

# Gene regulation

## Lecture 3: Chromatin structure and function II

Dr. Mohamed Kamal

Lecturer of Molecular Biology

E.mail: [mk-saleh1980@yahoo.com](mailto:mk-saleh1980@yahoo.com)

## **Notes:**

- \* Exam (15 minutes)
- \* Collecting the exercise answer sheets

# Structure of the Lecture:

## Histone tail modifications.

\*Histone methylation

\*Histone phosphorylation

\*Interplay between Histone modifications

# Histone Methylation

**Definition:** The process of Adding methyl group by Histone methyl transferases (HMTs) to the lysine or arginine residues of the Histone tails.

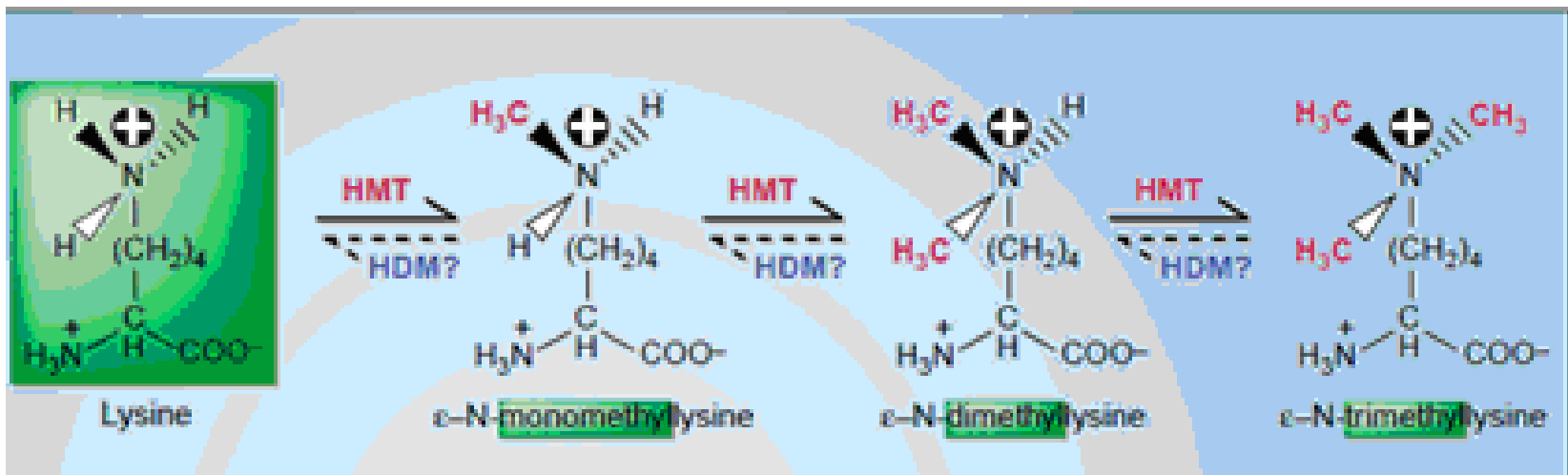
## **Importance:**

\*Histone methylation could activate or inactivate gene regulation depends on the form of methylation and its site.

\*It contributes to epigenetic “memory” by fixing the chromatin organization in a heritable manner.

# Histone Methylation

**Forms** : Mono, Di, and Tri methylation



# Histone Methylation

**Sites of methylation:** specific lysine and arginine residues.

## Arginine methylation

\*Abundant on shuttling proteins.

\*Playing a central role in the orchestration of the histone code.

\* Monomethylarginines (MMA), or dimethylarginines.

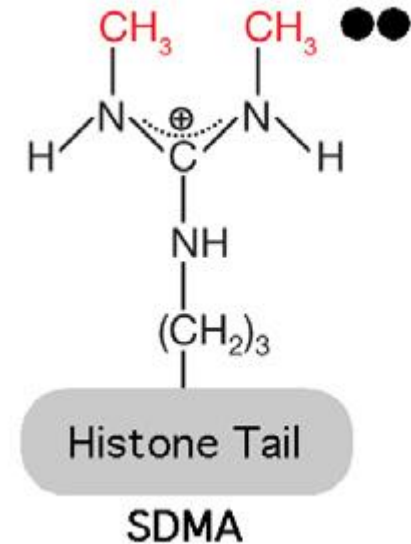
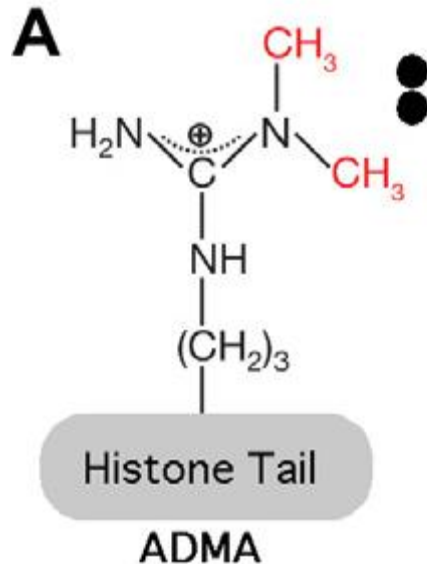
# Histone Methylation

Arginine methylation:

## Dimethylarginines

Asymmetric dimethylarginines

Symmetric dimethylarginines



# Histone Methylation

## **Lysine methylation**

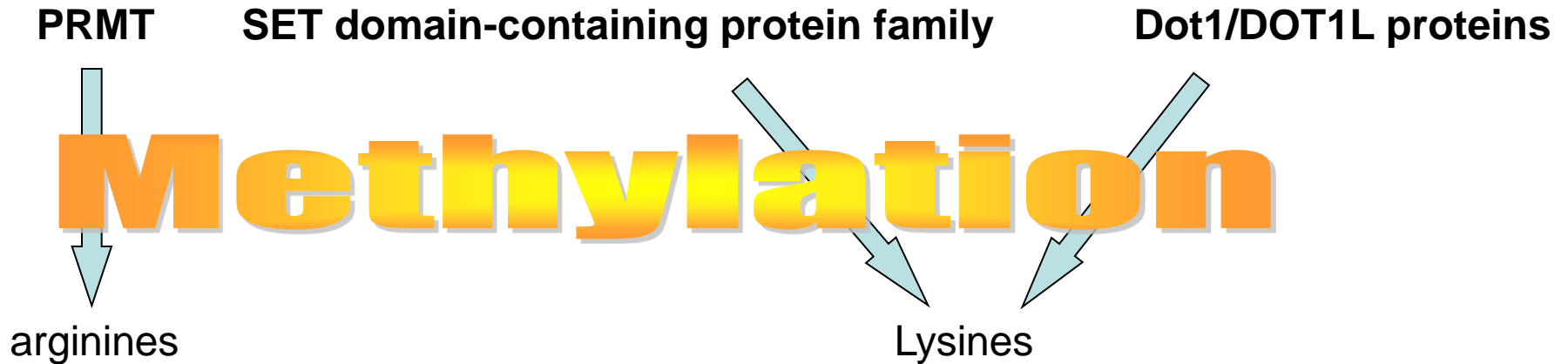
\*Associated to either activation or repression of the transcription.

\*Lysine could be mono, di-, or trimethylated.



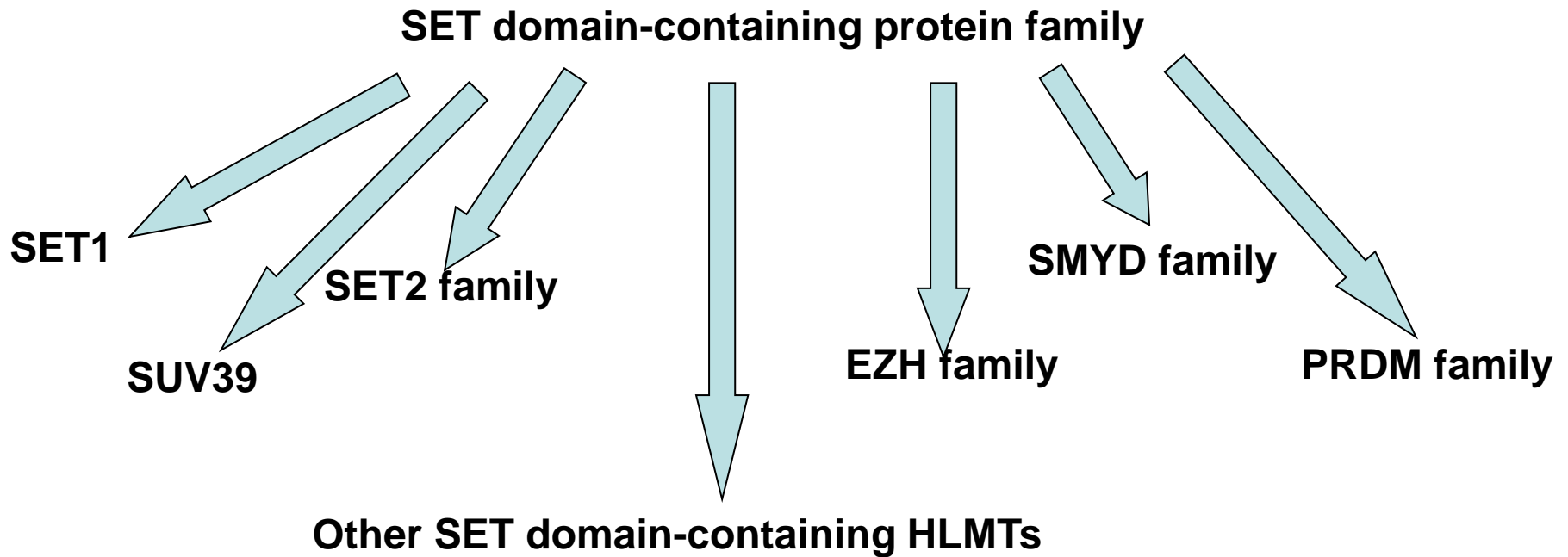
# Histone Methylation

## Histone Methyltransferases



# Histone Methylation

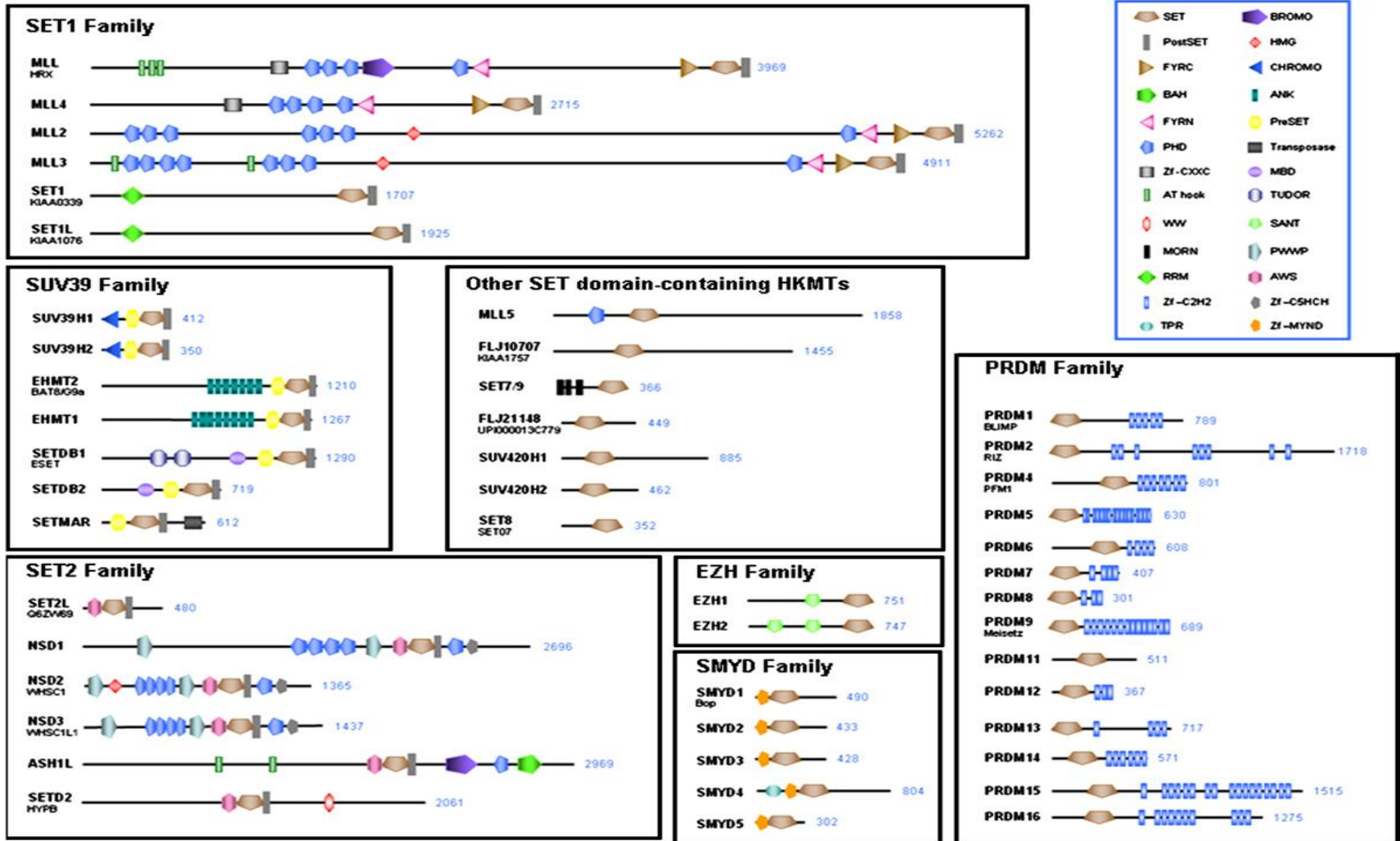
## Histone Methyltransferases



**Exercise:** Find the full names of these enzymes families

# Histone Methylation

## Structures of Histone methyltransferases.



**Exercise 2:** What distinguishes each family from the others?.

# Histone Methylation

## The effect on gene regulation

### Activators

H3K4me

H3K36me

H3K79me

### Repressors

H3K9me

H3K27me

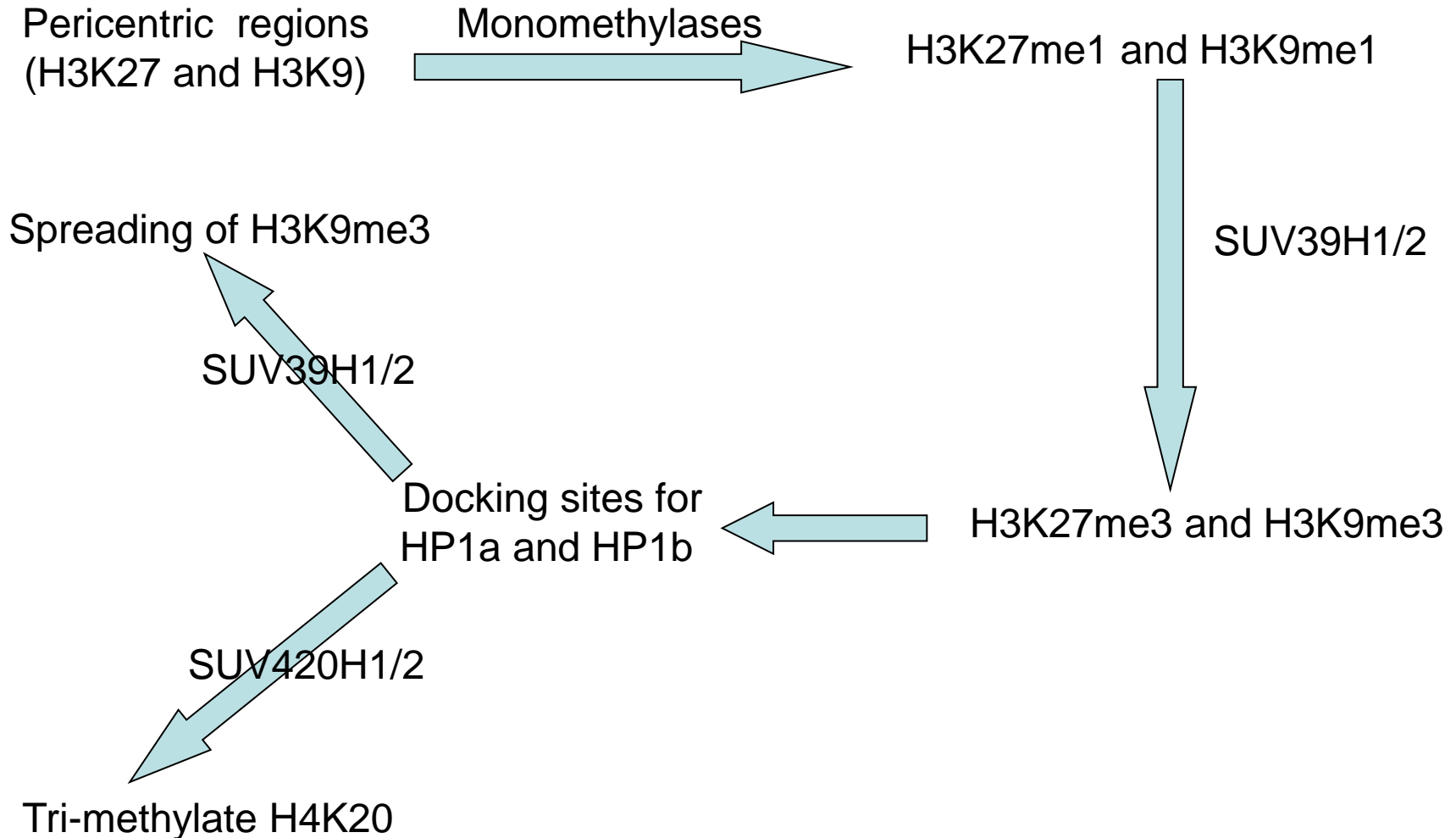
H4K20me

\*Plays important role in Heterochromatin formation

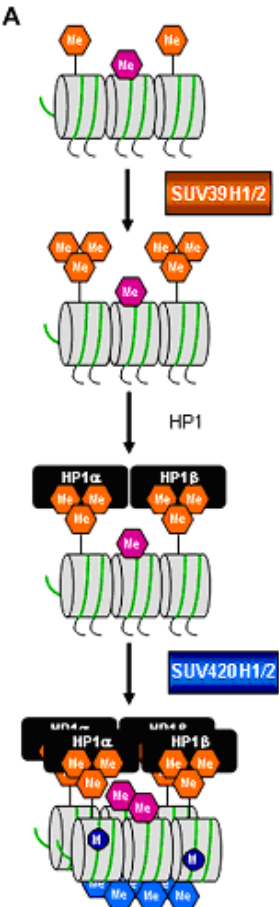
# Heterochromatin

- \*Chromosomal regions that remain condensed throughout the cell cycle.
- \*Contains DNA coding inactive genes ("turned off").
- \*Associated to specific domain such as centromeres, telomeres, and pericentric regions that are satellite-repeat-rich.

# Role of Histone methylation in Heterochromatin formation



# Role of Histone methylation in Heterochromatin formation



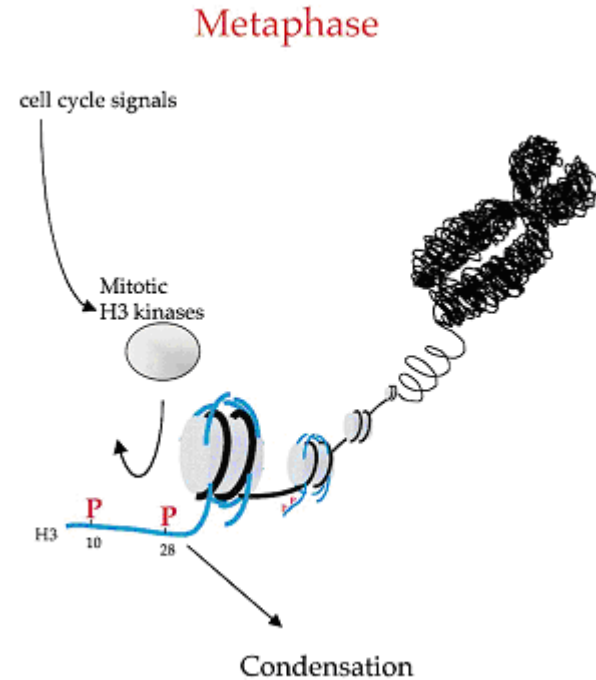
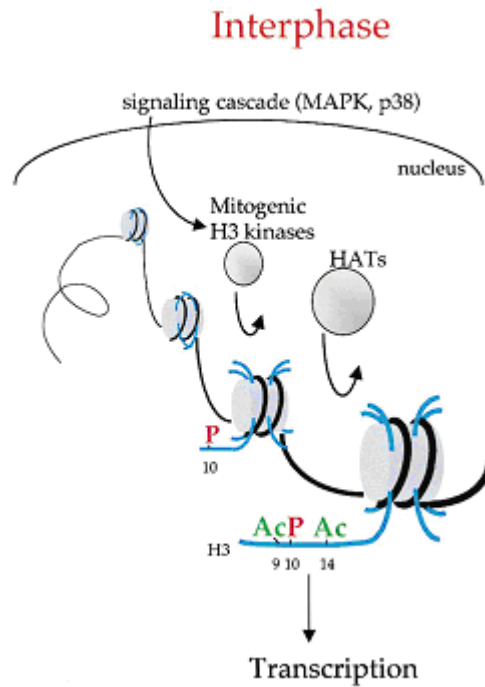
# Histone Phosphorylation

Definition: Addition of phosphate group to the histone tails

- \*Associated with active gene expression.
- \*Mechanistic link with acetylation

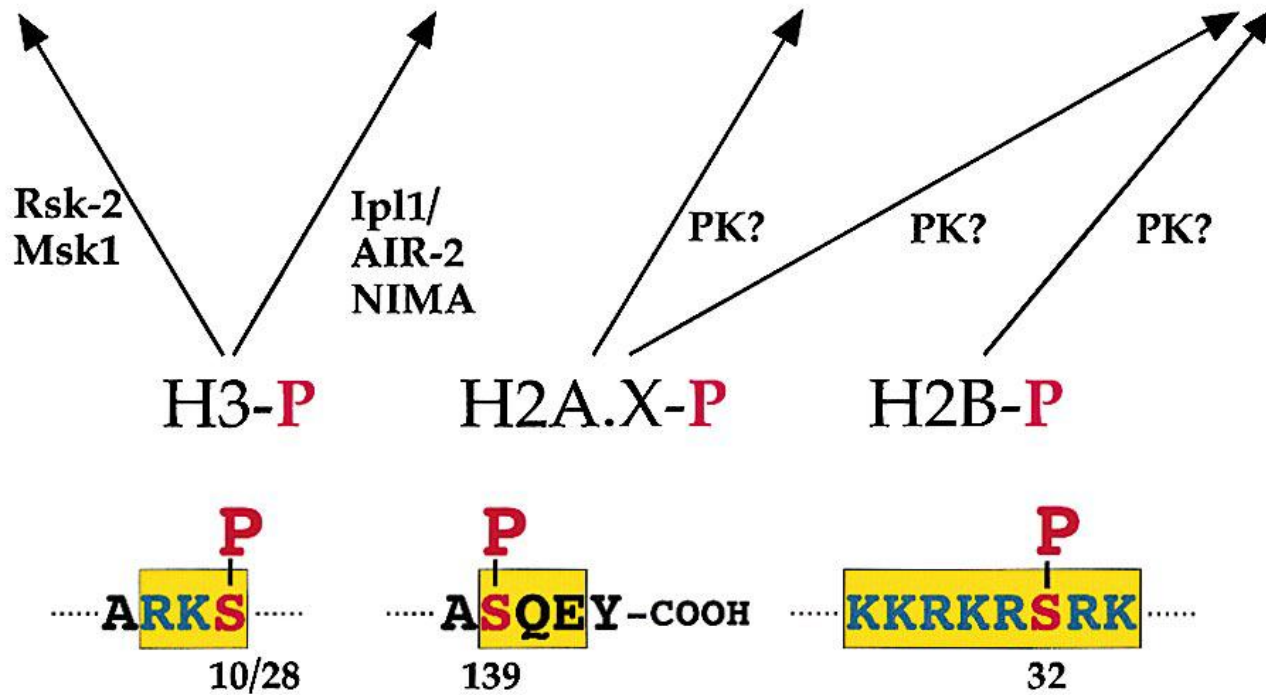


# Histone Phosphorylation



# Histone Phosphorylation

Transcription    Mitosis    DNA breaks/repair    Apoptosis

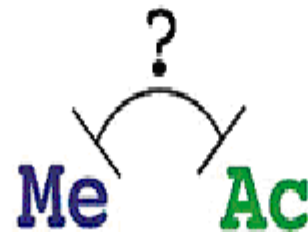
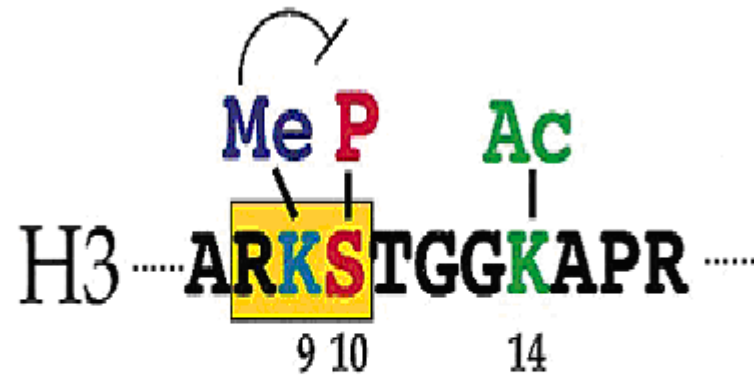


# Histone modifications interplay

\*Histone H3, phosphorylation of serine 10 inhibits methylation of K9.

\*Deacetylation of H3-K14 facilitates the subsequent methylation of K9

# Histone modifications interplay



**Questions**