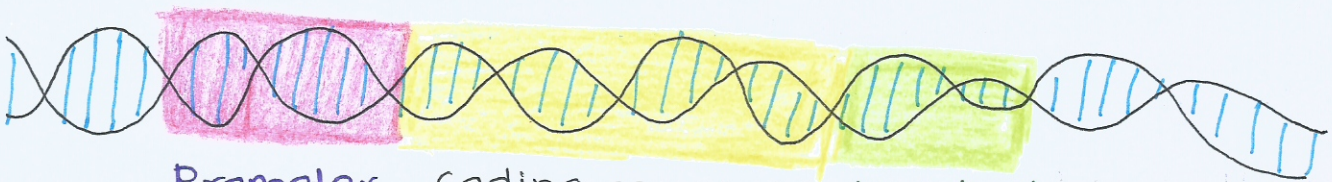
7.2. TRANSCRIPTION & GENE EXPRESSION

PROMOTER

- It is a non-coding sequence located near a gene.
- It is the binding site for RNA polymerase.
- It catalyses the formation of the covalent bond between nucleotides while the RNA is being synthesized.
- It does not get transcribed itself but plays a role in it.

Coding sequence:

- After the RNA polymerase has bound to the promoter, it causes the DNA strands to unwind and separate.
- The region of DNA that is being transcribed by the RNA polymerase is known as the coding sequence.

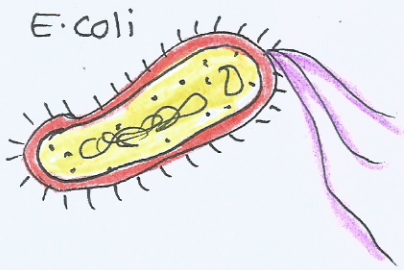


gene (sections)

Terminator:

- When the RNA polymerase reaches the terminator sequence, it stops transcribing the DNA.
- The RNA strand detaches.

REGULATION OF GENE EXPRESSION BY PROTEINS



Gene expression must be regulated.

IN PROKARYOTES:-

It is regulated as a consequence of variations in the environmental factors.

Example: E.coli

The genes responsible for the absorption and metabolism of lactose by E.coli are expressed in the presence of lactose.

▷ The breakdown of lactose results in regulation of gene expression by negative feedback.

Repressor protein is deactivated in the presence of lactose.

After the lactose has been broken down, the protein is activated again and it blocks the expression of lactose metabolism genes.

IN EUKARYOTES:-

Genes are regulated in response to variations in the environmental factors.

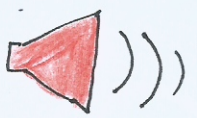
▷ The regulation is important for cellular differentiation and development.

The proteins which bind to the DNA and regulate transcription →

▷ Enhancers: Regulatory sequences on the DNA which increase the rate of transcription after proteins bind to them.

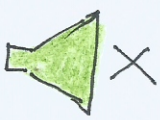
▷ Silencers: These are the sequences that reduce the rate of transcription.

Enhancers and silencers are distant from the promoter.



↑ rated transcription

Enhancers



↓ rate of transcription

silencers

▷ Promoter-proximal elements: these sequences are nearer to the promoter & the binding site. They are necessary to initiate transcription.

Direction of Transcription

→ Transcription occurs in a 5' to 3' direction.

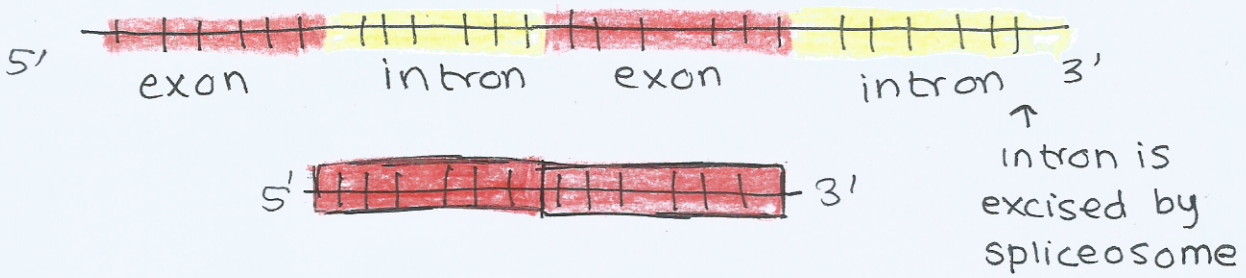
Initiation: Polymerase binds to the promoter and unwinds & seperates the DNA strands.

Elongation: RNA polymerase moves along the coding sequence in a 5'3' direction.

Termination: RNA is synthesized and detached.

POST-TRANSCRIPTION MODIFICATION

Eukaryotic cells modify mRNA after transcription.



- Eukaryotes have a nuclear membrane surrounding the genetic material whereas prokaryotes don't.

Prokaryotes → absence of compartment means that translation & transcription can be coupled.

Eukaryotes → the separation of the location of transcription & translation allows for post-transcription modification.

This occurs before the mature transcript exits the nucleus.

Example in Eukaryotes:-

Removal of introns from the RNA transcript.

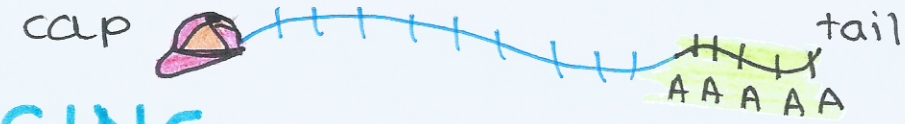
PRE-MRNA → RNA splicing → MATURE RNA

Introns - They don't contribute in the formation of a polypeptide and therefore need to removed.

Exons - They are the coding part of the mRNA and are spliced together to form mature mRNA.

▷ Post-modification also includes the addition of 5' cap. It occurs before the completion of transcription.

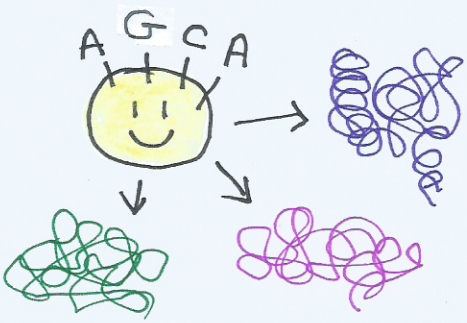
▷ Poly-A tail is added after the transcript has been made.

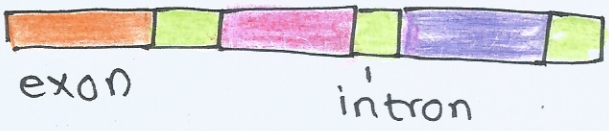


mRNA SPLICING

It increases the number of different proteins an organism can produce.

▷ It is a process during gene expression where a single gene codes for multiple proteins. Multiple exons need to be present for this to occur.





An exon may or may not be included in the final mRNA. This results in different proteins from alternatively sliced mRNA & the polypeptide formed will have a different amino acid sequence & function.