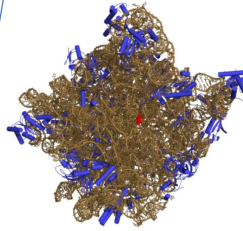


# Ribosomes and Protein Synthesis

## The Ribosome :

- \* Ribonucleoprotein Particle
- \* **Structure:** Very Complex
- \* **Activity:** Ribozyme
- \* **Function:** Synthesis of proteins

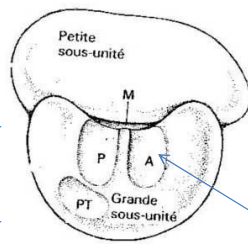


### Structure (1)

► Atomic structure of a large ribosomal subunit.

small subunit

large subunit

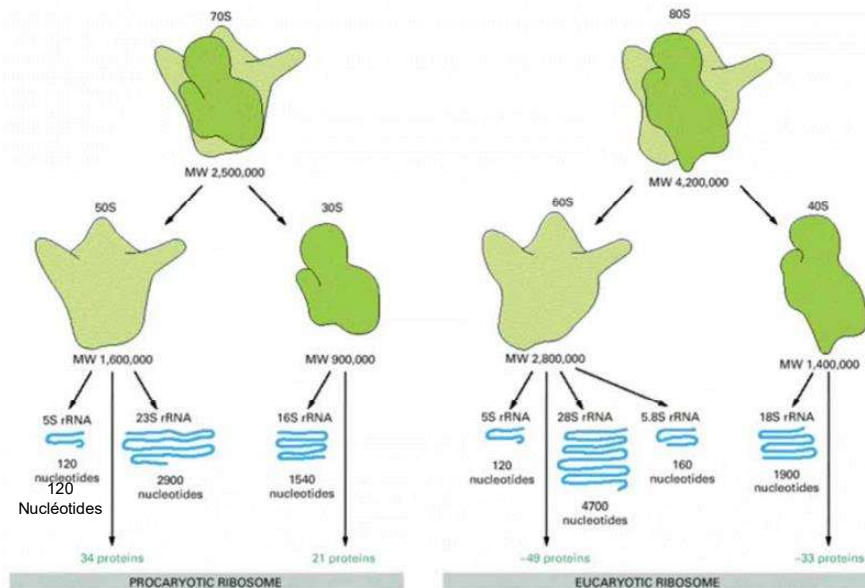


- Proteins are coloured in blue.
- RNA is coloured in brown.
- The active site is coloured in red.

Active site

1

### Structure (2)



2

## Function

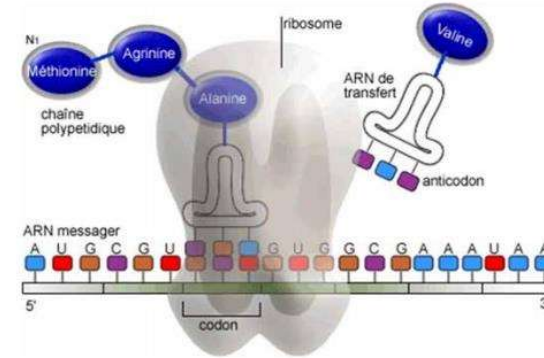
- = Protein synthesis:
- Reading the genetic code on mRNA
- Synthesis of the protein chain from amino acids charged on to tRNAs

• = تركيب البروتين

• قراءة الشفرة الوراثية على mRNA

• \*تركيب السلسلة البروتينية من الأحماض الأمينية المحملة على

tRNAs



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## Synthesis location

### Where proteins are synthesised:

1/ In the granular endoplasmic reticulum (REG) by bound (linked) ribosomes.

Destination:

- **Secreted proteins**,
- lysosomes
- and the plasma membrane

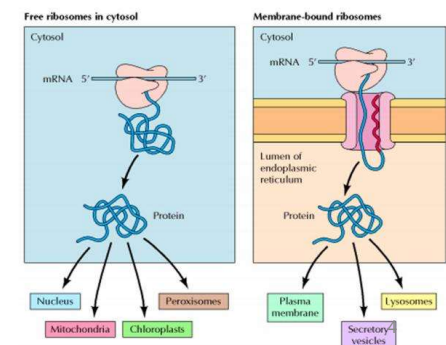
**Secreted proteins** follow the pathway:

- Endoplasmic Reticulum
- Golgi apparatus
- Secretory vesicles
- Periplasmic space

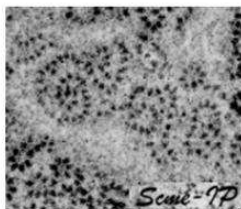
2/ Into the cytosol by free ribosomes.

Destination:

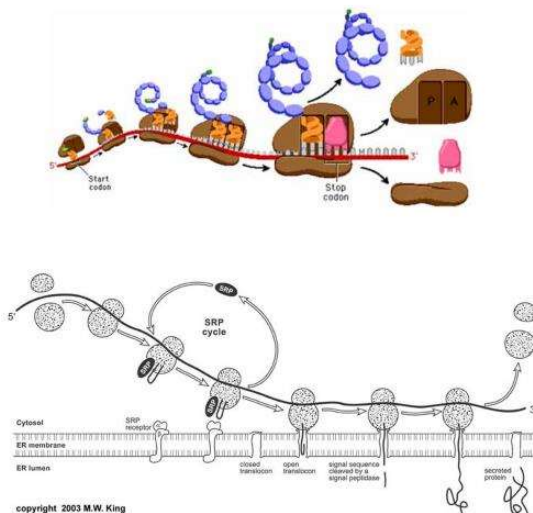
- Proteins from the nucleus,
- Mitochondria,
- Chloroplasts
- Peroxisomes



## Les polysomes



- Dans le Cytosol
- Liés à la membrane du RE



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## SYNTHESIS of PROTEINS

- Proteins essential for cell structure and function

Protein synthesis proceeds in 2 main stages:

I. TRANSCRIPTION: copying DNA to RNA [nucleus (G1 G2)].

II. TRANSLATION: RNA to PROTEIN [cytoplasm].

### Notions

**Genetic code:** Correspondence between codons and A.A. (Amino Acid).

**Proteins:** (sentences) sequence of A.A.(words)

20 different A.A.

**Gene** = DNA segment with instructions corresponding to a polypeptide chain

## GENETIC CODE :

**Nucleotide:** base + pentose + Phosphoric acid

**ADN :** Bases azotées

► Pyrimidiques : Cytosine Thymine

► Puriques : Adénine Guanine

Liaisons hydrogènes complémentarité

C  $\longleftrightarrow$  G

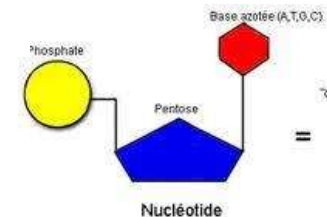
A  $\longleftrightarrow$  T

Letters 4 bases

Words = 20 A.A.

Sentences = proteins

**Genetic code** = correspondence between codons / A.A.



**Genetic information** is coded in 3 successive nucleotides Codons: triplets

► 43: 64 codons

► 61 codons- A.A.

► 3 stop codons: TAA TAG TGA

**Universal start codon:**

► ATG for Methionine.

► Proteins start with the same A.A. Methionine

## GENETIC CODE

20 A.A.

	U	C	A	G	
U	UUU } Phényl-alanine UUC } UUA } Leucine UUG }	UCU } UCC } Sérine UCA } UCG }	UAU } Tyrosine UAC } UAA } Non-sens UAG }	UGU } Cystéine UGC } UGA } Non-sens UGG } Tryptophane	U C A G
C	CUU } CUC } CUA } Leucine CUG }	CCU } CCC } Proline CCA } CCG }	CAU } Histidine CAC } CAA } Glutamine CAG }	CGU } CGC } Arginine CGA } CGG }	U C A G
A	AUU } AUC } Isoleucine AUA } AUG } Méthionine	ACU } ACC } ACA } Thréonine ACG }	AAU } Asparagine AAC } AAA } Lysine AAG }	AGU } Sérine AGC } AGA } Arginine AGG }	U C A G
G	GUU } GUC } Valine GUA } GUG }	GCU } GCC } Alanine GCA } GCG }	GAU } Acide aspartique GAC } GAA } Acide glutamique GAG }	GGU } GGC } Glycine GGA } GGG }	U C A G

Code génétique ARN<sub>m</sub>

A : Adénine U : Uracile G : Guanine C : Cytosine

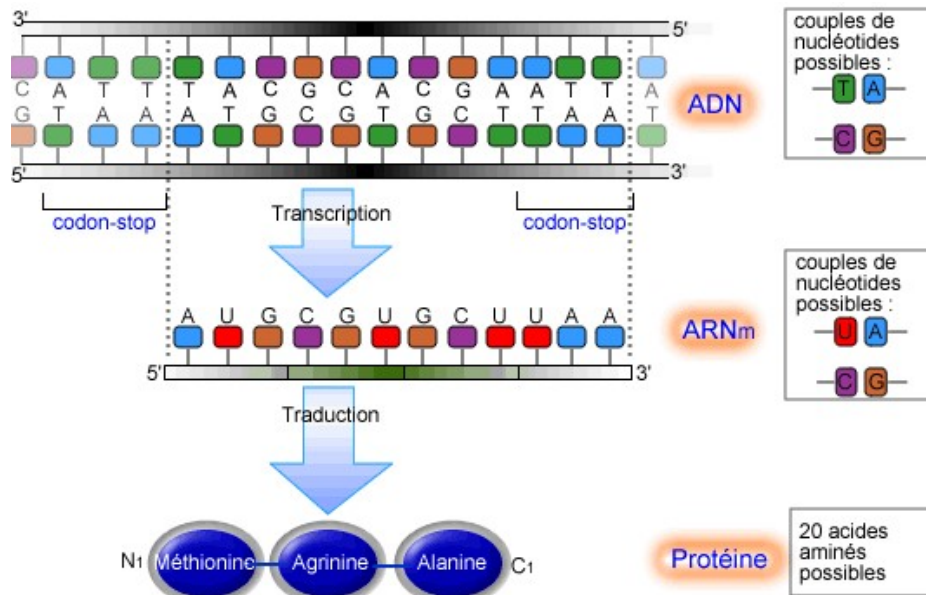
1ère SVT, HATIER, 1993

**Insuline** : 2 chaînes polypeptidiques 21 AA & 30 AA

**Collagène** : 3 chaînes polypeptidiques 1050 AA

**Hémoglobine** : 2 chaînes 141 et 2 chaînes 146 AA

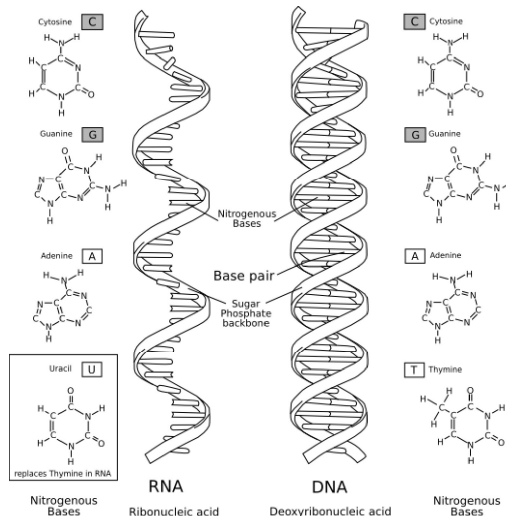
A.A. /plusieurs codons



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## Structure d'ARN

- **RNA**, like **DNA**, consists of long chains of nucleotides. However, there are three fundamental differences between DNA and RNA:
- 1. The sugar in RNA consists of ribose instead of deoxyribose.
- 2. RNA is a single strand instead of two strands.
- 3. RNA contains uracil instead of thymine.

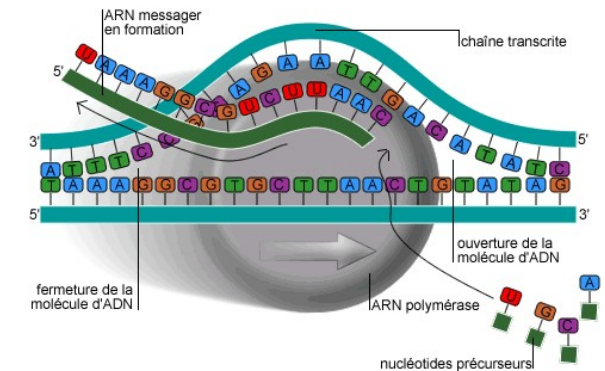


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## I. TRANSCRIPTION: Transcription (ADN to ARN)

- **Definition:** Transcription is the production of mRNA from a nucleotide sequence (or gene) found in DNA.
- **Location:** Nucleus
- There are **three** main **steps** involved in transcription:

1. Initiation
2. Elongation
3. Termination



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## II. TRANSLATION OF RNA INTO PROTEINS

**Location:** Cytoplasm

**Genetic Message Translation:**

**Tools:** - mRNA ; - tRNA (adapter) ; - Amino acids (A.A.) ; - Ribosomes ; - Energy (ATP), enzymes

**Steps:**

➤ **Initiation phase:** AUG/UAC signal, tRNA carrying Methionine on the ribosome  
Complementarity of anticodon/codon  
Messenger RNA: C-GA-U

➤ **Elongation phase:** Successive attachment of amino acids (order defined by mRNA)

➤ **Termination phase:** One of the three stop codons for synthesis (UAA, UGA, UAG)  
**Release of the polypeptide chain**  
**Ribosomes attached to the rough ER or free**

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