BHARATHIDASAN UNIVERSITY

Tiruchirappalli- 620 024
Tamil Nadu, India

Programme: M.Sc. Biochemistry

Course Title : Chromatin and Epigenetics
Course Code : BC205DCE

Unit-3
Epigenetic Modifications

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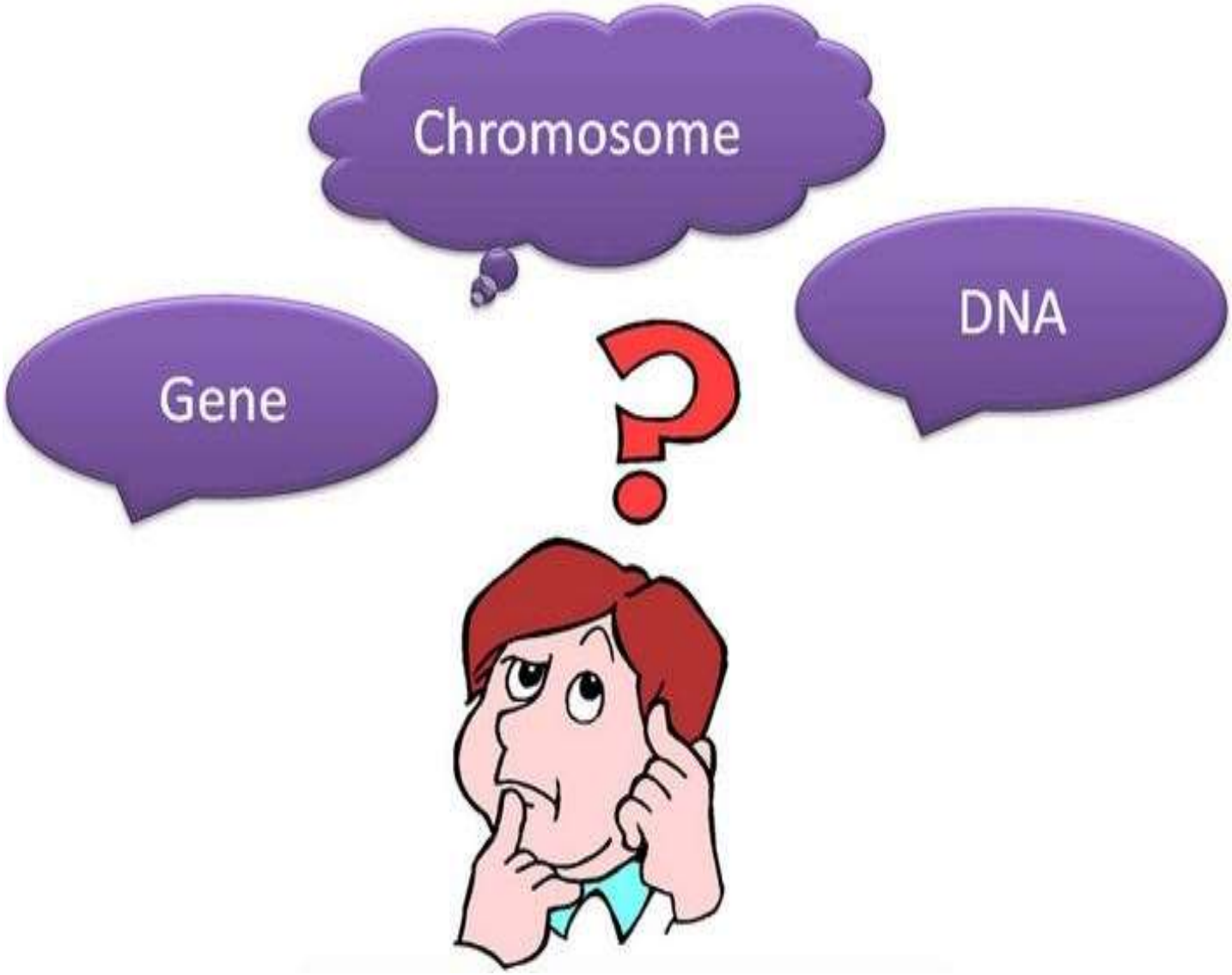
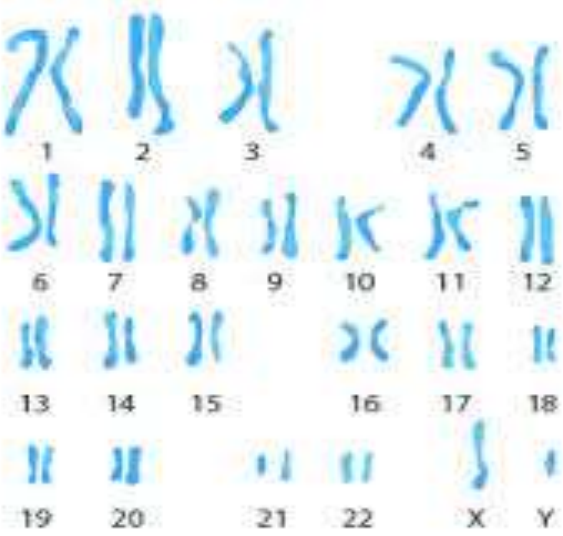
Unit-3 Overview

- Chromatin remodeling by DNA binding proteins
- SWI/SNF family repositioning nucleosomes
- Chromatin modifications by spontaneous conformational change
- Covalent modifications
- Epigenetic modifications
- DNA methylation
- Post translational modification of histones

Genetics to Epigenetics: It is not all in genes


Chromosome
Gene
DNA
?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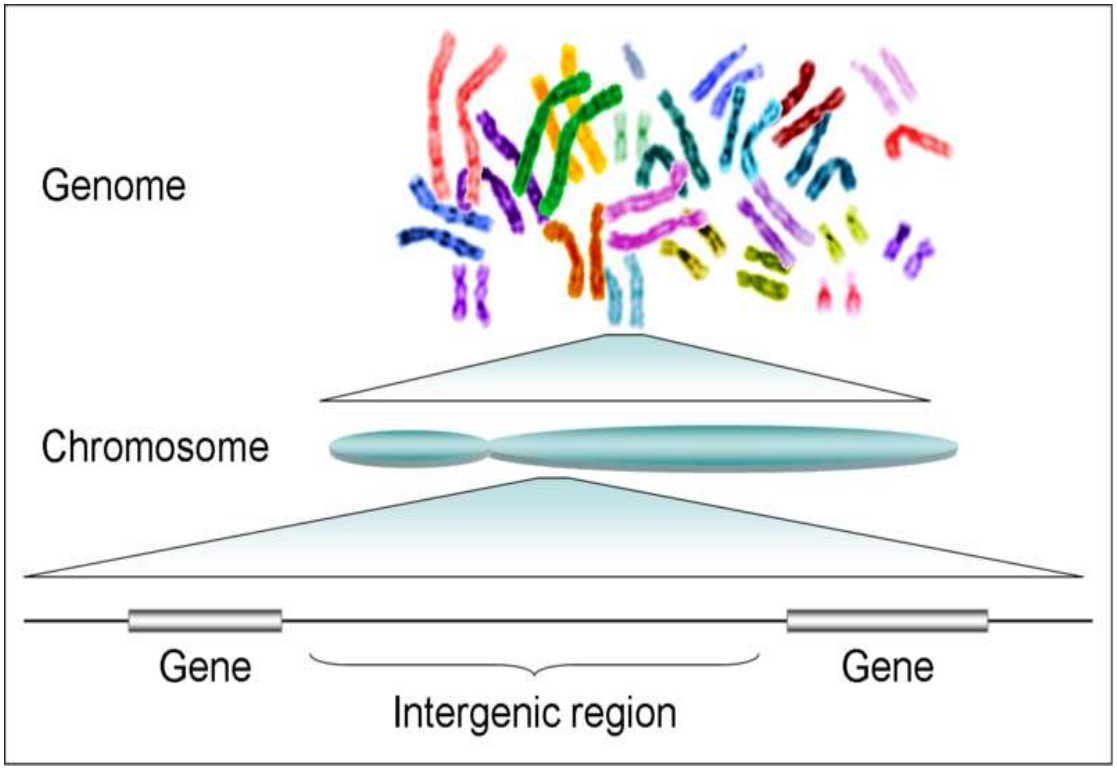
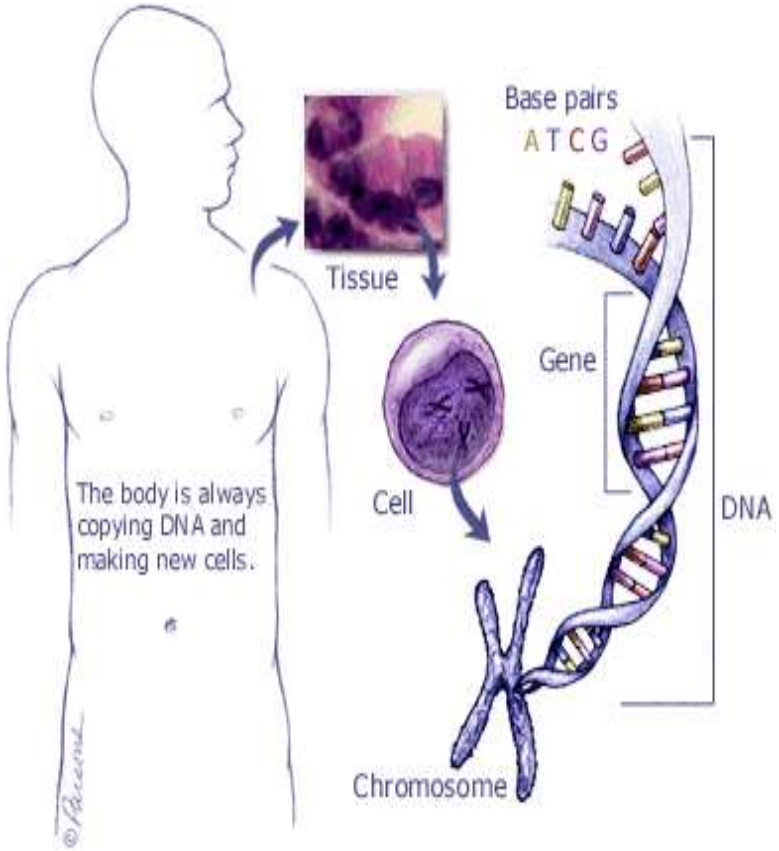
X
Y

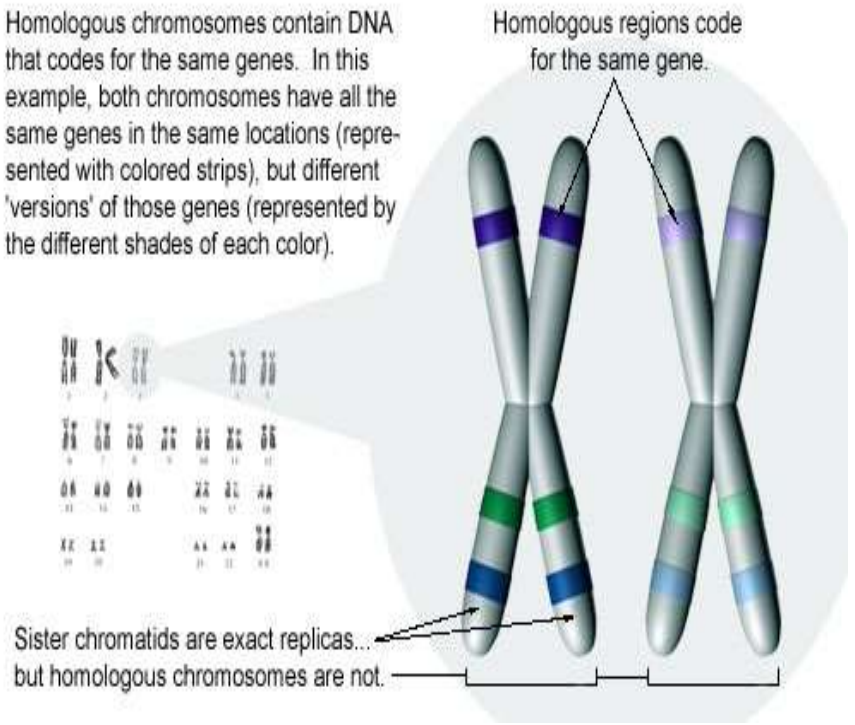

Genome
Chromosome
Gene
Gene
Intergenic region

GENETICS

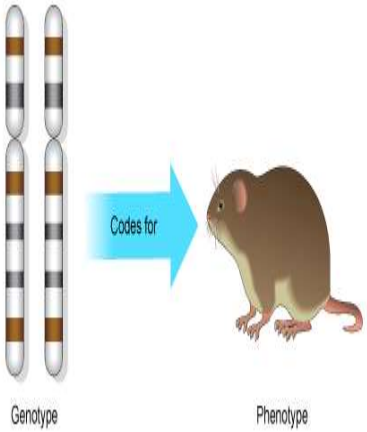
- Genetics: Study of how traits are passed from parent to offspring.

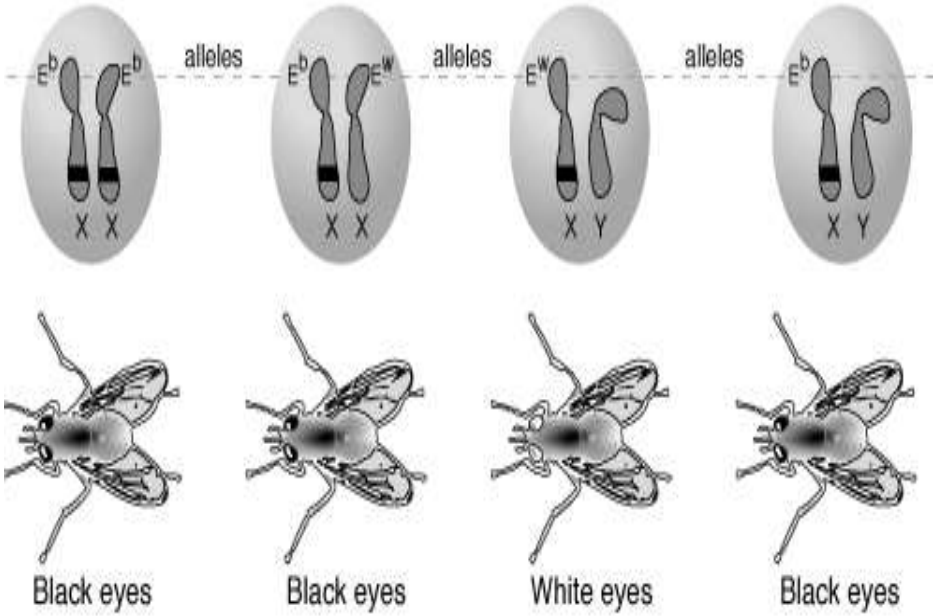
GENOTYPE TO PHENOTYPE





EXPRESSION OF A GENOTYPE IS TERMED A PHENOTYPE



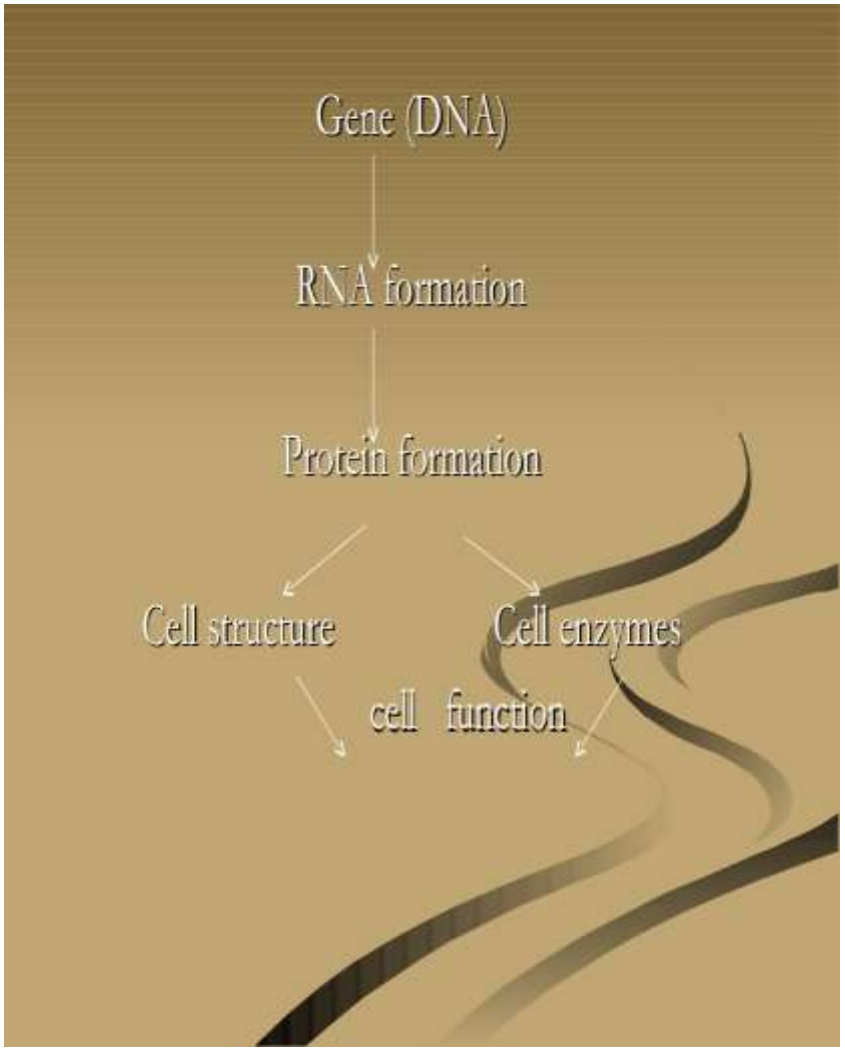


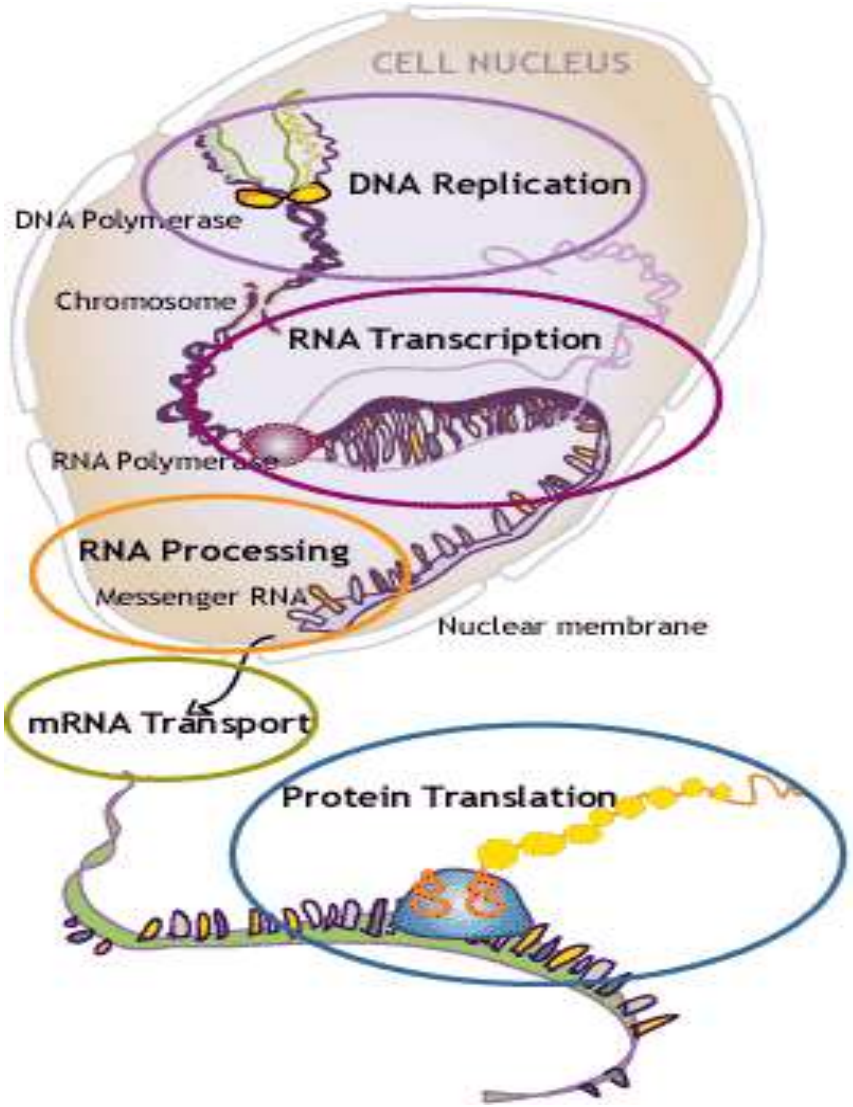
genotypes

phenotypes

- E^b- ***dominant*** allele.
- E^w- ***recessive*** allele.

GENE DECIDES THE FUNCTION OF THE CELL





GENETICS TO EPIGENETICS

- How do different adult stem cells know their fate?
  - Myoblasts can only form muscle cells
  - Keratinocytes only form skin cells
  - Hematopoetic cells only become blood cells

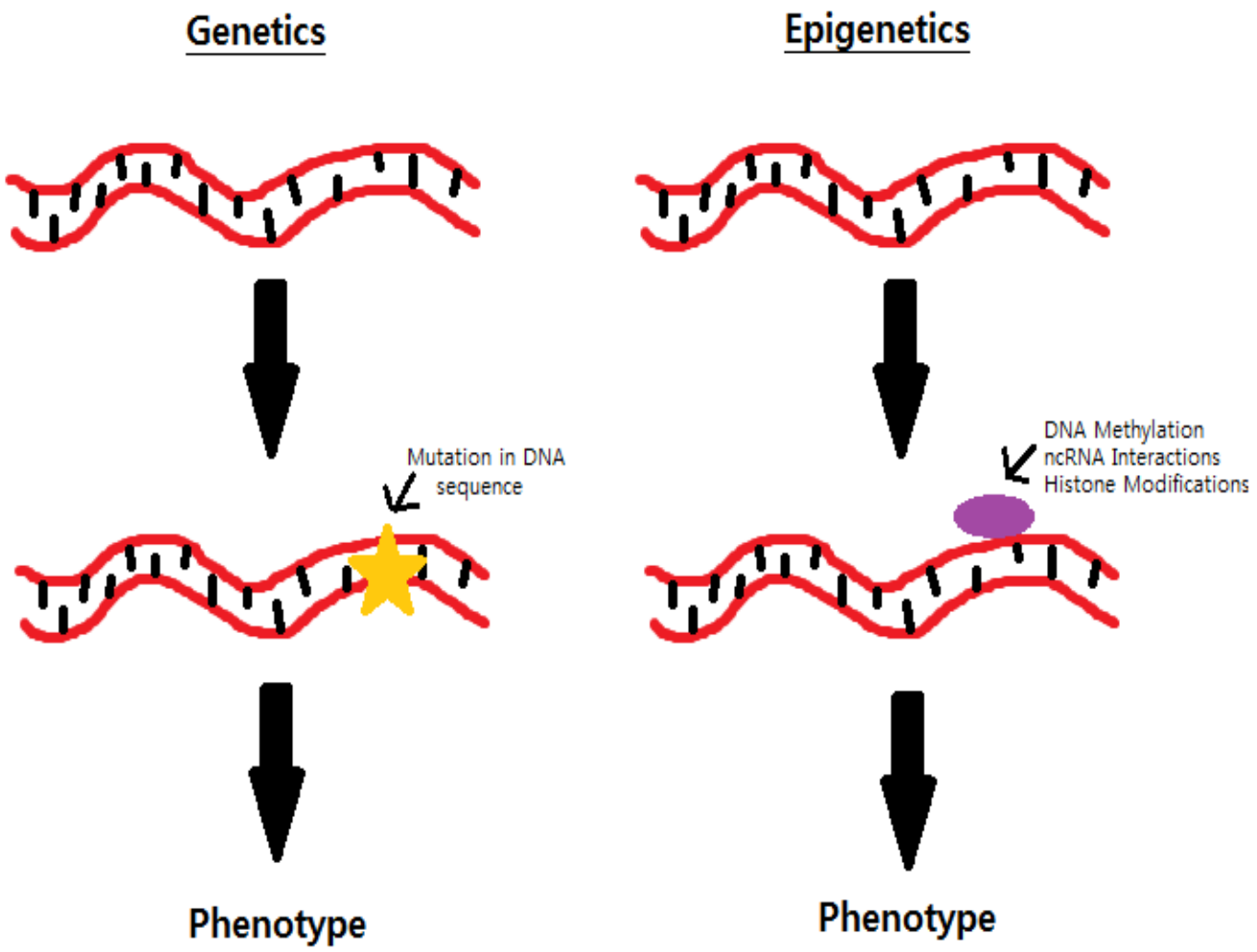
Epigenetics literally means “above genetics”, and refers to the heritable information in gene expression coded something other than DNA sequence.

heritable changes of DNA, not involving changes in DNA sequence

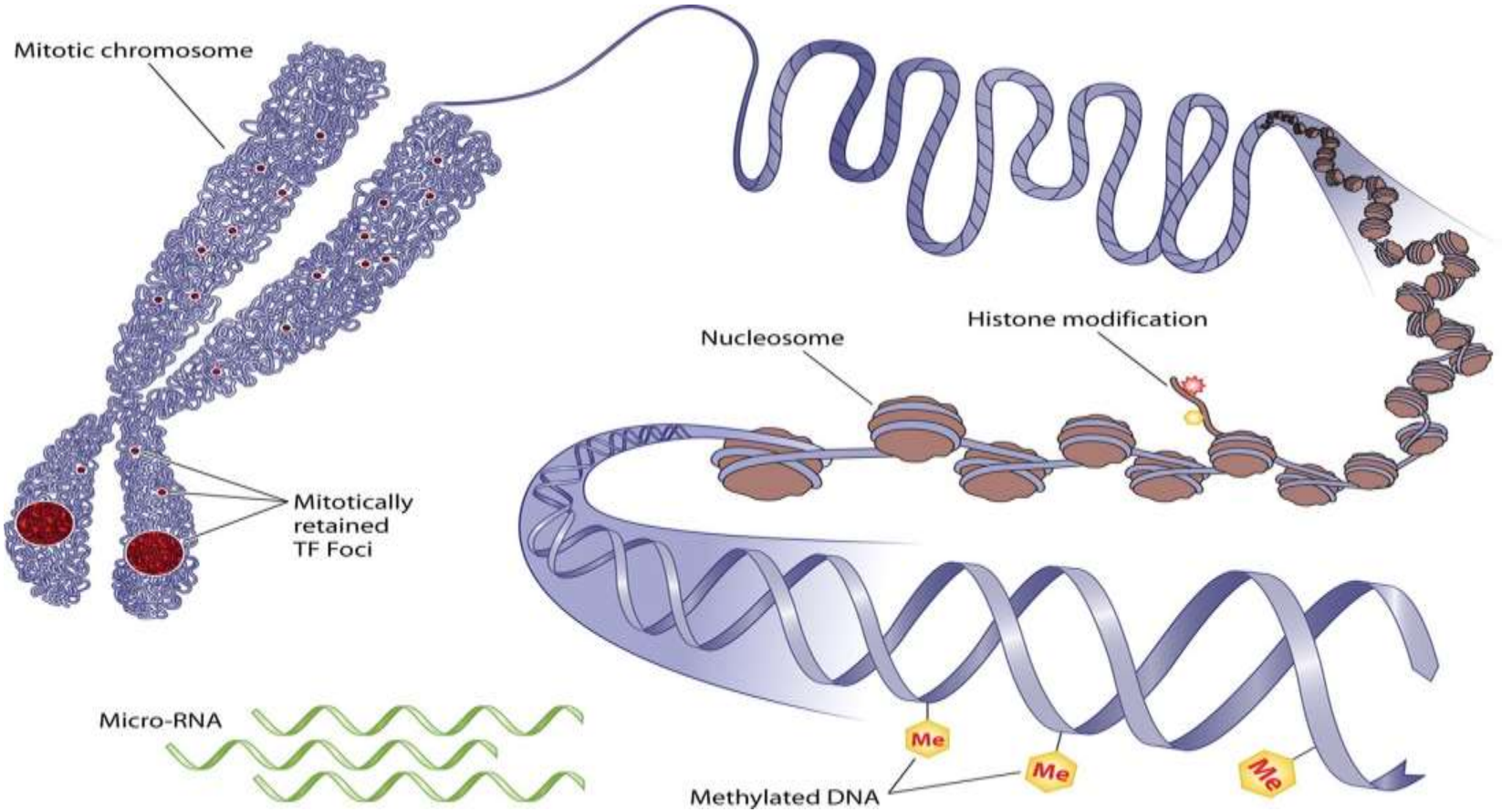
A- Genetic information: provides the information for the manufacture of all Proteins needed for the cell functional activity.

B- Epigenetic information: provides additional instruction on how, when and where these information should be used.

Simply change phenotype without changing the genome

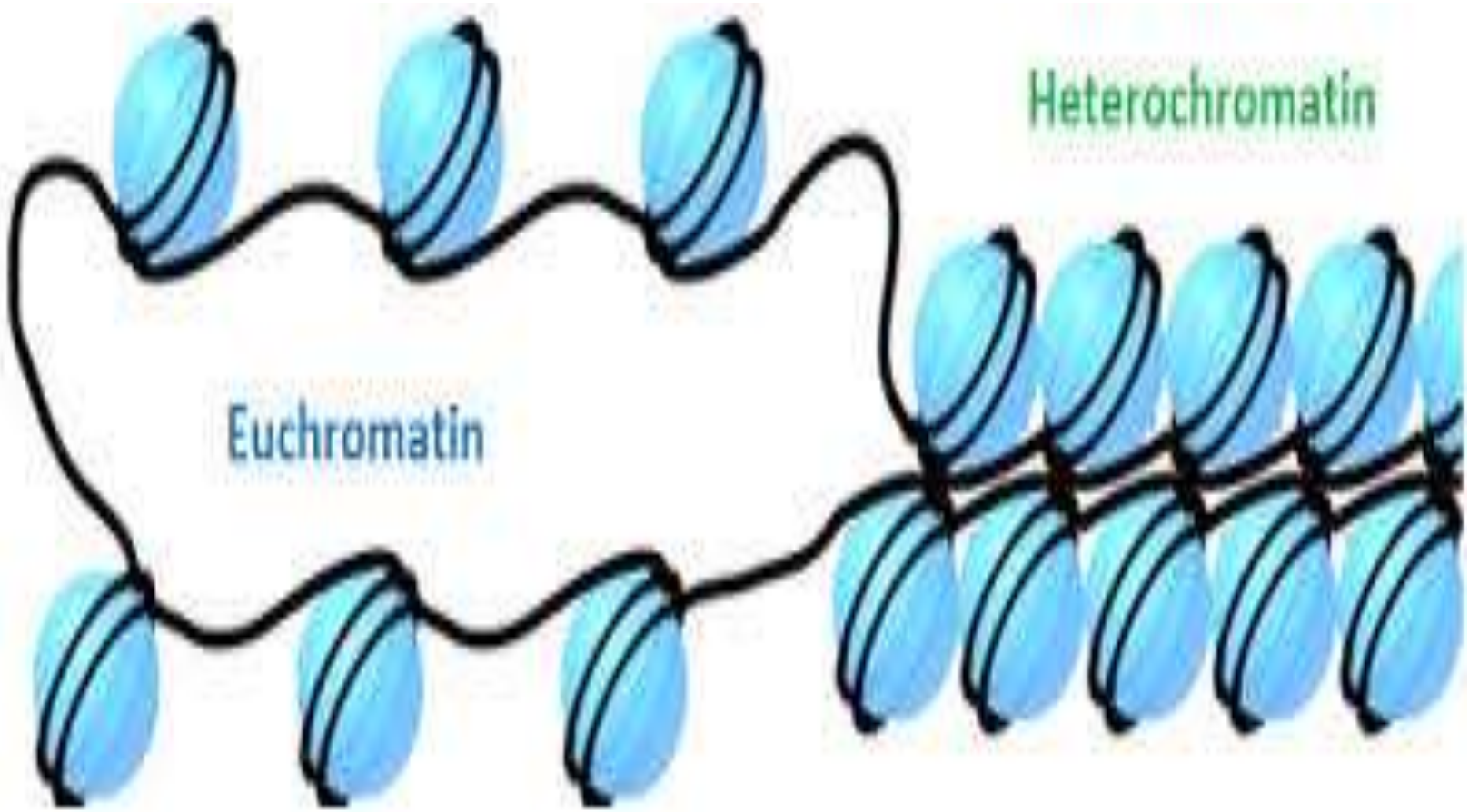

Genetics
Epigenetics
Mutation in DNA sequence
DNA Methylation
ncRNA Interactions
Histone Modifications
Phenotype
Phenotype

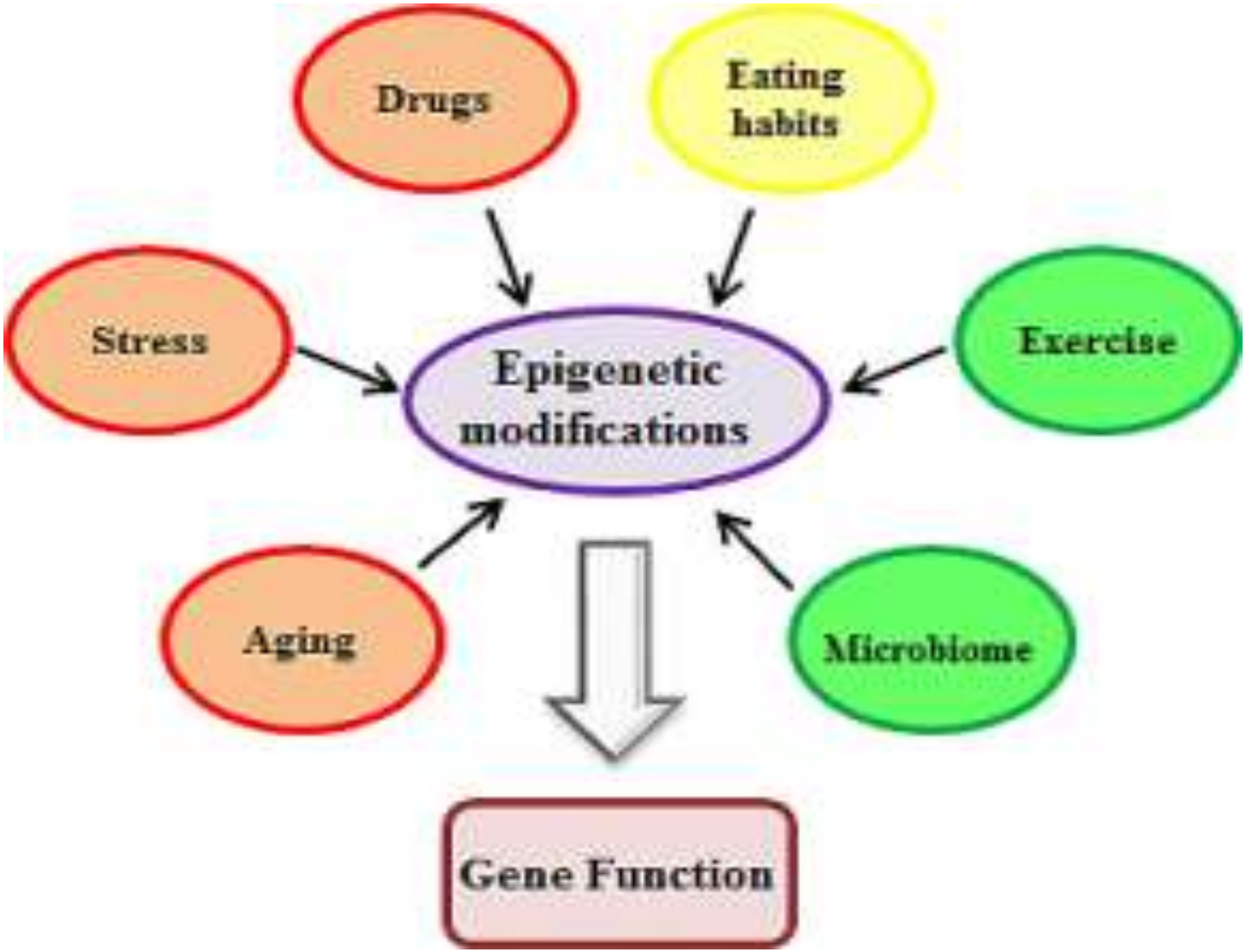
BEYOND GENETICS IS EPIGENETICS



Multiple Levels of packing are required to fit the DNA into the cell nucleus

EUCHROMATIN AND HETEROCHROMATIN




Drugs
Eating habits
Stress
Epigenetic modifications
Exercise
Aging
Microbiome
Gene Function

EPIGENETIC MODIFICATIONS

1. DNA METHYLTION

2. HISTONE MODIFICATION:

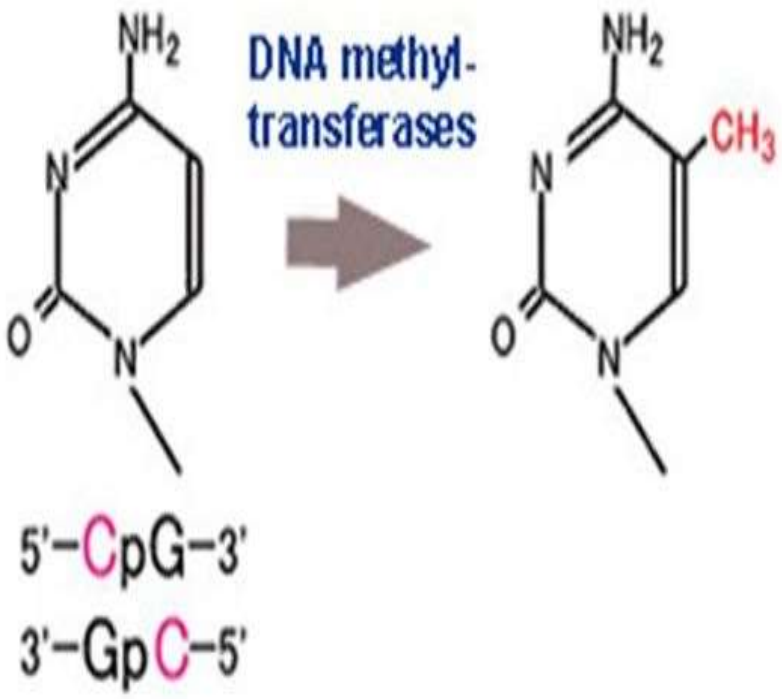
   a. ACETYLATION

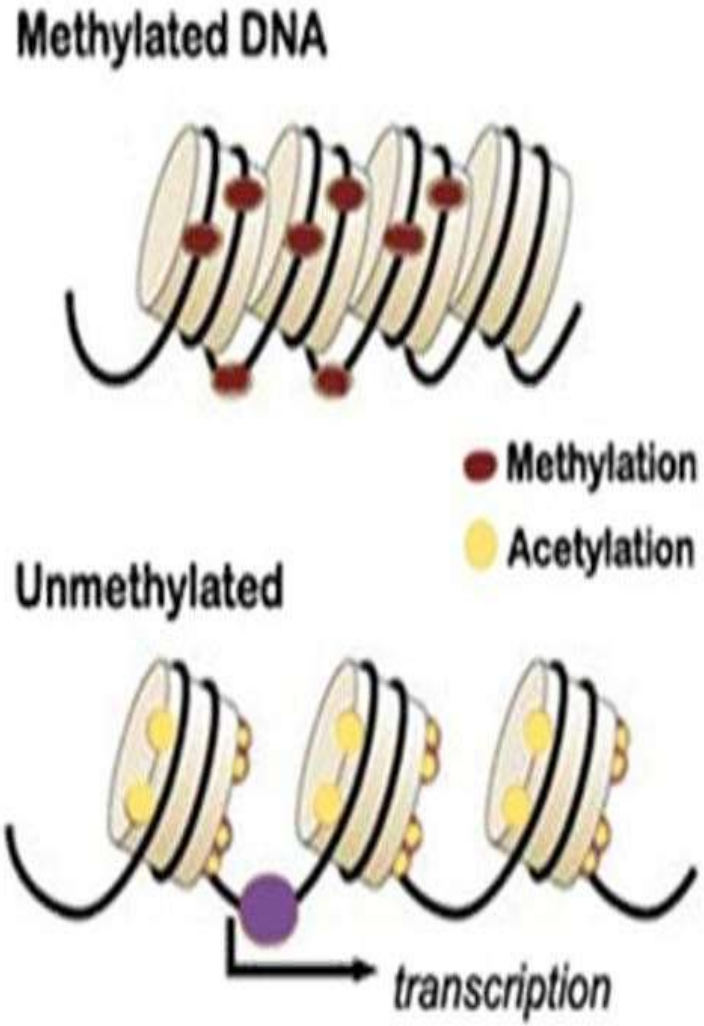
   b. METHYLATIONS

   c. PHOSPORYLATOIN

   d. UBIQUITYLATION

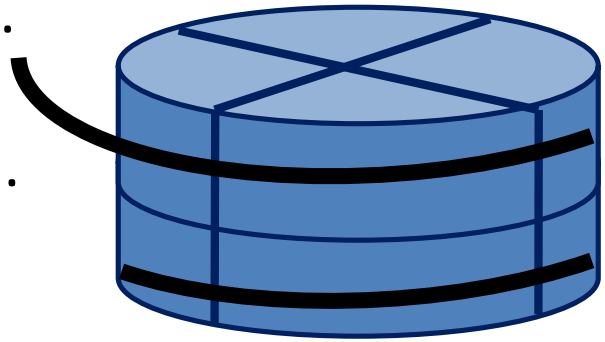
DNA METHYLATION

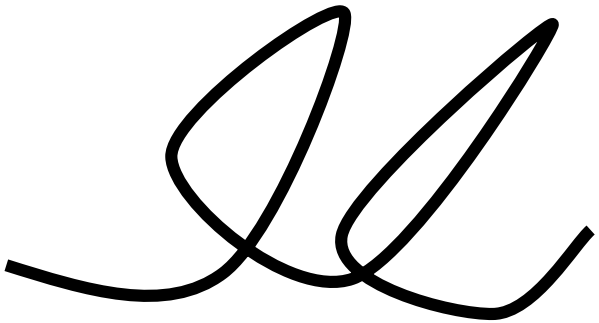




HISTONE MODIFICATIONS

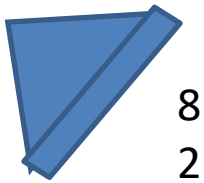
- In Eukaryotes, DNA is wrapped around histone proteins and forms nucleosome.
- Nucleosome is a basic unit of chromatin.





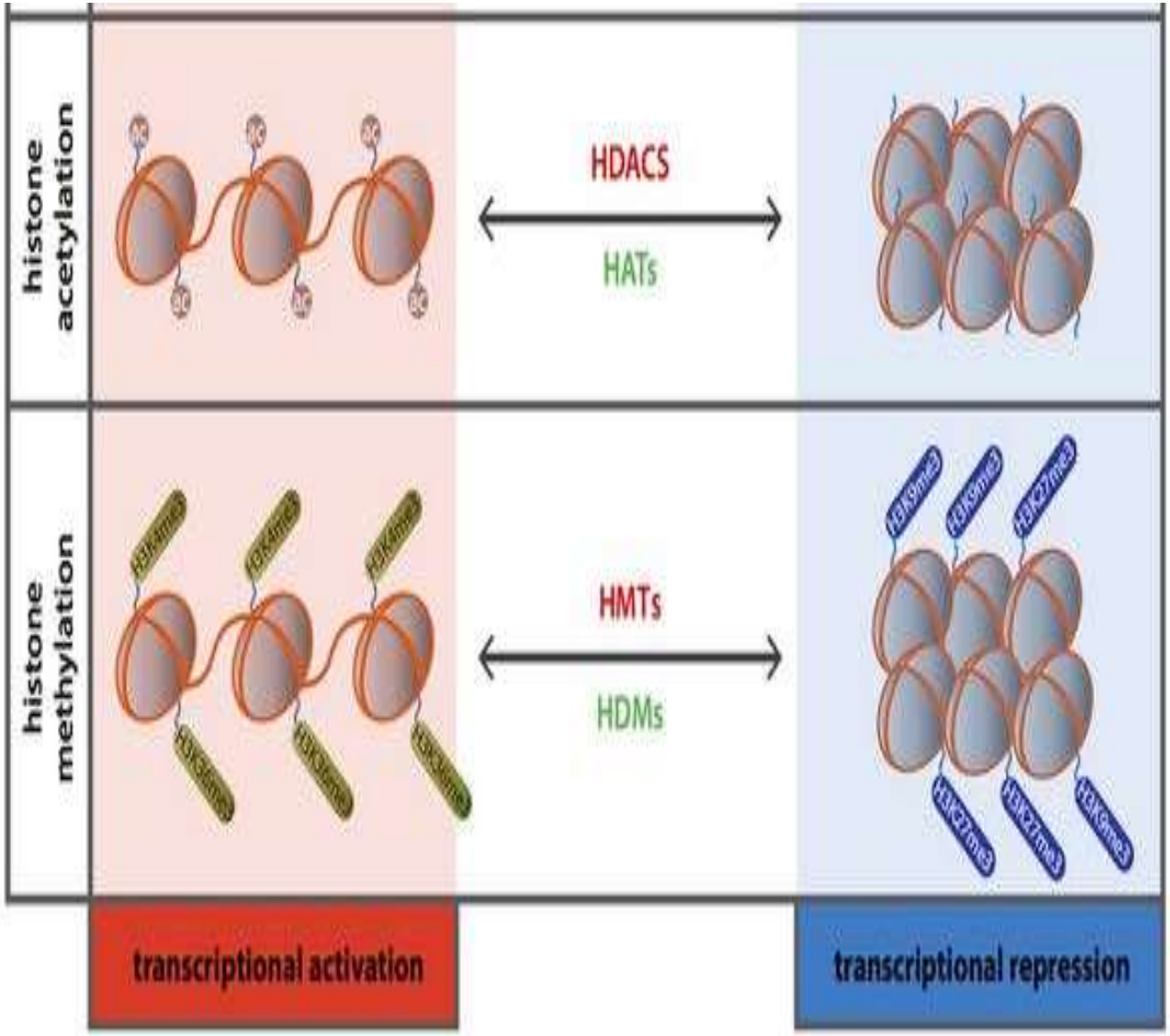
~ 147 bp DNA

+



8 histones:
2 each H2A
H2B
H3
H4

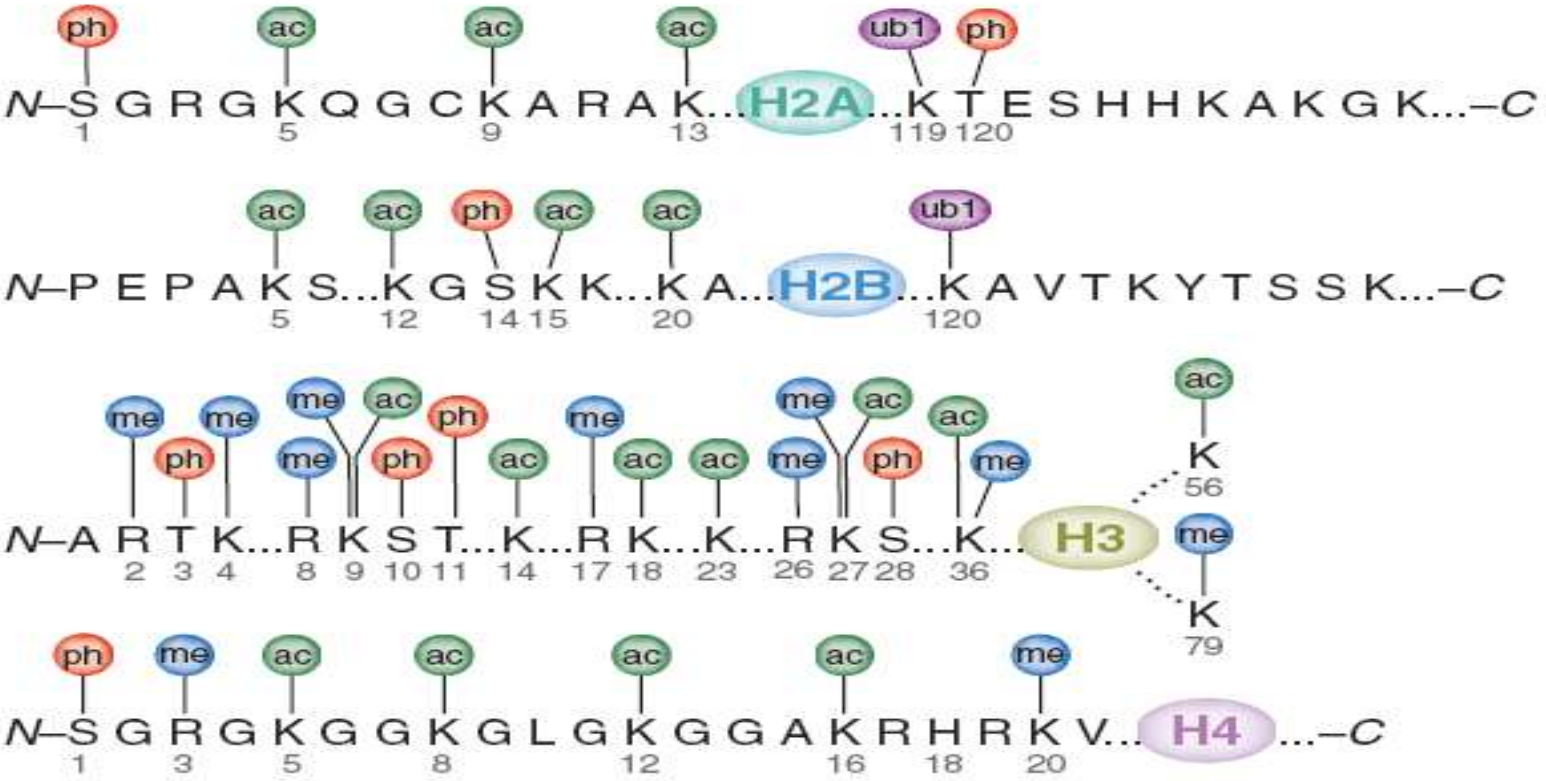
HISTONE ACETYLATION AND METHYLATION



HISTONE PHOSPHORYLATION

Serine threonine of lysine tails

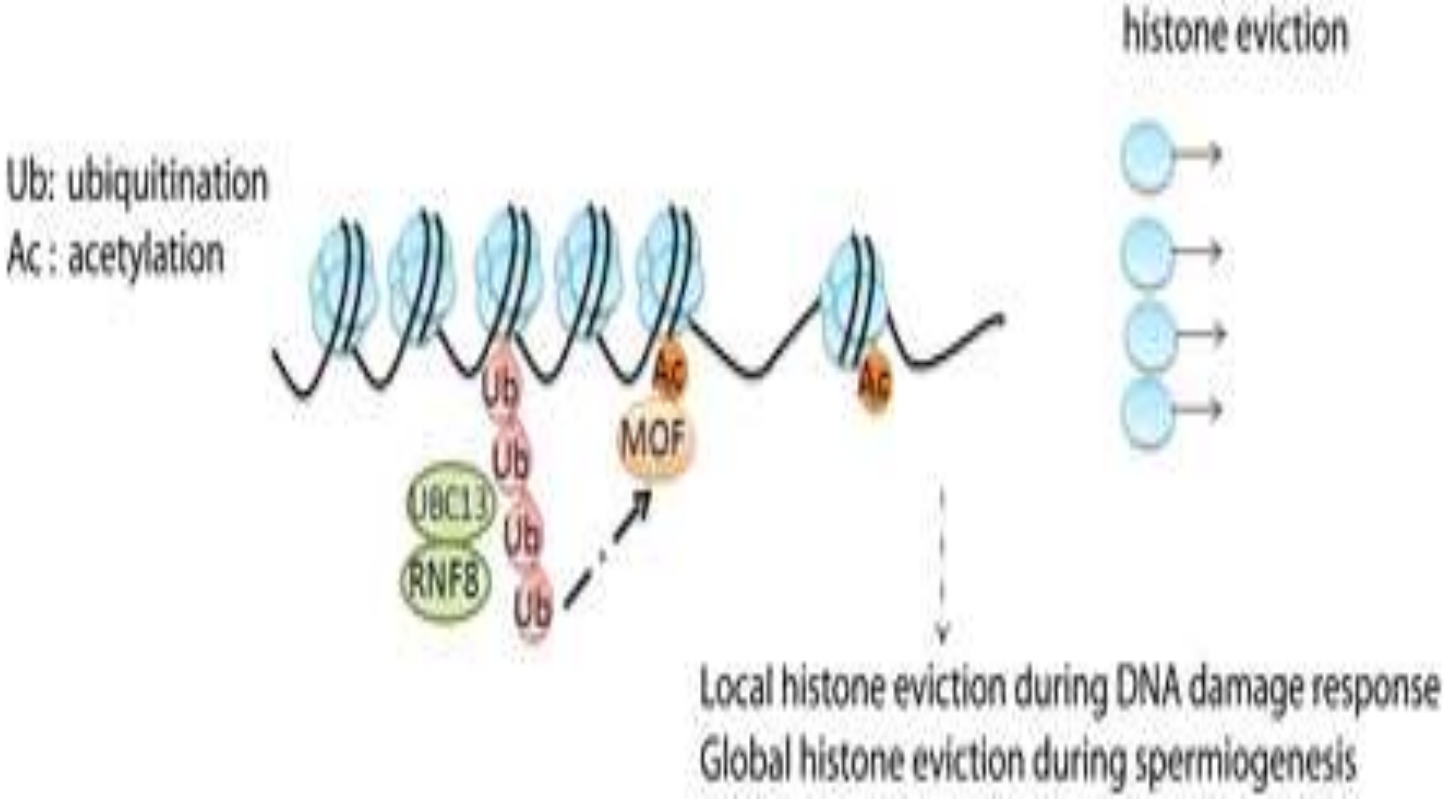
Kinase and phosphatase are involved

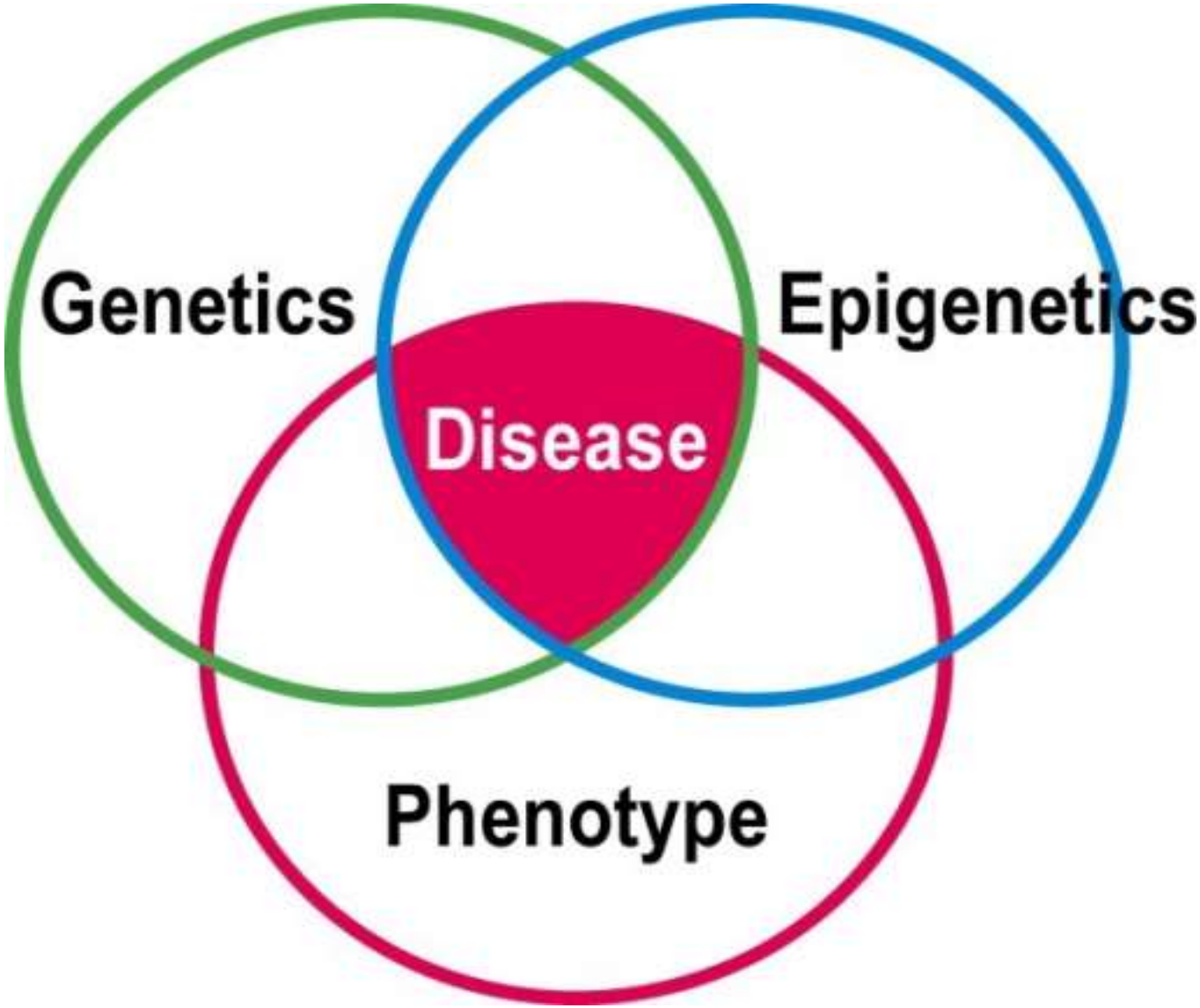


HISTONE UBIQUITYLATION

Lysine of hisone tails

Ubiquitin ligase and deubiquitination




Genetics
Epigenetics
Disease
Phenotype