

EXPERIMENT

Growth: Wild-type cells growing and dividing
No growth: Mutant cells cannot grow and divide
Minimal medium

RESULTS

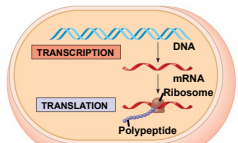
	Wild type	Class I mutants	Class II mutants	Class III mutants
Minimal medium (MM) (control)				
MM + ornithine				
MM + citrulline				
MM + arginine (control)				

CONCLUSION

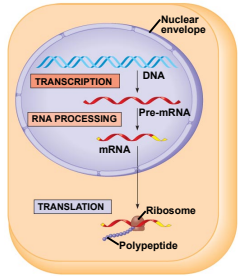
	Wild type	Class I mutants (mutation in gene A)	Class II mutants (mutation in gene B)	Class III mutants (mutation in gene C)
Gene A	Precursor Enzyme A	Precursor Enzyme A	Precursor Enzyme A	Precursor Enzyme A
Gene B	Ornithine Enzyme B	Ornithine Enzyme B	Ornithine Enzyme B	Ornithine Enzyme B
Gene C	Citrulline Enzyme C	Citrulline Enzyme C	Citrulline Enzyme C	Citrulline Enzyme C
	Arginine	Arginine	Arginine	Arginine

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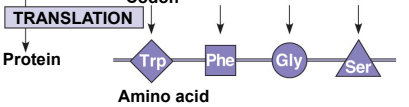
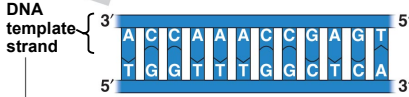
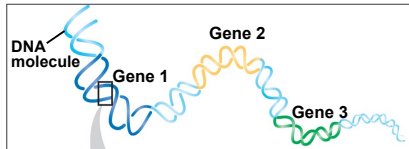
(a) Bacterial cell



(b) Eukaryotic cell

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		Second mRNA base				
		U	C	A	G	
First mRNA base (5' end of codon)	U	UUU Phe	UUC Phe	UAU Tyr	UGU Cys	U
	C	UUA Leu	UUG Leu	UAC Ser	UGC Cys	C
	A	CUU Leu	CUC Leu	CAU His	CGU Arg	A
	G	CUA Leu	CUG Leu	CAA Gln	CGG Arg	G
Second mRNA base (3' end of codon)	U	AUU Ile	AUC Ile	AAU Asn	AGU Ser	U
	C	AUA Ile	AUG Met or start	AAA Lys	AGA Arg	C
	A	GUU Val	GUC Val	GAU Asp	GGU Gly	A
	G	GUA Val	GUG Val	GAA Glu	GGA Gly	G

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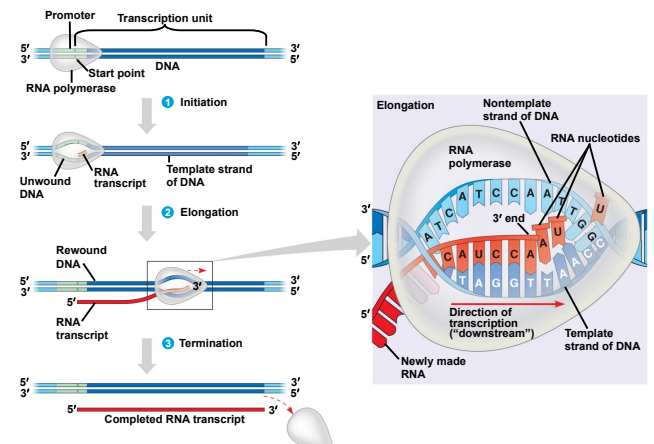
(a) Tobacco plant expressing a firefly gene



(b) Pig expressing a jellyfish gene

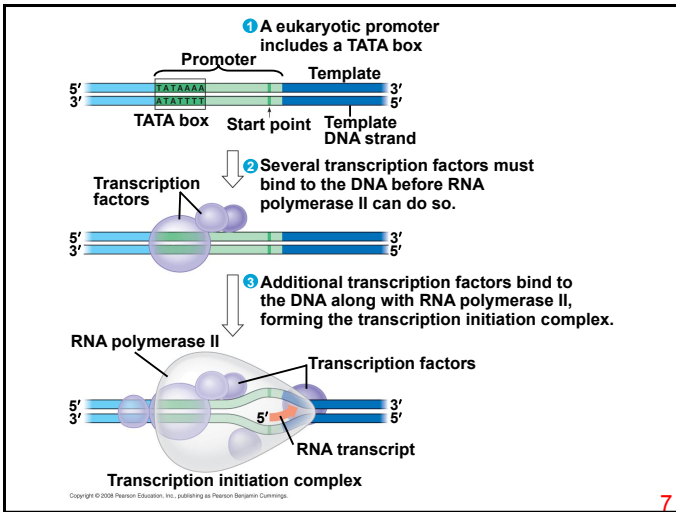
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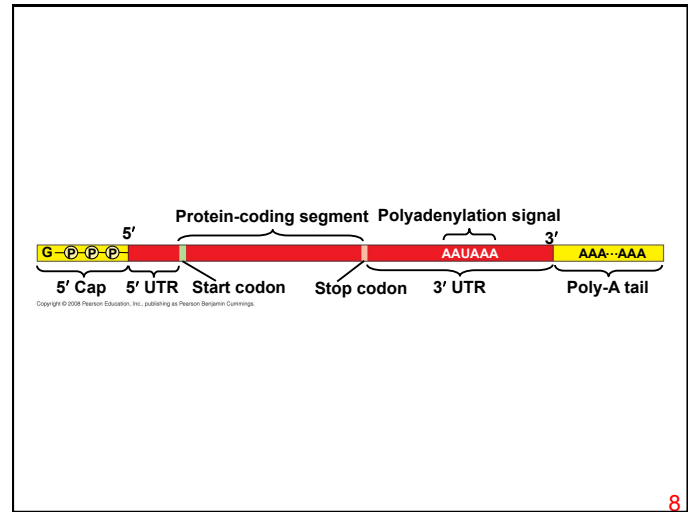


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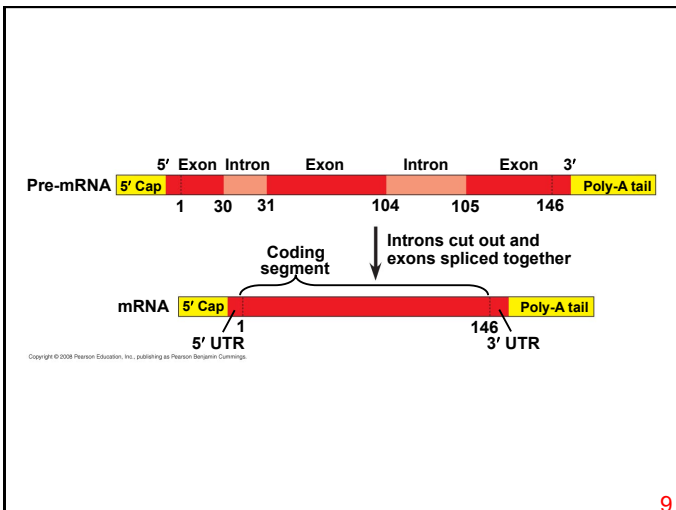
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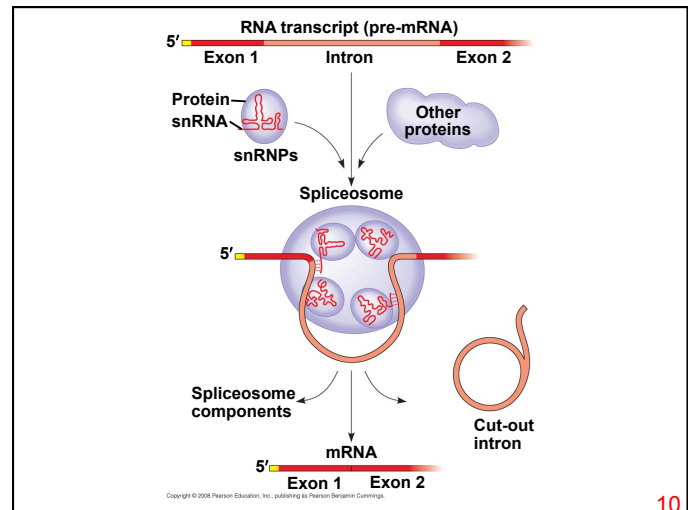
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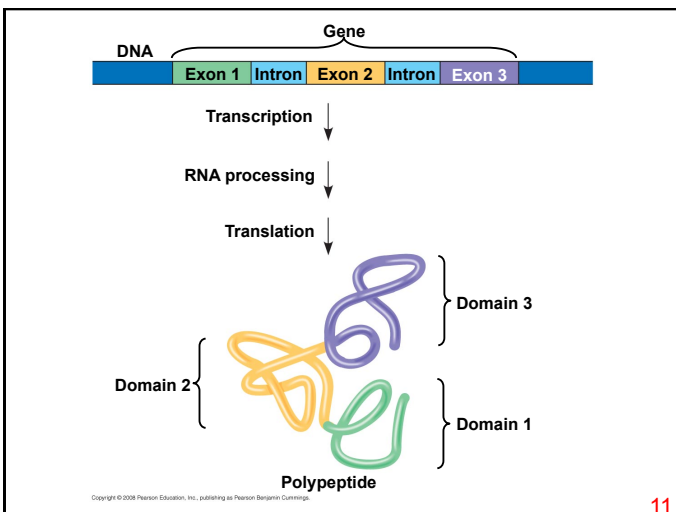
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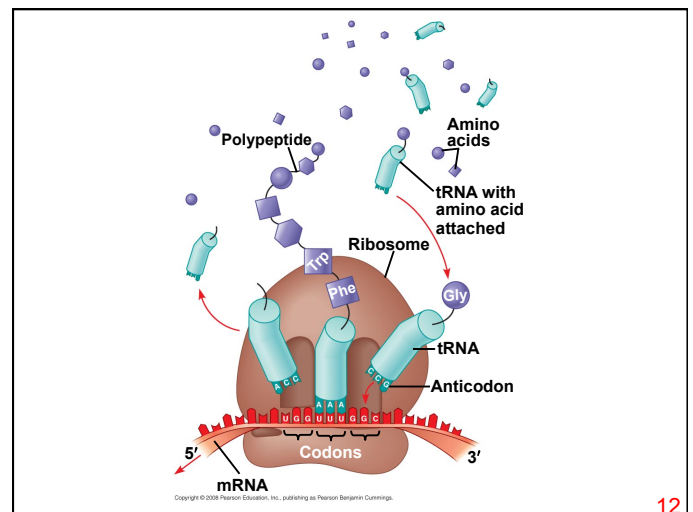
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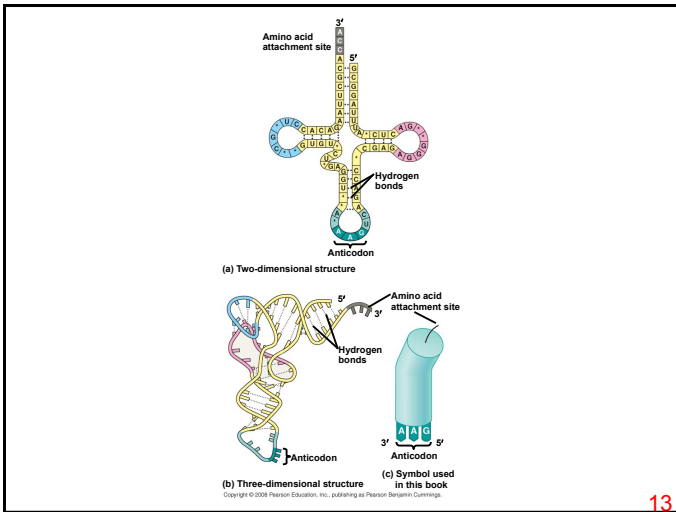
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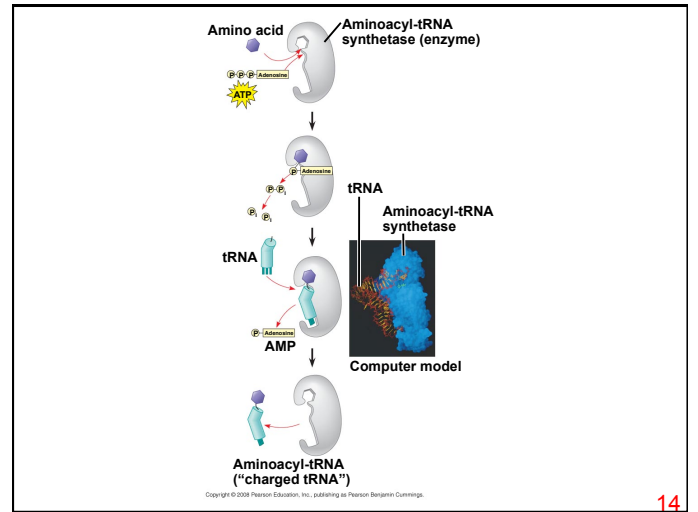
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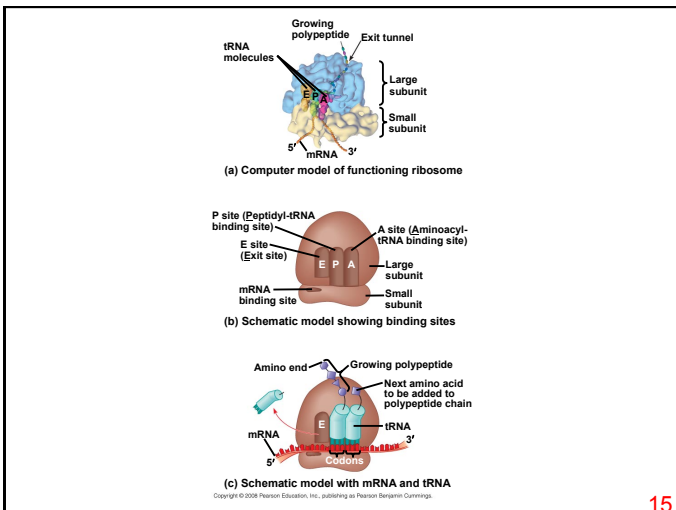
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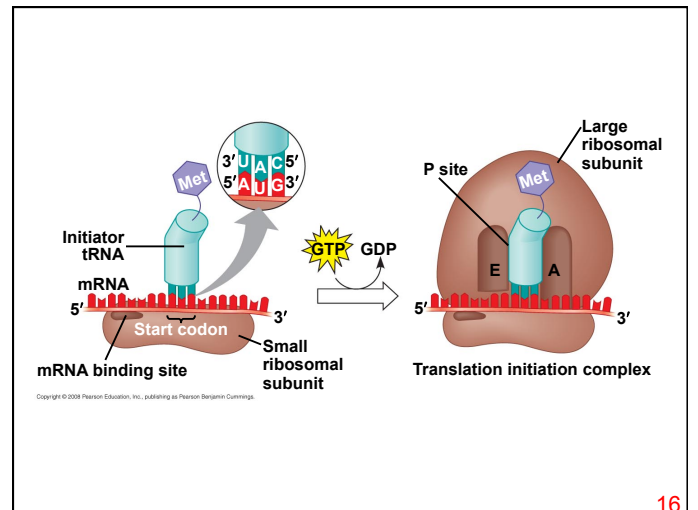
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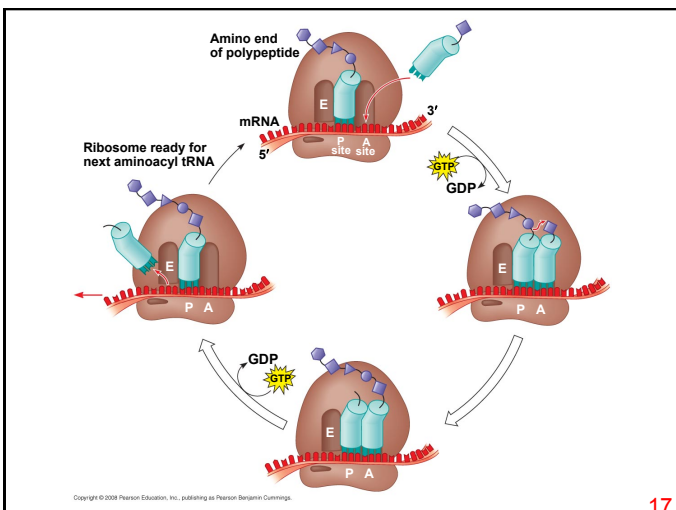
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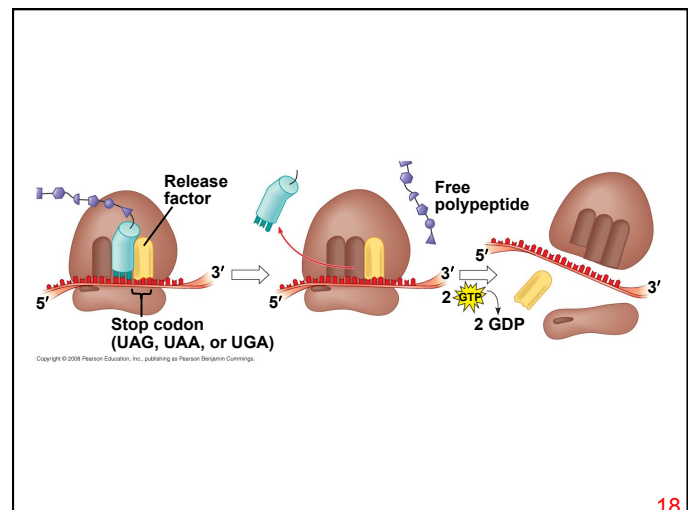
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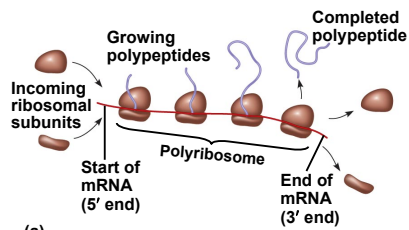
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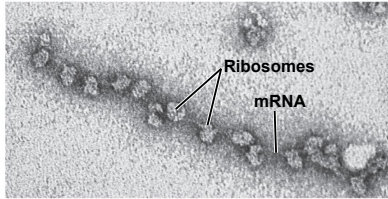
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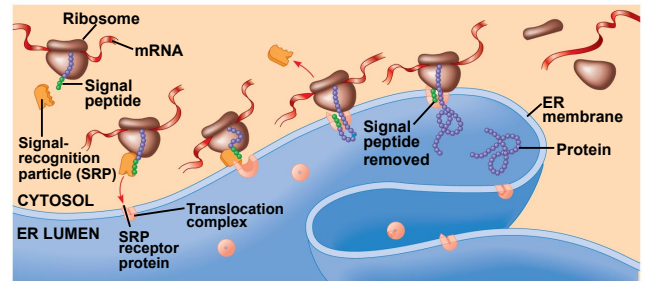
(a)



(b)

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Wild-type hemoglobin DNA

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

mRNA

5' G A A 3'

Normal hemoglobin



Mutant hemoglobin DNA

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

mRNA

5' G U A 3'

Sickle-cell hemoglobin



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Wild-type

DNA template strand 3' T A C T T C A A A C C G A T 5'
mRNA 5' A U G A A G U U G G C U A A 3'
Protein Met Lys Phe Gly Stop
Amino end Carboxyl end

A instead of G

3' T A C T T C A A A C C G A T 5'
5' A T G A A G T T T G G T A A 3'
mRNA 5' A U G A A G U U G G C U A A 3'
Protein Met Lys Phe Gly Stop
Silent (no effect on amino acid sequence)

Extra A

3' T A C T T C A A A C C G A 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 G G C U A A 3'
Protein Met Stop
Frameshift causing immediate nonsense (1 base-pair insertion)

T instead of C

3' T A C T T C A A A C C G A 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 G G C U A A 3'
Protein Met Lys Phe Ser Stop
Missense

A missing

3' T A C T T C A A A C C G A 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 G G C U A A 3'
Protein Met Lys Phe ...
Frameshift causing extensive missense (1 base-pair deletion)

A instead of T

3' T A C T T C A A A C C G A 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 G G C U A A 3'
Protein Met Stop
Nonsense

T T G missing

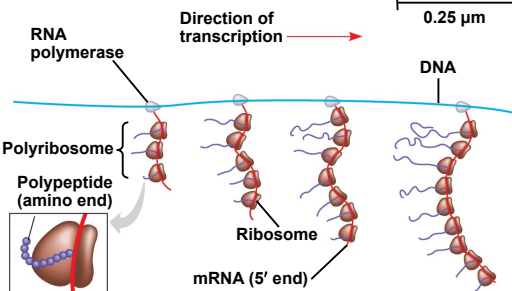
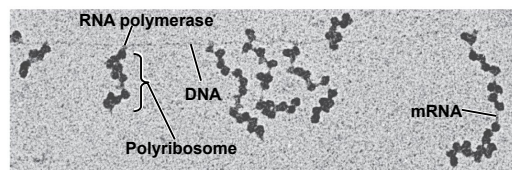
3' T A C T T C A A A C C G A T 5'
5' A T G A A G T T T G G C T A A 3'
mRNA 5' A U G U U U G G C U A A 3'
Protein Met Phe Gly Stop
No frameshift, but one amino acid missing (3 base-pair deletion)

(a) Base-pair substitution

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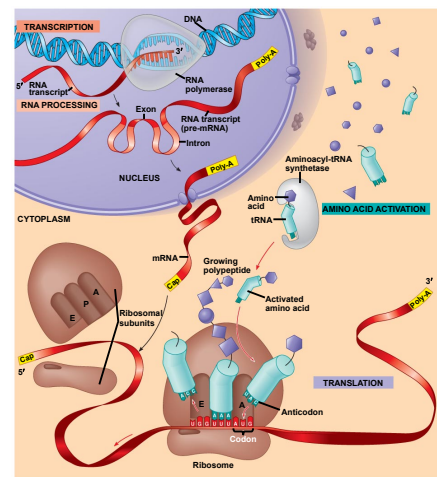
(b) Base-pair insertion or deletion

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