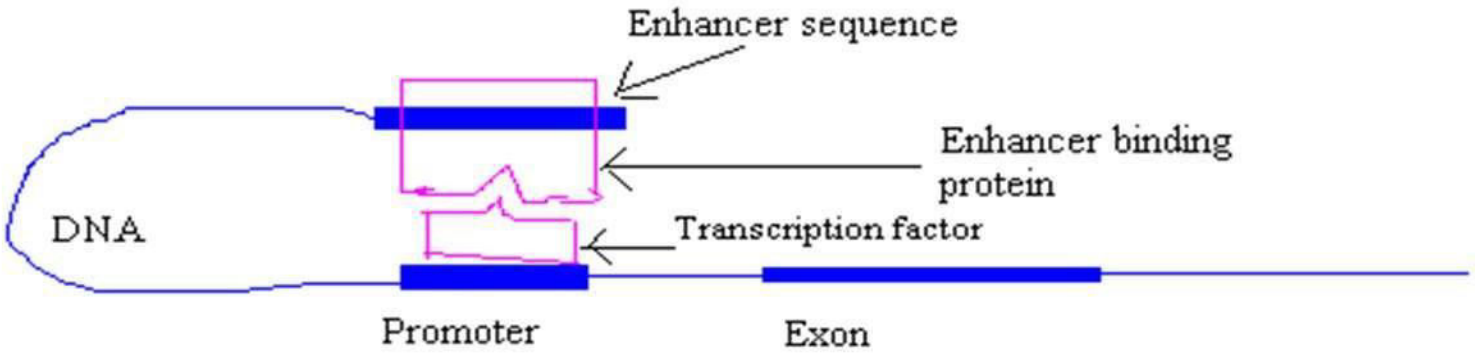
FACULTY OF ENGINEERING &TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

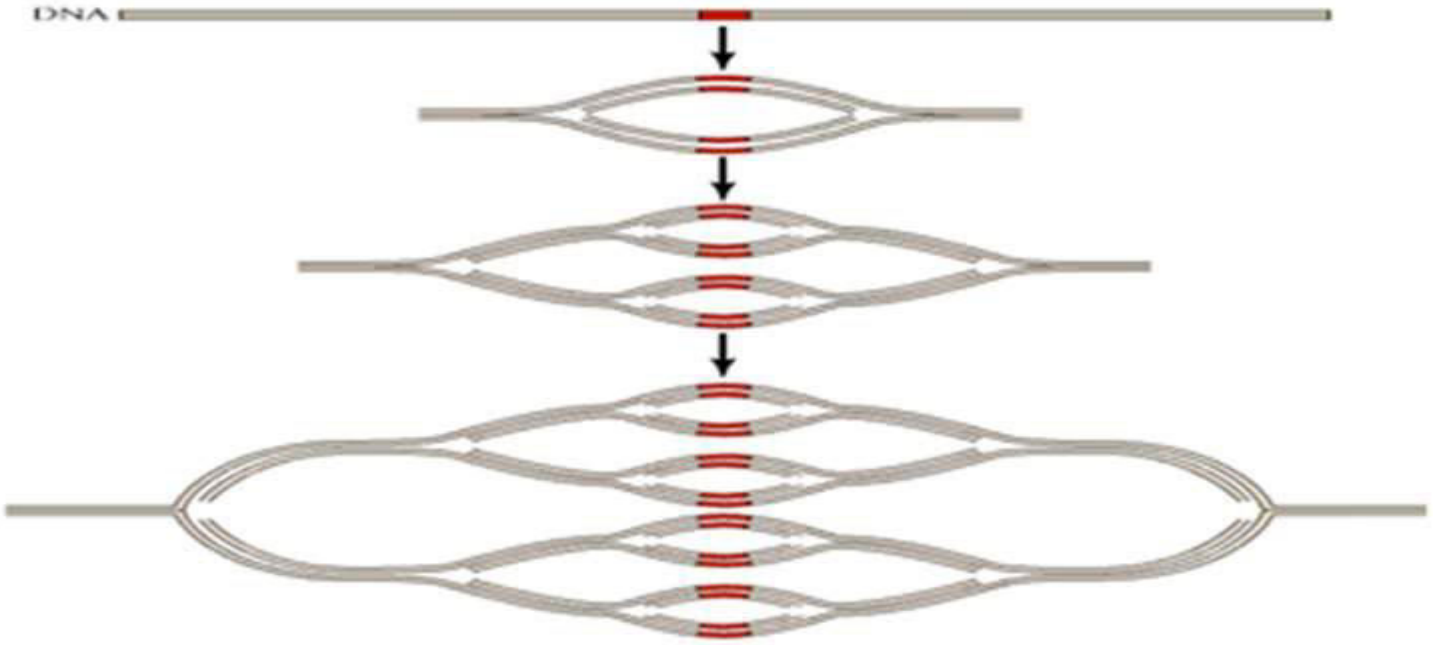
- Action of an enhancer

An enhancer binding protein has two binding sites

- Binds DNA
- Binds the transcription factors that are bound to the promoter



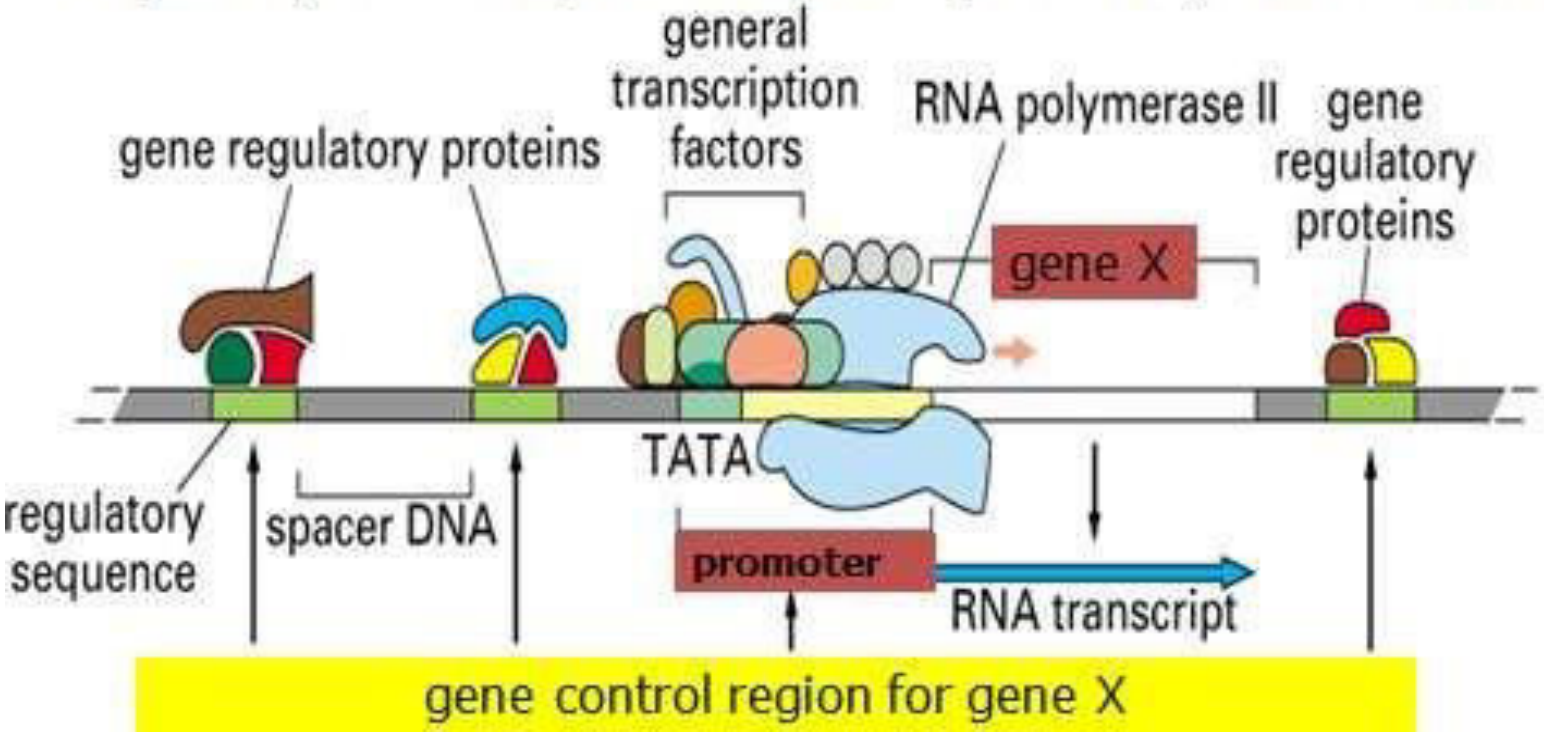
3-Control at DNA level by gene amplification:



Repeated rounds of DNA replication yield multiple copies of a particular chromosomal region.

4- Control at transcription initiation:

By using different sequences (promoter, enhancer or silencer sequences) and factors, the rate of transcription of a gene is controlled

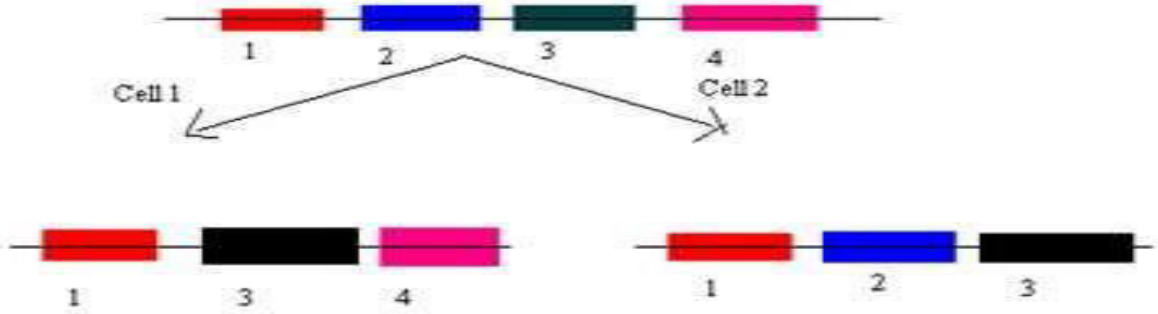


Regulation of RNA Processing

- RNA processing involves
  - o Addition of 5' cap
  - o Addition of a 3' poly (A) tail
  - o Removal of introns
- The RNAs which get translated to proteins are transported out from the nucleus to cytoplasm.
- Depending on the final combination of exons after splicing different kinds of proteins are obtained which can perform different functions in the cell.

Exon Shuffling

- The functions of two proteins synthesized from the same mRNA are different in different cells as different combination of exons exist in different cells.



Regulation of RNA Transport

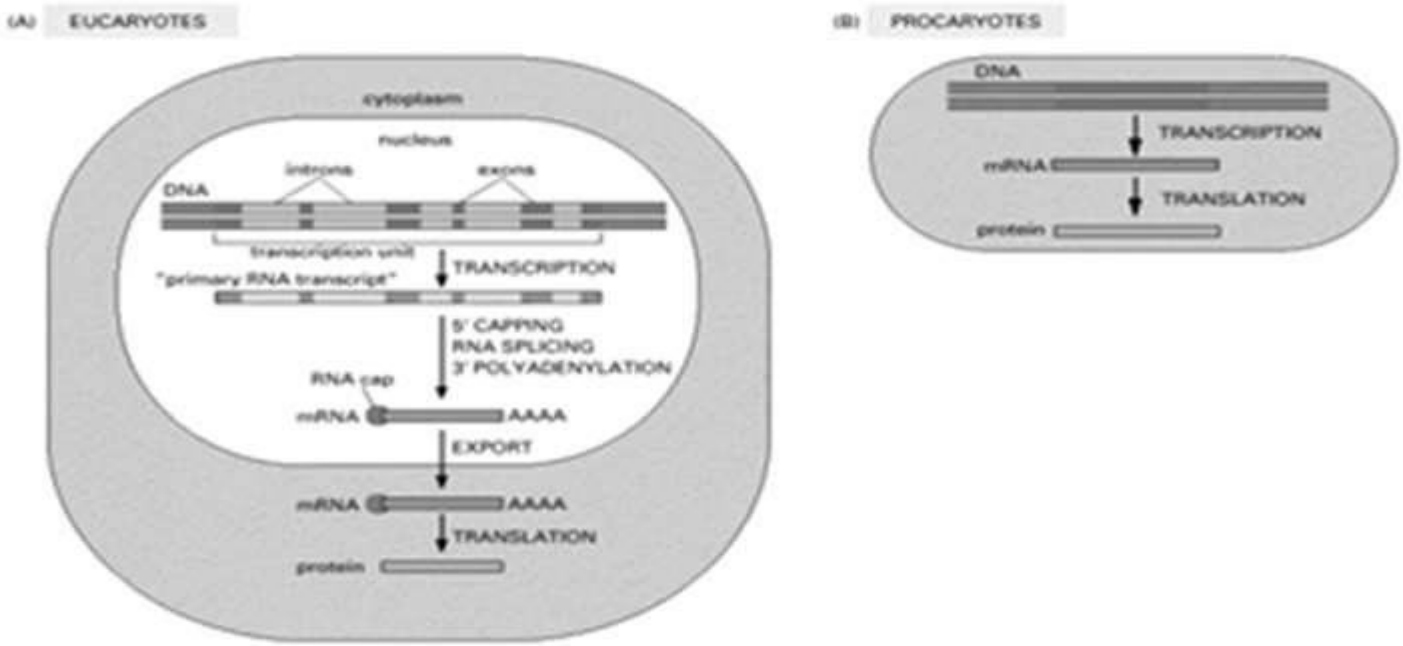
- Only some RNAs function within the nucleus whereas all other RNAs which are meant for protein synthesis have to be transported from the nucleus to the cytoplasm via nuclear pores.

Regulation of RNA Longevity

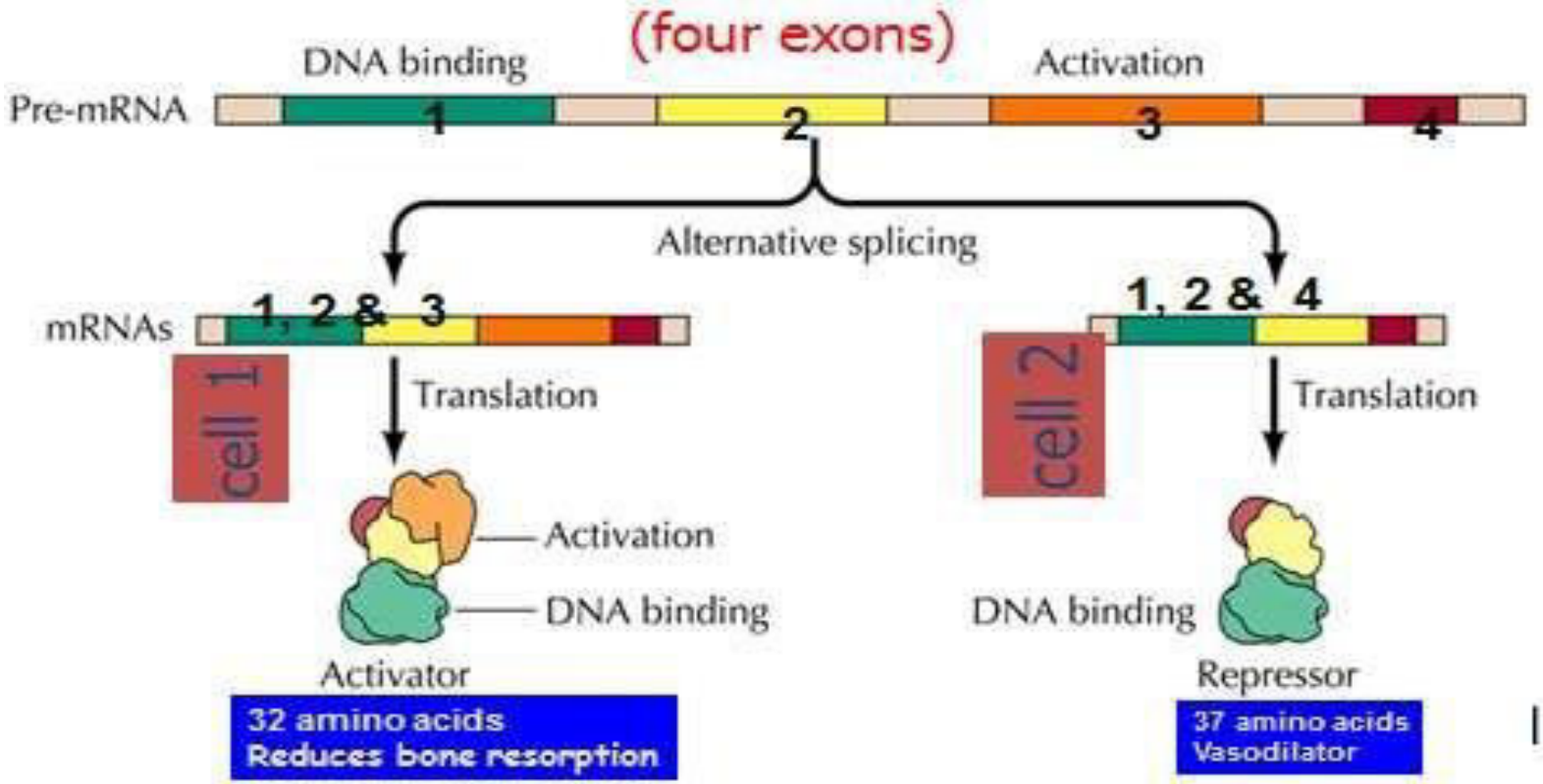
- mRNAs from different genes have different life spans.
- The information of the life span of mRNA is found in the 3' UTR.
- The sequence AUUUA within 3' UTR acts as a signal for early degradation.
- More the number of times the sequence is repeated → Shorter the lifespan of mRNA

RNA-processing control:

Capping, Splicing, Polyadenylation



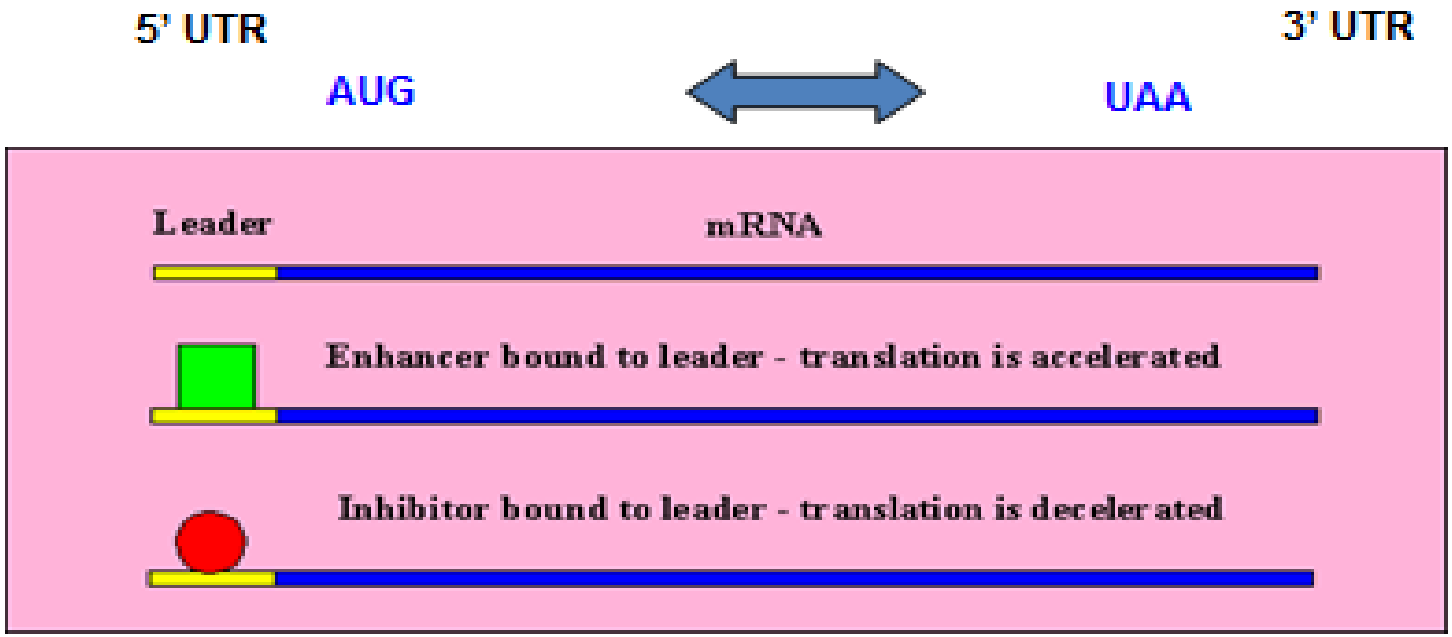
5- Control at mRNA splicing (alternate splicing) :



6.Regulation of Translation

- Translational initiation
  - The expression of a gene product also depends on the ability of the ribosome to recognize the correct AUG codon out of the multiple methionine codons present in the mRNA.
- Control of translational process
  - In many animals large amounts of mRNAs are produced by the eggs but all of them do not get translated until the egg is fertilized.

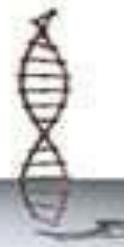
Control at initiation of translation:



Specific sequences make specific secondary structures

Specific protein factors bind to these secondary structures

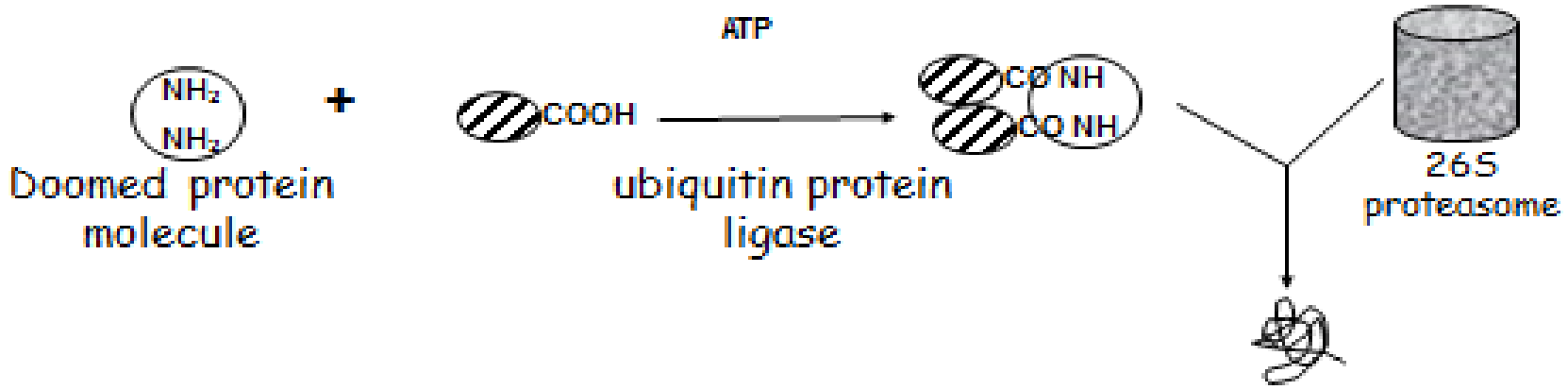
7.Post Translational Control Points



- Post translational modifications
  - Functional state of protein depends on modifications like glycosylation, acetylation, fatty acylation, disulfide bond formations.
  - Chaperons
- Protein transport
  - Transportation to the site of action
- Protein stability
  - The lifespan of a protein depends on the specific amino acid sequence present within them

8-Regulation by protein stability:

•Ubiquitin-dependent proteolysis. Cyclins control of cell cycle.
• Protein molecule is tagged for degradation by attachment of a 20 kDa protein, ubiquitin



• The stability of a protein depends upon its *N*-terminal amino acid (the *N*-end rule).

N-terminal : For example arginine , lysine : protein t1/2 = 3 min
N-terminal : For example methionine, alanine, : t1/2 >20 hrs.

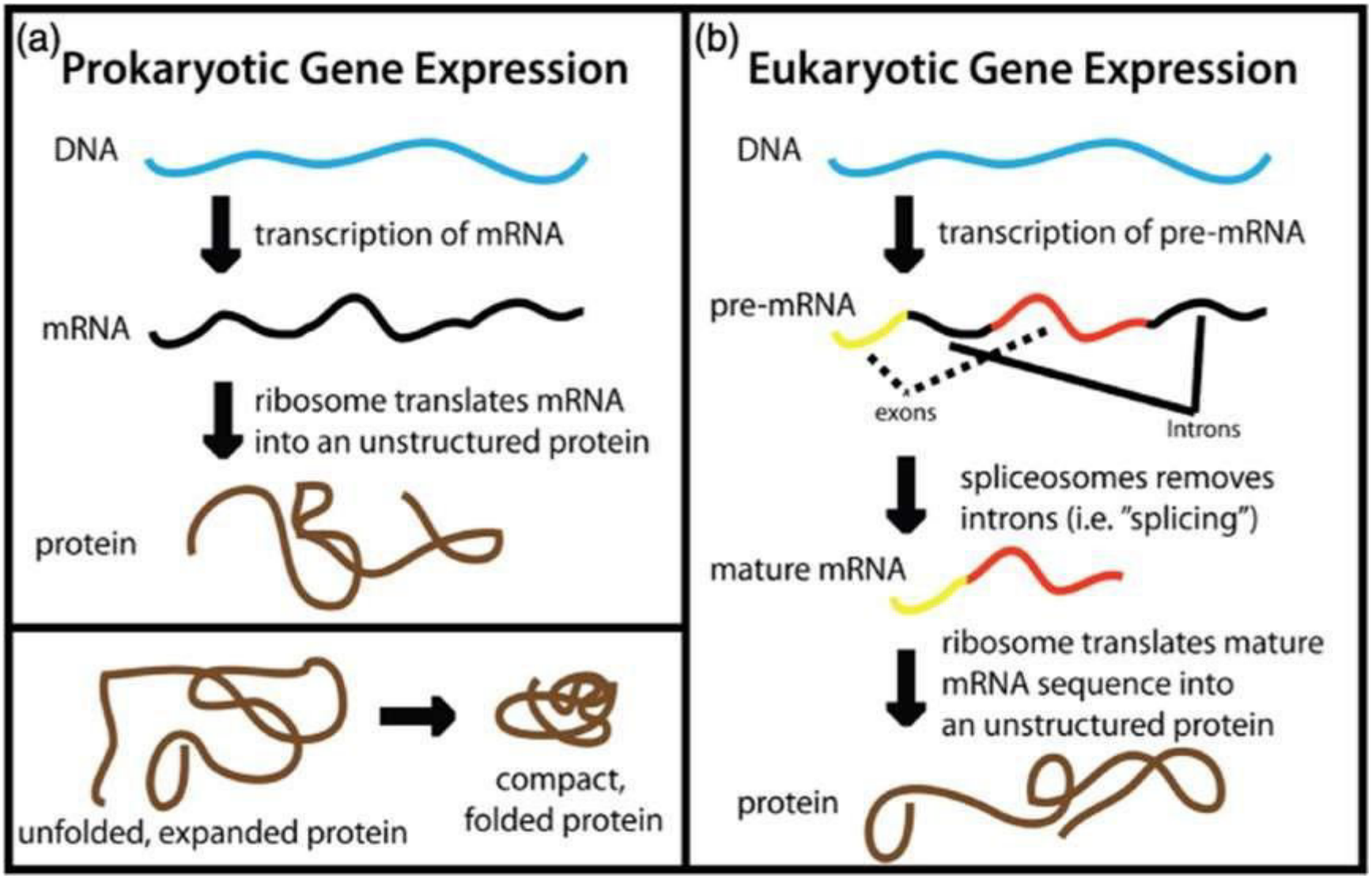
Regulation of gene expression

Prokaryotes

- Mainly at transcriptional level
- Sets of genes transcribed together (polycistronic)
- E.g. *lac* operon and *trp* operon in bacteria

Eukaryotes

- Other levels of regulation inlcude posttranscriptional and posttranslational regulation
- Each gene transcribed independently (monocistronic)


(a) Prokaryotic Gene Expression
DNA
transcription of mRNA
mRNA
ribosome translates mRNA into an unstructured protein
protein
unfolded, expanded protein
compact, folded protein
(b) Eukaryotic Gene Expression
DNA
transcription of pre-mRNA
pre-mRNA
exons
Introns
spliceosomes removes introns (i.e. "splicing")
mature mRNA
ribosome translates mature mRNA sequence into an unstructured protein
protein