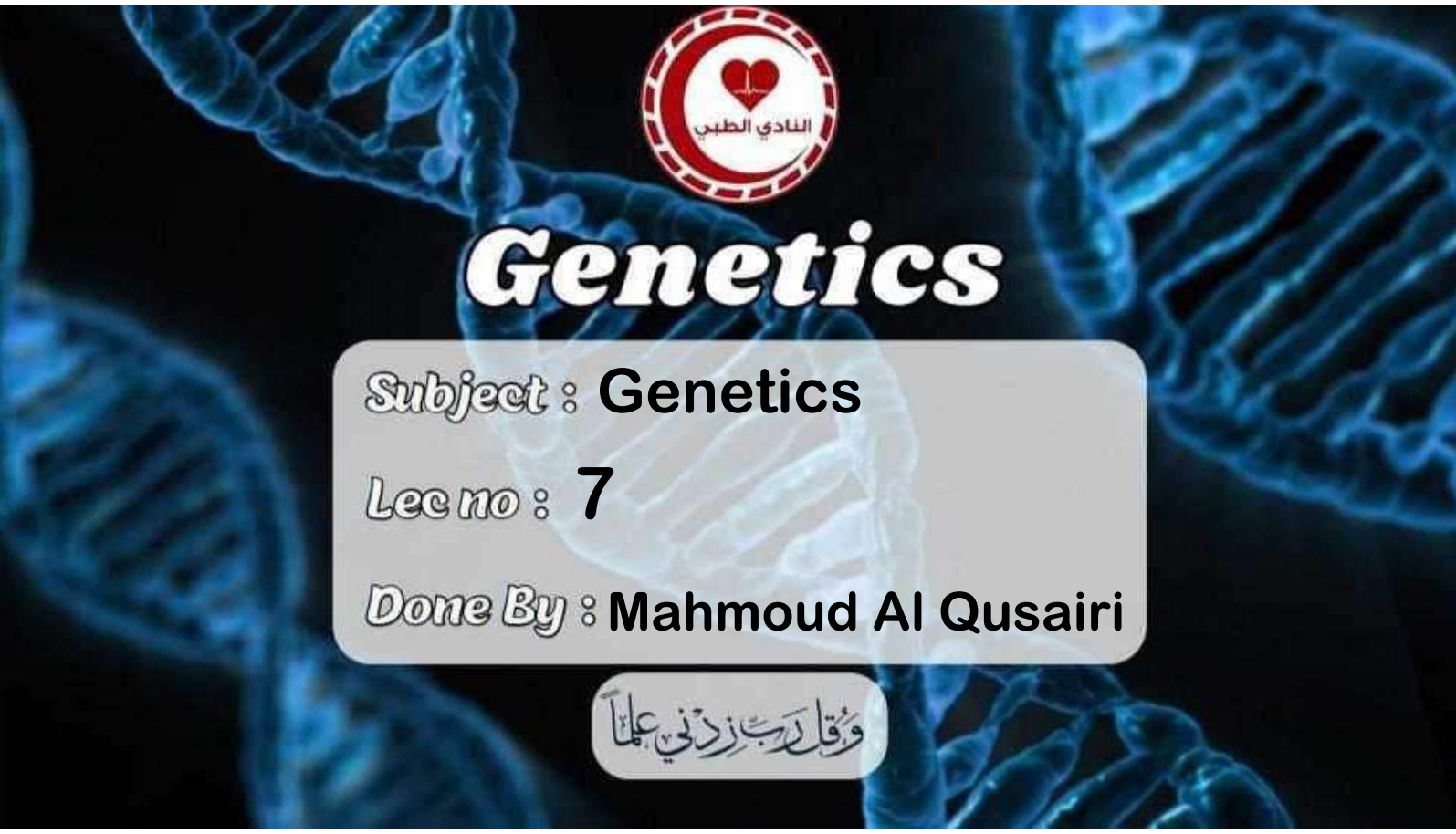

النادي الطبي
Genetics
Subject : Genetics
Lec no : 7
Done By : Mahmoud Al Qusairi
وقل رب زدني علماً

Ribonucleic Acid (RNA)

- **Ribonucleic acids are polyribonucleotides. They contain mainly four nucleotides; AMP, GMP, CMP, UMP.**
- **The nucleotides forming the structure of RNA are interconnected as in DNA by phosphodiester bonds.**

* تصنيع RNA يكون عن طريق transcription proces من DNA

له: sequence في RNA يكون معتمد على sequence في DNA

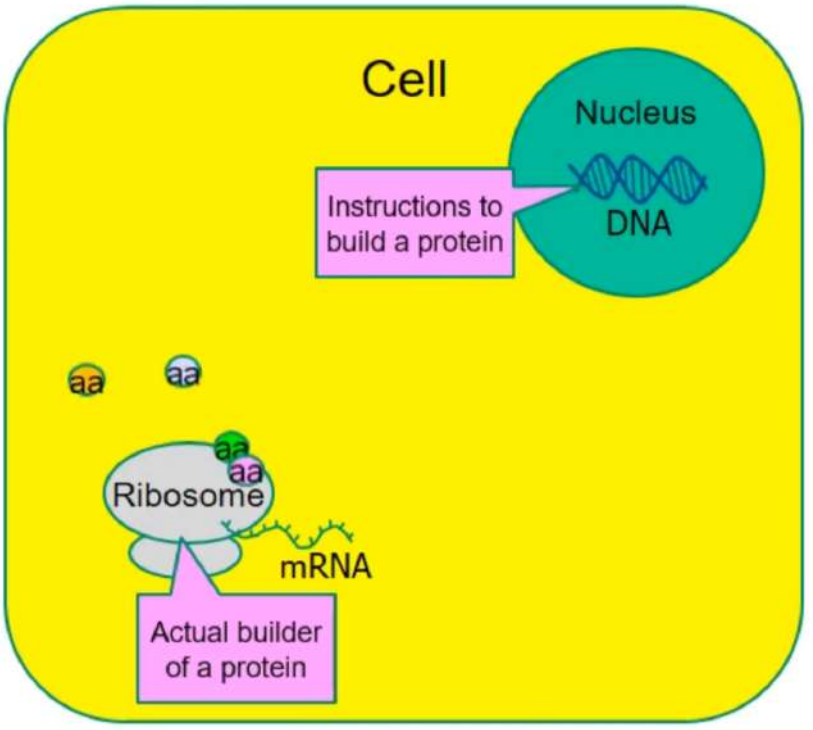
- **RNA molecules are synthesized in a process termed transcription where the sequence of bases in each RNA molecule is controlled by base sequence in one strand of DNA (template strand).**

موضوع أي strand في DNA الي رح يصير له transcription هي proces منظمة نشرحها لاحقاً.

- DNA يشبه RNA ولكن DNA ← double strands / RNA ← single strand
- DNA/RNA ← كلاهما poly nucleotides
- في RNA ← nucleotides يكون sugar فيها ribose
- في DNA ← nucleotides يكون sugar فيها deoxyribose
- nucleotides في RNA نفسها في DNA الا انه في DNA يوجد thymin ولكن في RNA يوجد uracel
- طريقة ربط nucleotides في RNA نفسها في DNA عن طريق phosphodiester band بين 3OH في ribose و 5P التي في nucleotide الذي يليه.

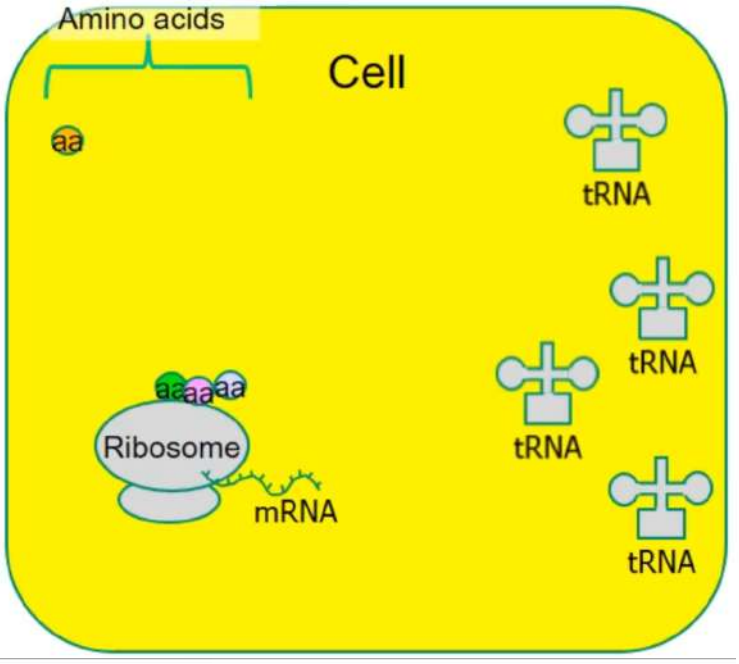
Messenger RNA

- mRNA
- **Location**: Starts in nucleus… moves to ribosome
- **Function**: Delivers a copy of the DNA code to a ribosome
- Once the ribosome has the mRNA instructions, it can then build a protein in the process called "translation"



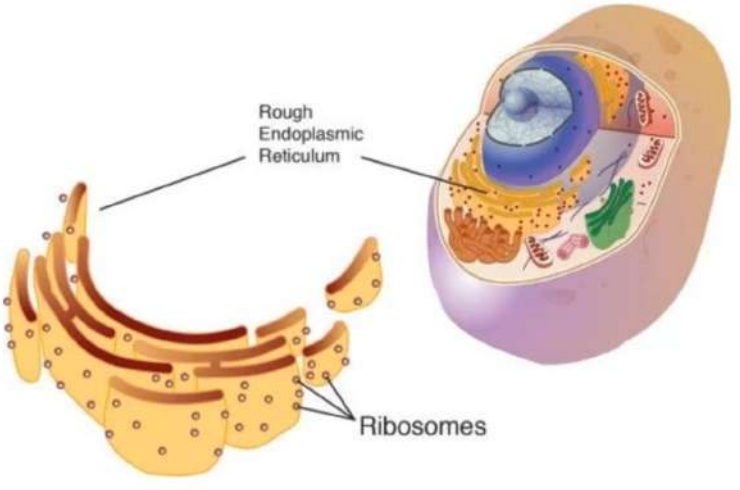
Transfer RNA

- tRNA
- **Location**: Cytoplasm
- **Function**: Transfer amino acids from the cytoplasm to a ribosome
- Ribosome will link the amino acids together to form a protein in a process called "translation"



Ribosomal RNA

- rRNA
- **Function**: main component of ribosomes
  - rRNA bonds with special proteins to form a ribosome
  - Ribosome = organelle that builds proteins



Types of RNA:

- Three main types of RNA are formed and all are related to protein synthesis:

1- Ribosomal RNA (rRNA) molecules form 80% of cellular RNA.

2- Transfer RNA (tRNA) form 15% of cellular RNA.

3- Messenger RNA (mRNA) molecules form 5% of cellular RNA.

rRNA → the most common form

mRNA → هو اللي دي يصير له translation ويعطينا protein

- هل منطقي انك يكون اكثر form اللي دي يعطينا proteins

أقل نسبة؟ نعم، لأن coding genome أقل من 2% من total genome

لي يعني انك sequence of DNA RNA انها تعطينا. اللي مفروض

من أجل انك تعطينا proteins قليلة.

Ribosomal RNA (r RNA):

- rRNA are found in association with several proteins as components of the ribosomes , which are the complex structure that serve as the site for protein synthesis by interacting with the mRNA and tRNA.

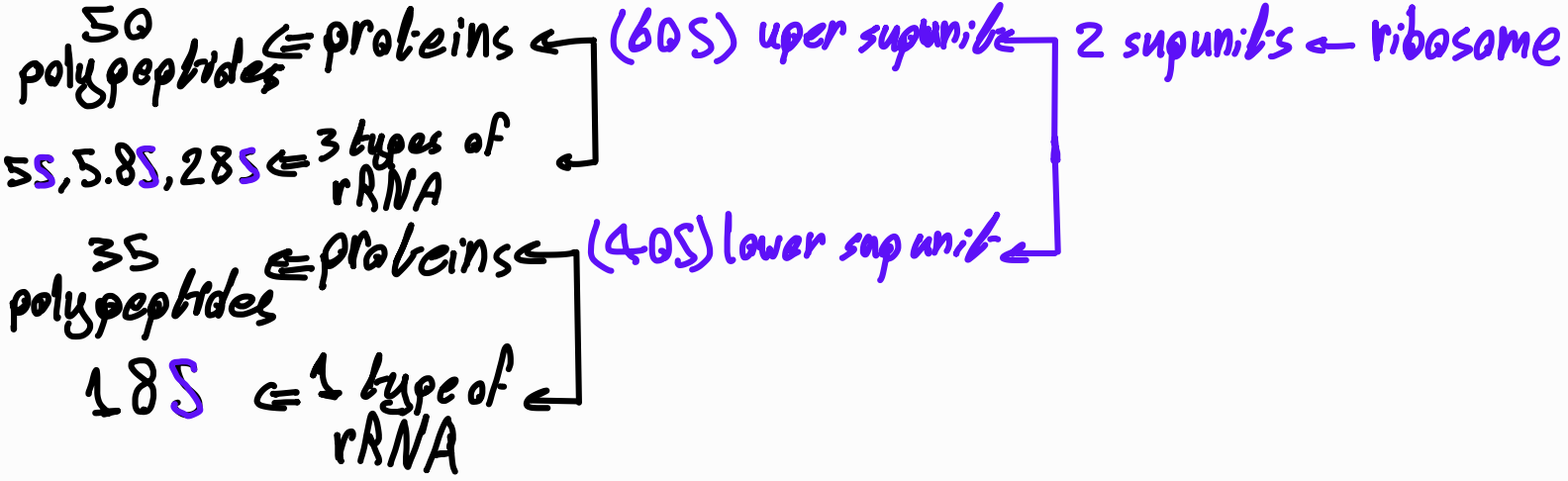
rRNA ← تكون بعد أنتاجها من DNA عن طريق transcription
مرتبطة مع بعض proteins ومكونة لـ important organe

هو ribosome

ribosome - هو المصنع الذي تتم عليه عملية translation
يوقف عليه mRNA ويحدث له translation عشان proteins تعطينا

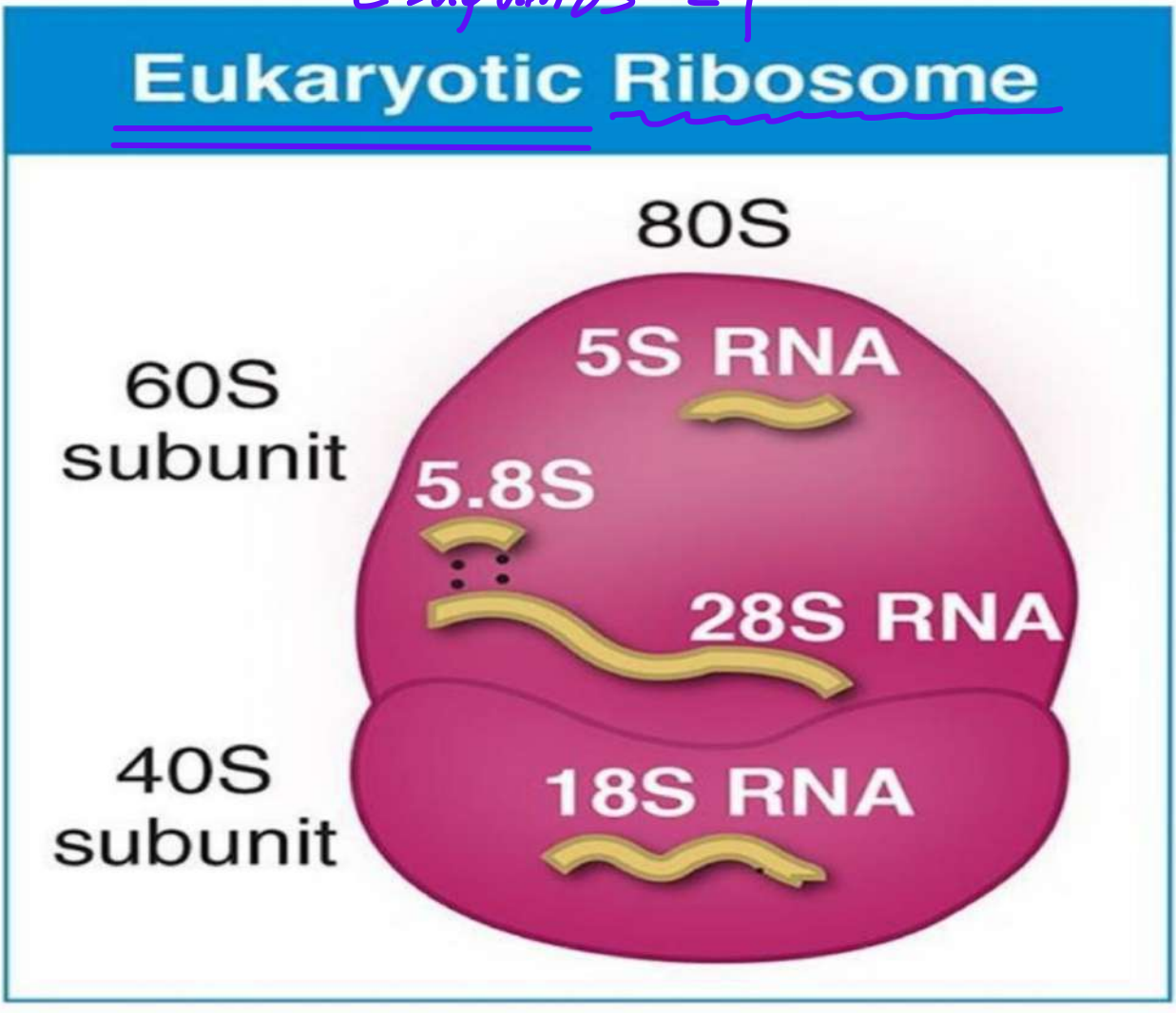
mRNA ← ينتج من transcription of DNA ثم يخرج من nucleus
ويوقف على ribosome ويصير له translation to proteins

ribosome ← proteins ← rRNA



- Eukaryotic 80S ribosome consists of two nucleoprotein subunits of unequal size, the 60S subunit and the 40S subunit:
- The 60 S ribosomal subunit: Consists of about 50 polypeptides combined with three subtypes of ribosomal RNA (5S, 5.8S , 28S rRNA)
- The 40 S ribosomal subunit: Consists of 35 polypeptides combined with one r RNA (18S)
- Both 60S and 40 S combine together to form the 80 S full ribosomal subunit.

2 subunits


Eukaryotic Ribosome
80S
60S subunit
5S RNA
5.8S
28S RNA
40S subunit
18S RNA

S → sedimentation velocity

لو أخذت large supunit ووضعتها في tube وحطيتها في centrifuge وعملت centrifugation مرة تميعها بنحسبها بـ unit ← (S) or (Svedberg unit)

60S ← large supunit لأنها sedimentation velocity

40S ← small supunit لأنها sedimentation velocity

80S ← large supunit and small supunit together وليست ~~100S~~

sedimentation velocity لأنها لا تعتمد فقط على molecular wight ولكنها تعتمد أيضاً على shape والترتيب

- S= Svedberg unit (sedimentation or S unit): it is the unit that measures the sedimentation velocity of different particles depending on their molecular weight as well as the size of the particles by using high speed centrifuge.

- Because the S values are determined both by shape as well as molecular mass, their numeric values are not strictly additive.

يعني الموضوع مش عملية إضافة ~~60+40=100~~

لذلك 60 + 40 يعطي 80 وليس 100

لذلك sedimentation velocity تعتمد على عاملين shape و molecular wight.

يمثل 5% من RNA الموجود في الـ cell.

Messenger RNA (mRNA)

transcription يتم تصنيعه عن طريق one strand of DNA

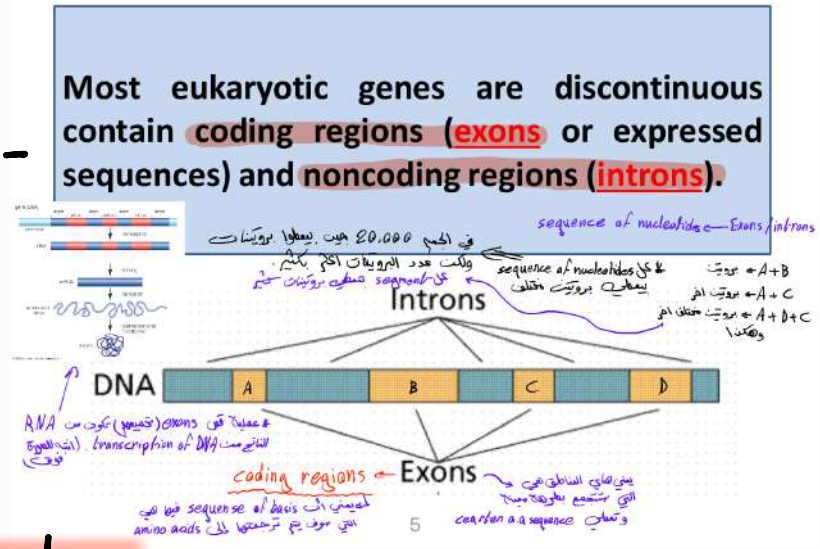
- It forms about 5 % of the total RNA. mRNA is synthesized in the nucleus as a single strand with base sequence complementary to a specific DNA region called gene (that codes the information of certain protein). Every three nitrogenous base in mRNA form one codon specific for one amino acid.

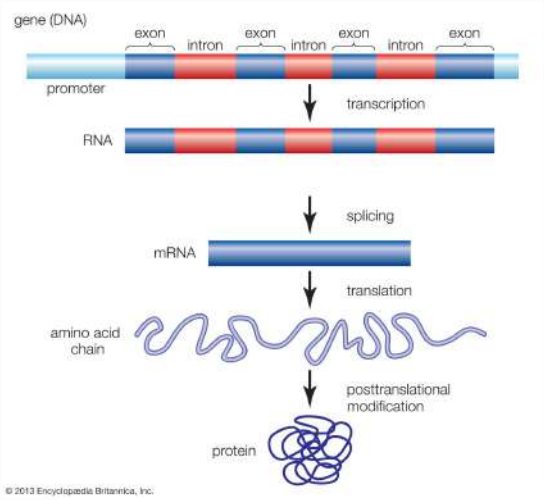
exons and introns: يتكون من discanbinuous في الجين sequence of nucleotides

exons ← coding regions
introns ← noncoding regions

بما انه في DNA يوجد introns, exons ← إذن
exons, introns فيه الناتج منه RNA في
sequence ← complemantre حيث أنه يكون
of nucleotides

في DNA
في mRNA ← 3 nucleotidee ← كل
1 a.a على ribosome يتم ترجمتهم على
a.a 1 one codon ← 3 nitrogenus base in mRNA





Eukaryotic mRNA has the following features:

- It contains coding regions (exons) that can be translated, and untranslated regions in between exons called introns.
- It contains noncoding segments called untranslated regions (UTRs) at both their 5\& 3\ ends.
- At the 5\ ends there is 7- methylguanosine triphosphate cap and at its 3\ ends there is a poly A tail, these modified ends are created by post-transcription modification process in the eukaryotic cells

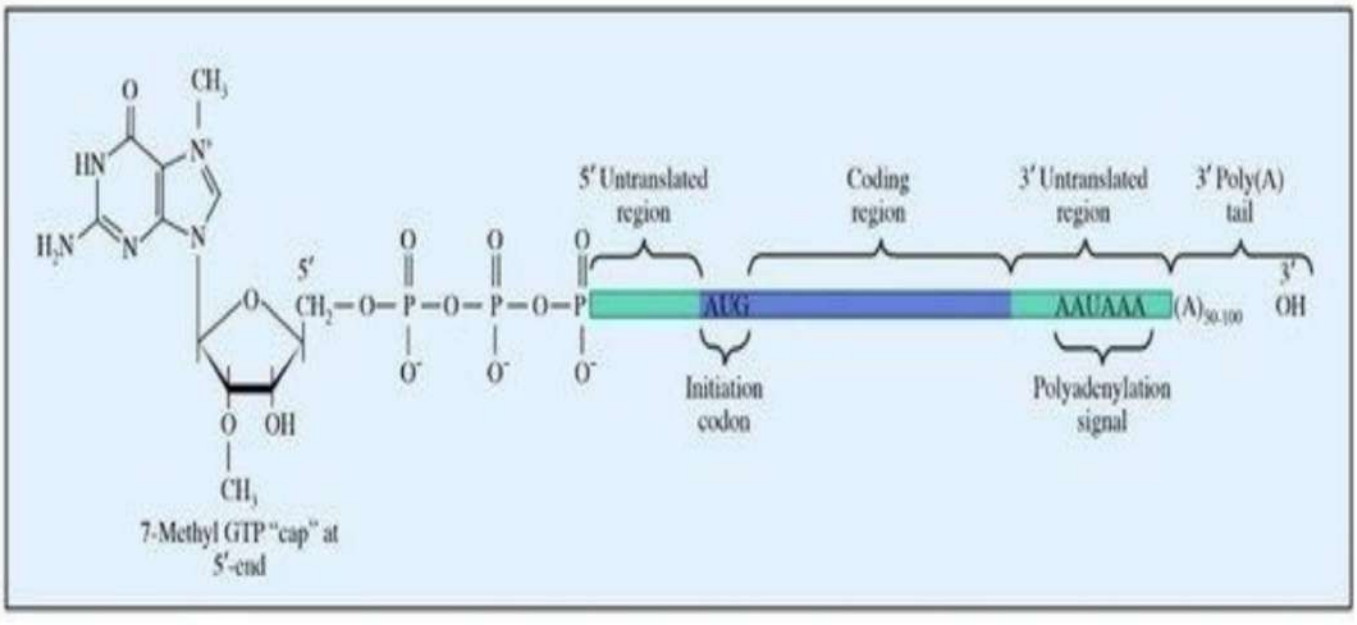
3 nucleotides هاي بالي دع يكون كل codon لـ a.a فيها عبارة عن

noncoding

After transcription.

فائدة وجود Introns مع exons

هي في انه نفس الجين في tissue معين دع يعطينا


5′ Untranslated region
Coding region
3′ Untranslated region
3′ Poly(A) tail
AUG
AAUAAA
(A)50-100
3′ OH
Initiation codon
Polyadenylation signal
7-Methyl GTP "cap" at 5′-end

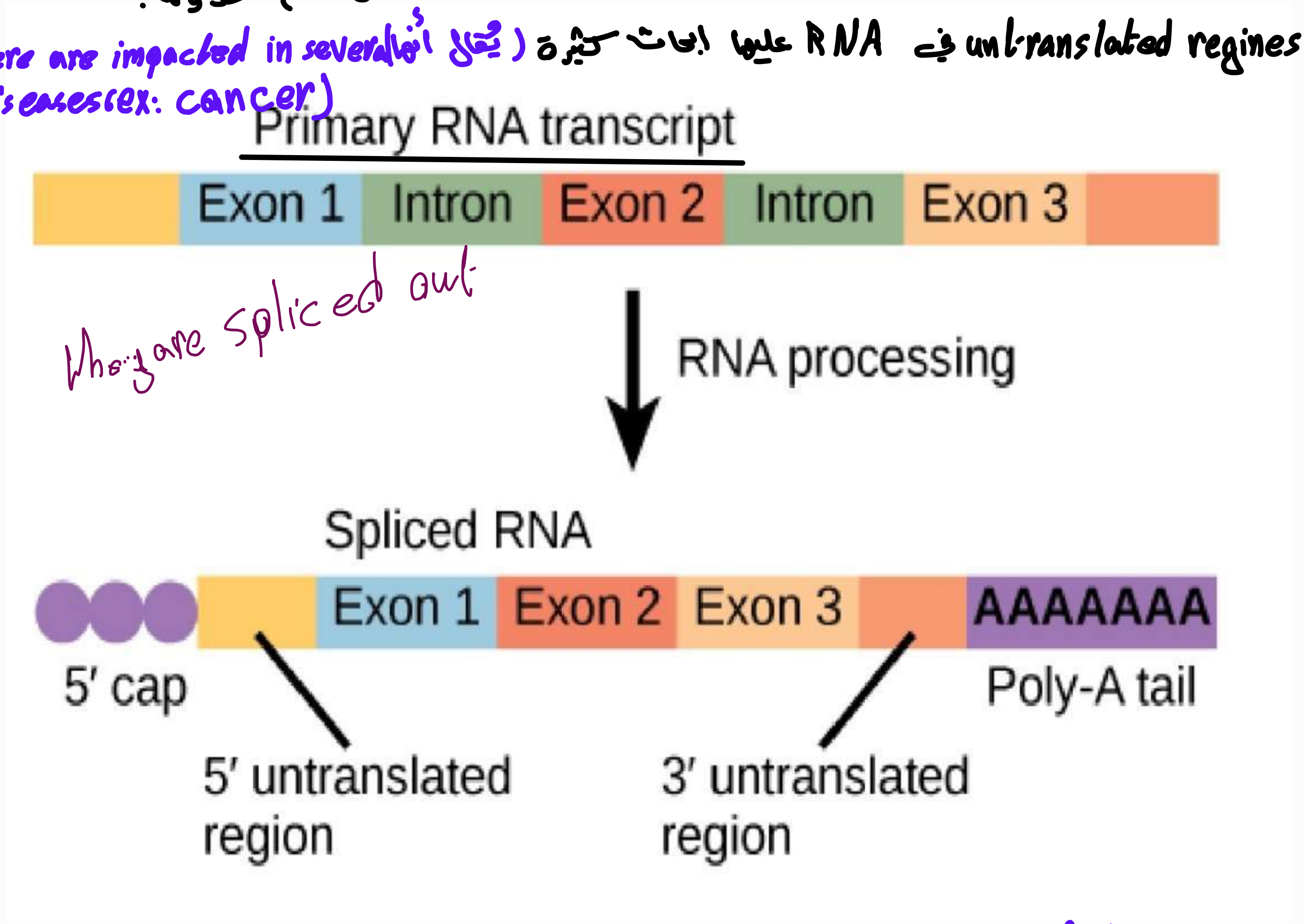
← RNA فيه exons, introns لأنه ناتج من DNA (من جين معين) discontinuous

← عند 5́ and 3́ of RNA يوجد untranslated regions وموجودة أيضاً في DNA gene

← DNA gene فيه قبله sequence وبعده sequence بيساعدوا في regulation of gene expretion

← معدل حصول expretion أو عدم حدوثه.

← untranslated regines في RNA عليها أبحاث كثيرة (يعني أنه there are impacted in several diseases (ex: cancer))

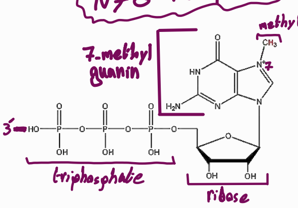


primary RNA transcript ← لأنه بعد حصول transcription رح نعمل modification

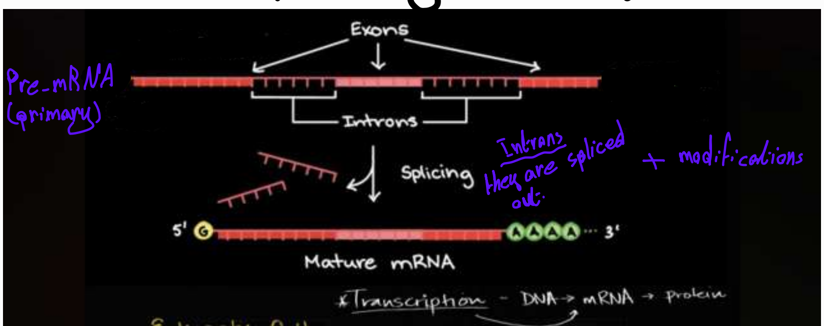
- mRNA بعد حصول

modification:

- عند 5́ نضع **5́ cap**: 7-methylguanosin triphosphate (ربطنا guanin مع ribose و 3P وعلى N7 methyl)
- عند 3́ نضع **poly-A tail**: because it has bunch of adenines at the 3́ end.



(DNA —transcription→ primary transcript —post transcriptional modification→ mRNA
mature mRNA



نفس الجين في tissue معين يعطيك بروتينات ونفس الجين في tissue آخر يعطيك بروتينات مختلفة.

Diversity in the arrangement of exons لـ بسبب

A + B ← بروتين
A + C ← بروتين
A + B + D ← بروتين وهكذا

وهذا يفسر وجود جينات قليلة بينما يوجد بروتينات كثيرة

Transfer RNA (tRNA)

- It forms about 15 % of the total RNA. Each tRNA consists of 70-90 nucleotides. The main role of t RNA is to carry and transport amino acids to the ribosome during protein synthesis. tRNA consists of single strand folded to have the shape of cloverleaf appearance with four loops & an acceptor arm

tRNA ← بيشيل a.a إلى الرايبوسوم ويحطه في المكان المناسب

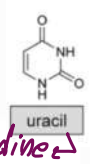
glycin يعني لو إنه شايل glycin ده يوقف عند codon الذي يعني

يتكون من (single strand) 70-90 nucleotides

cloverleaf appearance

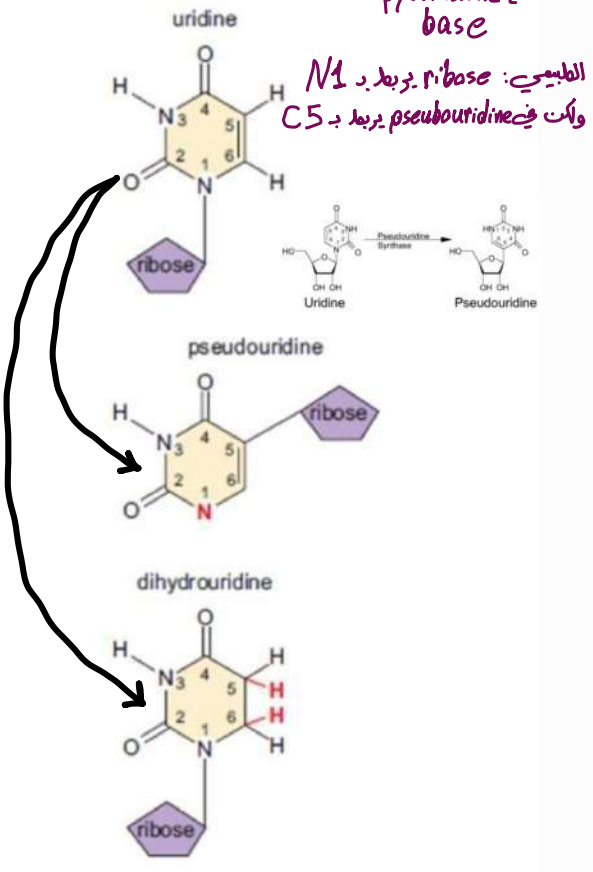
with (4 loops + acceptor arm)

ribose + nitrogenbase
nucleoside
uridine = ribose +



pyrimidine base

- A striking aspect of tRNAs is the presence of several unusual bases in their primary structure. These unusual features are created post-transcriptionally by enzymatic modification of normal bases in the polynucleotide chain. For example, pseudouridine (ΨU) is derived from uridine by an isomerization in which the site of attachment of the uracil base to the ribose is switched from the nitrogen at ring position 1 to the carbon at ring position 5 . Likewise, dihydrouridine (D) is derived from uridine by enzymatic reduction of the double bond between the carbons at positions 5and6.



N1 ribose يربط بـ الطبيعي:
C5 pseudouridine ولكن في يربط بـ

uridine reduction dihydrouridine
remove the double bond between the C5 and C6
uracil reduction dihydrouracil
+ ribose
+ ribose

- لا يوجد أي hypoxanthine في nucleic acid إلا في tRNA
- bases في tRNA يقوع بـ modifications وبدون تتعته ولكن function يكون بطيء.

- Other unusual bases found in tRNA include hypoxanthine, thymine, and methylguanine. These modified bases are not essential for tRNA function, but cells lacking these modified bases show reduced rates of growth. This observation suggests that the modified bases lead to improved tRNA function. For example, hypoxanthine plays an important role in the process of codon recognition by certain tRNAs.

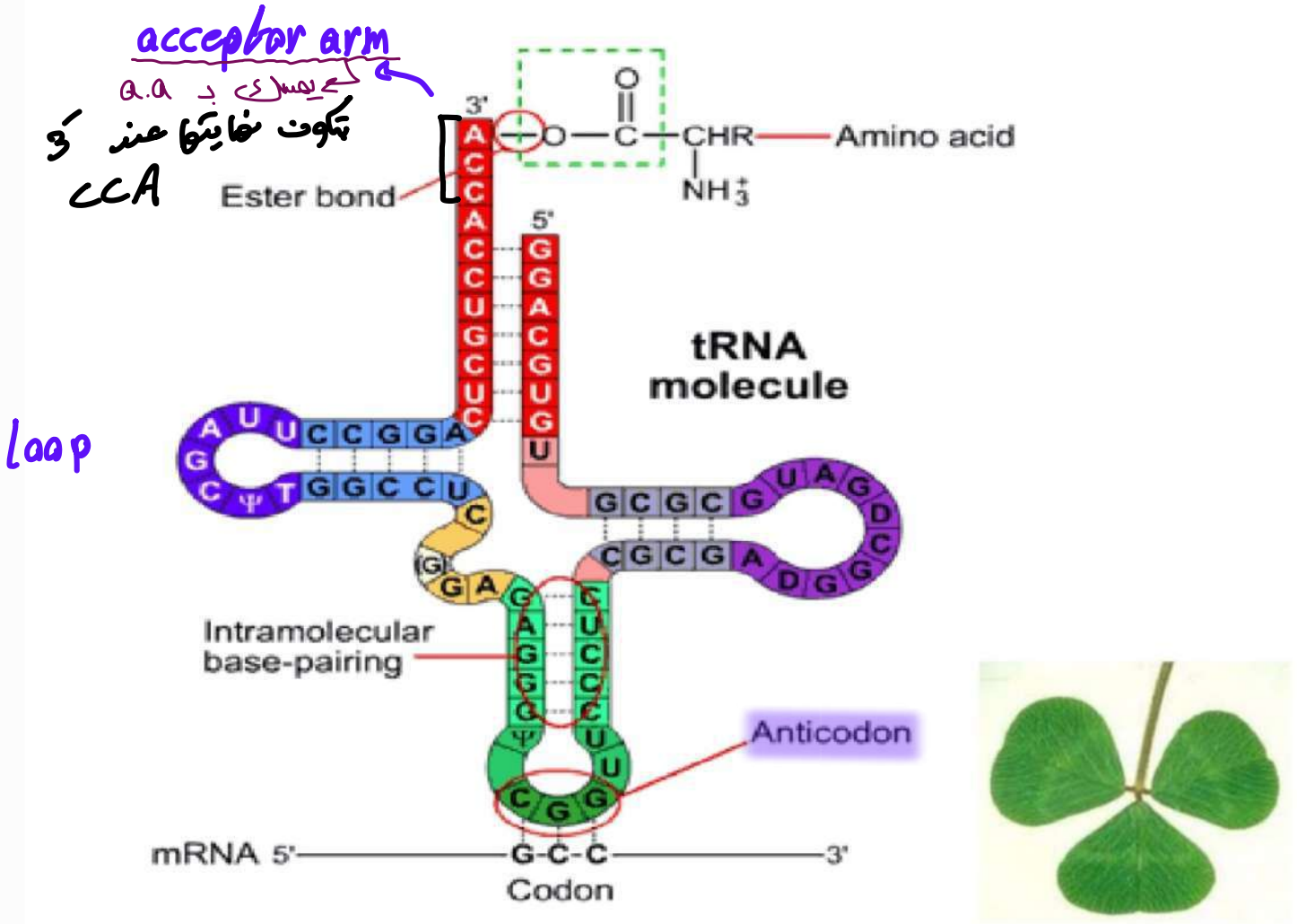
- There are several unusual bases in the structure of tRNA

1) pseudouridine nucleotide ← من pseudouracel
2) dihydrouridine
3) hypoxanthine
4) methylguanine

← هذه التعديلات تكون post-transcriptional modification

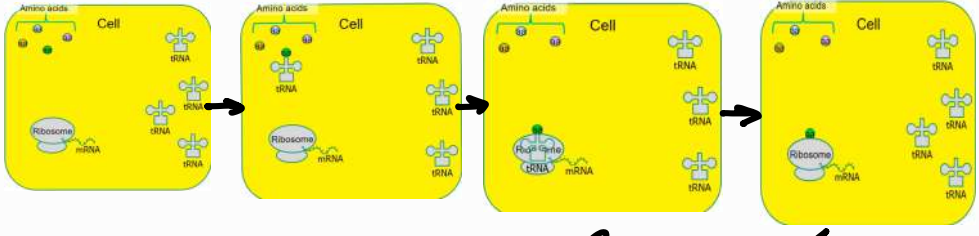
codon ← معين يعطي a.a موجود في mRNA سيأتي بعليه tRNA إلى شكل هذا a.a
من طريق anticodon دع توقف عند codon في mRNA حيث أن anticodon يكون
complementre لهذا codon

كل tRNA يكون مختص بـ a.a معين.



tRNA(anticodon) C G G

mRNA G C C



← يوجد انواع من tRNA اكثر بكثير من 20 ← عدد a.a

لأنه يوجد different codons for the same a.a
بعض a.a لها اكثر من codons

- The acceptor arm of tRNA is at the 3\ end and has the specific sequence CCA. Amino acids are carried on the 3\ end.
- There are at least 20 species of tRNA molecules in every cell, at least one (and often several) corresponding to each of the 20 amino acids required for protein synthesis.
- The different loops of tRNA are named according to their unique structures as follow:

- **Loop I** : contains the unusual base dihydrouracil so termed the **D-loop** → لأنه يحتوي على dihydrouracil
- **Loop II (Anticodon loop)**: It contains three bases known as the anticodon .It has anticodon sequence that **can form base pairing with complementary codon of mRNA** to put amino acid in it correct position during protein synthesis.
- **Loop III**: contains from **3-12 bases** and it is the major site for variation in tRNA, so termed the **variable loop**. → مختلف من tRNA لآخر
- **Loop IV**: contains the unusual **thymine and pseudouridine bases**, so termed the **TΨC** loop as it contains this specific sequence.

thymin pseudouracil cytosine