TRANSCRIPTION FACTORS

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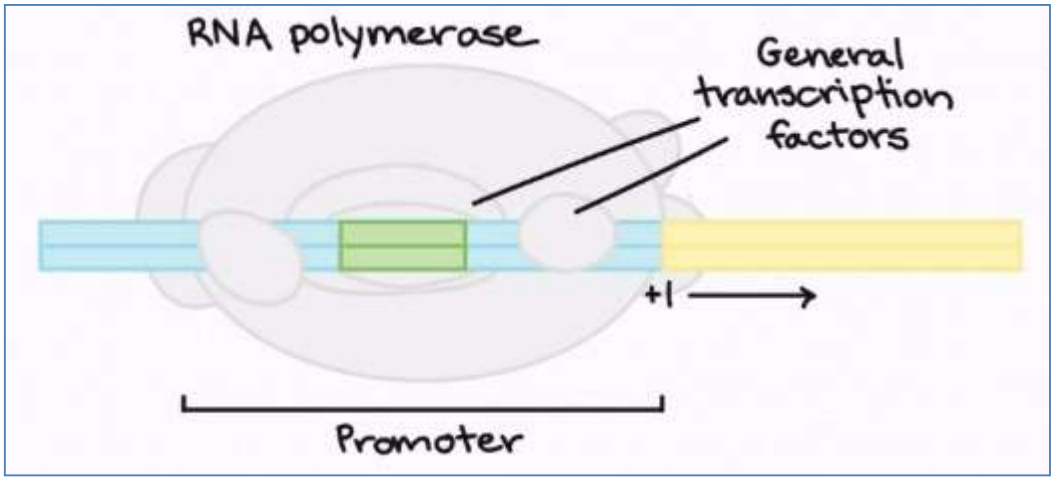
Transcription factors are proteins involved in the process of converting, or transcribing, DNA into RNA. Transcription factors include a wide number of proteins, excluding RNA polymerase, that initiate and regulate the transcription of genes.

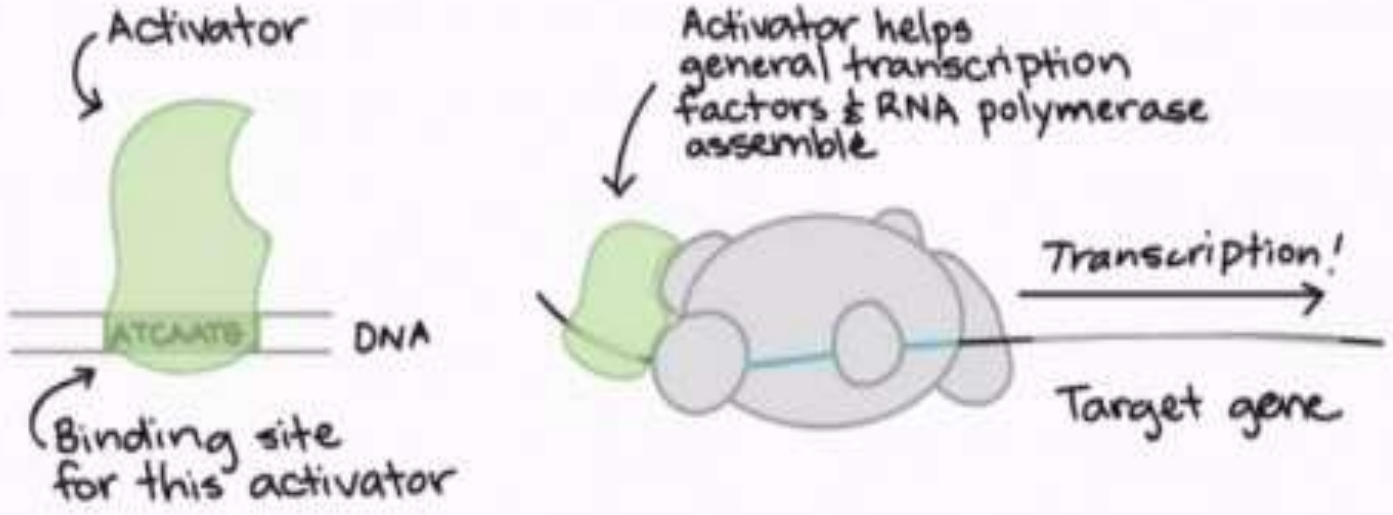
- Transcription factors are proteins that help turn specific genes "on" or "off" by binding to nearby DNA.
- Transcription factors that are activators boost a gene's transcription. Repressors decrease transcription.
- Groups of transcription factor binding sites called enhancers and silencers can turn a gene on/off in specific parts of the body.
- Transcription factors allow cells to perform logic operations and combine different sources of information to "decide" whether to express a gene.

- The enzyme RNA polymerase, which makes a new RNA molecule from a DNA template, must attach to the DNA of the gene. It attaches at a spot called the promoter.
- In bacteria, RNA polymerase attaches right to the DNA of the promoter. You can see how this process works, and how it can be regulated by transcription factors, in the lac operon and trp operon videos.
- In humans and other eukaryotes, there is an extra step. RNA polymerase can attach to the promoter only with the help of proteins called basal (general) transcription factors. They are part of the cell's core transcription toolkit, needed for the transcription of any gene.



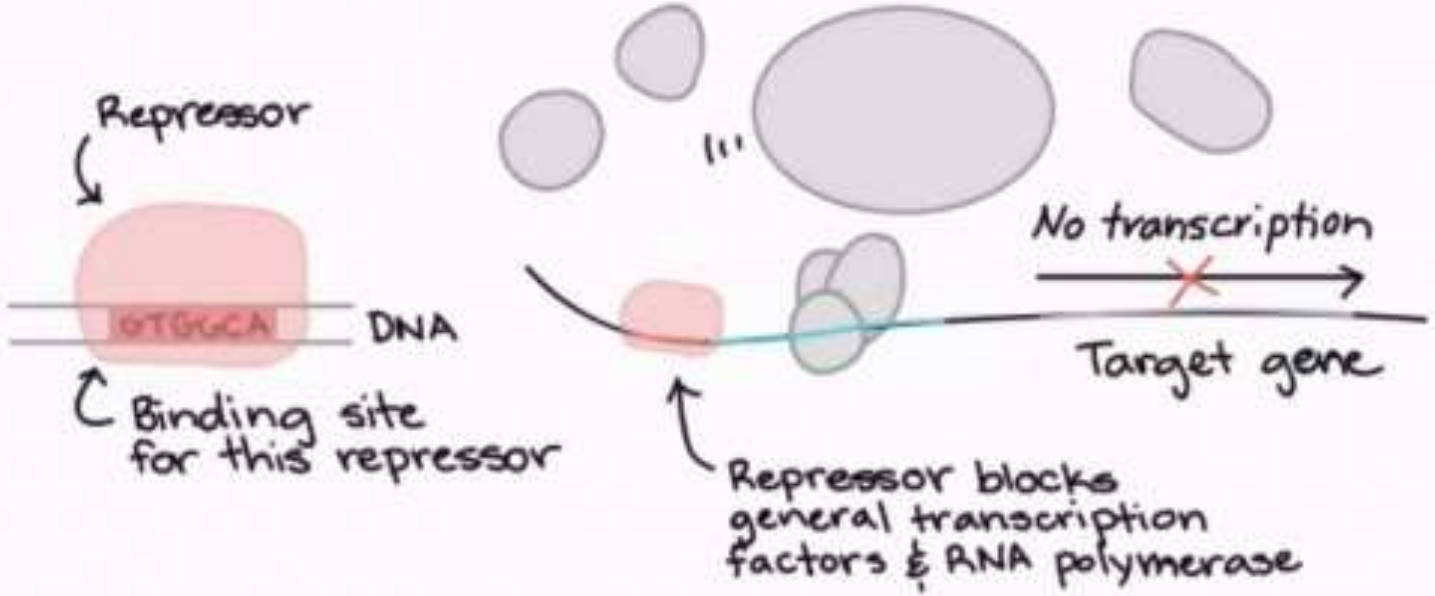
- **Activators**

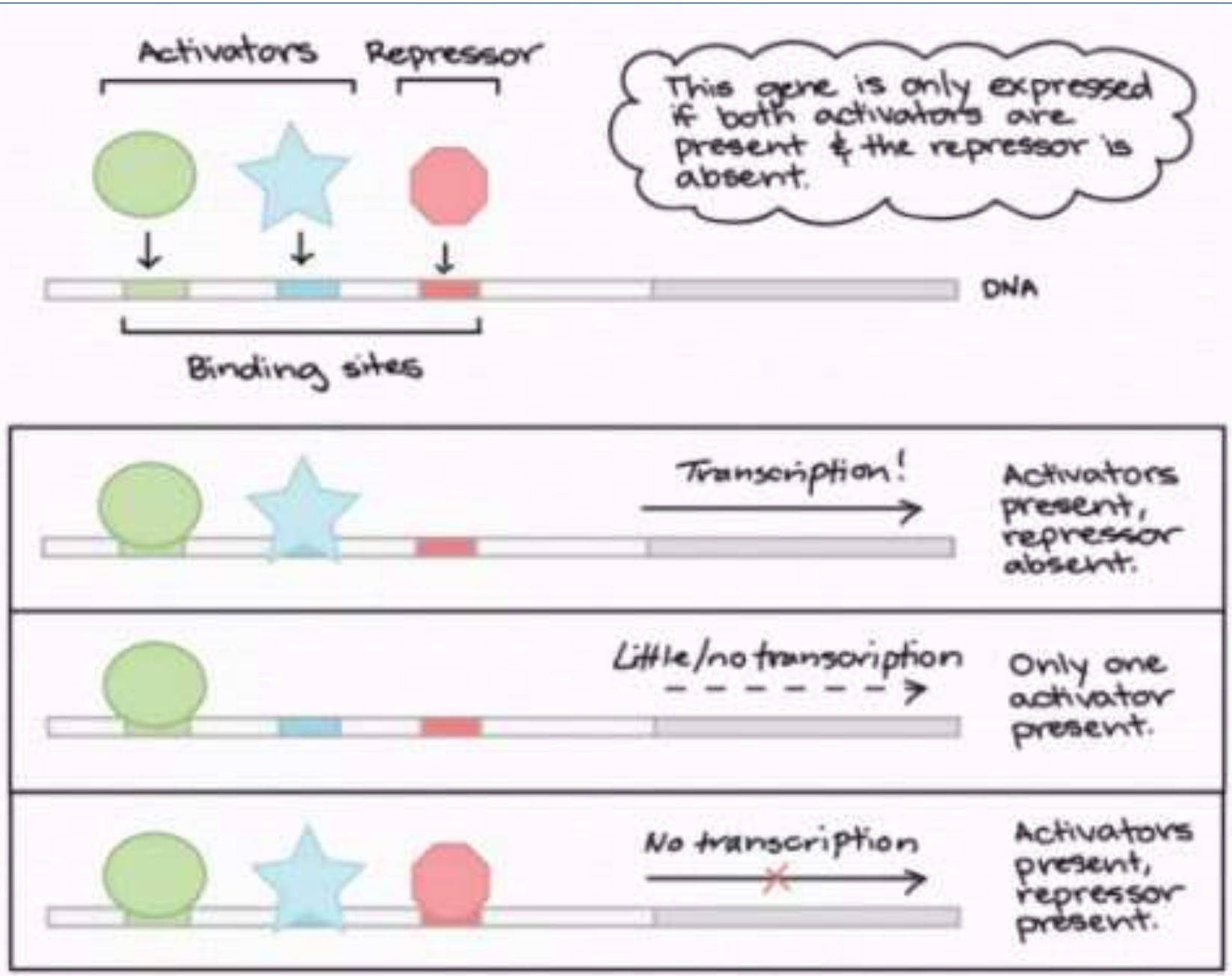
Some transcription factors activate transcription. For instance, they may help the general transcription factors and/or RNA polymerase bind to the promoter, as shown in the diagram below.



- **Repressors**

Other transcription factors repress transcription. This repression can work in a variety of ways. As one example, a repressor may get in the way of the basal transcription factors or RNA polymerase, making it so they can't bind to the promoter or begin transcription.




Activators
Repressor
This gene is only expressed if both activators are present & the repressor is absent.
DNA
Binding sites
Transcription!
Activators present, repressor absent.
Little/no transcription
Only one activator present.
No transcription
Activators present, repressor present.

The general transcription factors and its roles in initiation of eukaryotic transcription have been summarized in Table 12.3.

Table 12.3: General transcription factors needed for transcription initiation by *polymerase II*.

NAME	NUMBER OF SUBUNITS	ROLES IN INITIATION OF TRANSCRIPTION
TFIID		
TBP subunits	1	recognizes TATA box
TAF subunits	~11	recognizes other DNA sequences near the transcription start point; regulates DNA-binding by TBP
TFIIB	1	recognizes BRE element in promoters; accurately positions *RNA polymerase* at the start site of transcription
TFIIF	3	stabilizes *RNA polymerase* interaction with TBP and TFIIB; helps attract TFIIE and TFIIH
TFIIE	2	attracts and regulates TFIIH
TFIIH	9	unwinds DNA at the transcription start point, phosphorylates Ser5 of the *RNA polymerase* CTD; releases *RNA polymerase* from the promoter

(TFIID is composed of TBP and - 11 additional subunits called TAFs (TBP associated factors); CTD (C-terminal domain)