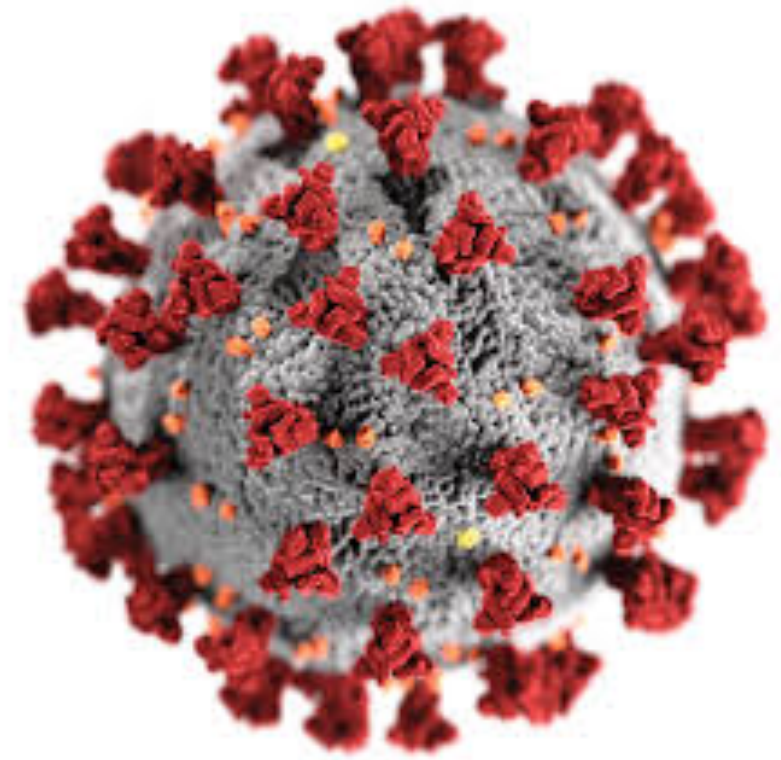


QUIZ SESSION 2

*DNA replication,
transcription and
translation*

*DNA mutations and their
outcome (lessons 10-13)*



Quiz #1 – DNA replication (lesson 10)

Which of the following statements about DNA replication is/are true or false?

a) The two DNA strand must unwind

TRUE (the enzyme helicase must separate the two DNA strands for replication to occur– slide 6)

b) The DNA replication is conservative

FALSE (the DNA replication is semiconservative because, although 2 DNA molecules are produced, each contains **one original strand** and **one newly-synthesized strand** - slides 4 and 8)

c) Each template strand is read 3'-5'

TRUE (DNA polymerases can only move in the 3' to 5' direction – slide 7)

d) The new strand is made 3'-5'

FALSE (the new strand is made in the 5'-3' direction - slide 8)

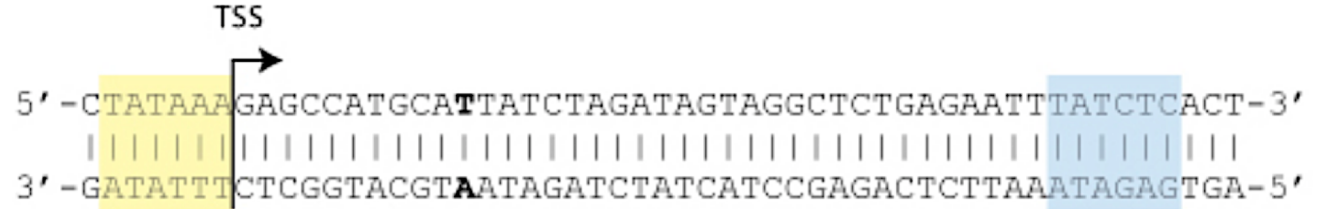
e) The template and the newly synthesized strand of the DNA duplex are complementary and antiparallel

TRUE

f) The 3' end of the newly synthesized strand could be the receiving end for a further potentially incoming base

TRUE

Quiz #2



Here is the double-stranded DNA sequence of part of a hypothetical yeast genome, which happens to contain a very small gene. Transcription starts at the **Transcription Start Site (TSS)**, and proceeds in the direction of the arrow. Transcription stops at the end of the **Transcription Terminator** (shown in blue)

Q1. What is the template strand?

A1. **The bottom strand** (this is DNA transcription, not replication! Only 1 strand is used, the bottom strand - lesson 11, slide 2)

Q2. In which direction the corresponding mRNA is transcribed?

A2. **In the 5'-3' direction** (this is DNA transcription, not replication! – slides 3 and 4)

Q3. What is the sequence of the **mRNA** produced from this gene? Label the 5' and 3' ends

A3. **5'GAGCCAUGCAUUAUCUAGAUAGUAGGCUCUGAGAAUUUAUCUC3'** (the same of the non-template strand, yet with U in place of T! – slide 6)

Q4. What is the sequence of the protein produced from the mRNA in Q3? Label the N and C termini

A4. **N-Met-His-Tyr-Leu-Asp-Ser-Arg-Leu-C** (identify the start and stop codon! Lesson 12, slides 8 and 9)

Q4. If a mutation were found where a T/A (top/bottom) base pair were added immediately after the T/A base pair shown in bold, what would be the sequence of the mRNA? What would be the sequence of the protein?

A4. **5'GAGCCAUGCAUUAUCUAGAUAGUAGGCUCUGAGAAUUUAUCUC3'**
N-Met-His-Leu-Ser-Arg-C

		Second Letter				
		U	C	A	G	
1st letter	U	UUU Phe UUC UUA Leu UUG	UCU UCC Ser UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	3rd letter
	C	CUU CUC Leu CUA CUG	CCU CCC Pro CCA CCG	CAU His CAC CAA Gln CAG	CGU CGC Arg CGA CGG	
	A	AUU AUC Ile AUA AUG Met	ACU ACC Thr ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	
	G	GUU GUC Val GUA GUG	GCU GCC Ala GCA GCG	GAU Asp GAC GAA Glu GAG	GGU GGC Gly GGA GGG	

Quiz #3

Q1. Which strand is used as a template for transcription, the top or the bottom?

A1. **Bottom**

Q2. What are the first 15 nucleotides of the resulting mRNA? (Indicate the 5' and 3' ends of the mRNA)

A2. **5'CUAAUUAUGUGAGAU3'**

Q3. What are the first 5 amino acids translated from the resulting mRNA? (Indicate the amino and carboxy termini of the protein)

A3. **N-Met-Leu-Tyr-Pro-Ala-C**

Q4. Do the underlined nucleotides TAA (indicated in blue) encode a stop codon for the protein? Briefly explain your answer

A4. **No. The underlined TAA is not read as TAA because of the reading frame. The sequence GATAAT forms the codons: GAU AAU**

Here is a double-stranded bacterial (*E. coli*) DNA sequence coding for a hypothetical protein. Both strands are shown. The nucleotides are numbered 1 to 100

```

1           20           40
5' -GTGTCCGTCTAAATATTGTGAGATGTTATATTCCCGCCGTCAACACCATCAA-3'
-----+-----+-----+-----+-----+
3' -CACAGGCAGATTATAACACTCTACAATATAGGGCGGCAGTTGTGGTAGTT-5'

           60           80           100
5' -ACAGGATAATCGCCTGCTGGGGCAAAGGCGGTGAAGGTAAAGGTGTTGCC-3'
-----+-----+-----+-----+
3' -TGTCCTATTAGCGGACGACCCCGTTTCCGCCACTTCCATTTCCACAACGG-5'
  
```

NOTE: For this problem, **transcription begins with and includes the red and underlined C/G (top strand/bottom strand) base pair** and **RNA polymerase proceeds from left to right along the DNA**

		Second Letter					
		U	C	A	G		
1st letter 5'	U	UUU Phe UUC UUA Leu UUG	UCU Ser UCC UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G	
	C	CUU Leu CUC CUA CUG	CCU Pro CCC CCA CCG	CAU His CAC CAA Gln CAG	CGU Arg CGC CGA CGG	U C A G	
	A	AUU Ile AUC AUA AUG Met	ACU Thr ACC ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G	
	G	GUU Val GUC GUA GUG	GCU Ala GCC GCA GCG	GAU Asp GAC GAA Glu GAG	GGU Gly GGC GGA GGG	U C A G	
						3rd letter 3'	

Quiz #3 - ctd

Consider the situations in Q5-Q7 independently

Q5. A mutation occurs which results in **the insertion of an extra G/C (top strand/bottom strand) base-pair immediately after base pair 11 (shown in bold)**. What effect will this insertion mutation have on the mRNA transcript and resulting protein? Elaborate your answer

A5. **The mRNA will be longer by one nucleotide, but because the insertion is prior to the start codon, the protein is unchanged**

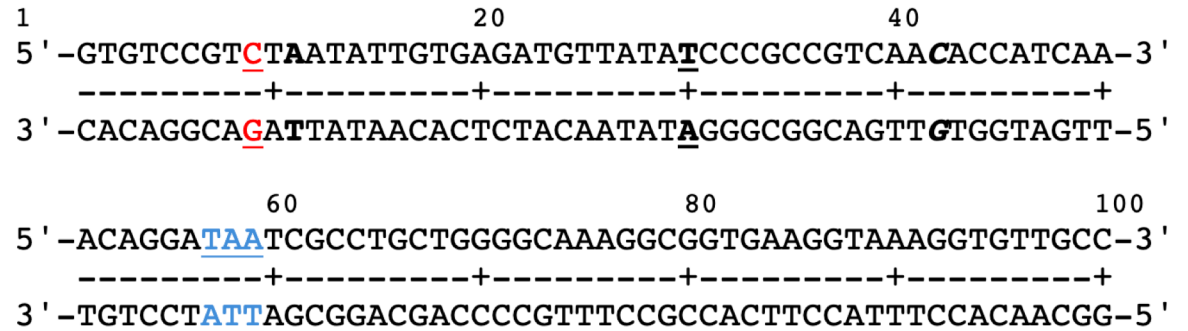
Q6. A different mutation results in the **substitution of the T/A base pair at position 30 (shown in bold and underlined) with a G/C base pair**. How would this mutation affect the sequence of the protein that is produced? Elaborate your answer

A6. **The codon UAU encoded Tyr, but now it is UAG, a stop codon. The protein is truncated**

Q7. A third mutation occurs which results in **the substitution of the C/G base pair at position 42 (shown in bold italics) to a T/A base pair**. How would this mutation affect the sequence of the protein that is produced? Elaborate your answer

A7. **The codon AAC which encoded Asn, now is AAU, which also encodes Asn. The protein is unchanged**

Here is a double-stranded bacterial (*E. coli*) DNA sequence coding for a hypothetical protein. Both strands are shown. The nucleotides are numbered 1 to 100.



NOTE: For this problem, **transcription begins with and includes the red and underlined C/G (top strand/bottom strand) base pair** and **RNA polymerase proceeds from left to right along the DNA**

		Second Letter					
		U	C	A	G		
1st letter 5'	U	UUU Phe UUC UUA Leu UUG	UCU Ser UCC UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G	
	C	CUU Leu CUC CUA CUG	CCU Pro CCC CCA CCG	CAU His CAC CAA Gln CAG	CGU Arg CGC CGA CGG	U C A G	
	A	AUU Ile AUC AUA AUG Met	ACU Thr ACC ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G	
	G	GUU Val GUC GUA GUG	GCU Ala GCC GCA GCG	GAU Asp GAC GAA Glu GAG	GGU Gly GGC GGA GGG	U C A G	
						3rd letter 3'	