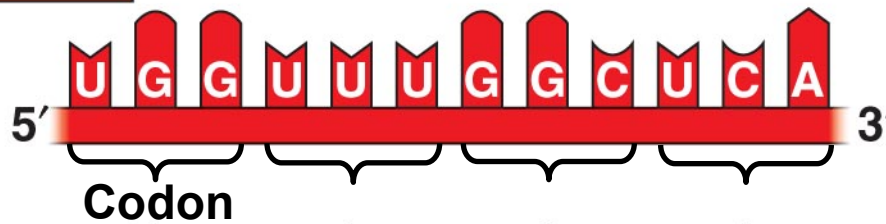


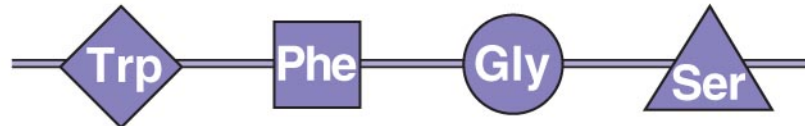
TRANSCRIPTION

mRNA



TRANSLATION

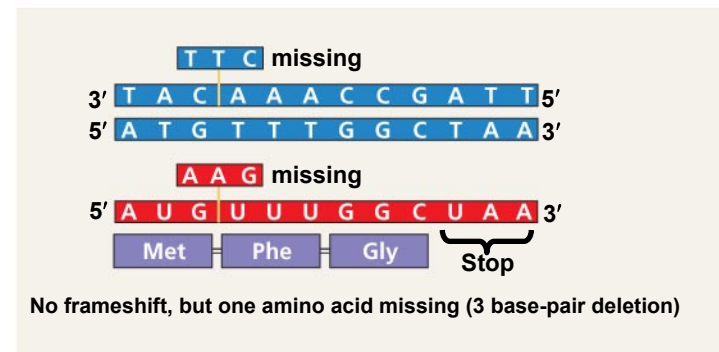
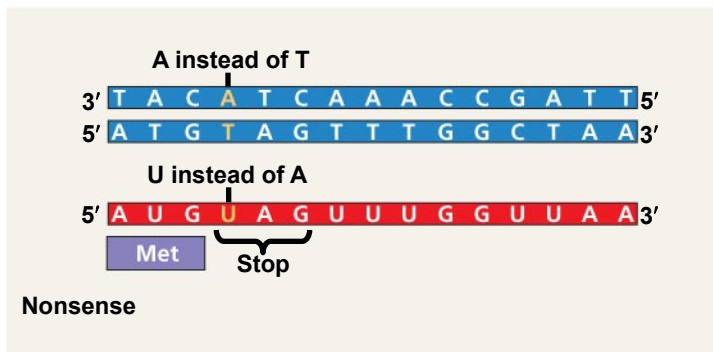
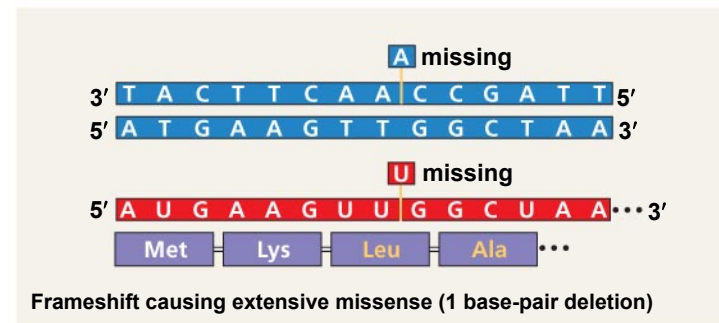
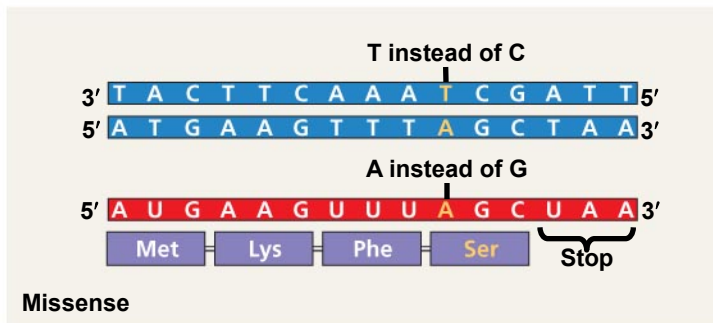
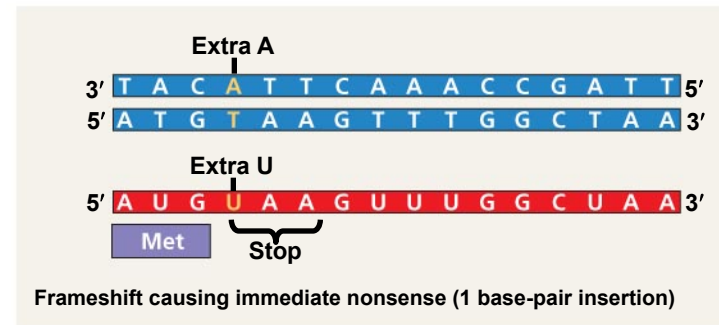
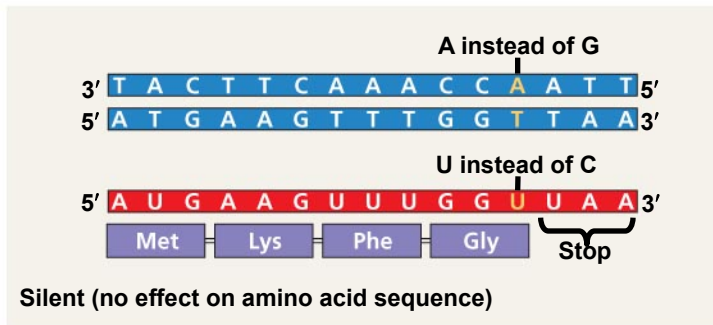
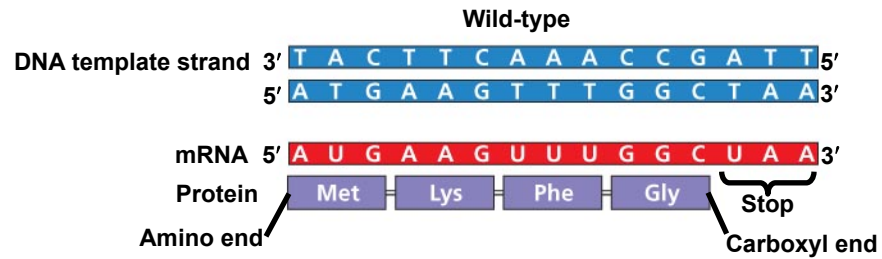
Protein



Amino acid

		Second mRNA base					
		U	C	A	G		
First mRNA base (5' end of codon)	U	UUU	UCU	UAU	UGU	U	C
		UUC	UCC	UAC	UGC		
		UUA	UCA	UAA Stop	UGA Stop		
		UUG	UCG	UAG Stop	UGG Trp		
	C	CUU	CCU	CAU	CGU	U	C
		CUC	CCC	CAC	CGC		
		CUA	CCA	CAA	CGA		
		CUG	CCG	CAG	CGG		
	A	AUU	ACU	AAU	AGU	U	C
		AUC	ACC	AAC	AGC		
		AUA	ACA	AAA	AGA		
		AUG Met or start	ACG	AAG	AGG		
	G	GUU	GCU	GAU	GGU	U	C
		GUC	GCC	GAC	GGC		
		GUA	GCA	GAA	GGA		
		GUG	GCG	GAG	GGG		
						Third mRNA base (3' end of codon)	

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(a) Base-pair substitution

(b) Base-pair insertion or deletion

Wild-type hemoglobin DNA



mRNA



Normal hemoglobin



Mutant hemoglobin DNA



mRNA



Sickle-cell hemoglobin



