TRANSCRIPTION & TRANSCRITPION FACTORS

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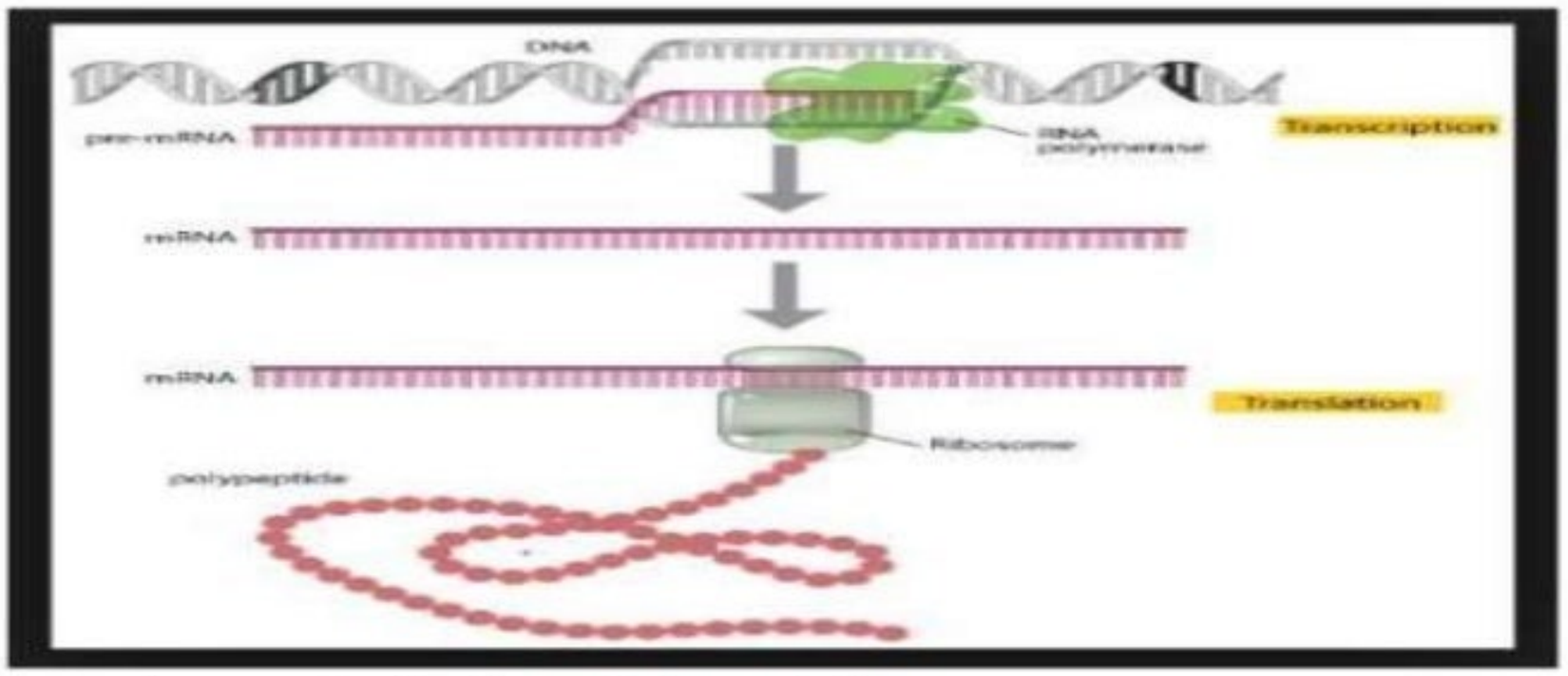
TRANSCRIPTION AND TRANSCRIPTION FACTORS

It is the synthesis of an mRNA molecule from a DNA template

All the cellular RNAs are synthesized from the DNA templates through the process the transcription, DNA regions that can be transcribed into RNA are called structural genes

Template strand on which the RNA is synthesized is called as antisense code or non-sense codon, the coding strand is known as sense codon, the enzyme that catalyze the RNA synthesis is RNA Polymerase and doesn't need a primer unlike replication



Difference between Replication and Transcription

REPLICATION	TRANSCRIPTION
It requires a primer, enzyme that catalyze this is DNA polymerase	This doen't require primer, enzyme that catalyze the synthesis of mRNA is RNA Polymerase
Product formed is ds DNA strand one each on the mother template and the other on the daughter strand	Product formed is one new single stranded mRNA is produced on the single stranded DNA as the template
Substrate for the synthesis are dNTPS. base pairing A pairs with T and G pairs with C	Substrate for the synthesis are NTPs. Base pairing A pairs with U and G pairs with C
Entire chromosome is replicated	Only a small portion of the DNA molecules is transcribed to RNA, and this varies based on the cells needs at the time , physiological need and environmental changes

TRANSCRIPTION IN EUKARYOTICS

- Transcription in eukaryotic is undertaken by different RNA Polymerase
- Eukaryotes have 3 polymerase Pol I II III
- Several initiation factors are required for efficient and promoter specific initiation in eukaryotes and are called as general transcription factors GTFs
- In vitro, the GTFs is required, together with Pol I, to initiate transcription on a DNA template
- Sometimes GTFs are not sufficient of promotes significant expression. Rather the additional factors are required such as mediator complex , DNA binding , regulatory proteins and chromatin modifying enzymes.
- In vitro, the GTFs is required, together with Pol II, to initiate transcription on DNA template

Transcription in eukaryotics can be divided into three classes. Each class is transcribed by a different RNA Polymerase

1. RNA Polymerase I to transcribes r RNA
2. RNA Polymerase II transcribes m RNA
3. RNA Polymerase III transcribes t RNA and other small RNA's

In eukaryotic cells, for all the RNA Polymerase, the factors creates and structure at the promoter to provide the target that is recognized by the enzyme.

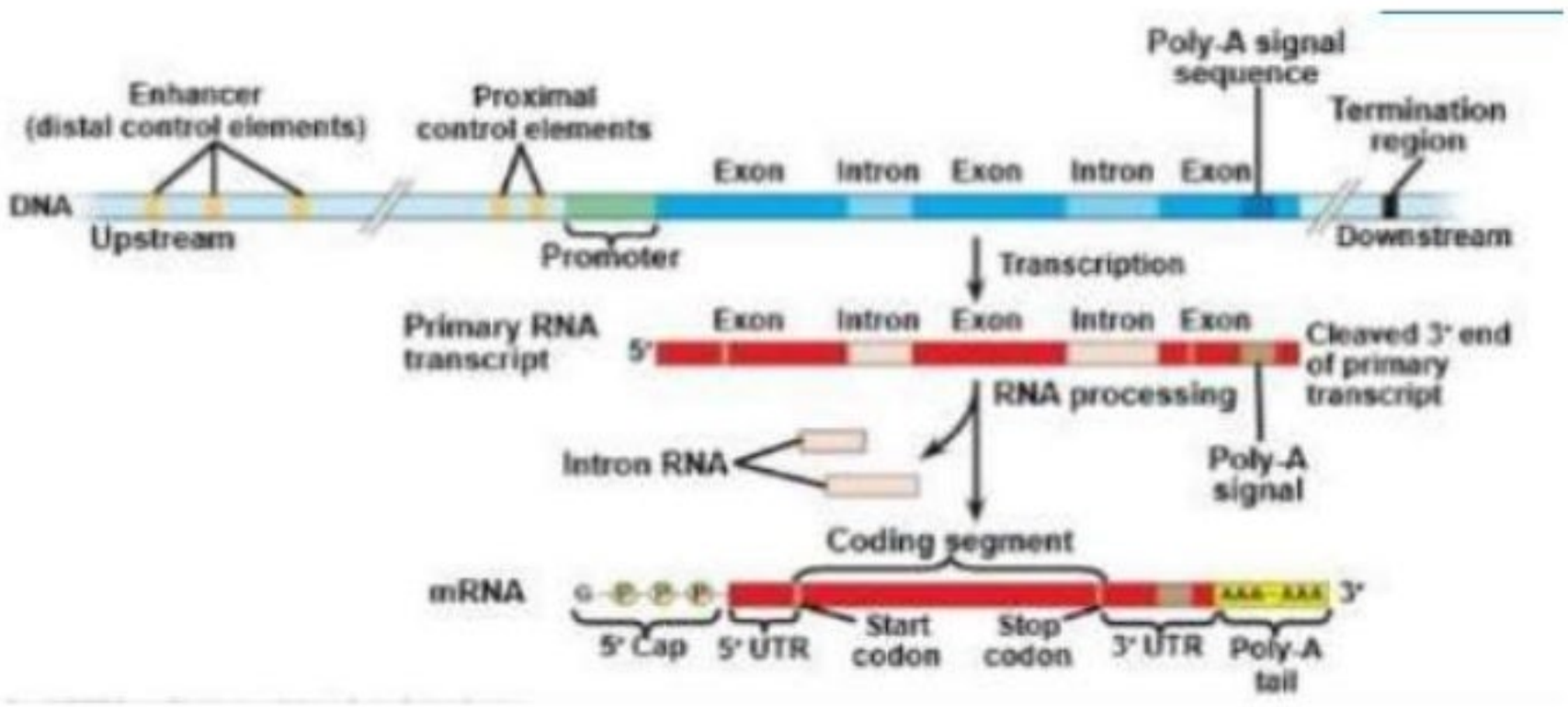
e.g. RNA Polymerase II the factors form a sizeable group collectively called as basal factors

TRANSCRIPTION FACTORS

- Any protein that are needed for initiation of transcription, but which is not itself part of RNA Polymerase, is defined as a transcription factor
- they act by recognizing cis acting sites on DNA
- Binding of transcription factors is not enough for the transcription, it may recognize another factor, or a RNA Polymerase, or it might get incorporated into an initiation complex only in the presence several proteins
- Transcription factors are needed for initiation

What are basal factors?

These are the factors that join with RNA Polymerase II and form a complex surrounding the start point , they determine the site of initiation.



Basal transcription apparatus:

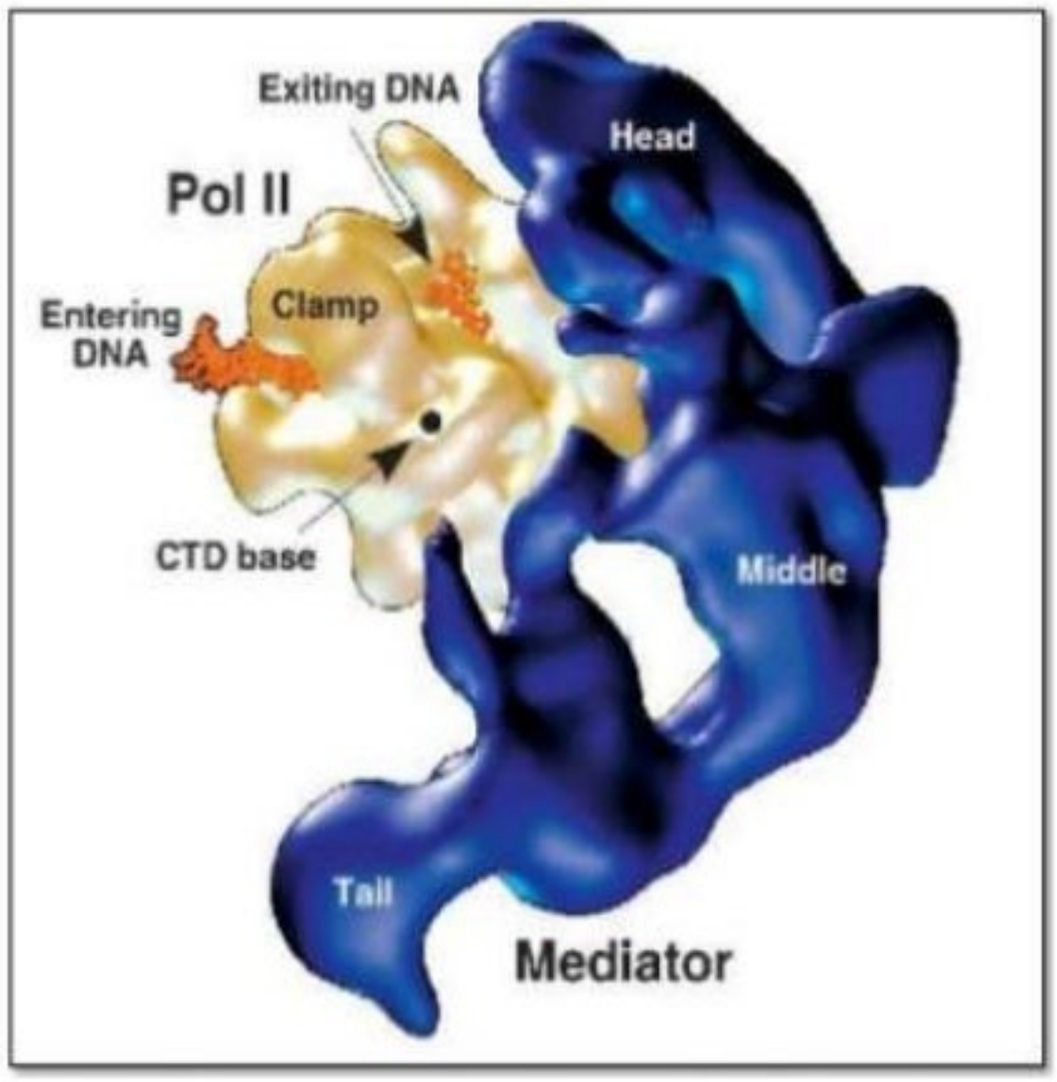
- Basal factors and RNA Polymerase II form the basal transcription apparatus
- RNA Polymerase have sequence elements close to the start point that are bound by basal apparatus and that established the site of initiation . RNA Polymerase II and general transcription factors are needed to transcribe any promoter
- The subunits of RNA Polymerase II and the general transcription factors are conserved among eukaryotes

WHAT IS PROMOTER

- The promoter is defined as the shortest region that contains all the binding sites, that is those sites that can support transcription at the normal efficiency and with the proper control.
- For eukaryotic m RNA is the basically the site at which the transcription on factors bind
- The promoter contains several short less than 10bp sequence elements that binds the transcription factors, dispersed over more than 200bp
- The promoter for RNA Polymerase II is located upstream of the start point and these help in initiating the transcription.

ENHANCERS:

- These are the types of the sites involved in initiation.it can be defined as the sequences that stimulate initiation but are located at a considerable distance from the start point.
- The components of enhancers are similar to that of the promoters
- They contain several closely arranged sequence elements that binds transcription factors
- The enhancer need not to be at start point
- The proteins that are bound to the enhancers are also interact with the proteins bound at promoter elements



STEPS OF TRANSCRIPTION

Transcription by RNA Polymerase proceeds through a series of well defined steps with are grouped into 3 phases

- Initiation
- Elongation
- Termination

RNA Polymerase II

- It is located in the nucleosome

- It represents most of the remaining activity and is responsible for synthesizing heterogenous nuclear RNA , The precursor of m RNA
- These are large proteins have large molecular weight more than 500KD
- RNA Polymerase II requires transcription factors TFII (X) to initiate the transcription
- The TATA box is common component of RNA Polymerase II promoters and consist of A-T rich octamer located -25 bp upstream of the start point
- Core promoter for RNA Polymerase II includes the InR and either a TATA box or a DPE

CORE promoter:

- **It** refers to minimum set of sequence elements required for accurate transcription initiation by Pol II
- Function at low efficiency
- A core promoter is about 40 nucleotides long extending either upstream and downstream of the transcription start site.

There are 4 elements found in Pol II Core promoter these are the :

1. TFIIB Recognition site
2. TATA element
3. The initiator (InR) element
4. The downstream promoter element (DPE)

Promoter includes 2 or 3 of these 4 elements

A core promoter is present either with a TATA BOX and Inr or with a Inr and a DPE

THE INITIATOR: At the start point there is no extensive homology of sequence , but these is a tendency for the first base of m RNA to be A, flanked on the either sides of the pyrimidines

- This region is known as initiator. described in the form of Py2CAPy5. The initiator is between position -3 to -5
- Core promoter with a TATA BOX at -25 and at +1 there is transcriptional start site
- Coding start sequence up to 100bp
- Upstream from TATA BOX may regulatory elements -cis acting elements
- DNA sequences- that exert their effects only over a particular gene: eg: TATA BOX, Enhancers and silencers

- Trans acting factors that bind to cis acting factors

PROTEIN NEEDED FOR TRANSCRIPTION IN EUKARYOTIC

RNA POLYMERASE II: the enzyme that catalyze the linkage between ribonucleotides in 5-3 direction, using DNA as a template. Eukaryotics RNA Polymerase II proteins are usually composed of 12 subunits . the two large subunits are structurally similar to beta and beta prime subunits found in E.coli RNA POLYMERASE.

TRANSCRIPTION FACTORS	FUNCTIONS
TFIID	Composed of TATA binding proteins (TBP) and other associated factors (TAFs) . recognizes the TATA box of eukaryotics proteins, encoding gene promoters
TFIIB	Binds to TFIID and then enable RNA PolymeraseII to bind to the core promoter . also promotes TFIIF binding. It is a monomer protein slightly smaller than TBP
TFIIF	A Tetrameric complex with RNA Polymerase II and play a role in its stability to bind to TFIIB and the core promoter. Also plays a role in ability of TFIIE and TFIIH to bind to RNA Polymerase II
TFIIE	Tetrameric complex that bind to the DNA and creates a dock site for TFIIH
TFIIH	It is a multimeric factors containing 9 subunits. The binding of TFIIH Completes the assembly of the transcription preinitiation complex in vitro . it has multiple roles.