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FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

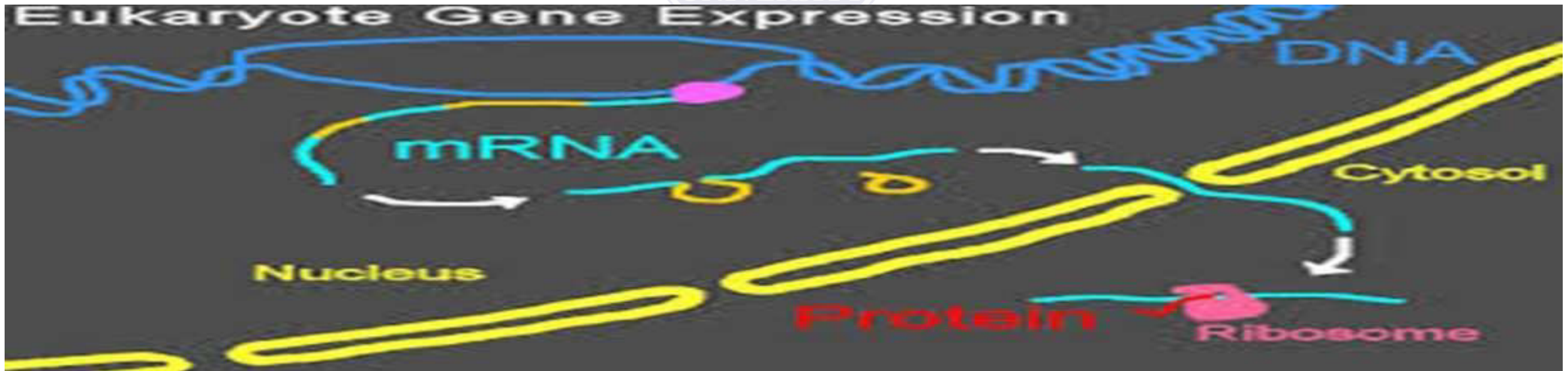
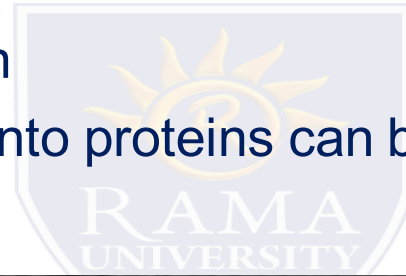
Eukaryotic gen Regulation

Eukaryotic cells have a much larger genome Eukaryotes have much greater cell specialization

Thus eukaryotic cells contain an enormous amount of DNA that does not program the synthesis of RNA or protein

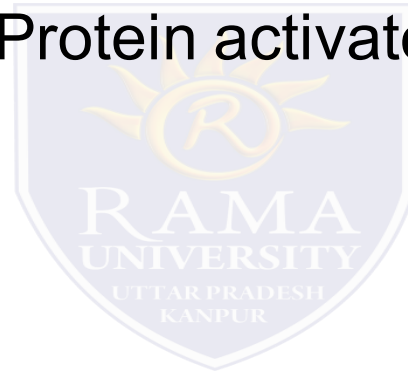
This requires complex organization

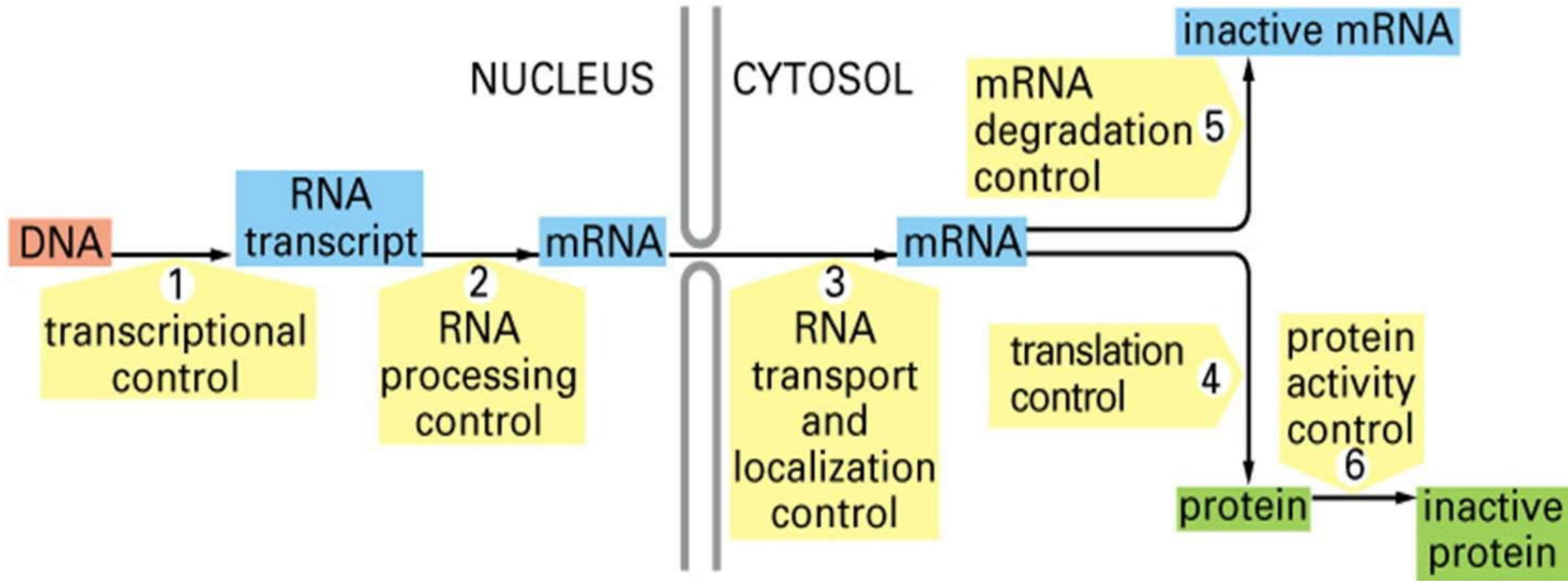
In eukaryotes expression of gene into proteins can be controlled at various locations



Steps of Eukaryotic gene Regulation

1. Transcriptional control.
2. RNA processing control.
3. RNA transport & localisation control
4. Translation control.
5. mRNA degradation control.
6. Protein activator control.



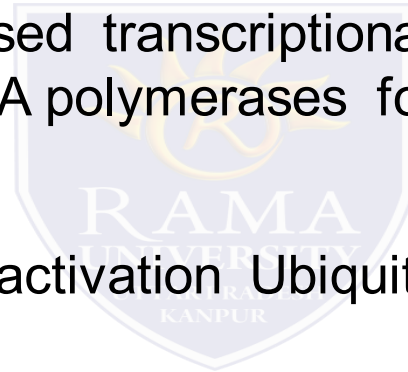


Two forms of chromatin

- Euchromatin – A lesser coiled transcriptionally active region which can be easily accessed by the RNA polymerases.
- Heterochromatin – A highly condensed transcriptionally inactive region. The genes in this region cannot be accessed by the RNA polymerases for active transcription.

- **Ubiquitination:**

Ubiquitination of H2A – Transcriptional inactivation Ubiquitination of H2B -
Transcriptional activation



Mechanisms affects the chromatin Structure:

- Histone modifications – These modifications make a region of gene either transcriptionally active or inactive.

Acetylation

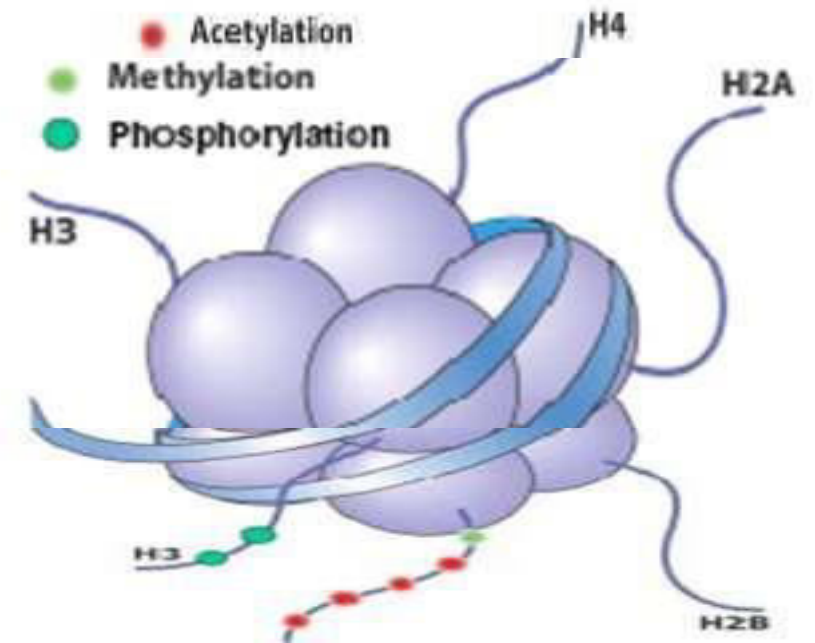
- ↑Acetylation ----↓ Condensation of DNA ----- ↑ Transcription of genes in that region Ubiquitination

Ubiquitination of H2A – Transcriptional inactivation Ubiquitination of H2B - Transcriptional activation



Methylation

- DNA methylation: is the addition or removal of a methyl group predominantly where cytosine bases occur consecutively.
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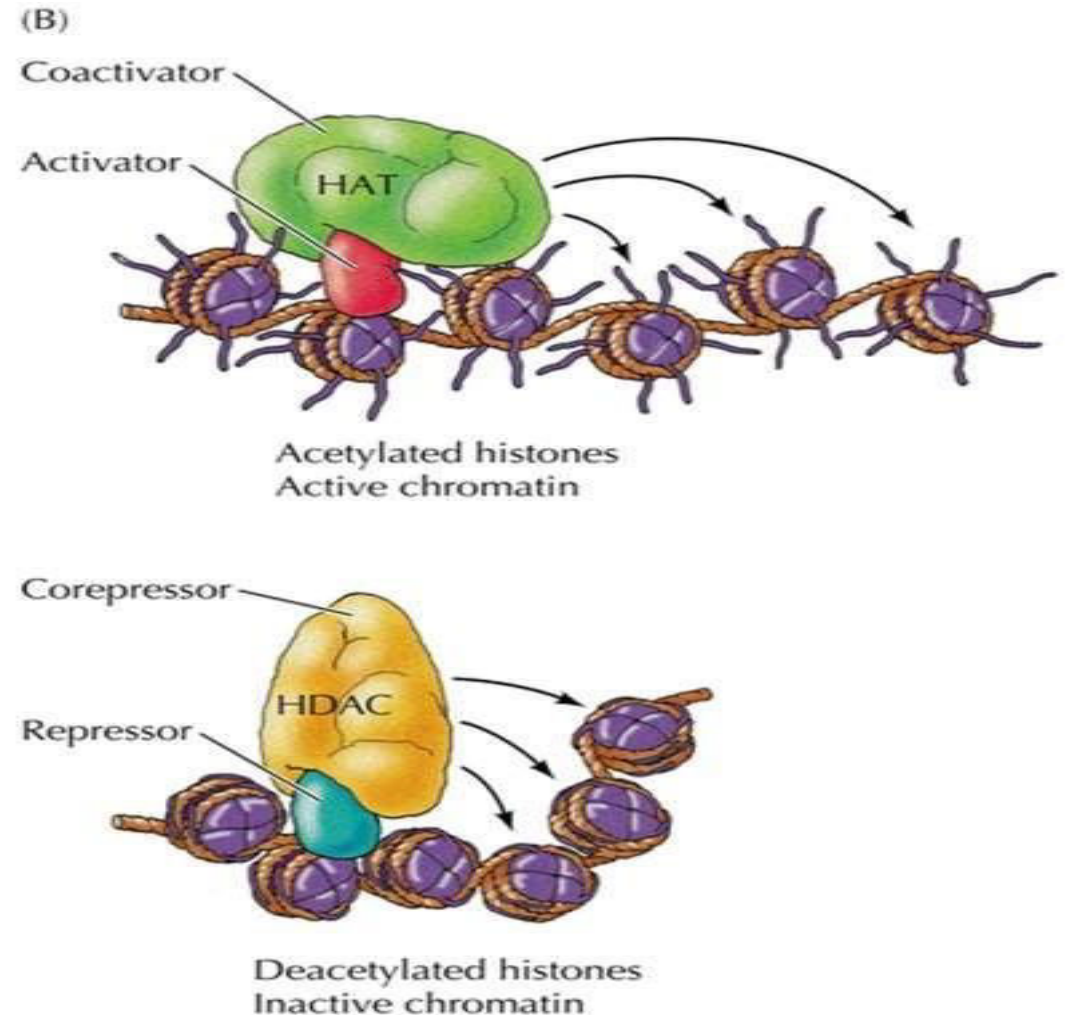
ACETYLATION :

by HATs and coactivators leads to euchromatin formation



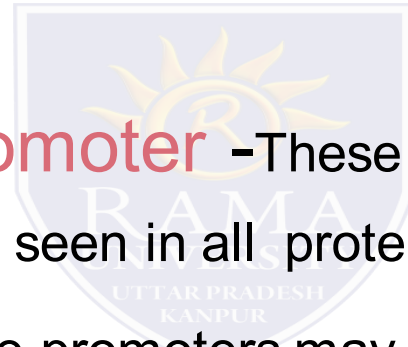
METHYLATION:

by HDACs and corepressors leads to heterochromatin formation



Regulation of Transcription:

- Eukaryotes – There are two types of promoters which are:
 - i. Basal promoters**
 - ii. Upstream promoters**
- **Basal promoter or core promoter** - These promoters reside within 40bp upstream of the start site. These promoters are seen in all protein coding genes.
- **Upstream promoters** - These promoters may lie up to 200bp upstream of the transcriptional initiation site. The structure of this promoter and the associated binding factors keeps varying from gene to gene.



Transcriptional control:

... controlling when and how often a given gene is Transcribed

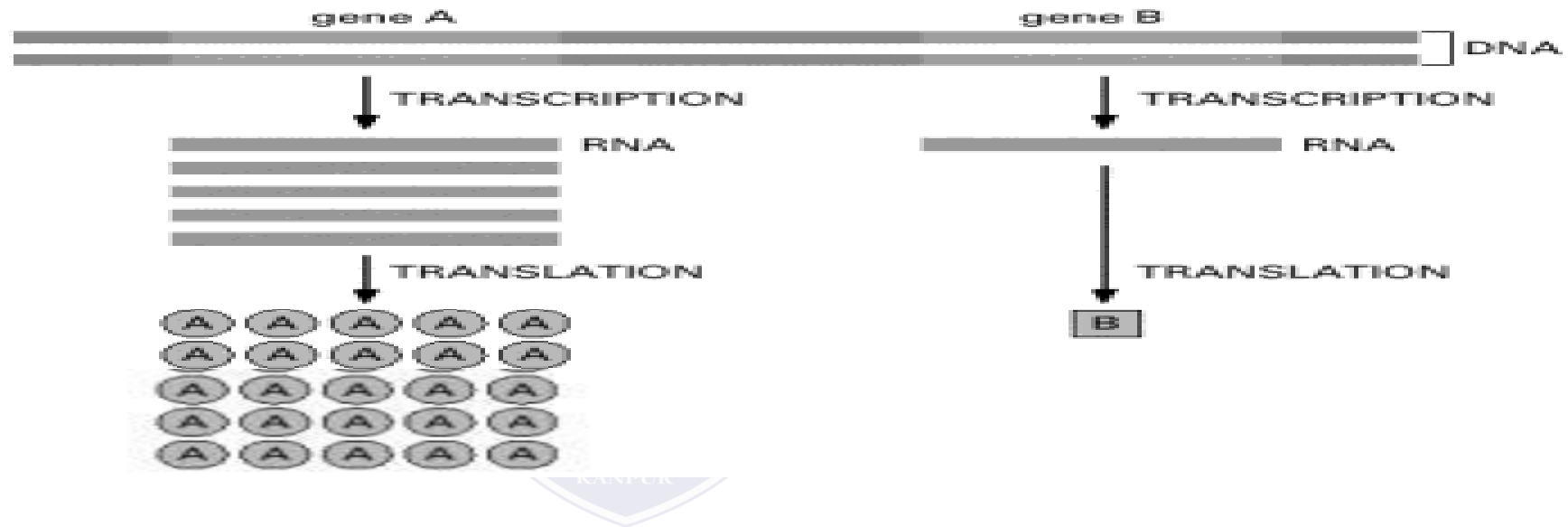
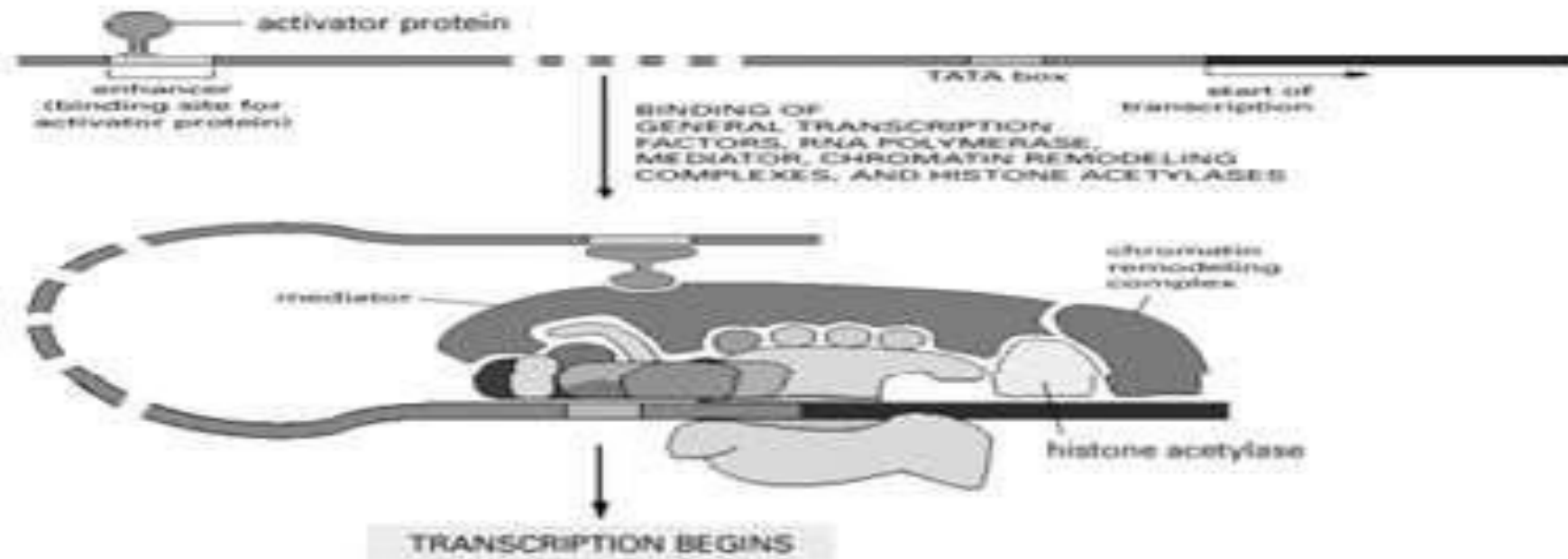


Figure 6. Genes can be expressed with different efficiencies.

Gene A is transcribed and

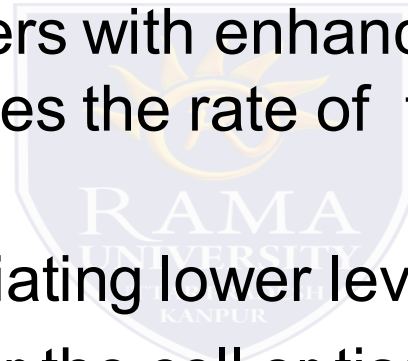
translated much more efficiently than gene B. This allows the amount of protein A in the cell to be much greater than that of protein B.

Transcriptional control – regulation by RNA polymerase:



Enhancers

- Enhancers can be located upstream, downstream or within the gene that is transcribed
- The binding of these enhancers with enhancer binding proteins (transcription factors) increases the rate of transcription of that gene to a greater extent.
- Promoters are capable of initiating lower levels of transcription.
- Enhancers are responsible for the cell or tissue specific transcription.
- Each enhancer has its own transcription factor that it binds to.

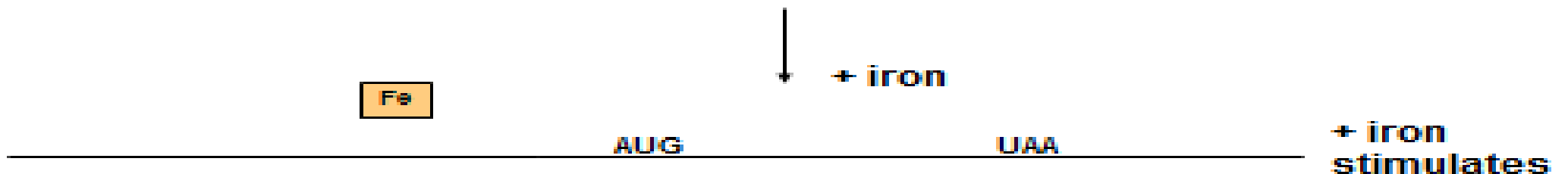


Control at mRNA stability

- A stem loop is stabilised by the 90 kDa protein in the absence of iron.
- This time, the stem loop is at the 5' end of the mRNA.



- The presence of the stem loop prevents translation of this mRNA by blocking the progress of the ribosomes along the mRNA.



- In the presence of iron, the hairpin is lost, the ribosomes can translate the mRNA and ferritin protein synthesis is increased.