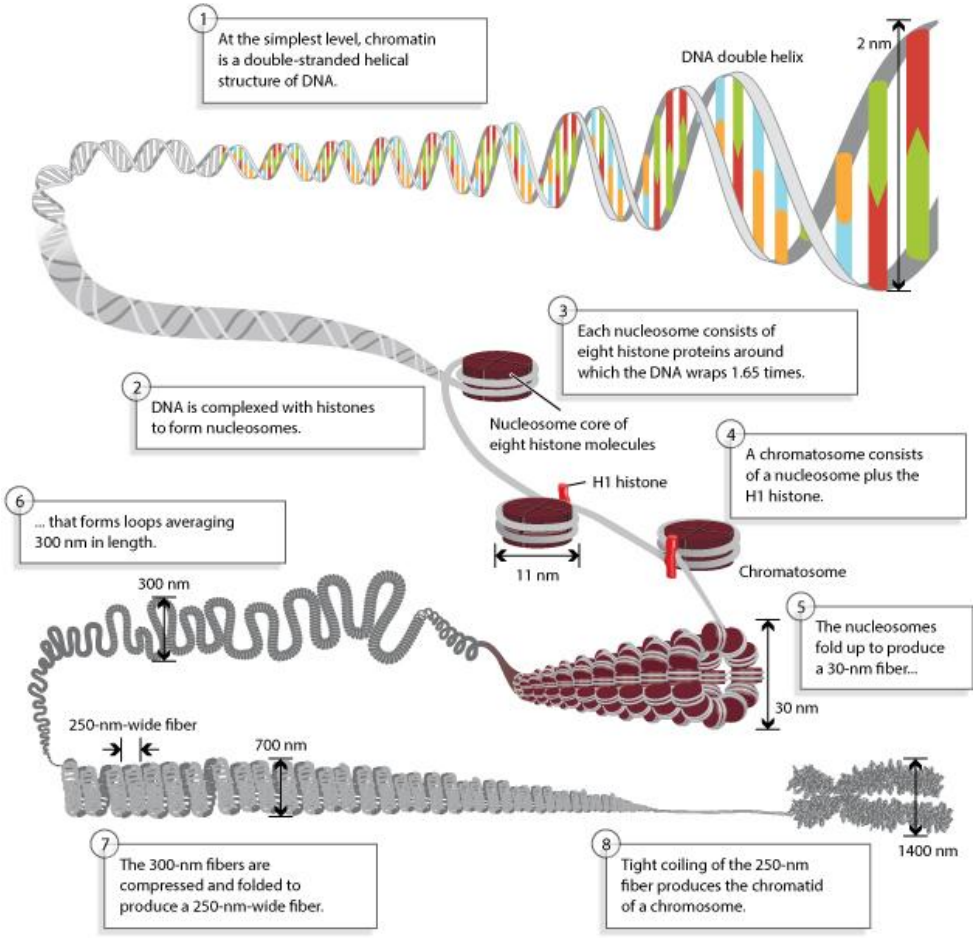
Nucleosome

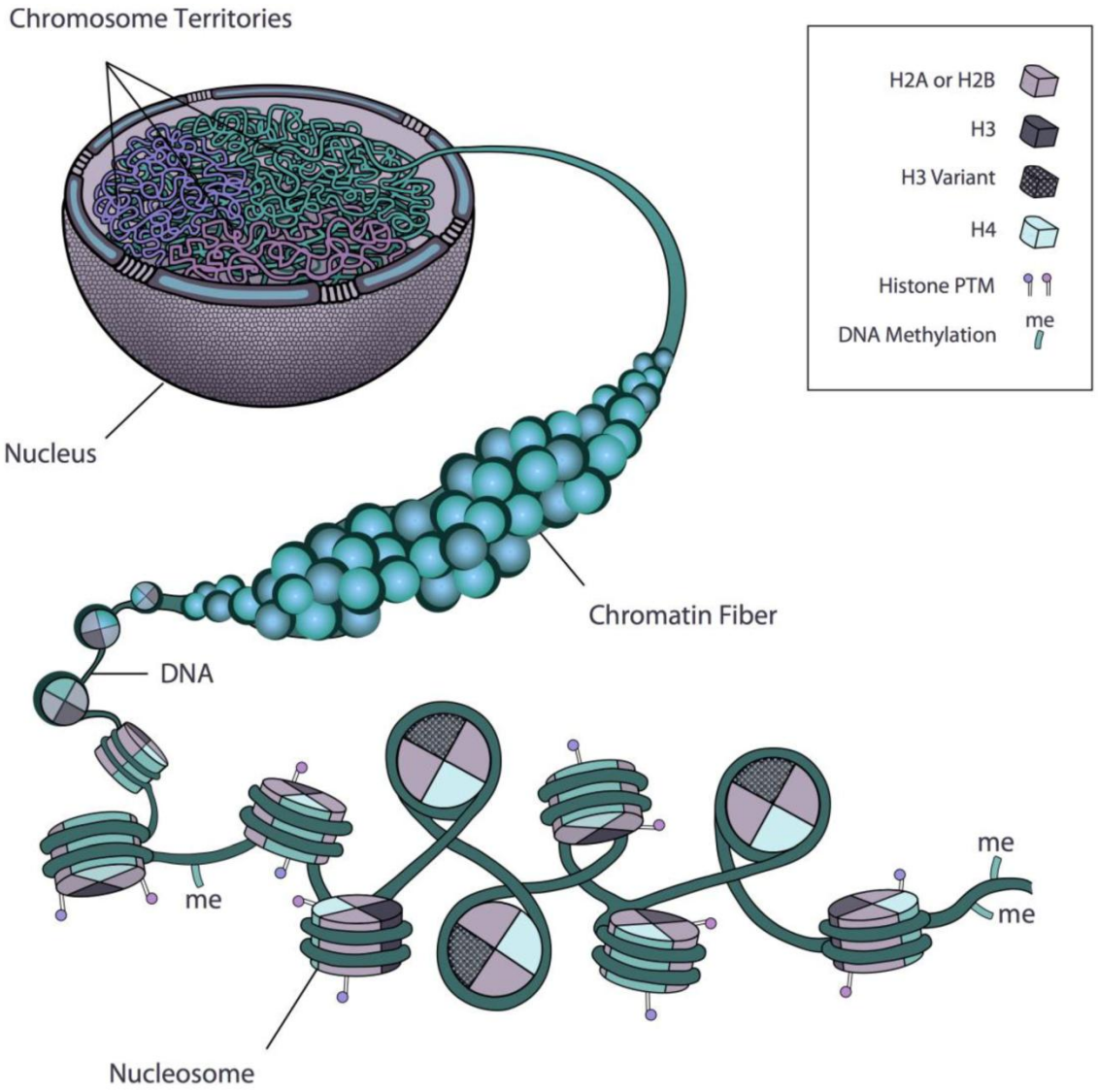
- In eukaryotic cells DNA is structurally organized – “packaged” or compacted by association with specific proteins and protein complexes
- The basic unit of DNA compaction is nucleosome
- Nucleosome consists of a segment of DNA wound in sequence around eight histone protein cores.


octamer of core histones:
H2A, H2B, H3, H4 (each one ×2)
core DNA
histone H1
linker DNA

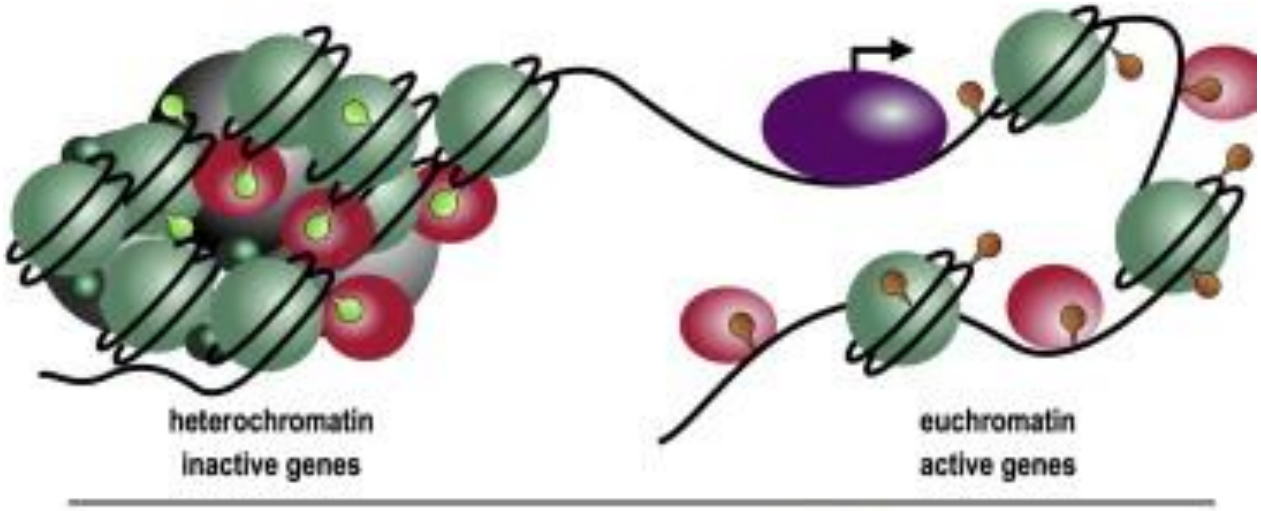

Linker DNA
H1
Histone octamer
~11 nm

Higher levels of DNA organization




Chromosome Territories
Nucleus
Chromatin Fiber
DNA
Nucleosome
me
me
me
H2A or H2B
H3
H3 Variant
H4
Histone PTM
DNA Methylation
me

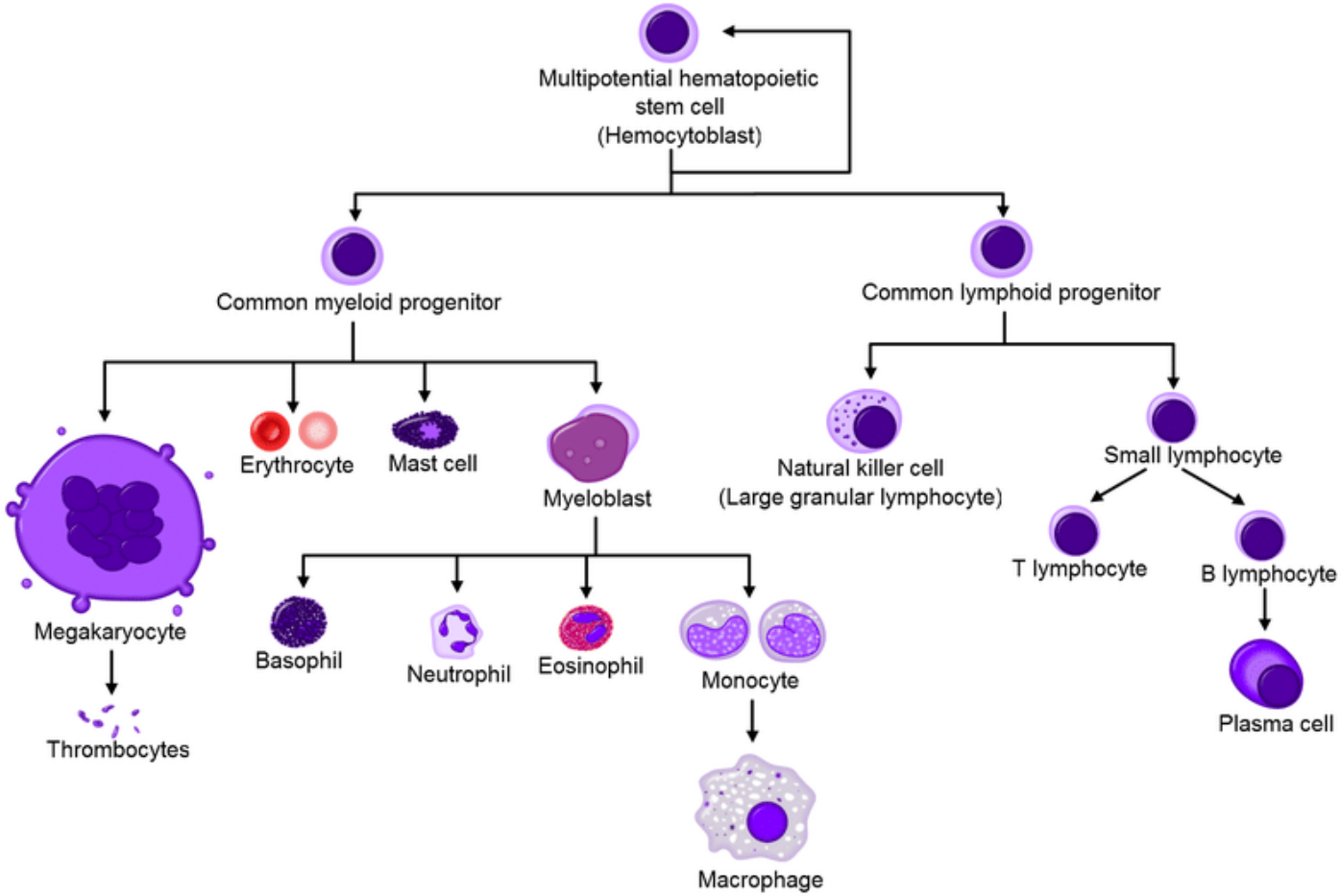
Euchromatin and heterochromatin

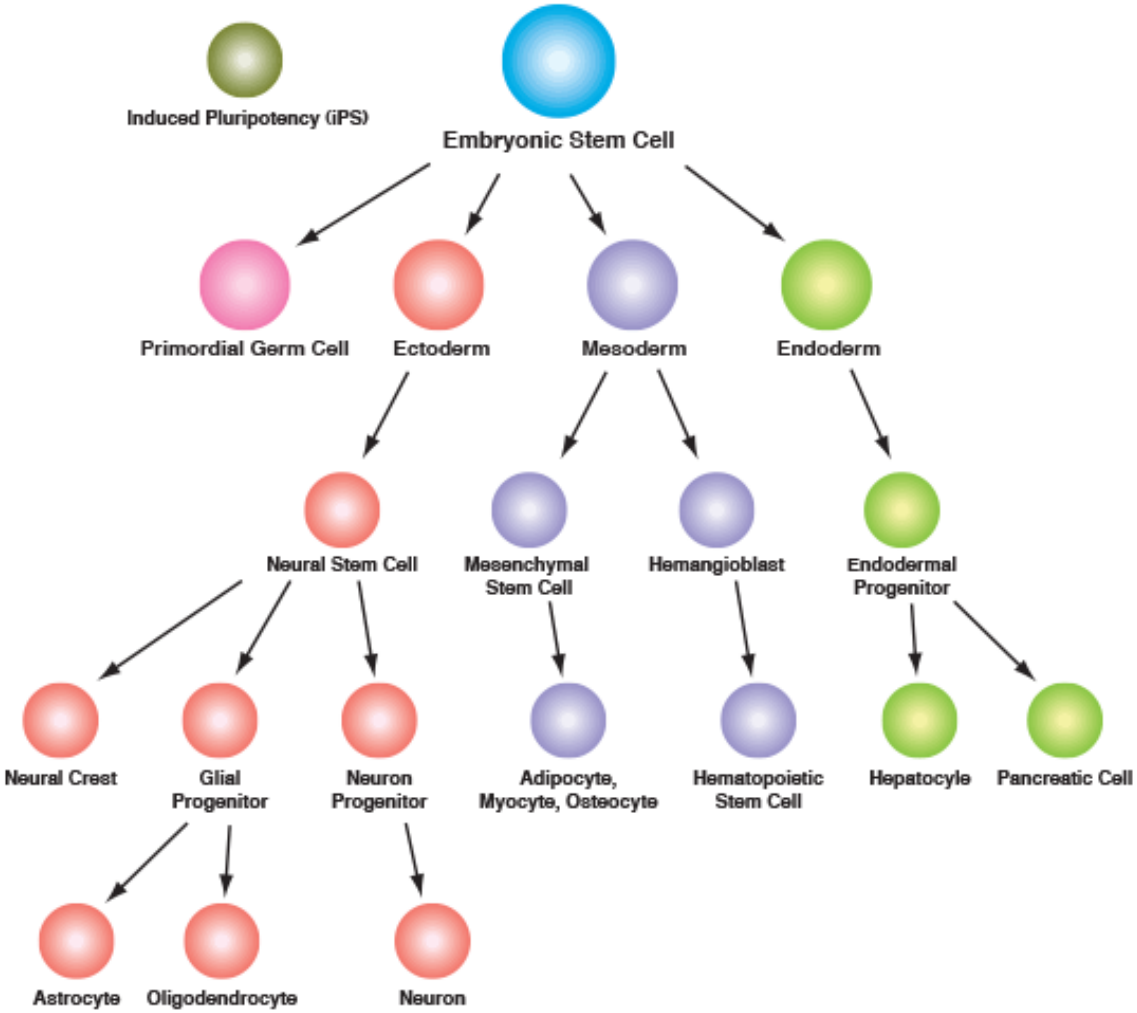


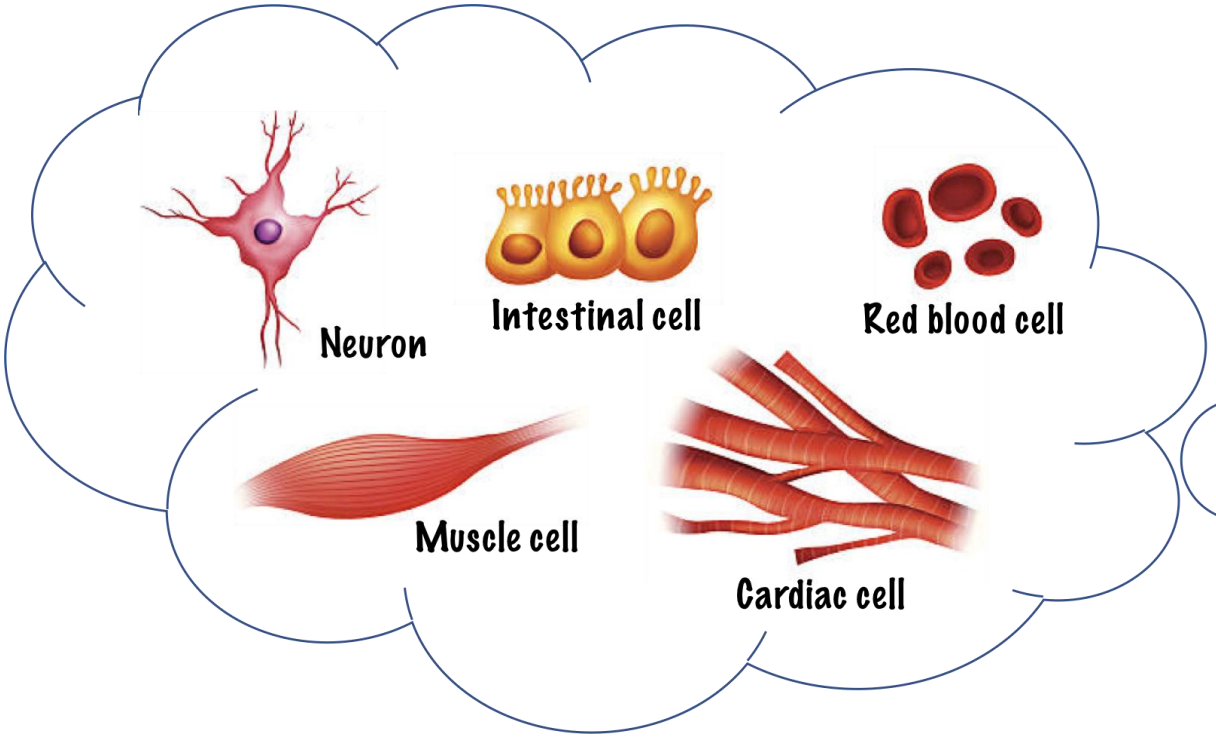
Epigenetics

- epigenetic trait is a "stably heritable phenotype resulting from changes in a chromosome without alterations in the DNA sequence“.
- The term "epigenetic code" has been used to describe the set of epigenetic features that create different phenotypes in different cells
- Epigenetic regulation is crucial in development of a tissue or organ from the fertilized embryo.
- The developmental history could be described as a cell lineage.

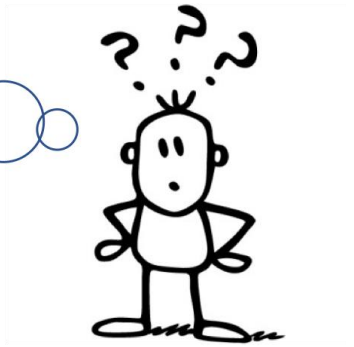
Blood cell lineages

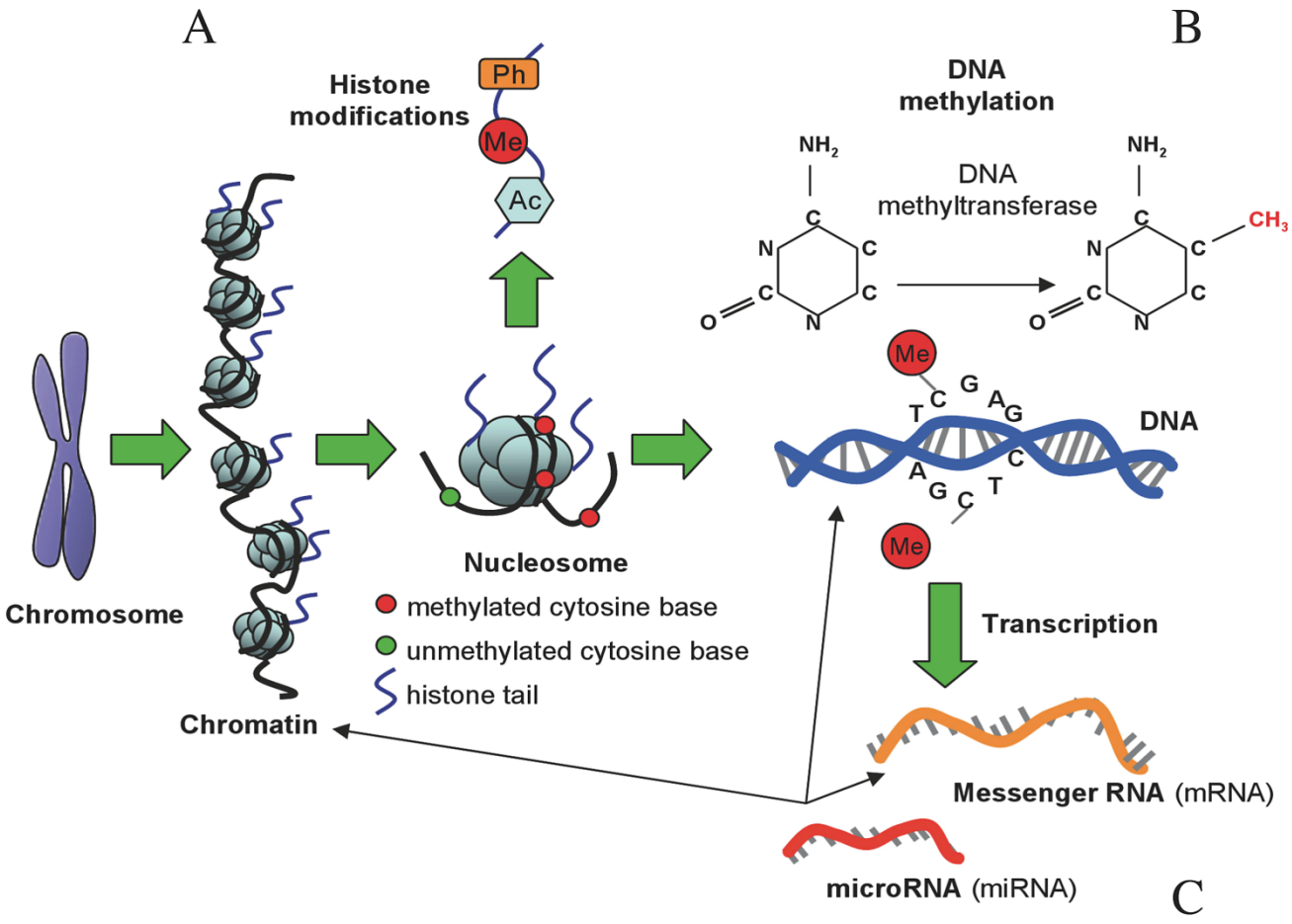



Induced Pluripotency (iPS)
Embryonic Stem Cell
Primordial Germ Cell
Ectoderm
Mesoderm
Endoderm
Neural Stem Cell
Mesenchymal Stem Cell
Hemangioblast
Endodermal Progenitor
Neural Crest
Glial Progenitor
Neuron Progenitor
Adipocyte, Myocyte, Osteocyte
Hematopoietic Stem Cell
Hepatocyte
Pancreatic Cell
Astrocyte
Oligodendrocyte
Neuron



"How can different cells do so many different things even when they all have the same DNA??"




A
B
C
Histone modifications
Ph
Me
Ac
DNA methylation
DNA methyltransferase
NH2
CH3
Chromosome
Chromatin
Nucleosome
DNA
Transcription
methylated cytosine base
unmethylated cytosine base
histone tail
Messenger RNA (mRNA)
microRNA (miRNA)