



Genetics

Subject : Gene expression

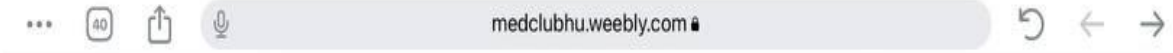
Lec no : 7

Done By : Esra'a Khaled

وَقُلْ رَبِّ زِدْنِي عِلْمًا

تجدون في guidance مادة الجينتكس على موقع النادي :

للوصول الى guidance الجينتكس و تفاريغ
المادة كاملة :



GUIDANCE

SLIDES

NOTES

RECORDS

تجدون هنا شرح المادة كاملة

GENITICS ALAA AL-GAZZAR

تجدون هنا شرح الفريق العلمي للمادة كاملة

شرح قديم (الاسلايدات مختلفة) ، يمكن الاستفادة منها لفهم المواضيع

OLD GENETICS

يمكن الاستفادة من تفاريغ الدفع السابقة

ATHAR BATCH

YAQEEN BATCH

VEIN BATCH

شرح الدكتورة ولاء الجزار للمادة



كل اعمال الفريق العلمي تنشر على قناة
التيليجرام



Gene expression

By

Dr. Wasaa Bayoumie El Gazzar

Gene expression

يعني كيف الجين يعبر عن
حاله و يعطي بروتين

ال gene expression يشمل :

1. Transcription from DNA to mRNA
2. Translation from mRNA to proteins

- **Definition:** Gene expression can be defined as the gene (DNA) undergoes transcription into mRNA that can translate the encoded genetic information into protein.

* في عملية تصنيع البروتين في انزيم واحد بعمل كل شي مش زي عملية ال replication

Transcription (RNA synthesis)

- **Definition:** Transcription is the synthesis of RNA using DNA as a template by an enzyme DNA –dependent RNA polymerase or RNA polymerase (**RNAP**) هاد هو الانزيم الي يقوم بكل العملية

Features of transcription:

- One strand of the two DNA strands is transcribed only, this strand is called template strand (anti-sense), because it provides template for ordering the sequence of nucleotides in an RNA transcript.

ال sequence of nucleotide على ال
template strand (DNA strand)
هي ال sequence تعرفني على ال

- The other strand (non-transcribed) is called

سميناه coding لانه يكون نفس ال sequence of nucleotides لل

RNA transcribed

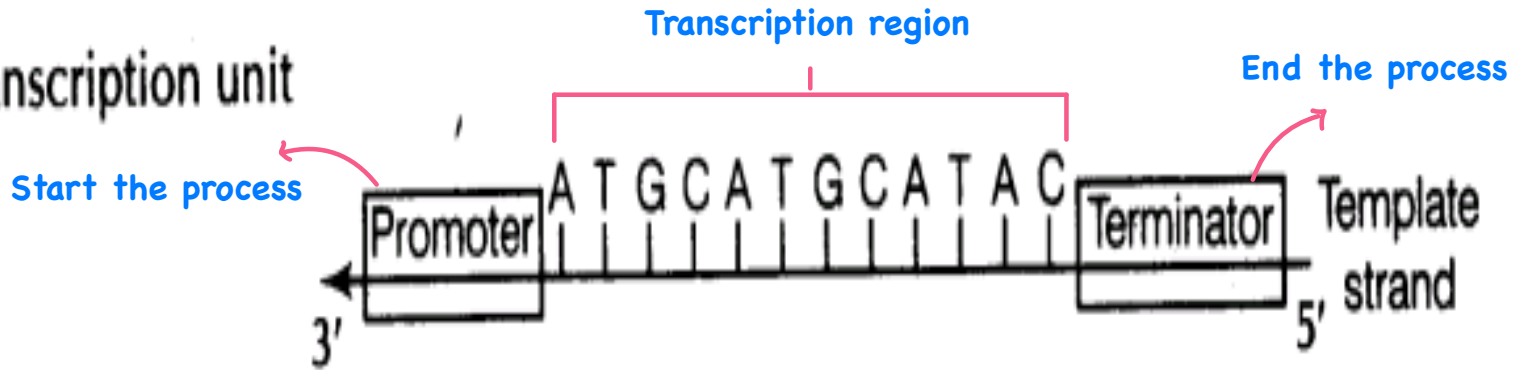
* بتشوفوها
عالصورة
تحت

coding strand (sense strand), because its sequence is the same as the newly synthesized RNA transcript (except for thymine is substituted by uracil)

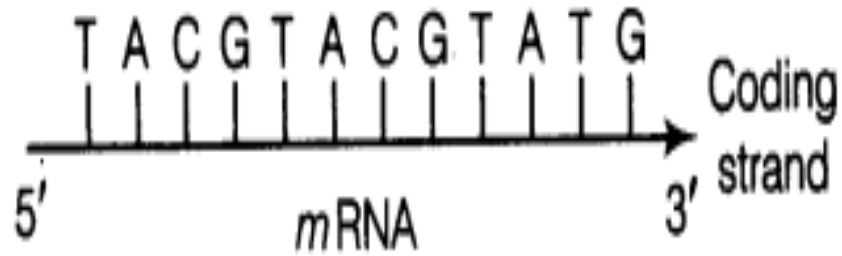
mRNA

- The DNA template strand is read in 3' to 5' by RNA polymerase enzyme and the new RNA is synthesized in the direction of 5' to 3'.
- Upstream means in the 3' direction of the template strand. * ننتبه انه لل template strand
- Downstream means in the 5' direction of the template strand.
- A transcription region ^{In the DNA} is the nucleotide sequence transcribed by the enzyme RNAP. It is the region between the promoter and the terminator.

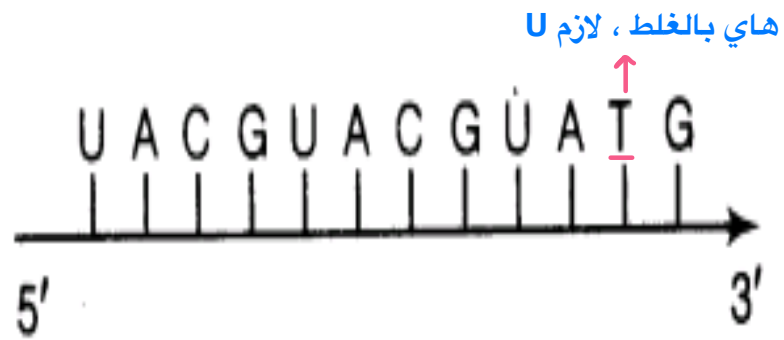
(i) Transcription unit



نفس ال sequence of nucleotide
بس انه ال T صارت U عشان RNA



(ii) RNA transcribed



• **Promoter:** A promoter is the DNA sequence that initially binds the RNA polymerase (together with any initiation factors required). i.e. Nucleotide sequence in DNA to which RNA polymerase binds to begin transcription.

هاي المنطقة الي
بتمنع ال
polymerase
يكمل تصنيع
mRNA و بتخليه
يحرر ال RNA
chain

• **Terminator:** Sequences trigger the elongating polymerase to dissociate from the DNA and release the RNA chain it has made.

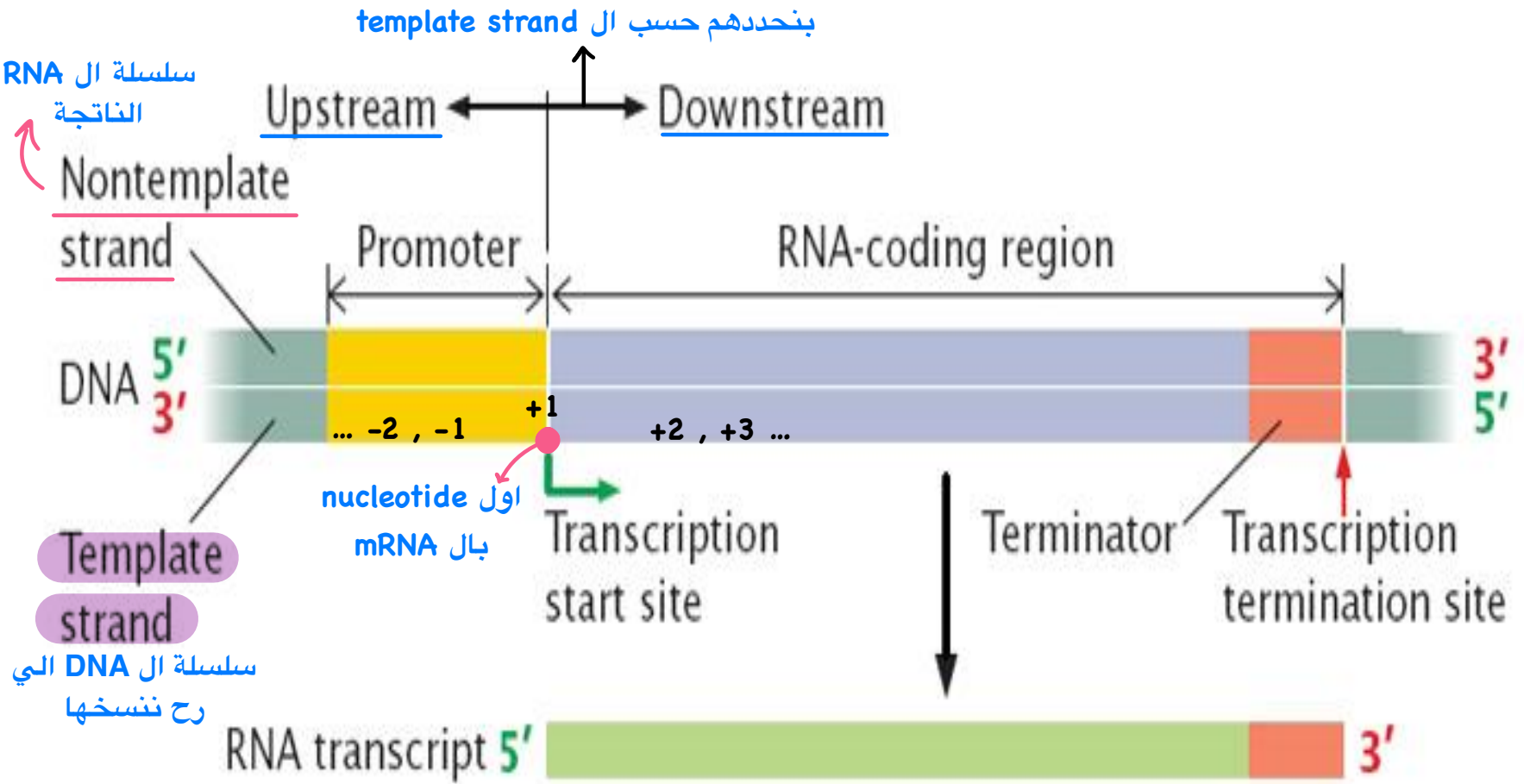
• **The start point** is the nucleotide at the 3` end of the transcription region "that codes for the initial base of the mRNA". It is designated +1. Adjacent nucleotides are given positive numbers that increase as we go downstream the transcription unit.

- The nucleotide in the promoter adjacent to the +1 nucleotide is designated -1 and adjacent nucleotides are given negative numbers that increase as we go upstream the promoter.

بشمل كل شيء :

Promoter / transcription region / terminator

- The transcription unit Sequence of nucleotides in DNA that codes for a single RNA molecule, along with the sequences necessary for its transcription; normally contains a promoter, an RNA-coding sequence, and a terminator. (i.e. includes the promoter, the transcription region, and the terminator)



- The DNA nucleotide encoding the beginning of the RNA chain is called the **transcription start site** and is designated the “+1” position. يعني ماشي باتجاه ال 5 'end
Of the template
- Sequences in the direction in which transcription proceeds are referred to as **downstream** from the start site. Likewise, sequences preceding the start site are referred to as **upstream** sequences. تسبق
- When referring to a specific position in the upstream sequence, this is given a negative value. Downstream sequences are allotted positive values.

Transcription in prokaryotes:

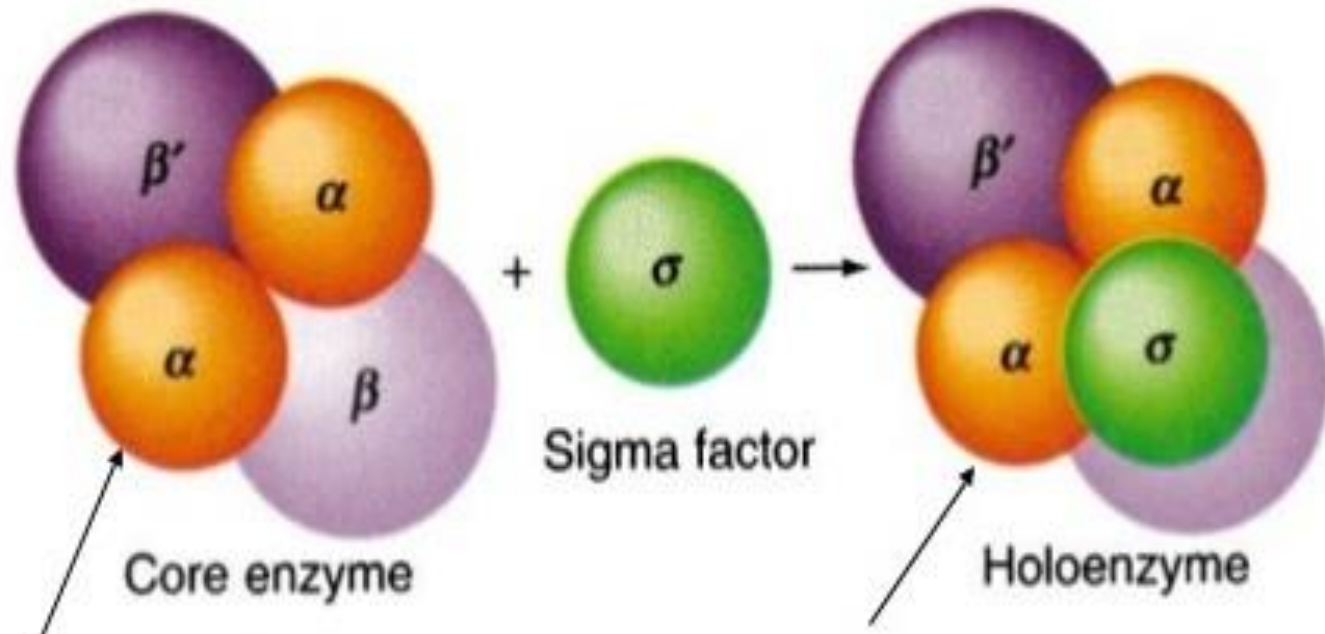
كل انواع ال RNA سواء mRNA , rRNA , tRNA يتم تصنيعهم
عن طريق ال RNA polymerase بال prokaryotes

- All types of RNA is synthesized by a specific enzyme called RNA polymerase **except** for the short RNA primers needed for DNA replication are synthesized by a primase enzyme.

حكينا قبل انه
ال primase هو
اللي بحط ال
primers

✿ Structure of prokaryotic RNA polymerase:

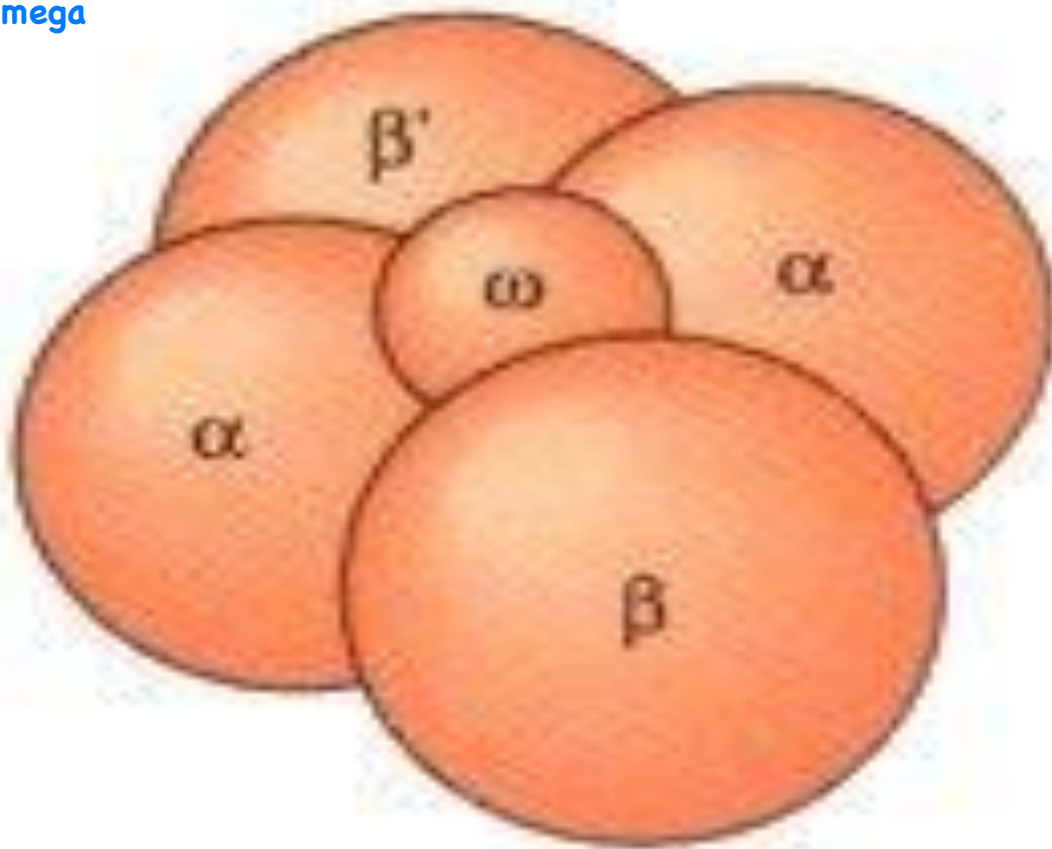
- It is a multi-subunit enzyme formed of core enzyme and sigma factor



Required for polymerization activity

Required for correct initiation of transcription:
binding to promoter

- 2 alpha identical
- 2 Beta non identical
- 1 omega



Core enzyme



Subunit

- **Core enzyme:** two identical α subunits (regulatory subunits) and two β not identical (β & β') and one ω chain. One of the β subunits (β) binds to the DNA and the other (β') is responsible for the formation of phosphodiester bond.

ال B بتخلي الانزيم يمسك بال template و ال B مسؤولة عن ربط ال nucleotides مع بعضها البعض

- RNA polymerase enzyme lacks specificity, that is, it cannot recognize the promoter region on the DNA template.

ال sigma بتساعدنا بتحديد ال promoter region الي لازم يبدأ من عنده الانزيم

- **The σ subunit (“sigma factor”):** It enables RNA polymerase to recognize promoter regions on the DNA. The σ subunit plus the core enzyme make up the holoenzyme. [Note: Different σ factors recognize different groups of genes.]

☀️ N.B.: The antibiotic rifampicin binds to the β subunits of RNA polymerase and inhibits RNA synthesis in prokaryotes as it interferes with the formation of the first phosphodiester bond. Rifampicin is useful in the treatment of tuberculosis.

Steps of RNA synthesis in prokaryotes:

- It is divided into three phases: ¹ initiation, ² elongation and ³ termination.

Initiation:

- It involves the binding of RNA polymerase to a specific region on the DNA known as the promoter region formed of specific base sequence. It needs a specific protein factor called sigma factor (σ) that recognizes and binds to the promoter region at the TATA box then RNA polymerase starts transcription at the start point (+1) it is the first base transcribed as RNA.

- The characteristic nucleotide sequences of the prokaryotic promoter region (as indicated in the coding strand in the 5` to 3` direction) include:

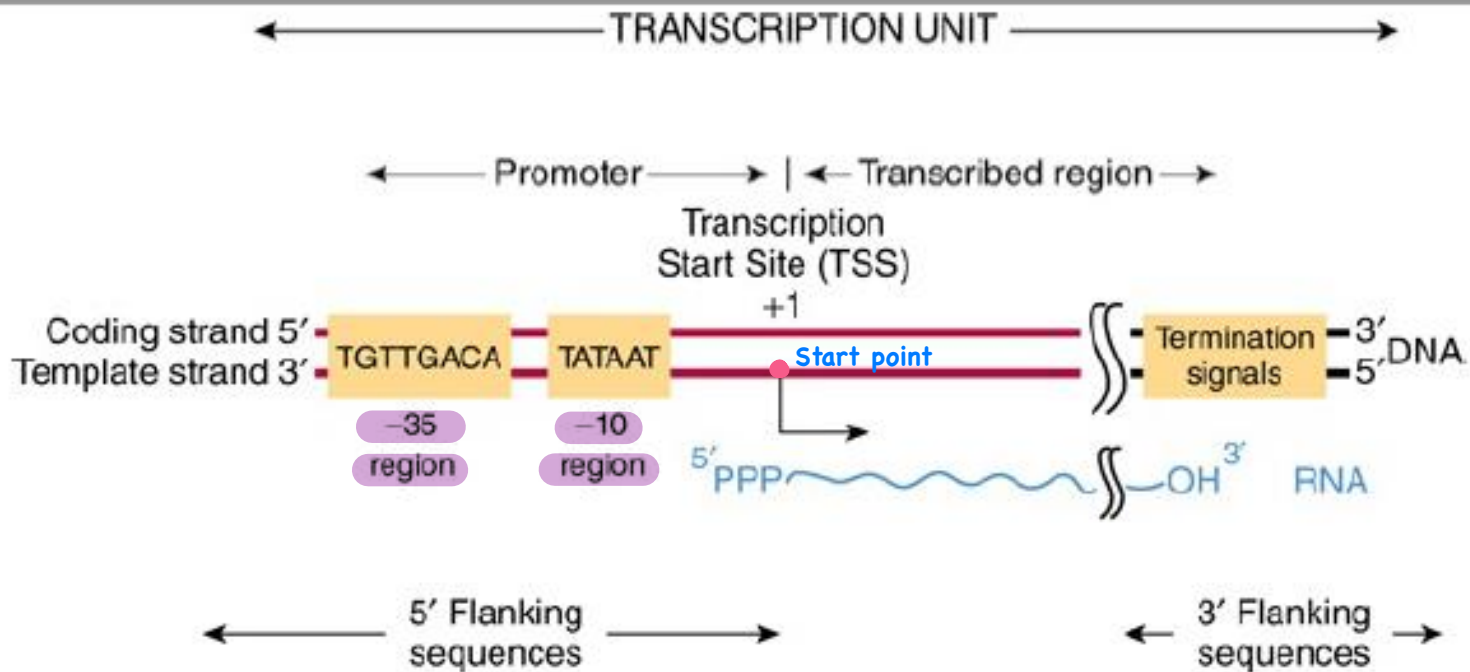
TATA box: It is formed of six nucleotides (TATAAT) and is located 10 bases upstream (i.e. usually occurs around base-10)to the start point (+1 point). It determines where transcription starts.

The (TTGACA) box: this sequence is 35 bases upstream to the start point (located at -35 base i.e. centered about 35 bases to the left of the transcription start site) .It determines the frequency of transcription

سلسلة ال RNA

يمكن يختلف
الترتيب من
بكتيريا لبكتيريا
بس لازم نشوف
ال TATA فيهم

اهميته :



Source: Murray RK, Bender DA, Botham KM, Kennelly PJ, Rodwell VW, Weil PA: *Harper's Illustrated Biochemistry, 29th Edition*: www.accessmedicine.com

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Elongation:

- In prokaryotes **only one** type of RNA polymerase synthesizes the three types of prokaryotic RNA.
- The binding of RNA polymerase to DNA template produce **local unwinding** of the DNA double helix to expose the bases. عشان نبنني سلسلة مكلمة.
- The enzyme begins to synthesize RNA in the direction of 5' to 3' with the base sequence complementary to that of the DNA template strand. **Sigma factor is released after initiation of transcription.** sigma factor بس نبليش عملية النسخ بروح ال
لانه خلص عرفنا نقطة البداية
- The core enzyme moves along the DNA template **uses ribonucleoside triphosphate (ATP, GTP, CTP & UTP) and releases pyrophosphate**

ما يعرف يبني *de novo*

بفتح السلسلة لحواله و برضه يبني لحواله

- Unlike DNA polymerase, RNA polymerase does not require a primer and has intrinsic helicase activity, therefore no separate enzyme is needed to unwind the DNA (in contrast to DNA polymerase).
- RNAP not only initiates RNA transcription, it also guides the nucleotides into position, facilitates attachment and elongation, has intrinsic proofreading (It doesn't not posses a proof reading feature as efficient as the DNA polymerase but it posses the capability of correct some misadded nucleotide as well) and replacement capabilities, and termination recognition capability.