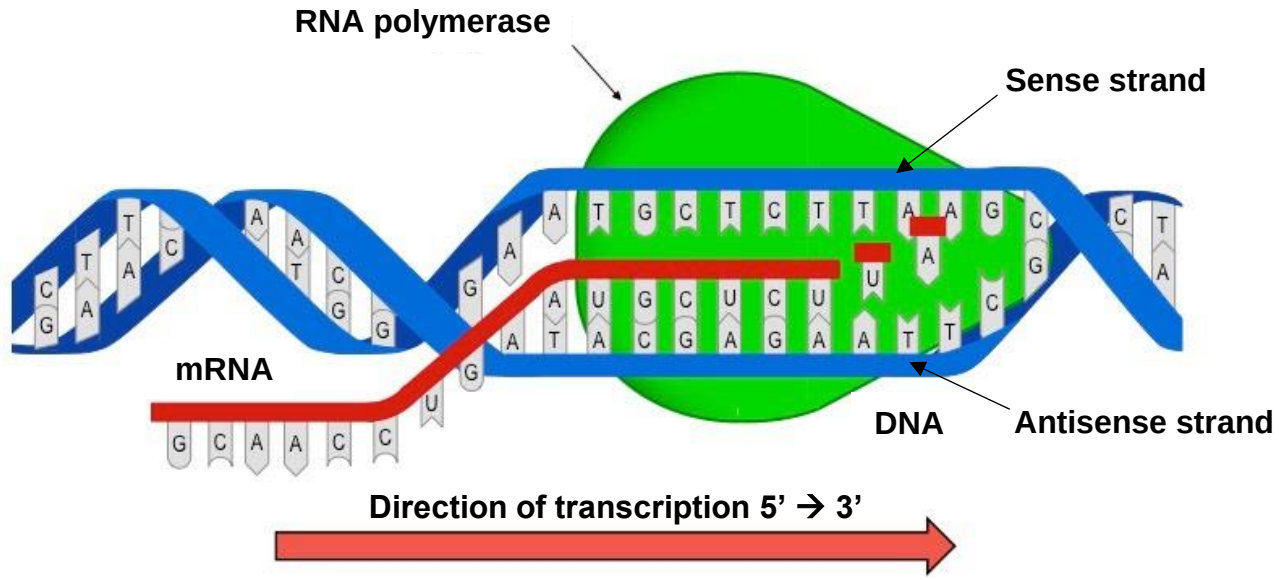
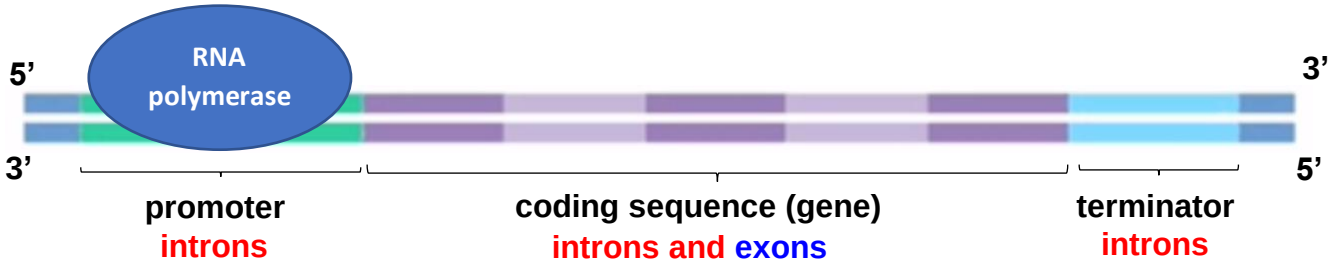
A. TRANSCRIPTION



- The strand that is **transcribed** is called the **antisense** strand and is **complementary** to the **mRNA** sequence (with T instead of U)

- The strand that is **not transcribed** is called the **sense** strand and is **identical** to the **mRNA** sequence (with T instead of U)

The process (DNA → mRNA)



What happens

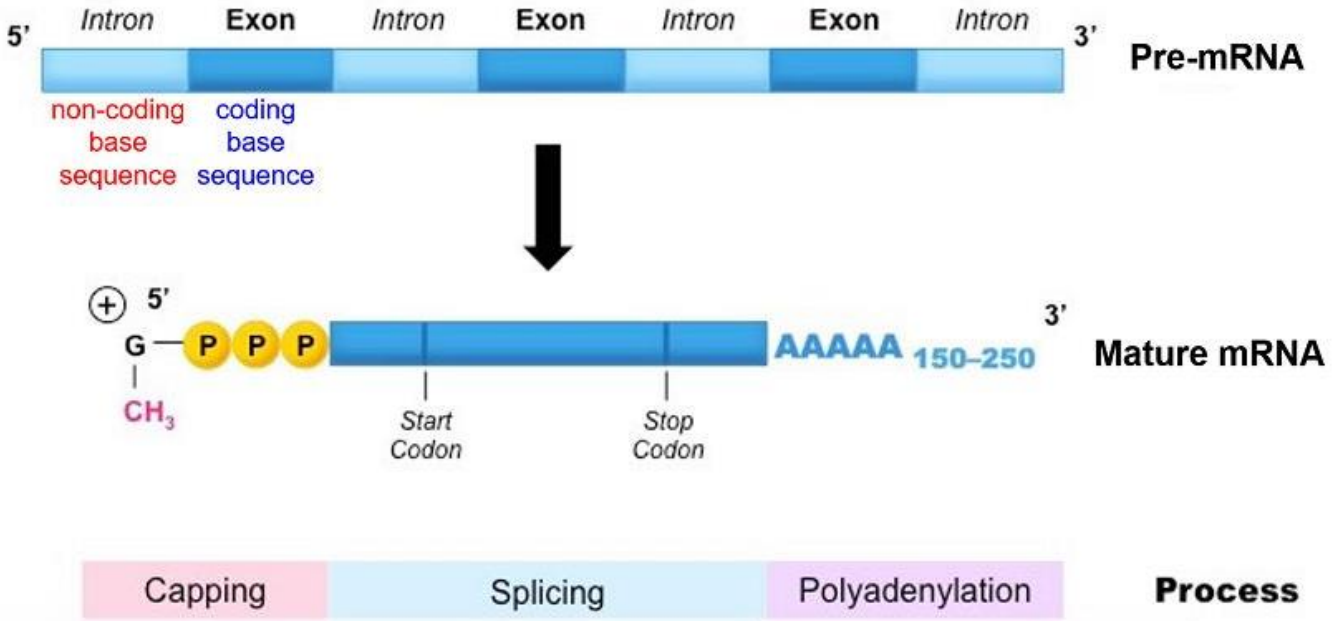
- **RNA polymerase** binds to **promoter** (at start of gene)
- (And) **separates strands** / unzips DNA / breaks hydrogen bonds
- **Antisense** strand acts as a **template**;
- **Free RNA nucleotides** added **5' --> 3'** (direction);
- By **complementary base pairing** / adenine & uracil and cytosine & guanine;
- **RNA polymerase** joins **RNA nucleotides** together;
- **RNA polymerase** and **mRNA** detach at **terminator**;
- **DNA strands** attach **back** together / **H-bonds reform** between DNA strands;

How it is controlled

- **Transcription factors** bind to **promoter** and **help RNA polymerase** to bind
- **Repressor proteins** can bind to **promoter** and **prevent RNA polymerase** binding;
- **Methylation** (of **cytosine** bases) can **prevent transcription**;

B. POST-TRANSCRIPTION MODIFICATION OF mRNA

- The **introns** are **removed** and the **exons** are then **joined** together.
- **Only** happens in **eukaryotes** – **not prokaryotes**.



Methyl (CH_3) group added to **5' end** of **mRNA** to:

- **protect** it from **enzyme digestion**
- allow a **ribosome** to **recognise** it

Introns are **removed** by **splicing.**

Exons are **joined** together**.**

A **long chain** of **adenine** nucleotides (a p**oly-A tail)** is **added** to the **3**' end of the mRNA**.** This:

- makes it **more stable**
- **helps** it to **leave** the **nucleus**

- Splicing of exons is the reason we can produce so **many different types of antibody**, each having a **specific shape**.

C. FUNCTIONS OF DNA BASE SEQUENCES THAT DO NOT CODE FOR PROTEINS

- **Non-coding** DNA base sequences can have **four** main roles:

1. **Introns** – involved in **processing mRNA**
2. **Coding for tRNA and rRNA** – these are involved in **translation**
3. **Controlling gene expression/transcription** – **binding sites** for **proteins** that can **allow** or **prevent transcription**.
4. **Telomeres** – **repetitive base sequences** at the **ends** of **chromosomes**, which **prevent parts of genes here from being lost** each time the **DNA is replicated**.

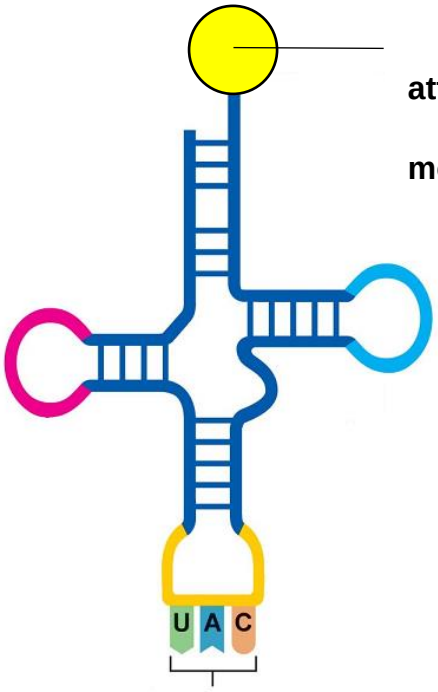
tRNA (transfer RNA)

Each tRNA molecule **carries** a **specific amino acid**

tRNA-activating enzyme **attaches** this **specific amino acid** to the **3' end** of a **tRNA molecule,** using **energy** from **ATP**

The **specific amino acid carried** is **determined** by the **anticodon**

i.e. all tRNA molecules with the anticodon **UAC** will carry the amino acid **methionine** (Met)

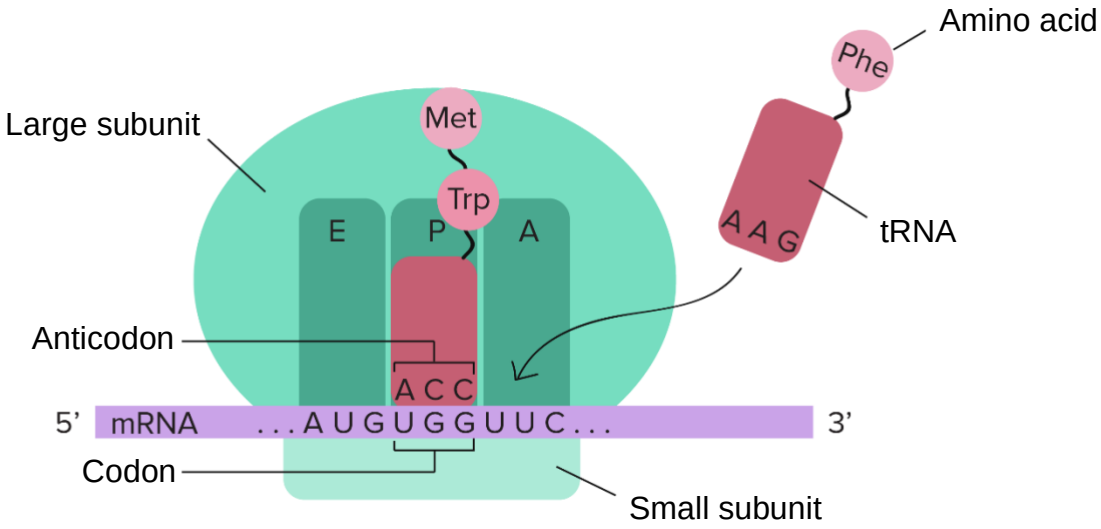


Anticodon

Three bases that bind to a **specific codon** on **mRNA**

A ribosome

- Has **large** and **small subunits**.



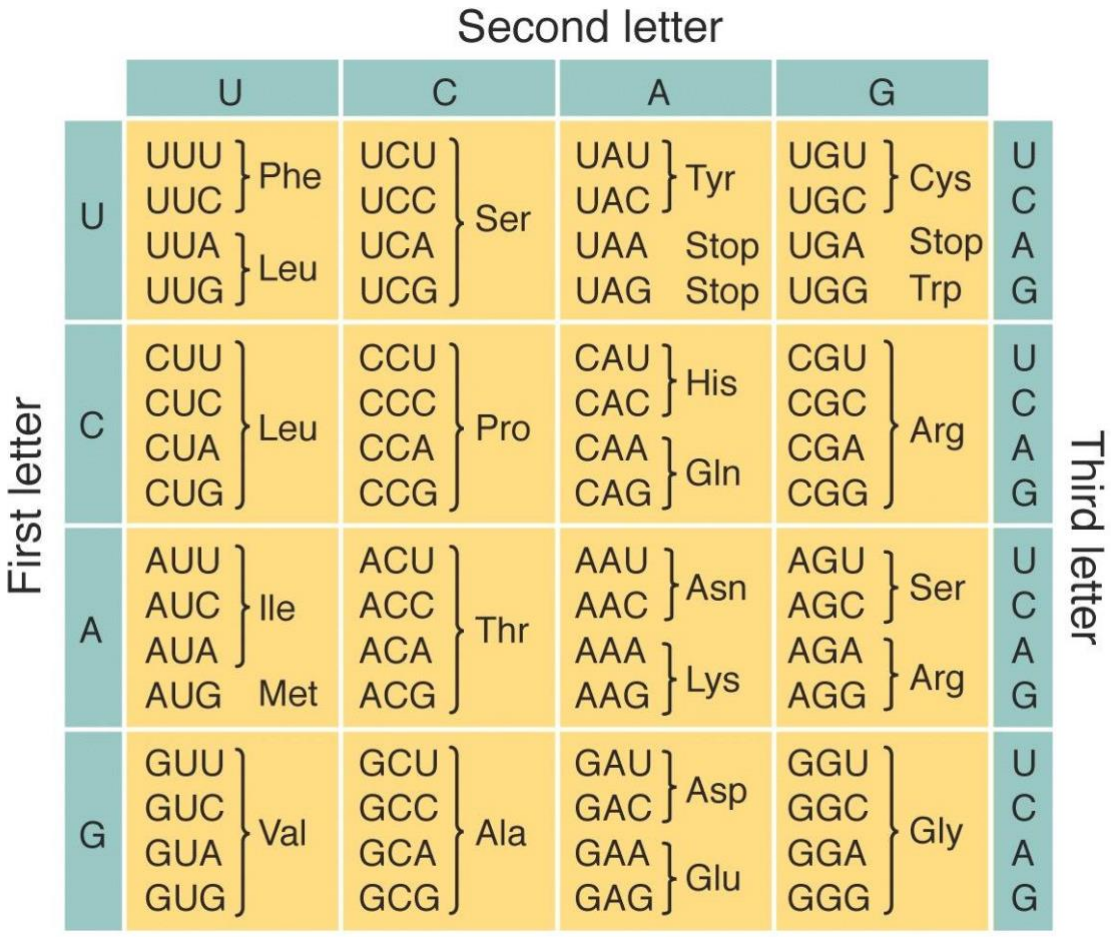
- **A** site = tRNA carrying a new **A**mino acid binds here
- **P** site = tRNA carrying the growing **P**rotein binds here
- **E** site = tRNA that has lost its amino acid **E**xits here

D. THE GENETIC CODE

- The **base sequence** of a **mRNA** molecule **codes for** the production of a **polypeptide**
- This **base sequence** is read by a ribosome in **triplets of bases** called **codons**
- Each **codon** codes for one **specific amino acid** in a protein chain
- The **order** of the **codons** in an **mRNA** determines the **order** of **amino acids** in a protein

The **genetic code** is **UNIVERSAL**

The **same mRNA codons** code for the **same amino acids** in **all organisms**



mRNA codons and the amino acids they code for

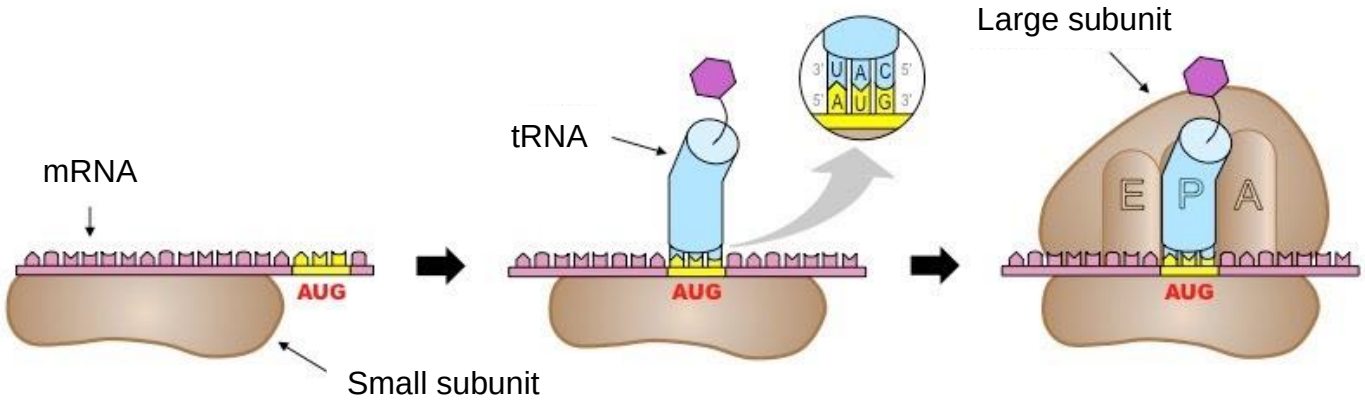
The **genetic code** is **DEGENERATE**

Different mRNA codons can code for the **same amino acid**

- The **mRNA codon** CCU codes for the **amino acid** Proline

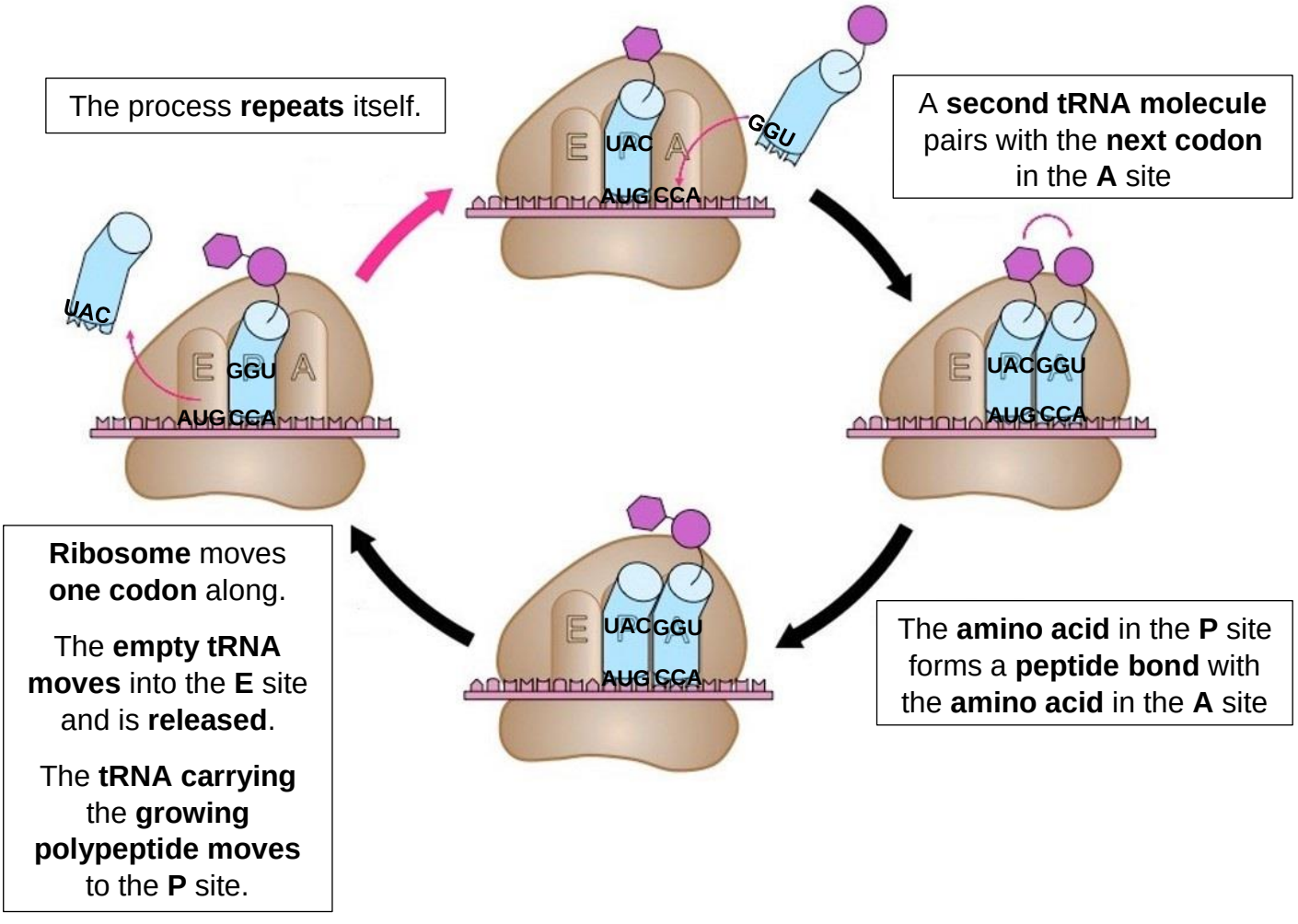
E. TRANSLATION (mRNA → POLYPEPTIDE/PROTEIN)

Stage 1: Initiation

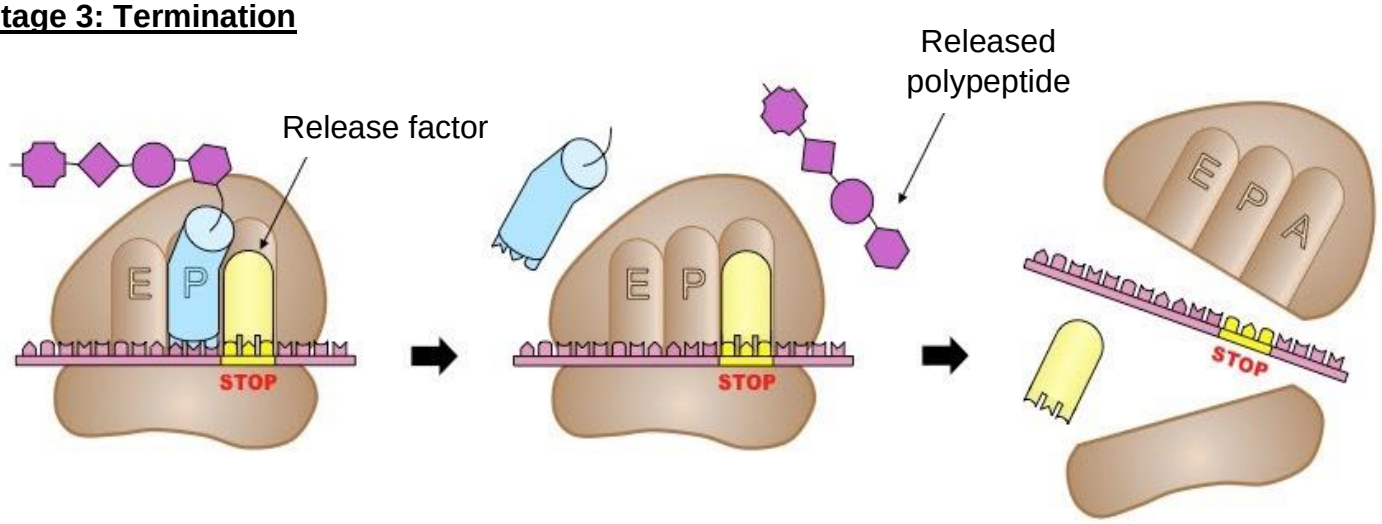


- **Small** ribosome **subunit** attaches to **5' end** of **mRNA**
- **First tRNA** with **anticodon UAC attaches** to **first codon (AUG)**;
- (tRNA) carries the amino acid **methionine**/met;
- **Large** ribosome **subunit** attaches (forming a complex);
- **First tRNA** is in the **P** site;

Stage 2: Elongation



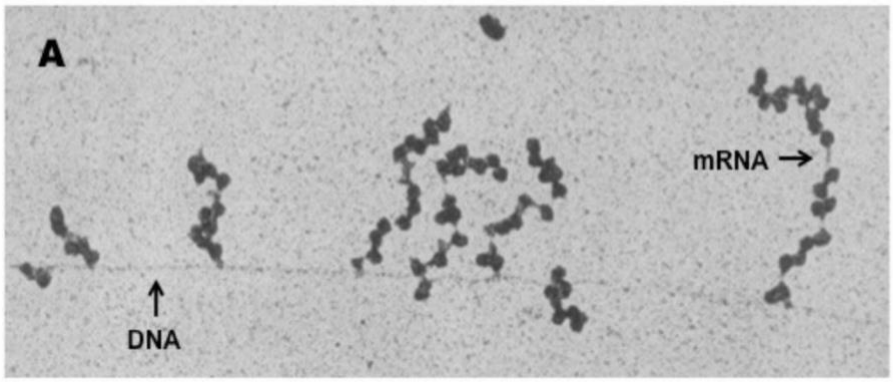
Stage 3: Termination

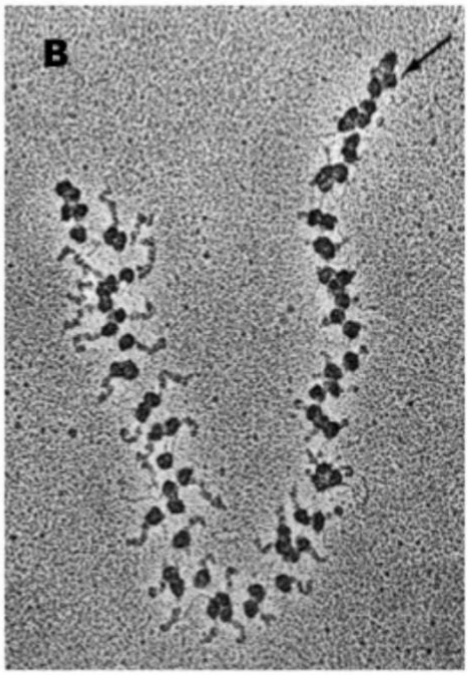


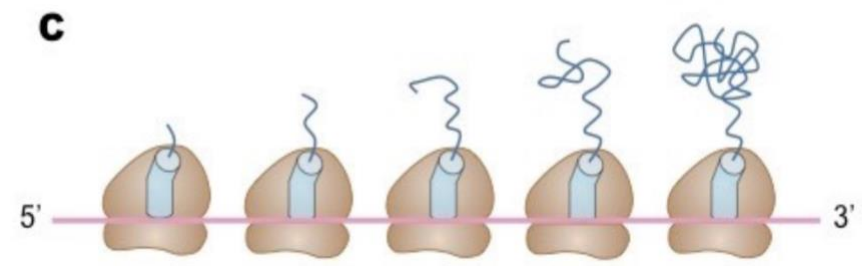
- **Ribosome** reaches a **stop codon**;
- This causes a **release factor** to **attach**;
- The **polypeptide** is **released**;
- The **ribosome separates** back into its **two subunits**;

Polysome

- A group of **two or more ribosomes** translating a mRNA base sequence **simultaneously.**
- They appear as **beads** on a **string** (bead = ribosome; string = mRNA).







F. COMPARE AND CONTRAST DNA REPLICATION & TRANSCRIPTION

DNA replication	Transcription
DNA → **DNA**	DNA → **mRNA**
Involves **DNA polymerase**	Involves **RNA polymerase**
Involves **thymine**	Involves **uracil**
Product is **double stranded**	**Product** is **single stranded**
Both strands act as **templates**	**One strand** acts as a **template**
Complete strand copied	**Part** of a strand copied
Happens in the **nucleus**	
DNA **unzips/strands separate**	
Complementary copy/strand produced	
DNA molecule **zips back up** (at the end)	

G. WHY IS THE DNA BASE SEQUENCE SO IMPORTANT?

DNA base sequence determines:

mRNA base sequence determines:

amino acid sequence determines:

tertiary structure of protein determines:

if the protein is functional or non-functional