LECTURE 18 – DNA Replication

QUESTIONS TO TRY FOR PRACTICE

1) Watson and Crick elucidated the structure of DNA in 1953. Their research built on and helped explain the findings of other scientists, including
A) X-ray diffraction studies by Rosalind Franklin and Maurice Wilkins.
B) Chargaff's rules: C = G and T = A.
C) Scientists who recognized that a nucleotide consisted of a sugar, a phosphate, and a nitrogen-containing base.
D) All of the above were important considerations in the elucidation of the structure of DNA.

2) How does the simple primary and secondary structure of DNA hold the information needed to code for the many features of multicellular organisms?
A) The hydrogen bonding among backbone constituents carries coded information.
B) The base sequence of DNA carries all the information needed to code for proteins.
C) The covalent bonding among backbone constituents contains the information that is passed from generation to generation.
D) The amino acids that make up the DNA molecule contain the information needed to make cellular proteins.

3) The fact that within a double-stranded DNA molecule, adenine forms two hydrogen bonds with thymine and cytosine forms three hydrogen bonds with guanine is known as
A) semi-conservative replication.
B) complementary base pairing.
C) secondary structure of a DNA molecule.
D) a double helix.

4) Semiconservative replication involves a template. What is the template?
A) single-stranded binding proteins
B) DNA polymerase contains the template needed
C) one strand of the DNA molecule
D) an RNA molecule

5) DNA is synthesized through a process known as
A) semiconservative replication.
B) conservative replication.
C) dispersive replication.
D) transcription.

6) In the polymerization of DNA, a phosphodiester bond is formed between a phosphate group of the nucleotide being added and _____ of the last nucleotide in the polymer.
A) ATP
B) C_6
C) the 3′ OH
D) a nitrogen from the nitrogen-containing base

7) At a specific area of a chromosome, the following sequence of nucleotides is present where the chain opens to form a replication fork:
3' C C T A G G C T G C A A T C C 5'

An RNA primer is formed starting at the underlined T (T) of the template. Which of the following represents the primer sequence?
A) 5' G C C T A G G 3'
B) 3' G C C T A G G 5'
C) 5' A C G T T A G G 3'
D) 5' A C G U U A G G 3'
E) 5' G C C U A G G 3'

8) What provides the energy for the polymerization reactions in DNA synthesis?
A) ATP
B) DNA polymerase
C) breaking the hydrogen bonds between complementary DNA strands
D) the deoxyribonucleotide triphosphate substrates

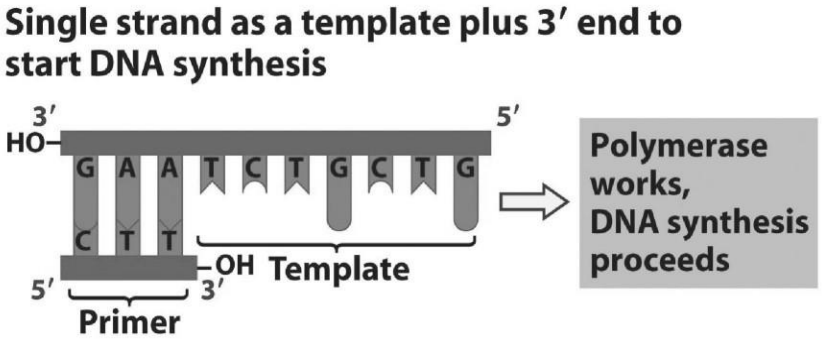

Figure 15.1

9) Refer to Figure 15.1. What bases will be added to the primer as DNA replication proceeds? The bases should appear in the order that they will be added.
A) C, A, G, C, A, G, A
B) T, C, T, G, C, T, G
C) A, G, A, C, G, A, C
D) U, G, U, C, G, U, C

10) Put the following steps of DNA replication in chronological order.
1. Single-stranded binding proteins attach to DNA strands.
2. Hydrogen bonds between base pairs of antiparallel strands are broken.
3. Primase binds to the site of origin.
4. DNA polymerase binds to the template strand.
5. An RNA primer is created.

A) 1, 2, 3, 4, 5
B) 2, 1, 3, 5, 4
C) 3, 2, 1, 5, 4
D) 1, 2, 3, 4, 4

11) What is the difference between the leading strand and the lagging strand in DNA replication?
A) The leading strand is synthesized in the 3′→ 5′ direction in a discontinuous fashion, while the lagging strand is synthesized in the 5′→ 3′ direction in a continuous fashion.
B) The leading strand requires an RNA primer, whereas the lagging strand does not.
C) The leading strand is synthesized continuously in the 5′→ 3′ direction, while the lagging strand is synthesized discontinuously in the 5′→ 3′ direction.
D) There are different DNA polymerases involved in elongation of the leading strand and the lagging strand.

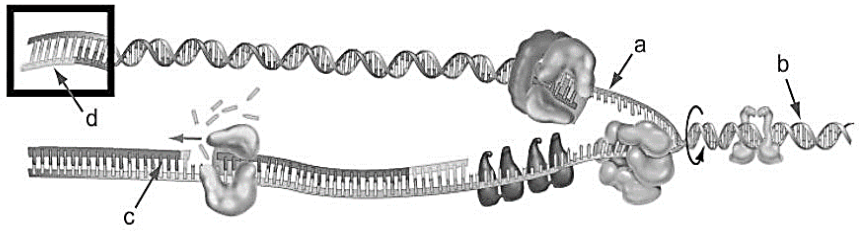

Figure 15.2

12) Identify the lagging strand in Figure 15.2.
A) a
B) b
C) c
D) d

13) In Figure 15.2, which is the template strand?
A) a
B) b
C) c
D) d

14) What can you infer from the information presented in this table?

Proteins Involved in DNA Synthesis		
Process	**Protein**	**Function**
Opening the helix	Helicase SS binding proteins Topoisomerase	Breaks hydrogen bonds between base pairs Stabilizes single-stranded DNA Breaks and rejoins DNA strand to untwist the double helix
Synthesis of leading strand	Primase DNA polymerase III Sliding clamp	Catalyzes the synthesis of the RNA primer Adds bases to the growing DNA strand Holds DNA polymerase in place during strand elongation
Synthesis of the lagging strand	Primase DNA polymerase III Sliding clamp DNA polymerase I Ligase	Catalyzes the synthesis of RNA primers Adds bases to the growing end of the Okazaki fragment Holds DNA polymerase in place during strand elongation Removes the RNA primer and replaces it with DNA Joins Okazaki fragments into a continuous strand

A) DNA polymerase I and DNA polymerase III are the same enzyme found in different organisms.
B) DNA polymerase I and DNA polymerase III have different functions.
C) The sliding clamp molecule is a ribozyme.
D) Topoisomerase is involved in proofreading activity.

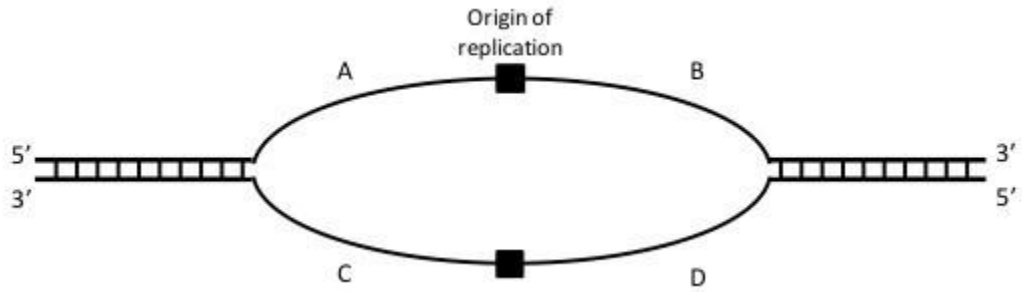

Figure 15.4

15) Where would Okazaki fragments be found in the image above? Note: The black boxes represent RNA primers and the polarities of the template strands are indicated.
A) A, B
B) C, D
C) A, C
D) B, D
E) A, D
F) B, C

16) If during the process of DNA replication, the enzyme topoisomerase was not functioning (i.e. it was mutated) what do you expect will happen to the replication process?
A) The double helix would not begin to unwind at all.
B) The double helix would begin to unwind but this unwinding would stop prematurely due to over-twisting of the DNA.
C) The double helix would unwind completely but no primers would be added to the template strand.
D) The double helix would unwind completely but no new strand would be created due to the formation of secondary structures.

17) Which of the following agents can cause mutations in DNA?
A) aflatoxins that are found in moldy grains
B) free radicals that are formed as by-products of aerobic respiration
C) ultraviolet radiation from sunlight
D) All of the above are mutagenic agents.

18) Which one of the following is least likely to cause mutations in DNA?
A) aflatoxins that are found in mouldy grains
B) hydroxyl radicals formed as by-products of aerobic respiration
C) ultraviolet radiation from sunlight
D) light from an incandescent bulb
E) medical X-rays to detect broken bones