

Name: _____

DNA Replication Quest

Vocabulary: Matching.

Please write the letter from the explanation or definition on the right on the line next to the word on the left

- | | | |
|-------|---|---|
| _____ | 1. Okazaki fragment M | a. Cells grown in culture stop dividing |
| _____ | 2. Leading strand B | b. new strand made continuously |
| _____ | 3. Telomerase L | c. new strand made in short pieces |
| _____ | 4. DNA Polymerase I I | d. uses ATP to join the ends of two DNA strands |
| _____ | 5. Primase G | e. Special structure at the ends of linear eukaryotic chromosomes |
| _____ | 6. Single-strand Binding Protein K | f. enzyme that opens or "unzips" DNA |
| _____ | 7. Helicase F | g. lays down a short RNA complementary to the DNA |
| _____ | 8. Lagging strand C | h. site where replication begins |
| _____ | 9. Origin of replication H | i. replaces RNA primer with DNA |
| _____ | 10. Telomere E | j. fragments of new DNA about 200 bases long |
| _____ | 11. DNA Polymerase III O | k. "covers up" exposed single strands of DNA |
| _____ | 12. Primer M | l. RNA and Protein-based machine that maintains the ends of chromosomes |
| _____ | 13. Ligase D | m. short RNA needed to begin DNA synthesis |
| _____ | 14. Template N | n. complementary to newly synthesized DNA |
| _____ | 15. Hayflick limit A | o. Does the major work making new DNA |

Multiple Choice: choose the best answer

16. Assume that a short stretch of the **template** strand being replicated has the sequence 5'-ATGT-3'. What would be the sequence of the newly made strand paired with that?

- C**
- | | |
|---------------|---------------|
| a. 5'-ATGT-3' | c. 5'-ACAT-3' |
| b. 5'-TGTA-3' | d. 5'-TACA-3' |

17. An inherited disease Dyskeratosis congenita results in problems with skin and blood cells made in bone marrow. Cells taken from patients with this disease hit the "Hayflick Limit" sooner and have shorter chromosomes than expected. This mutation could affect:

- B**
- | | |
|---------------------|------------|
| a. DNA Polymerase I | c. Primase |
| b. Telomerase | d. Ligase |

18. A temperature-sensitive mutation in bacteria fails to complete DNA replication when shifted to high temperature (42°C). You examine the DNA more closely and find that new Okazaki fragments fail to initiate and long stretches of single-stranded template are exposed. This is likely a mutation in

- C**
- | | |
|---------------------|------------|
| a. DNA Polymerase I | c. Primase |
| b. Telomerase | d. Ligase |

19. Bacterial replication and eukaryotic DNA replication are similar in many ways. However, bacteria do *not* have telomerase. The reason for this difference is
- A a. bacteria have a circular chromosome either to the 5' or 3' end d. only eukaryotes make Okazaki fragments
- b. bacterial DNA polymerase can add c. bacterial DNA polymerases do not require RNA primers
20. Somatic (body) cells of fruit flies have 8 chromosomes (4 pairs). Following mitosis, how many chromosomes will each new cells have?
- A a. 8 b. 4 c. 16 d. 23
21. How many chromosomes will a fruit fly gamete have following meiosis?
- B a. 8 b. 4 c. 16 d. 23
22. Which of the following is a *difference* between meiosis and mitosis
- D a. only mitosis uses microtubules to move chromosomes
- b. only mitosis has the typical phases, such as metaphases
- c. sister chromatids do not pair in meiosis
- d. homologous chromosomes only pair in meiosis
23. There is a famous quote from the 1953 Watson and Crick paper on the structure of DNA in which they say that "It has not escaped our notice that the...we have postulated immediately suggests a possible copying mechanism for the genetic material." What key detail were they referring to?
- B a. that DNA is helical
- b. that base-pair rules mean one strand tells you what the other should be
- c. that polymerase reading one strand can make an exact copy of that template
- d. that the anti-parallel structure meant DNA could be replicated in both directions
24. There are mutations that lead to an increase in the frequency of new mutations. Newly replicated DNA contains more errors than it normally would. Mutations to the gene for which protein is most likely to cause more errors to occur?
- A a. DNA polymerase c. primase
- b. helicase d. "gyrase"
25. In one Christmas episode of Phineas and Ferb, Santa manages to give Dr. Doofenshmirtz the gift he always wanted for Christmas. What was it?
- B a. a "figgy pudding" c. a naughty-inator to make everyone naughty
- b. the ability to hate Christmas d. an evil reindeer
-

Free response

1. (5—no need to fill the page) There are several "quirks" of DNA replication that all are due to the specific chemistry of DNA polymerases (consider terms 1; 5; 8; and 12 from the matching column, for example). All known DNA polymerases can only add an incoming deoxy-NTP to the 3' OH of an existing DNA or RNA strand. Explain how this requirement explains why Okazaki fragments occur and why the enzyme "primase" is required for DNA replication.

The limitation of DNA polymerase cited means that the first base of a new strand cannot be incorporated by DNA polymerase. Since RNA polymerase can carry the initial base and incorporate it, the initiation of DNA synthesis requires a primer of RNA.

The second implication is that polymerization of DNA can only proceed in one direction 5' to 3'. Since the strands are antiparallel, one of them must be replicated in the opposite direction of overall replication-fork travel. This results in the short, discontinuous replication by Okazaki fragments.