

SOLUTION KEY- SECTION 6

Questions

1. Say you wanted to replicate the following piece of DNA:

5' -GTACGTTTACGCCGTATATATCGTCGTAATGCTACGTAGCTCTACGAACA-3'
3' -CATGCAAATGCGGCATATATAGCAGCATTACGATGCATCGAGATGCTTGT-5'

a) Design a 10-bp-long primer you would use to generate a new copy of the entire bottom strand of DNA. Label the 5' and 3' ends of the primer.

5'-TGTTTCGTAGA-3' (replace Ts by Us)

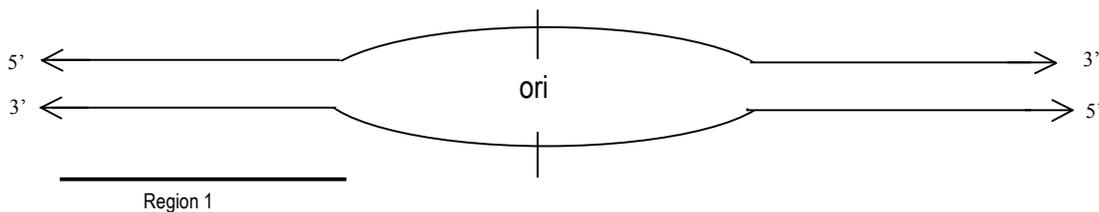
b) In what direction does the **new strand** of DNA get synthesized? 5'→3'

c) In what direction is the **template strand** for DNA synthesis read? 3'→5'

d) In the cell during DNA replication, the cell is not heated up each time to denature the original duplex. How does the cell separate the two strands of its double-stranded DNA during DNA replication?

In a cell, the two strands of the DNA duplex are separated by the action of helicase enzyme and stabilized by single stranded DNA binding proteins.

2. Consider the following segment of the DNA that is a part of a much larger molecule constituting a chromosome. The sequence of region 1 is shown below.



Region 1: 5' ...ATTCGTACGATCGACTGACTGACAGTC...3'
 3' ...TAAGCATGCTAGCTGACTGACTGTCAG...5'

a) If we assume that a fragment of the lagging strand is made from region 1, what will be its sequence? Label the 5' and the 3' ends.

5' ...ATTCGTACGATCGACTGACTGACAGTC...3'

b) Why is DNA synthesis continuous at one strand and discontinuous at the other strand?

This is because the two strands of DNA duplex are anti-parallel but the replication always occurs in a 5'→3'. Accordingly, the synthesis is continuous at one strand and discontinuous at the other strand.

c) State the three major processes of DNA repair, which you were introduced to in 7.013 lecture.

- 3'→5' exonuclease activity of DNA polymerase,
- excision repair and
- mismatch repair mechanisms.

3. The following is a partial sequence from the hypothetical gene, gene X. The boxed region is the promoter, and the direction of transcription is indicated by the arrow. Transcription begins at and includes the first G/C base pair after the box.

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5' ATCAGACAACGTCTCATGGGAGTACTTGGATGGAAGAGTAGAAGGTCATGACCAACCTCTTCCAATCCAACCACAAACAG
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3' TAGTCTGTTGCAGAGTACCCTCATGAACCTACCTTCTCATCTTCAGTACTGGTTGGAGAAGGTTAGGTTGGTGTGTTGTC

5' AAAATCAGCCAATATGTCCGACTTCGAGAACAAGAACCCCAACAACGTCCTTGGCGGACACAAGGCCACCCTTCACAACC
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3' TTTTAGTCGGTTATACAGGCTGAAGCTCTTGTCTTGGGGTTGTTGCAGGAACCGCCTGTGTTCCGGTGGGAAGTGTG

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What are the first 10 nucleotides of the mRNA produced from gene X?
In the sequence above the top strand is the template strand for transcription that always proceeds in a 5'→3' direction. Therefore the first 10 nucleotides of the mRNA will be 5'CUUCCAUCCA3'.

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