





# ***Genetics***

**Subject** :  Genetic code  
 protein synthesis ( Translation )

**Lec no** : 14

**Done By** : Esra'a Khaled

وَقُلْ رَبِّ زِدْنِي عِلْمًا

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

OLD GENETICS

يمكن الاستفادة من تفاريغ الدفع السابقة

ATHAR BATCH

YAQEEN BATCH

VEIN BATCH

كل اعمال الفريق العلمي تنشر على قناة  
التليغرام



\* بالمحاضرة الماضية اخدنا ال wobble hypothesis و الي هو باختصار بشرحنا كيف ال A.A الواحد اله اكثر من كودون ، هلاً رح نكمل بال Characteristics و بعدها ملف جديد بحكي عن ال Translation

# Characteristics of Genetic Code

## ➤ Non-overlapping and commaless:

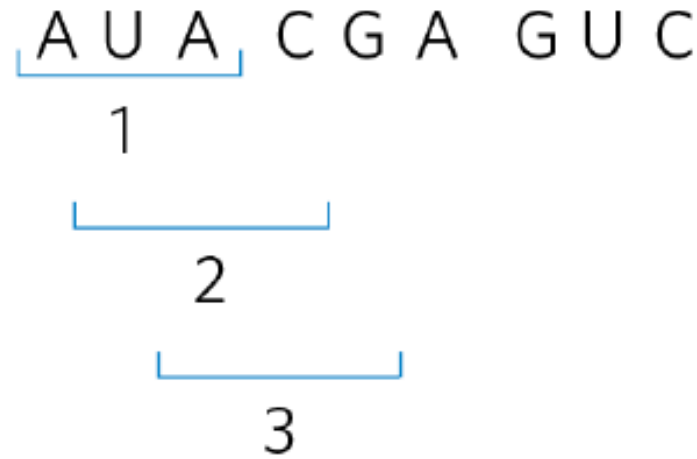
The genetic code is non-overlapping and commaless, that is, the code is read from a fixed starting point as a continuous sequence of bases, taken three at a time.

❖ For example, AGCUGGAUACAU is read as AGC/UGG/AUA/CAU without any "punctuation" between the codons.

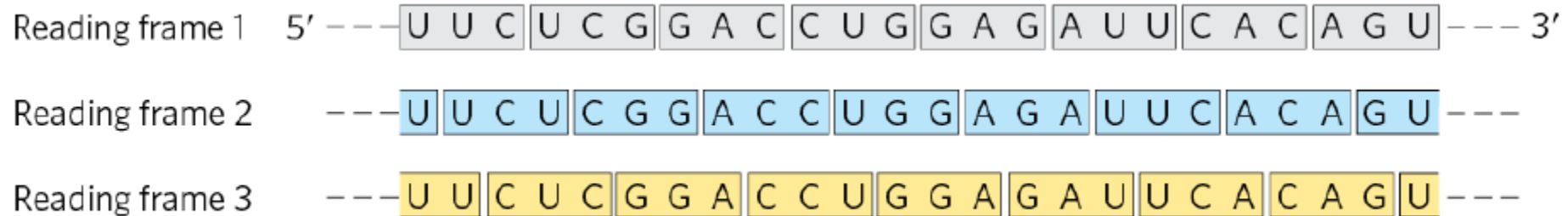
Nonoverlapping  
code



Overlapping  
code



هاد الاشي ما بصير و  
اذا صار بكون في  
mutations






# Characteristics of Genetic Code

- **Reading frames:** usually one reading frame will produce a functional protein, the codons are read from a specific starting point (initiating codon) on the mRNA as a continuous uninterrupted sequence of bases taken 3 at a time. ال start codon و ال stop codon بنظمو بداية و نهاية تصنيع البروتين
- **Unidirectional:** The letters in each codon are written from 5' -end to the 3' -end and codons on mRNA are written and read also from 5' -end to the 3' -end.

# Characteristics of Genetic Code

- **The genetic code functions via linker molecules.** The tRNAs are the crucial adaptor, matching amino acids with DNA codons.



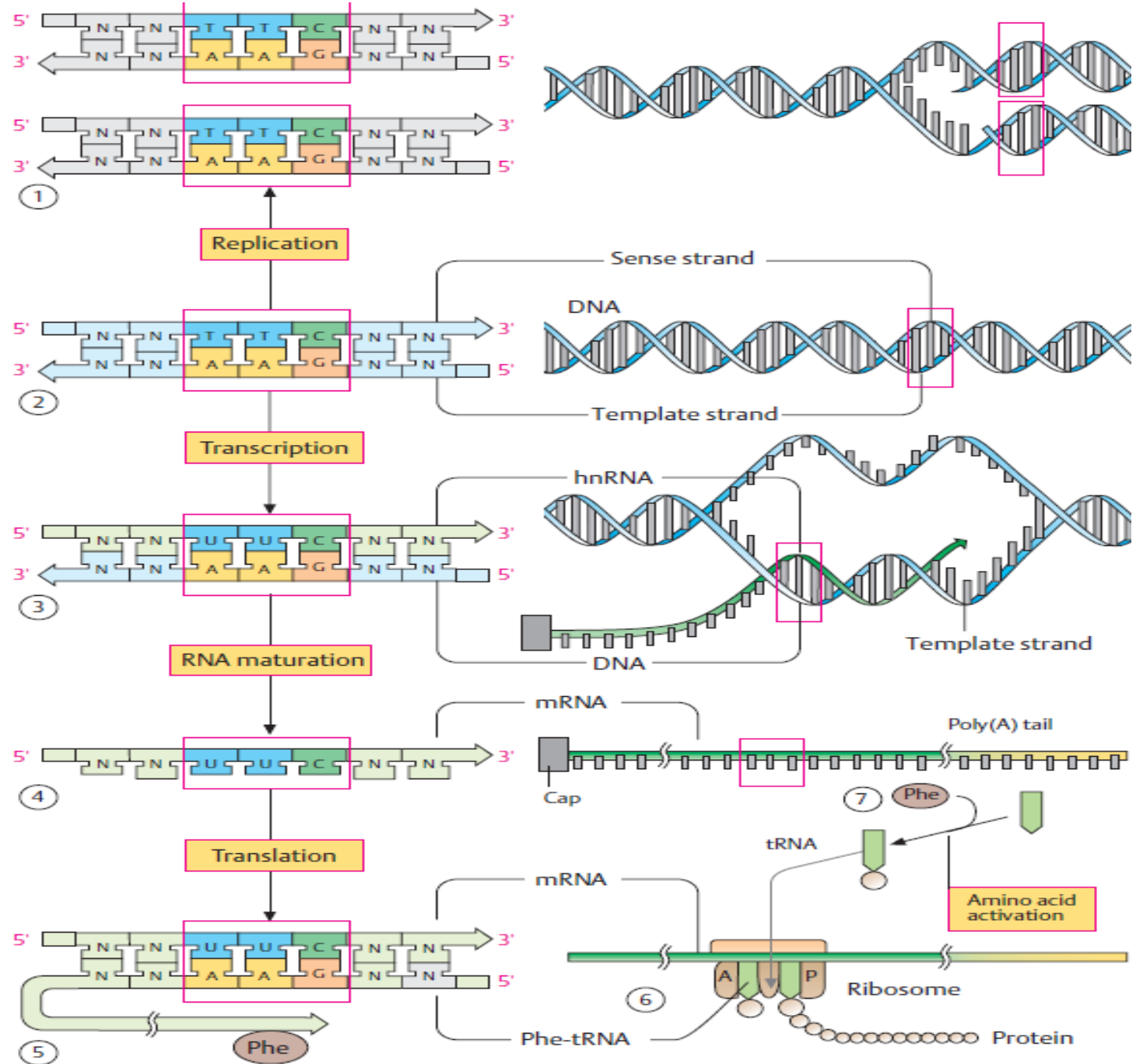
# Protein Synthesis (Translation)

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Nebras Melhem

Dr. Walaa Bayoumie El Gazzar

بالمحاضرة هاي رح نحكي عن ال tRNA من وين اجى و كيف بشتغل





1. Ribosomes
2. tRNA
3. mRNA

# Steps of protein synthesis

## • Activation of amino acid (AA) and synthesis of aminoacyl-tRNA:

هاد الانزيم *specific* ، يحتوي على موقع بكون مناسب ل A.A معين

هاد الانزيم عنده وظيفتين : ①

Aminoacyl t-RNA synthetase belongs to the enzyme family which is required for attachment of AAs to their corresponding tRNA.

Each member of this family recognizes a specific AA and all the tRNAs that correspond to that AA. يعني في 20 انزيم

وظيفته الثانية بشيك على ال A.A ②

The enzymes check their work, and if the incorrect amino acid has been linked to a particular tRNA, the enzyme will remove the amino acid from the tRNA and try again utilizing the correct amino acid.

# Steps of protein synthesis

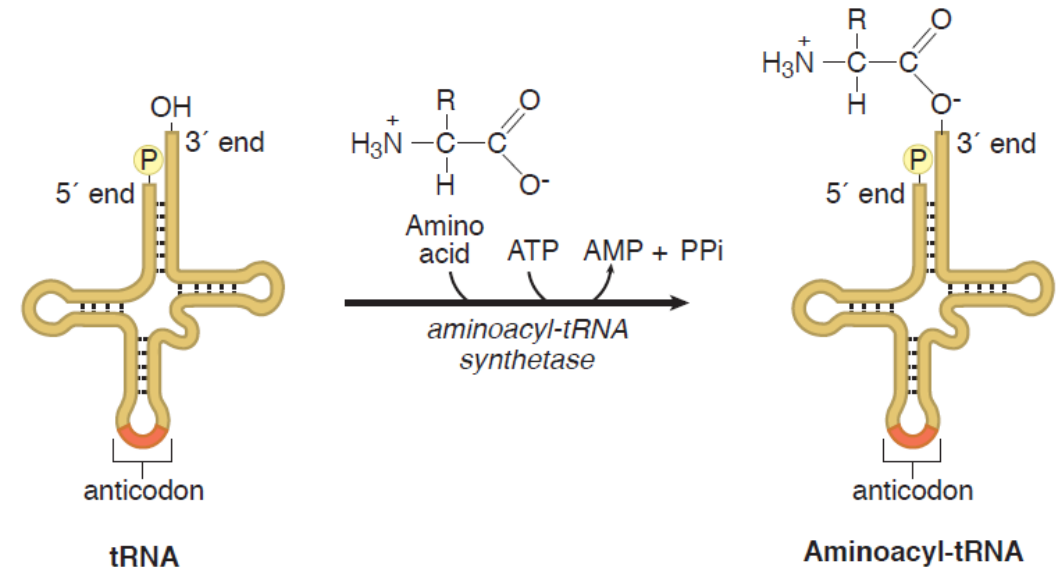
هي الي بتميز ال A.A عن بعض

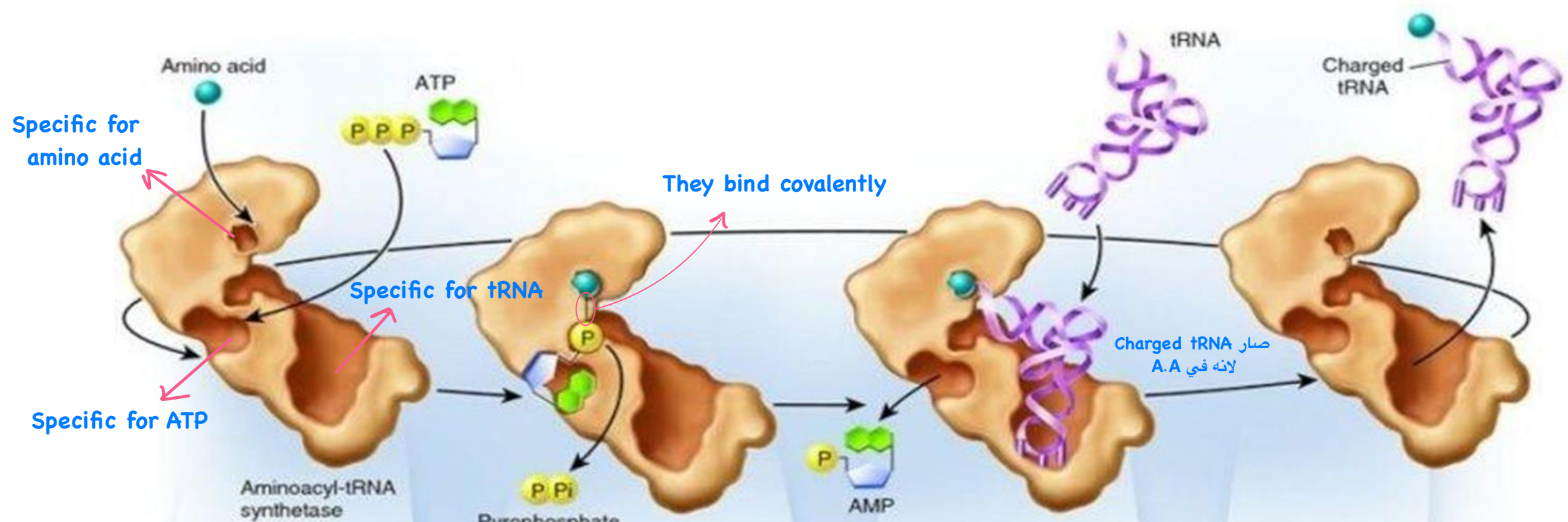
- The enzyme recognizes the -R radical of the amino acid and recognizes the anticodon of the tRNA. الانزيم بتعرف على ال R radical تاقت ال A.A و بتأكد انها واصلة مع ال Anticodon loop و بتطلع ع whole configuration of tRNA
- Transfer-RNAs for different amino acids differ not only in their anticodon but also at other points, giving them slightly different overall configurations. The aminoacyl-tRNA synthetases recognize the correct tRNAs primarily through their overall configuration, not just through their anticodon.
- In the cytosol, there are 20 species for this enzyme, one specific for each of the 20 amino acids required for protein synthesis.
- This enzyme connects the carboxyl group of the amino acid to the 3'-OH of the specific tRNA.

# Steps of protein synthesis

- Each type of amino acid is activated by a different aminoacyl tRNA synthetase.
- Two high-energy bonds from an ATP are required.
- The aminoacyl tRNA synthetase transfers the activated amino acid to the 3' end of the correct tRNA.
- The amino acid is linked to its cognate tRNA with an energy-rich bond.

This bond will later supply energy to make a peptide bond linking the amino acid into a protein.





Specific for ATP

Specific for amino acid

Specific for tRNA

They bind covalently

Charged tRNA صار لانته في A.A

Aminoacyl-tRNA synthetase

Pyrophosphate

AMP

tRNA synthetase هون خلص شغل

1 A specific amino acid and ATP bind to the aminoacyl-tRNA synthetase.

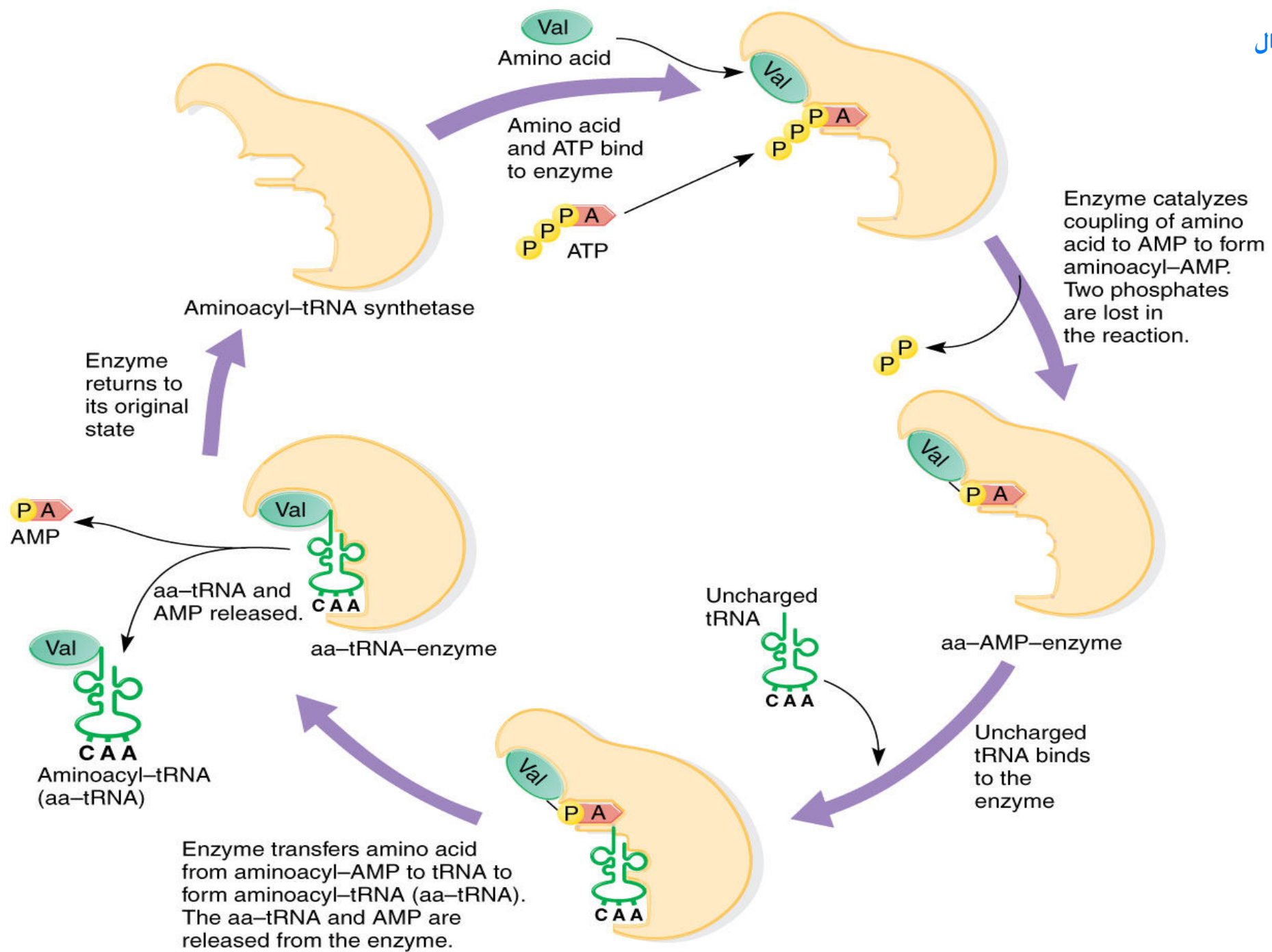
2 The amino acid is activated by the covalent binding of AMP, and pyrophosphate is released.

3 The correct tRNA binds to the synthetase. The amino acid is covalently attached to the tRNA. AMP is released.

4 The charged tRNA is released.

\* بس يرتبط ال A.A بال AMP بصير active

بناخذ الطاقة من ال releasing of AMP



# Translation phases Occurs in the cytoplasm

بعد ما صار ال tRNA جاهز و عليه A.A ، رح نبش ال Translation و بشمل 3 خطوات ( نفس خطوات ال Transcription )

I. Initiation تفعيل

II. Elongation تطويل

III. Termination انهاء

\* ال protein factors حفظ

- Special protein factors for initiation (IF)<sup>1</sup>, elongation (EF)<sup>2</sup>, and termination (release factors)<sup>3</sup>, as well as GTP<sup>4</sup>, are required for each stage.

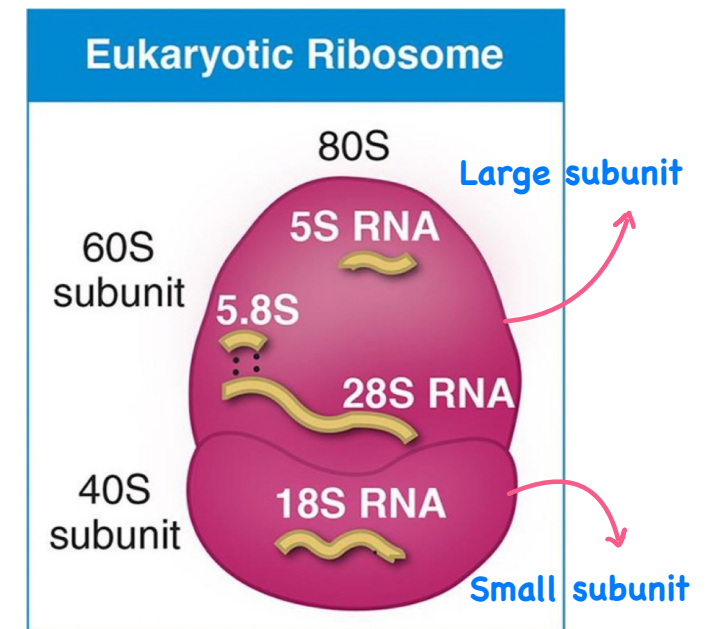


# I. Initiation

اول شي بنفك ال ribosome و بنشتغل بعدها على 3 مراحل

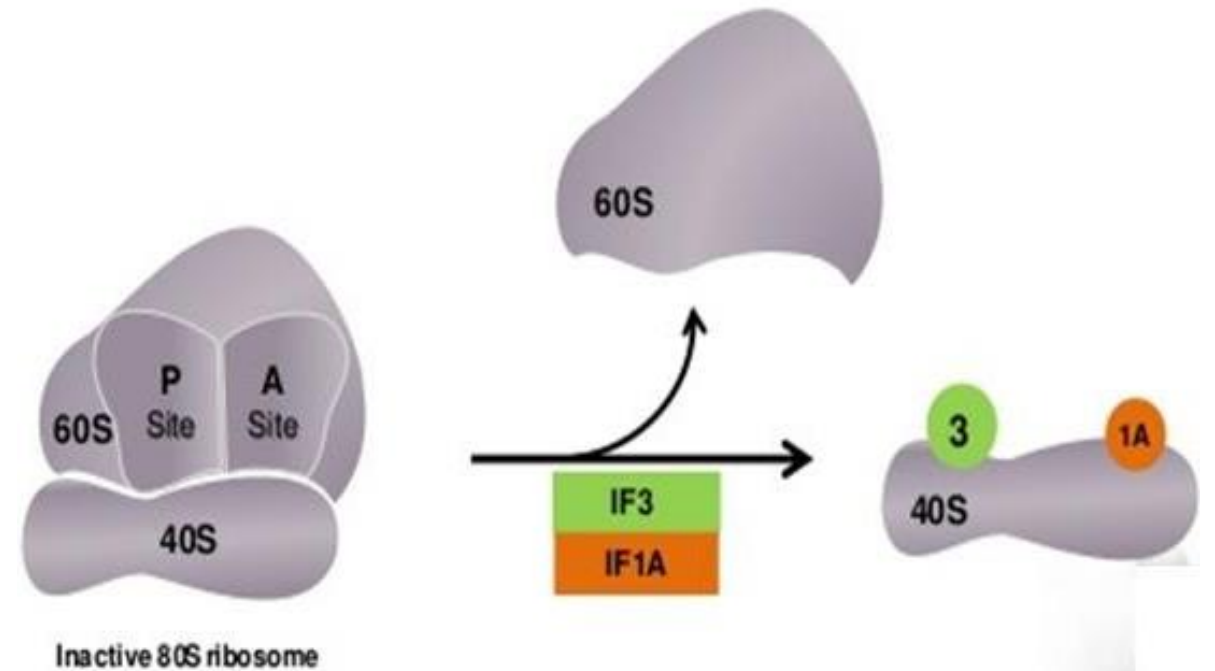
- Ribosomal dissociation
- Formation of 43S preinitiation complex
- Formation of 48S initiation complex
- Formation of 80S initiation complex

هاد الي بدنا ننسخه

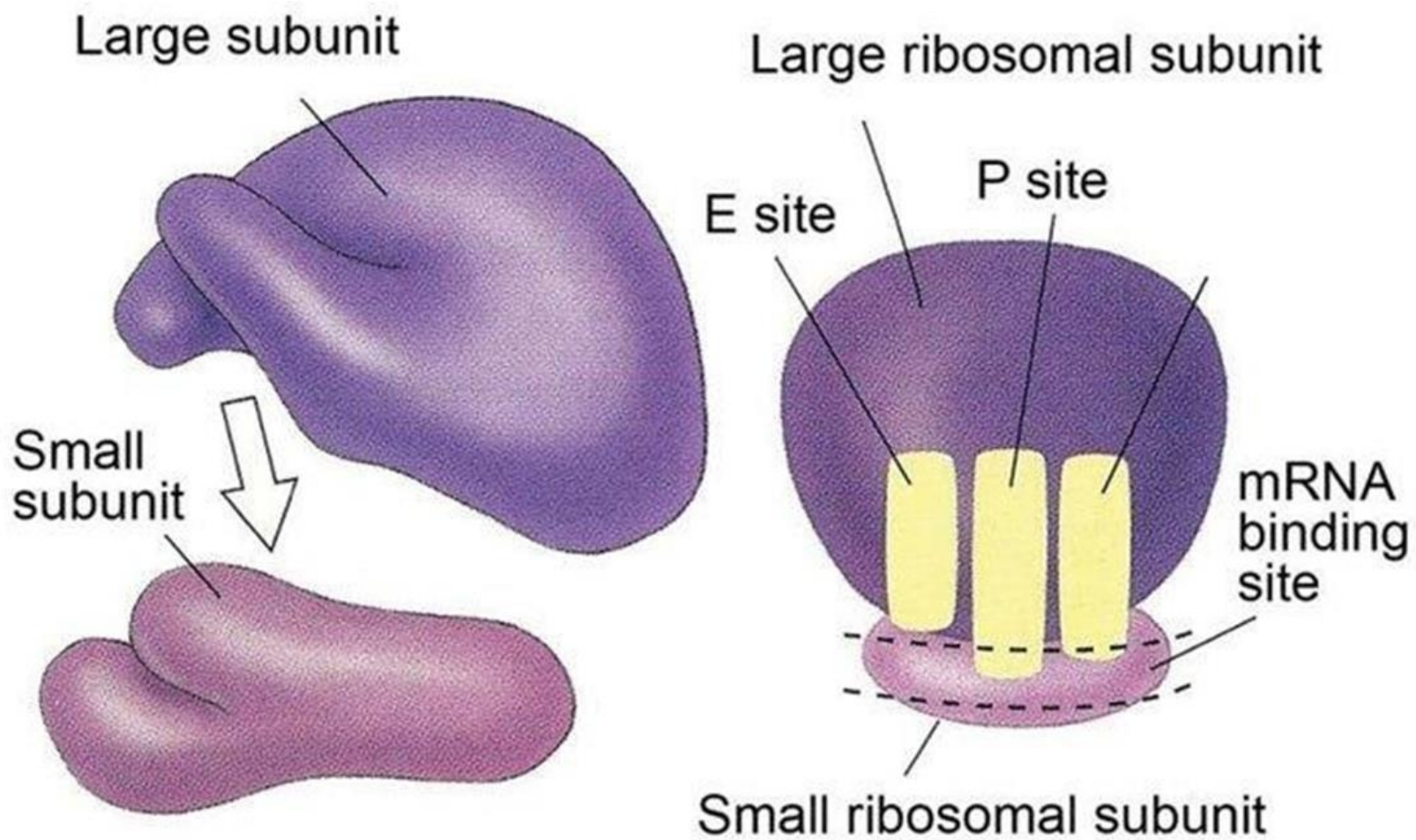


# Ribosomal dissociation

Two initiation factors (**IF-1A** and **IF3**) bind to the 40S subunit of the 80S ribosome and produce its dissociation to 40S and 60S ribosomal subunits.



لما يرتبط ال IF-1A و IF3 بال 40 S بتفكها عن ال 60 S



- The ribosome has three binding sites for tRNA

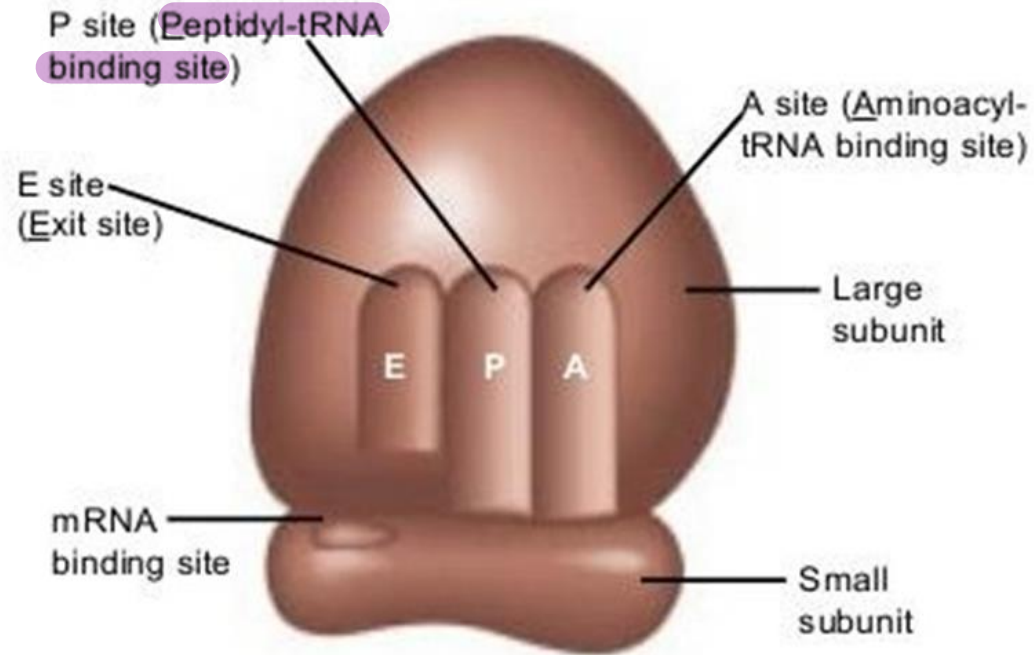
- The P site

Acceptor site

- The A site

- The E site

Exit site



**(b) Schematic model showing binding sites.** A ribosome has an mRNA binding site and three tRNA binding sites, known as the A, P, and E sites. This schematic ribosome will appear in later diagrams.

**Figure 17.16b**

## Formation of 43S preinitiation complex

- This step requires : بنحتاج طاقة عشان نقدر ننقل ال tRNA

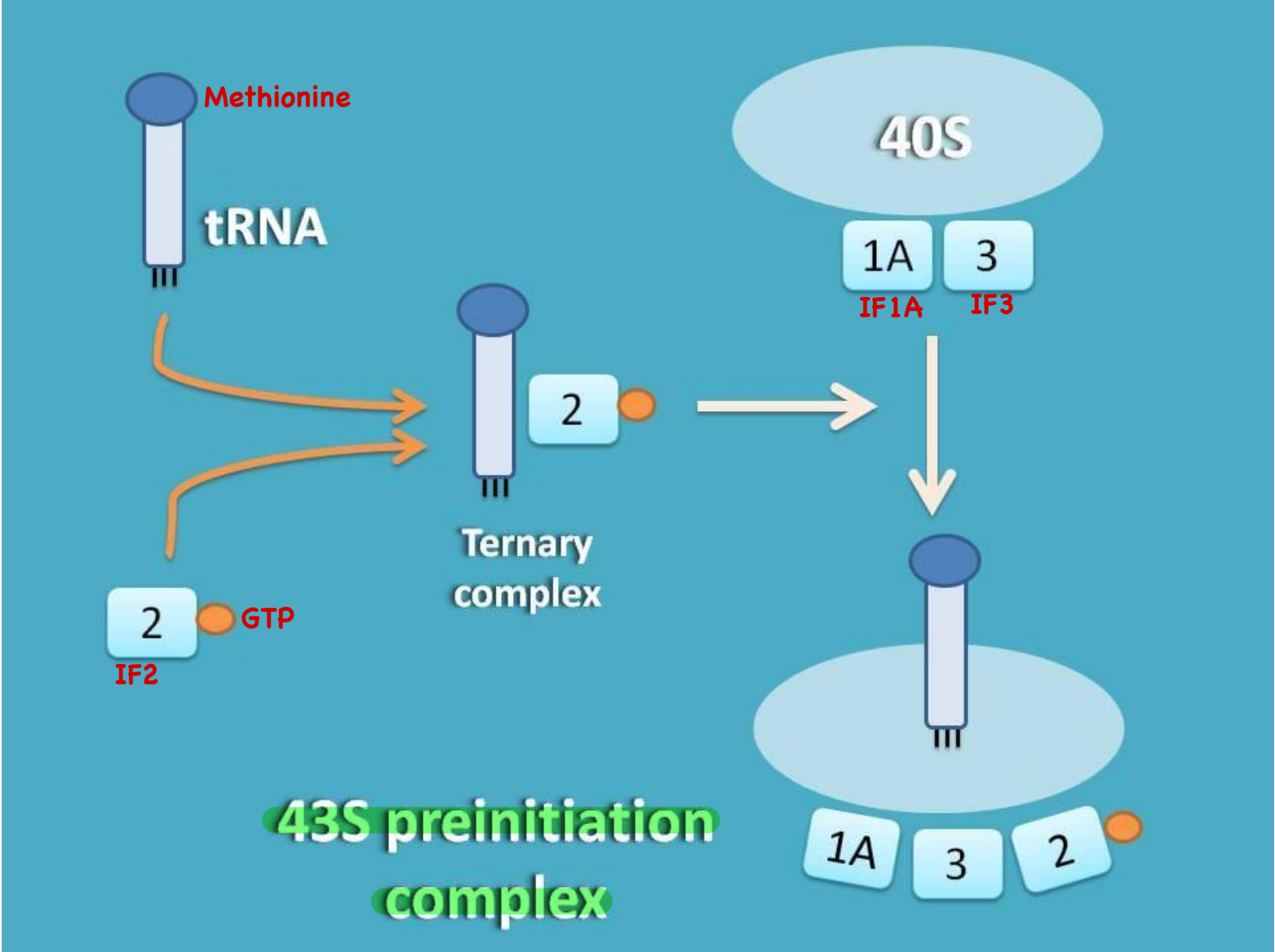
➤ **IF-2** complexed with **GTP**

هو start codon لهيك بلشنا فيه

➤ Methionine tRNA (met-tRNA)

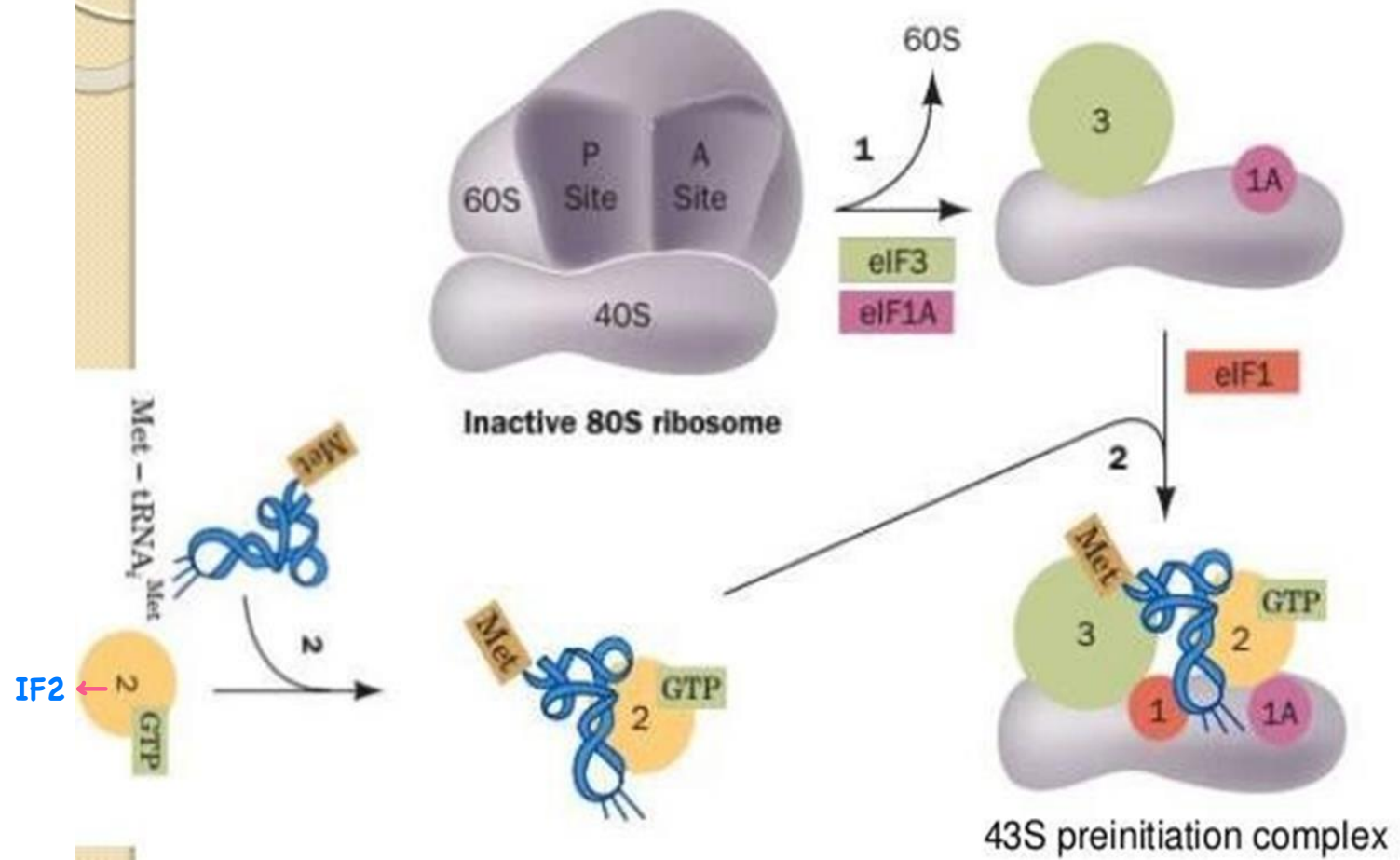
Eukaryote

- The **eIF-2** binds **GTP** then binds to met-tRNA<sub>i</sub> (initiating methionyl-tRNA) to form a complex that binds to the *P-site of the 40S* ribosomal subunit, forming the 43S preinitiation complex.





# Initiation in Eukaryotes



هنا نحن عننا 43s preinitiation complex بنعمل activation لل mRNA عشان نربطهم مع بعض و يصير عننا 48s initiation complex

43 s + activated mRNA = 48 s initiation complex

# Formation of 48S initiation complex

ارتبط بال mRNA عشان يعمله activation

- The mRNA is **activated** by several initiation factors (**eIF-4**), **a process associated with hydrolysis of ATP.** وهاي العملية بتحتاج طاقة
- **The 43S preinitiation complex becomes associated with the 5` capped end of the activated mRNA forming the 48S initiation complex.** بربطه من عند ال 5` end

\* الدكتور اعطتنا Homework انه دور ليش ال methionine يرتبط بال p site مش بال A site ؟

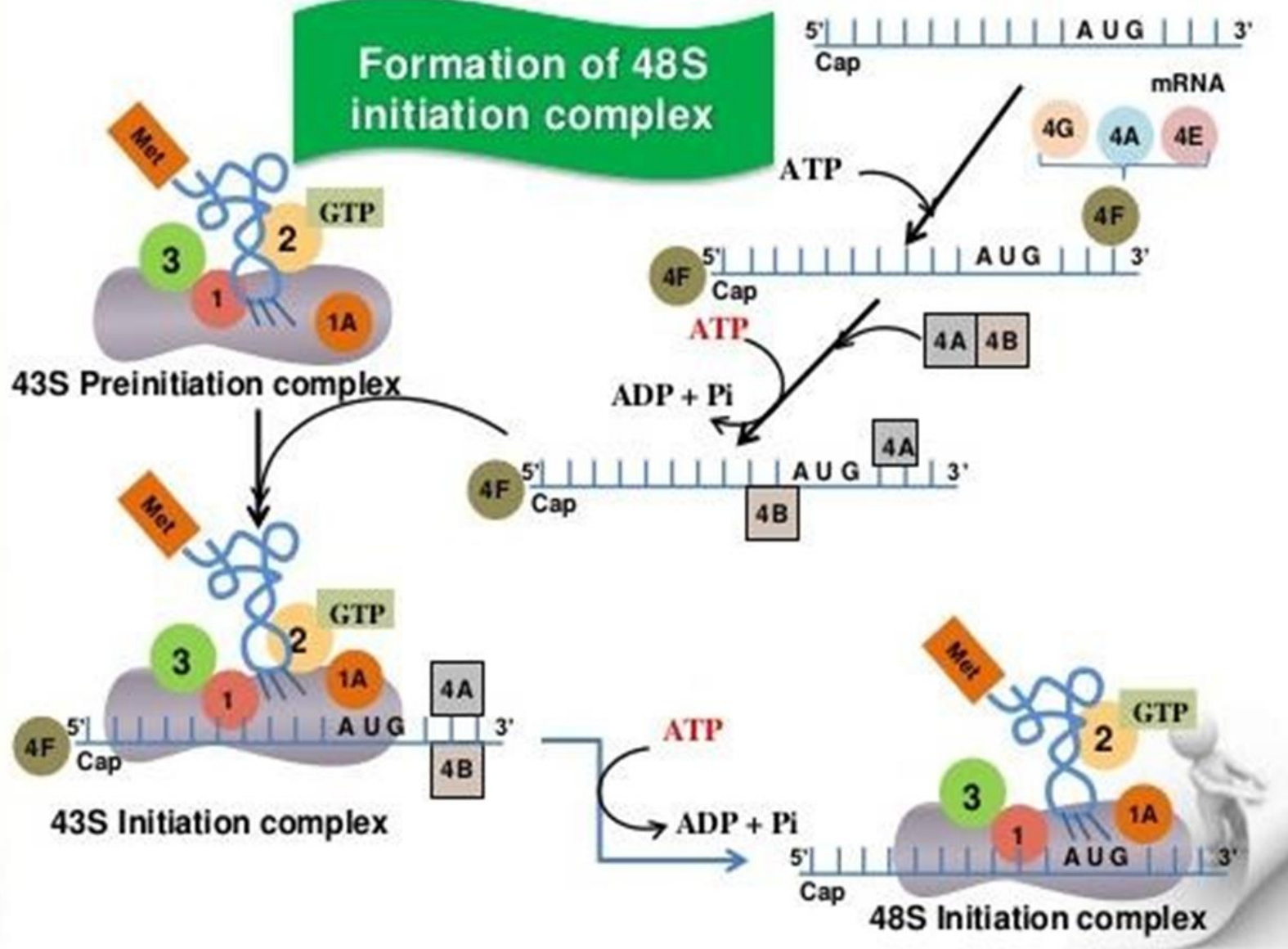
اتوقع الجواب لانه ال methionine هو ال start codon ببلش من عنده فال A site رح يكون فاضي عشان يجي ال A.A

الي بعده يرتبط فيه

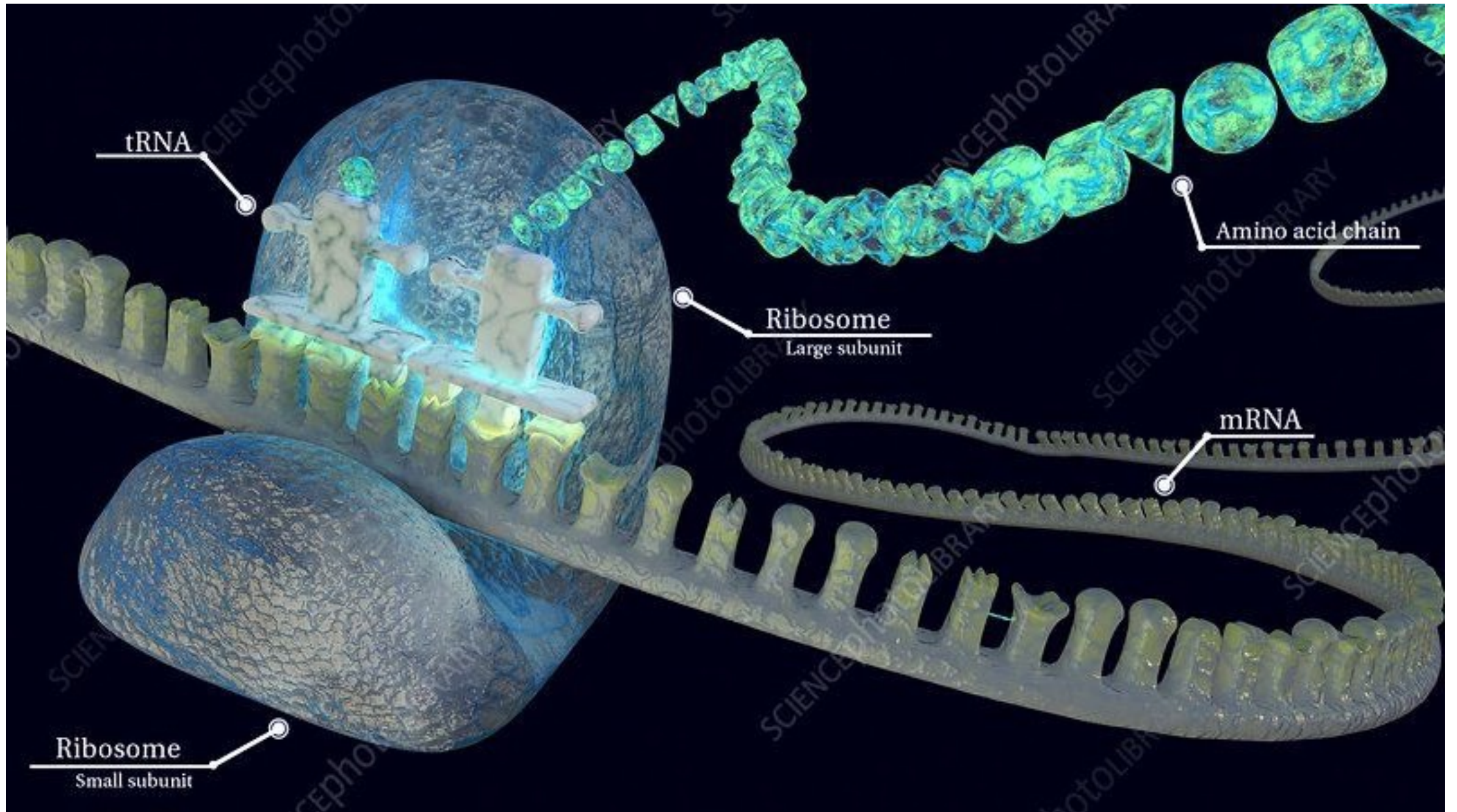
# Formation of 48S initiation complex

- The 43S preinitiation complex scans the activated mRNA for the initiating codon, which is usually the 1st AUG on the 5` side.
- The preinitiation complex stops moving on the mRNA when the initiating codon is in the P- site opposite the anticodon of the met-tRNA<sub>i</sub>. ال methionine و هو موجود بال P site رح يخلي ال 43s تمسك في التسلسل تبعه AUG

# Formation of 48S initiation complex







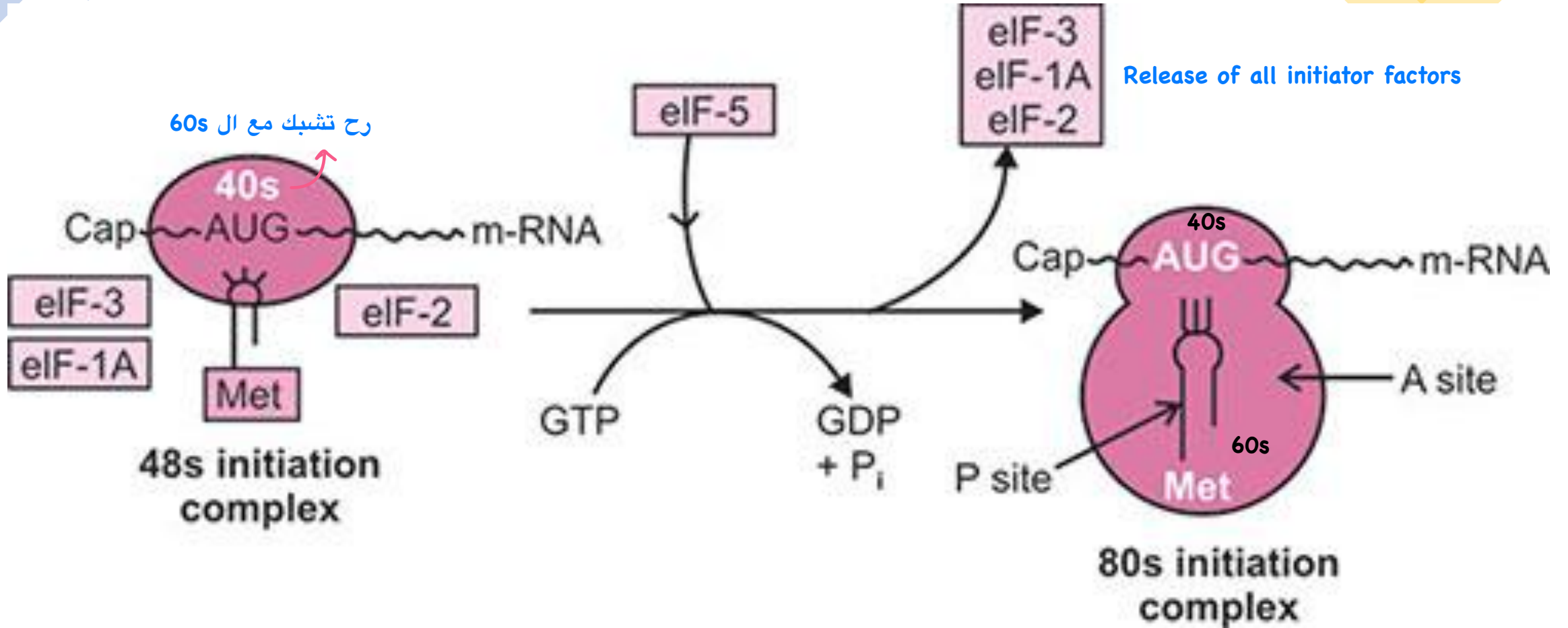
# Formation of 80S initiation complex

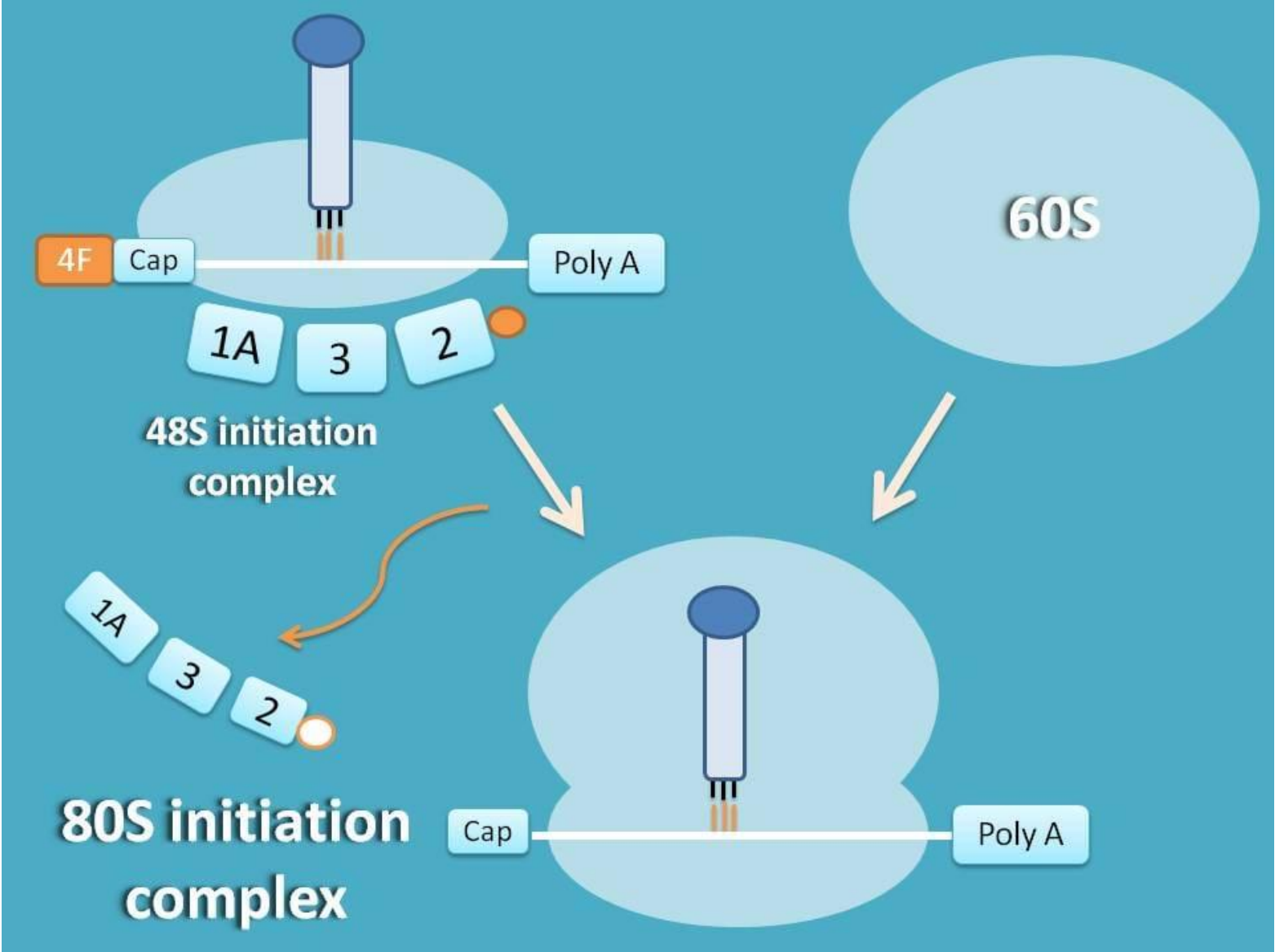
هون بنجيب ال 60s بنشبكة مع ال 48s عن طريق eIF-5 و بنستخدم طاقة GTP فبطلع عنا ال 80s

- With the help of the **eIF-5**, the 60S ribosomal subunit binds to the 48S initiation complex, forming the 80S ribosome.
  - This is associated with the release of all eIFs as well as the hydrolysis of GTP to GDP and Pi.
  - At this point, met-tRNA is on the P-site (peptidyl site) of the ribosome ready for elongation & the A-site is free ready to accept the next aminoacyl-tRNA.
-



رح تشبك مع ال 60s





## Eukaryotic translation initiation

تلخيص لكل الاحداث الي صارت :

