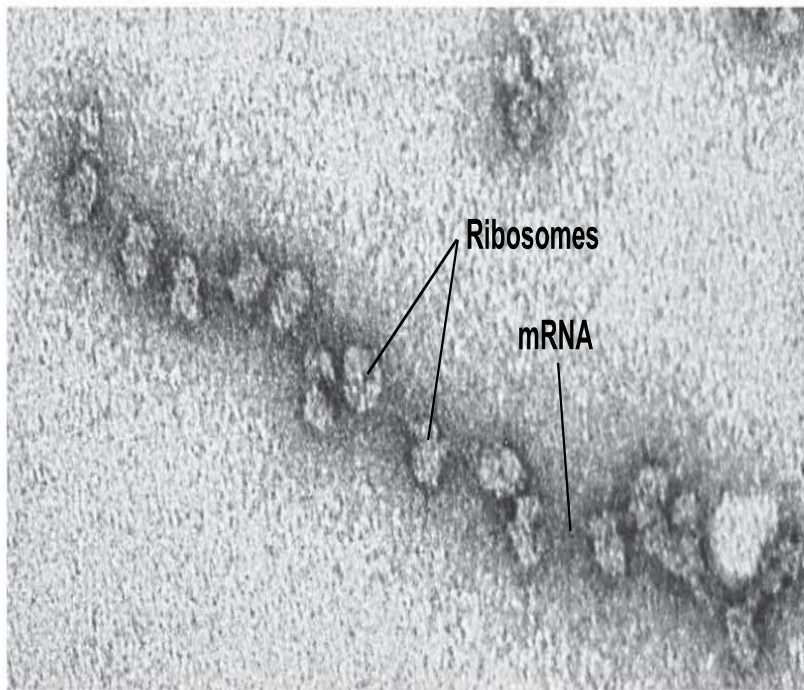


(a) An mRNA molecule is generally translated simultaneously by several ribosomes in clusters called polyribosomes.



(b) This micrograph shows a large polyribosome in a prokaryotic cell (TEM).

# Completing and Targeting the Functional Protein

- Often translation is not sufficient to make a functional protein
- Polypeptide chains are modified after translation
- Completed proteins are targeted to specific sites in the cell

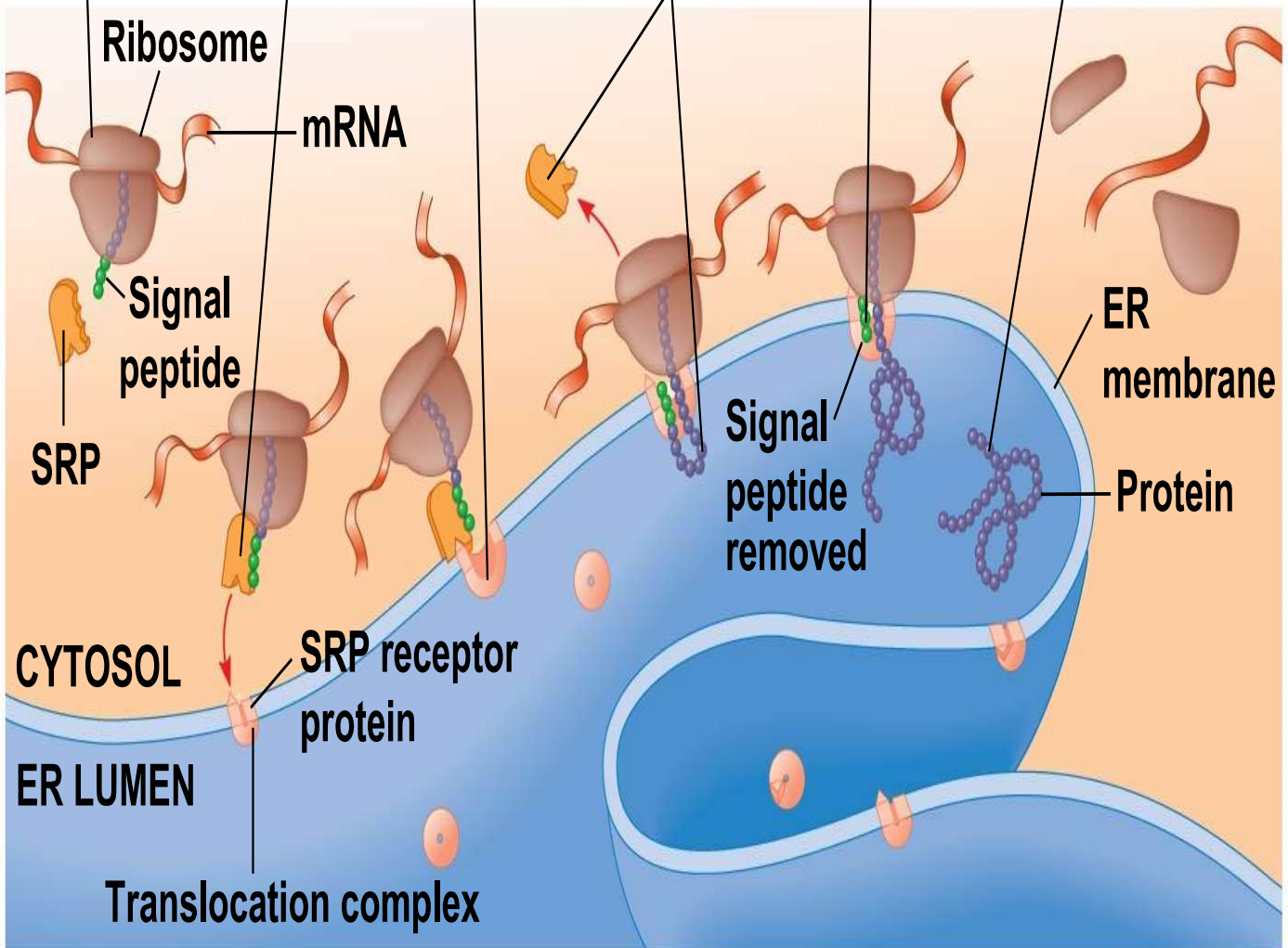
# *Targeting Polypeptides to Specific Locations*

- Two populations of ribosomes are evident in cells: free ribosomes (in the cytosol) and bound ribosomes (attached to the ER)
- **Free ribosomes** mostly synthesize proteins that function in the cytosol
- **Bound ribosomes** make proteins of the endomembrane system and proteins that are secreted from the cell (**rough ER**)
- Ribosomes are identical and can switch from free to bound

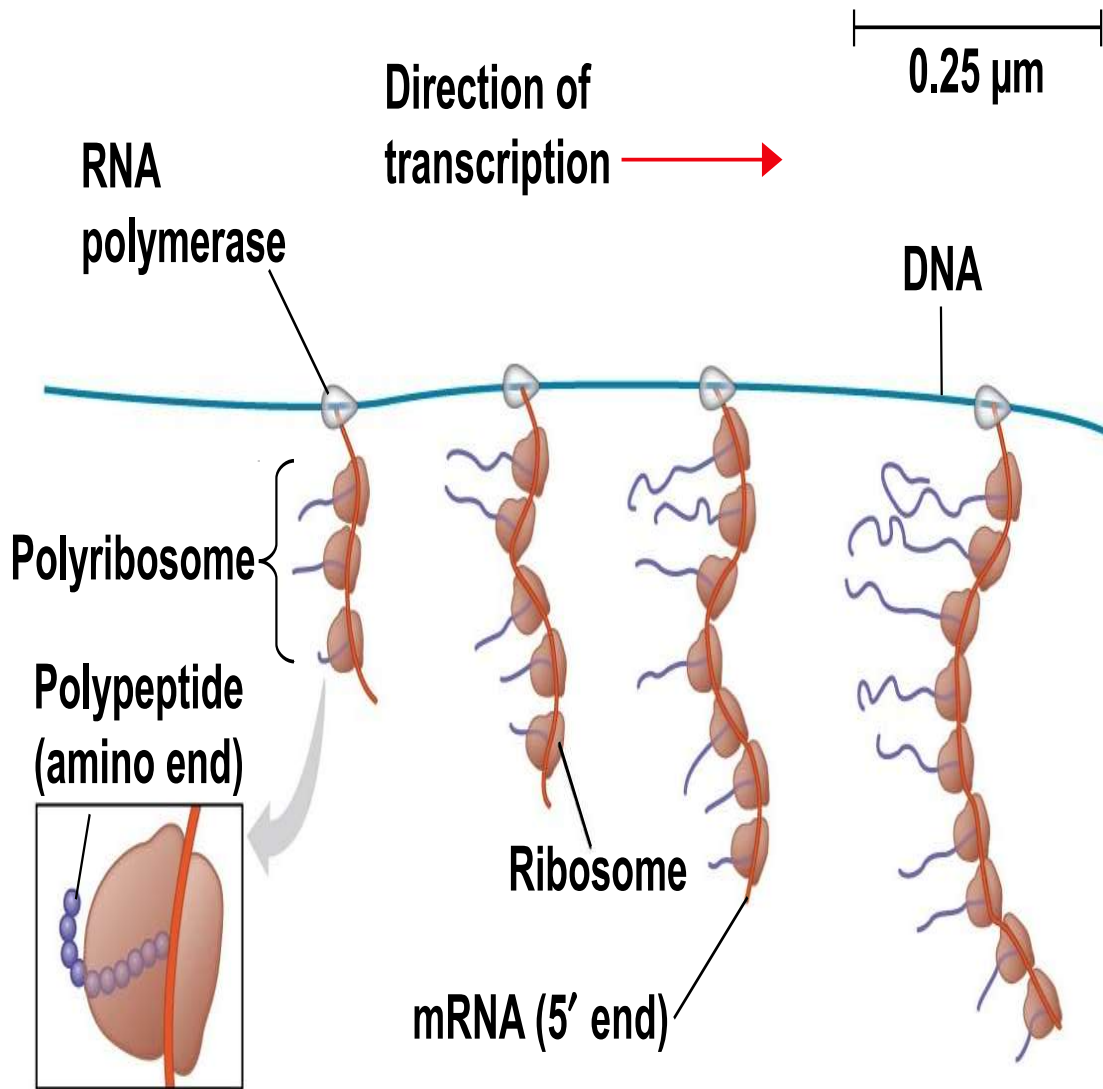
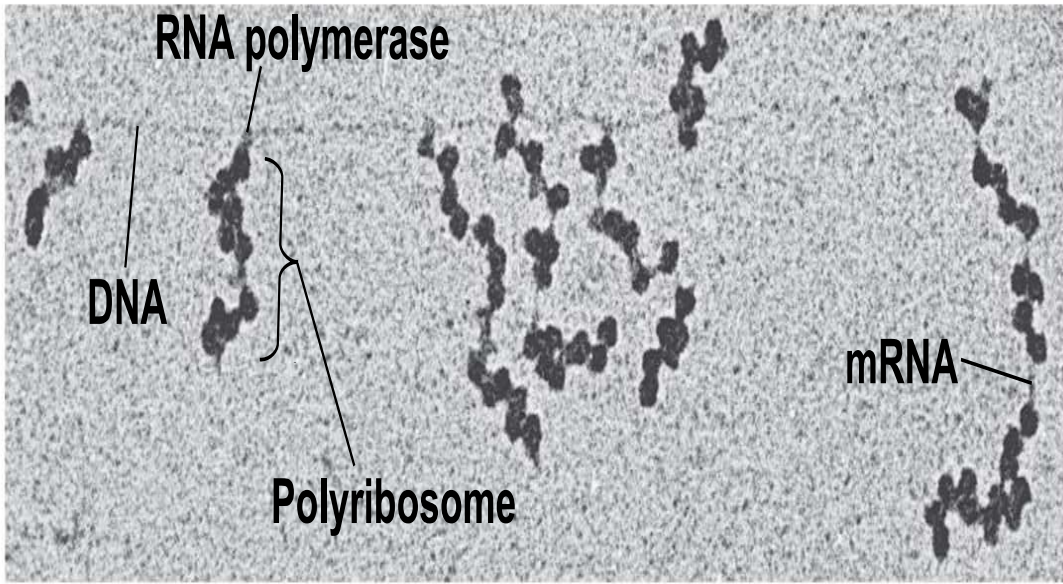
- Polypeptide synthesis always begins in the cytosol
- Synthesis finishes in the cytosol *unless* the polypeptide signals the ribosome to attach to the ER
- Polypeptides destined for the ER or for secretion are marked by a **signal peptide**
- A **signal-recognition particle (SRP)** binds to the signal peptide
- The SRP brings the signal peptide and its ribosome to the ER

# Figure 17.21

- 1** Polypeptide synthesis begins.
- 2** SRP binds to signal peptide.
- 3** SRP binds to receptor protein.
- 4** SRP detaches and polypeptide synthesis resumes.
- 5** Signal-cleaving enzyme cuts off signal peptide.
- 6** Completed polypeptide folds into final conformation.

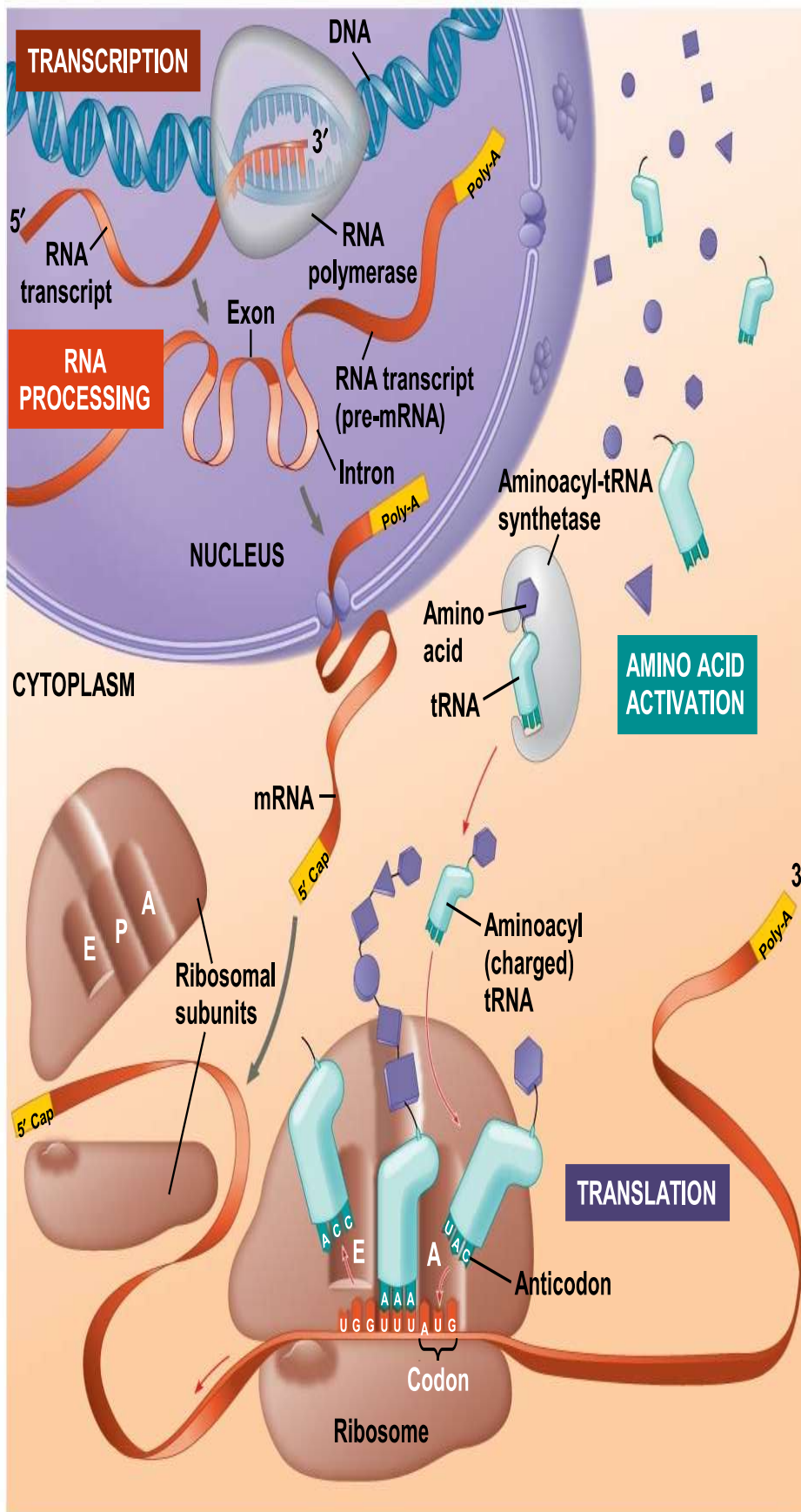


- A **bacterial cell** ensures a streamlined process by **coupling transcription and translation**
- In this case the newly made protein can quickly diffuse to its site of function



- In eukaryotes, the nuclear envelop separates the processes of transcription and translation
- RNA undergoes processes before leaving the nucleus





# Concept 17.5: RNA plays multiple roles in the cell: *a review*

Type of RNA	Functions
Messenger RNA (mRNA)	Carries information specifying amino acid sequences of proteins from DNA to ribosomes
Transfer RNA (tRNA)	Serves as adapter molecule in protein synthesis; translates mRNA codons into amino acids
Ribosomal RNA (rRNA)	Plays catalytic (ribozyme) roles and structural roles in ribosomes

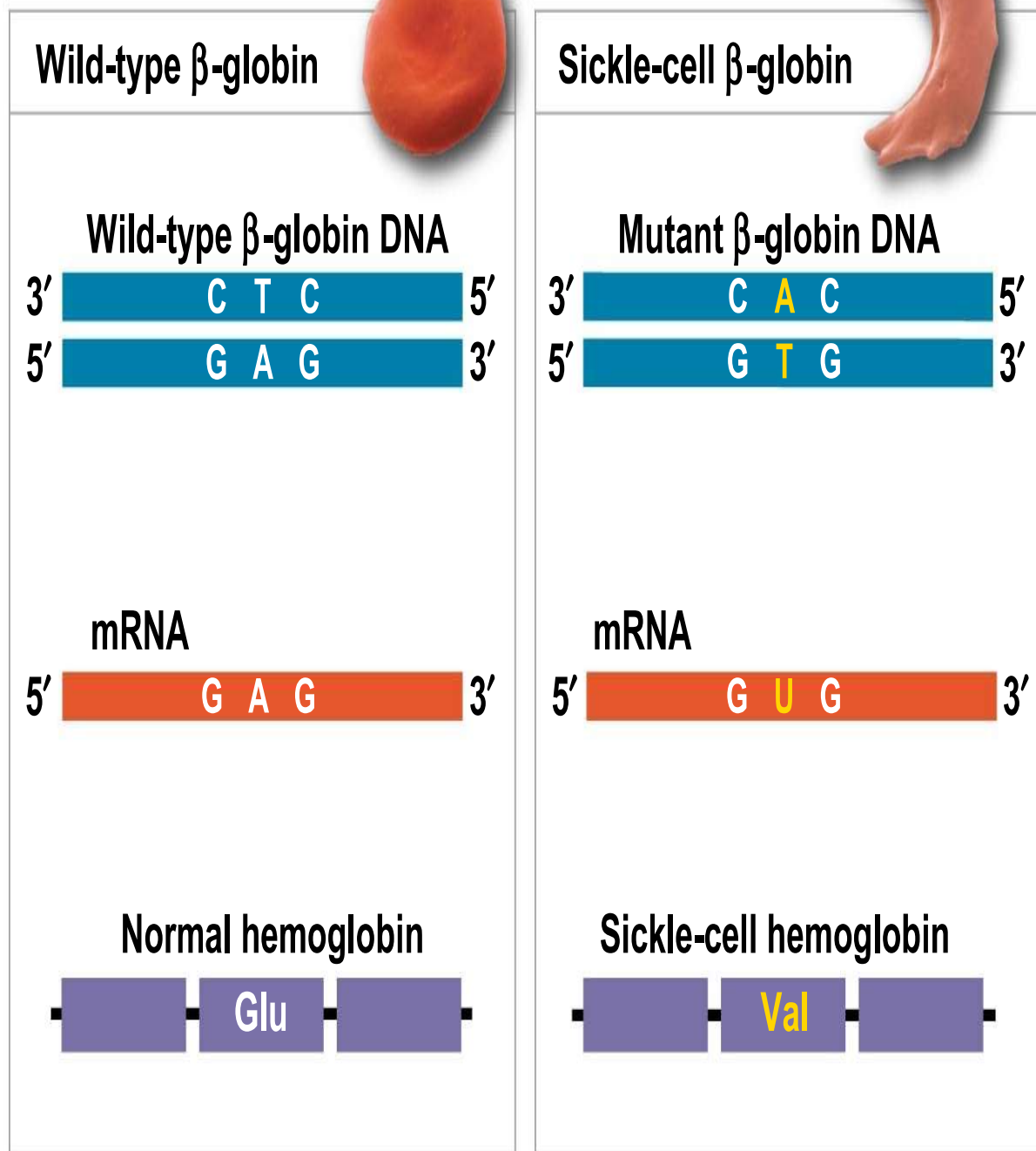
<b>Type of RNA</b>	<b>Functions</b>
Primary transcript	Serves as a precursor to mRNA, rRNA, or tRNA, before being processed by splicing or cleavage
Small nuclear RNA (snRNA)	Plays structural and catalytic roles in spliceosomes
SRP RNA	Is a component of the the signal-recognition particle (SRP)

Video: [protein synthesis](#)

# Concept 17.7: Point mutations can affect protein structure and function

- **Mutations** are changes in the genetic material of a cell or virus
- **Point mutations** are chemical changes in just one base pair of a gene
- The change of a single nucleotide in a DNA template strand leads to production of an abnormal protein

# Figure 17.25



# Types of Point Mutations

- Point mutations within a gene can be divided into two general categories
  - Base-pair substitutions
  - Base-pair insertions or deletions

# *Substitutions*

- A base-pair substitution replaces one nucleotide and its partner with another pair of nucleotides
- Base-pair substitution can cause missense or nonsense mutations
- **Missense mutations** still code for an amino acid, but not necessarily the right amino acid
- **Nonsense mutations** change an amino acid codon into a stop codon, nearly always leading to a nonfunctional protein
- Missense mutations are more common

### Wild type

DNA template strand 3' T A C T T C A A A C C G A T T 5'  
 5' A T G A A G T T T G G C T A A 3'

mRNA 5' A U G A A G U U U G G C U A A 3'

Protein Met Lys Phe Gly Stop  
 Amino end Carboxyl end

#### (a) Nucleotide-pair substitution

A instead of G

3' T A C T T C A A A C C A A T T 5'  
 5' A T G A A G T T T G G T T A A 3'

U instead of C

5' A U G A A G U U U G G U U A A 3'  
 Met Lys Phe Gly Stop

Silent

T instead of C

3' T A C T T C A A A T C G A T T 5'  
 5' A T G A A G T T T A G C T A A 3'

A instead of G

5' A U G A A G U U U A G C U A A 3'  
 Met Lys Phe Ser Stop

Missense

A instead of T

3' T A C A T C A A A C C G A T T 5'  
 5' A T G T A G T T T G G C T A A 3'

U instead of A

5' A U G U A G U U U G G U U A A 3'  
 Met Stop

Nonsense

#### (b) Nucleotide-pair insertion or deletion

Extra A

3' T A C A T T C A A A C C G A T T 5'  
 5' A T G T A A G T T T G G C T A A 3'

Extra U

5' A U G U A A G U U U G G C U A A 3'  
 Met Stop

Frameshift (1 nucleotide-pair insertion)

A missing

3' T A C T T C A A C C G A T T 5'  
 5' A T G A A G T T G G C T A A 3'

U missing

5' A U G A A G U U G G C U A A ... 3'  
 Met Lys Leu Ala ...

Frameshift (1 nucleotide-pair deletion)

TTC missing

3' T A C A A A C C G A T T 5'  
 5' A T G T T T G G C T A A 3'

AAG missing

5' A U G U U U G G C U A A 3'  
 Met Phe Gly Stop

3 nucleotide-pair deletion

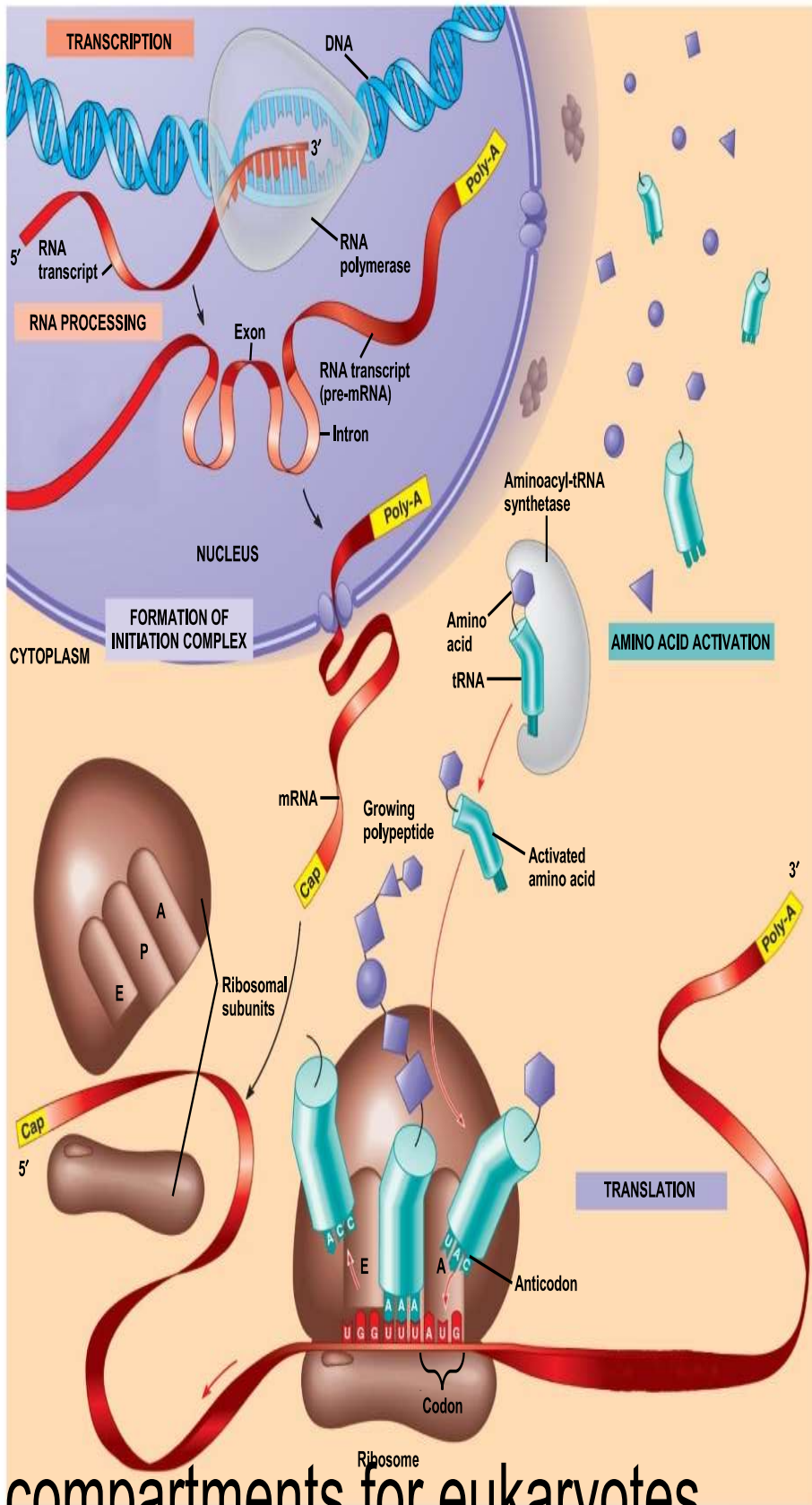


# Mutagens

- Spontaneous mutations can occur during DNA replication, recombination, or repair
- **Mutagens** are physical or chemical agents that can cause mutations

# What is a gene? *revisiting the question*

- A gene is a region of DNA whose final product is either a polypeptide or an RNA molecule



# Review compartments for eukaryotes

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