

KEY TERMS

Match the numbered term with the definition that fits it best. Put the corresponding number in front of the appropriate definition.

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|------------------------|-----------------------|---------------------|
| 1. genes | 10. complementary | 19. replisome |
| 2. transformation | 11. semiconservative | 20. replicon |
| 3. bacteriophages | 12. primer | 21. supercoiling |
| 4. purine | 13. endonuclease | 22. excision repair |
| 5. pyrimidine | 14. exonuclease | 23. thymine dimer |
| 6. nucleic acid | 15. leading strand | 24. telomerase |
| 7. nucleotide | 16. lagging strand | 25. processivity |
| 8. phosphodiester bond | 17. Okazaki fragments | 26. telomeres |
| 9. Chargaff's rules | 18. replication fork | 27. mutagen |

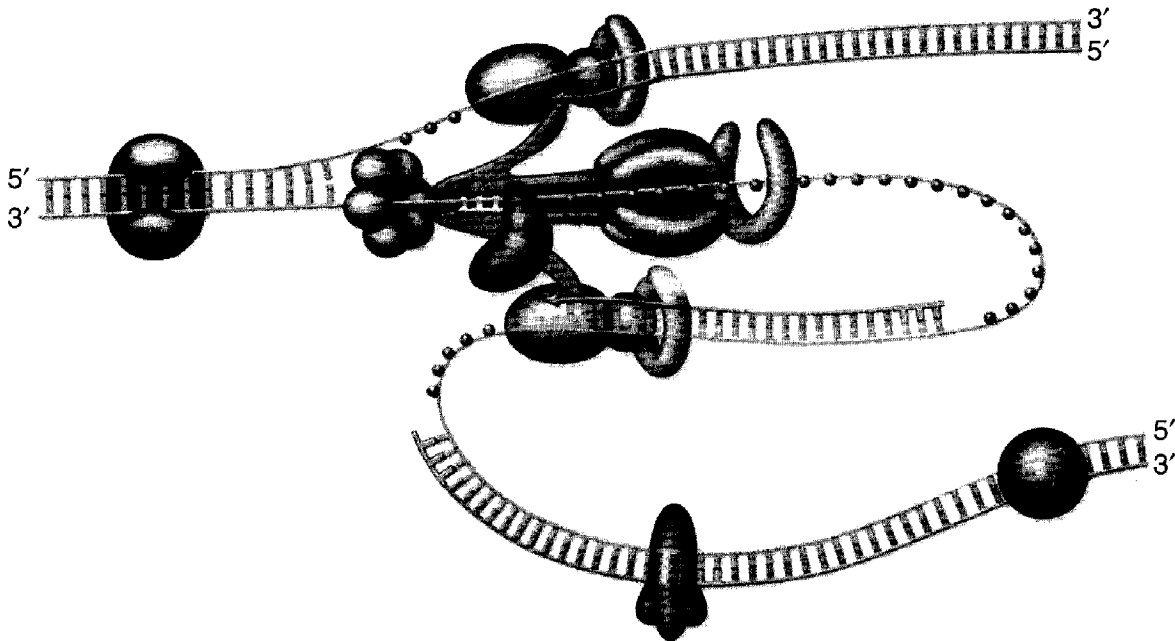
- a. ____ The ability of a polymerase to remain attached to a template, primarily due to the action of the β subunit.
- b. ____ The partial unwinding of a DNA double helix to form two single stands where the replisome is formed.
- c. ____ Short sections of DNA synthesized discontinuously and then ligated together.
- d. ____ The proportion of adenine always equals thymine; the proportion of guanine always equals cytosine.
- e. ____ The DNA strand on which replication occurs continuously from one initial primer.
- f. ____ An enzyme that synthesizes the ends of chromosomes using an internal RNA template.
- g. ____ Viruses that infect bacteria consisting of genetic material that is surrounded by a protein coat.
- h. ____ Each strand of a DNA molecule can be used to specify the other by base-pairing.
- i. ____ Any agent that increases the number of mutations above background levels.
- j. ____ The covalent linkage between two adjacent thymine bases in the DNA caused by UV radiation.
- k. ____ A single-ringed nitrogenous base, such as thymine or cytosine in DNA, or uracil or cytosine in RNA.
- l. ____ The topological state of the DNA that determines how the double helix coils in space.
- m. ____ A nonspecific form of repair in which a damaged region in the DNA is removed and replaced by DNA synthesis.
- n. ____ Enzymes that can chew away at an end of a DNA molecule.
- o. ____ A subunit of DNA consisting of a five-carbon sugar, a PO_4 group, a nitrogenous base.
- p. ____ A model for DNA replication in which one strand of a parental duplex remains intact in the daughter strands.
- q. ____ The DNA strand where replication occurs discontinuously and requires multiple priming events.
- r. ____ Specialized structures that protect the ends of eukaryotic chromosomes from nucleases.
- s. ____ A transfer of virulence from one cell to another that was described in the experiments by Frederick Griffith.
- t. ____ A white, slightly acidic material extracted from nuclei, discovered by Miescher, known as DNA or RNA today.
- u. ____ A two-ringed nitrogenous base, such as adenine or guanine.
- v. ____ Enzymes that can break phosphodiester bonds between nucleotides internally.
- w. ____ A single functional unit consisting of the complete chromosome plus the origin in prokaryotes.
- x. ____ Functional units of DNA that contain the information to specify traits and are located on chromosomes.
- y. ____ Linkage of a phosphate group to two sugars by means of a pair of ester bonds allowing DNA to form long chains.
- z. ____ A multiprotein complex containing a primosome and two DNA pol III enzymes capable of DNA replication.
- aa. ____ A short stretch of RNA or DNA approximately 10-20 base pairs long that anneals to the template strand.

LEARNING BY EXPERIENCE

The following two activities should be useful in understanding the concepts of this chapter.

1. Color this illustration. As you color each structure or molecule, review its function. Fill in the circle following the name of each object listed below with the color you will use on the illustration:

First subunit of DNA polymerase III Single-strand binding proteins Helicase
Primase Second subunit of DNA polymerase III RNA primer DNA ligase
Okazaki fragment DNA polymerase I



2. Using Chargaff's rules, print the base sequence of the complementary strand beneath the DNA strands shown here.

a. CATGGTA

b. TTGGCAA

c. AGCTACG

EXERCISING YOUR KNOWLEDGE

Briefly answer the following questions in the space provided.

1. In the Avery experiments, removing nearly all of the protein from the dead *S. Streptococcus* did not reduce the transforming activity. What properties of the transforming substance suggested that it was DNA?
2. How did Hershey and Chase conclude that the genetic information that bacteriophages use to infect bacteria is DNA, not protein?
3. Watson and Crick deduced the structure of DNA based on what was known from Chargaff's, and Franklin and Wilkins's experiments. What did these scientists discover and how was this interpreted in the Watson-Crick model?
4. When deoxyribose molecules bind in DNA formation, (a) what kind of reaction takes place? (b) What kind of a bond is formed? (c) Which carbons are involved in the respective molecules?
5. What is the relationship between the constant 2-nanometer diameter of DNA and the nature of base-pairing?
6. What is the evidence for the conclusion that DNA replication is semiconservative?
7. What is the role of the RNA primer in DNA replication?
8. Why does replication on the lagging strand occur away from the replication fork instead of toward it as in the leading strand?
9. Why is the single-strand binding protein needed in DNA replication?
10. What is the purpose of DNA gyrase in DNA replication?

Circle the letter of the one best answer in each of the following questions.

11. DNA pol. I, unlike the other DNA polymerases has 5' to 3' exonuclease activity that is essential during lagging strand replication to
 - a. remove damaged Okazaki fragments.
 - b. repair damaged template DNA.
 - c. degrade template DNA.
 - d. remove the RNA primers.
 - e. remove overlapping segments of Okazaki fragments.
12. The two strands of DNA found in a double helix are _____
 - a. semidiscontinuous.
 - b. antiparallel.
 - c. identical.
 - d. topoisomers.
 - e. linked by a phosphodiester bond.
13. Griffith infected mice with different strains of bacteria to demonstrate the presence of genetic material in bacteria. Which of the following best describes Griffith's explanation for one of his observations?
 - a. Dead bacteria are less lethal than live ones.
 - b. Genetic material transferred from dead type s bacteria into live type r bacteria transform them into bacteria capable of killing a mouse.
 - c. Genetic material in type s bacteria allowed them to evade the immune system.
 - d. Genetic material in type r bacteria transferred to dead type s bacteria restored their life and allowed them to kill mice again.
 - e. High levels of the heat-killed type s bacteria localize to the lungs killing the mice.

14. The fact that some viruses use DNA to direct their heredity was demonstrated by finding
 - a. radioactive sulfur from a bacteriophage in a bacterium.
 - b. radioactive phosphorus from a bacterium in a bacteriophage.
 - c. that radioactive phosphorus from a bacteriophage had mutated a bacterium.
 - d. radioactive phosphorus from a bacteriophage in a bacterium.
 - e. radioactive sulfur from a bacterium in a bacteriophage.
15. What functional group is found at the 5' end of a DNA strand?
 - a. a phosphate group
 - b. a hydroxyl group
 - c. a carbonyl group
 - d. a deoxyribose sugar
 - e. a carboxyl group
16. In a nucleic acid, the bases are always attached to the ____ carbon of the sugar.
 - a. 5'
 - b. 4'
 - c. 3'
 - d. 2'
 - e. 1'
17. In nucleic acids, the free hydroxyl group is attached to the ____ carbon of the sugar.
 - a. 5'
 - b. 4'
 - c. 3'
 - d. 2'
 - e. 1'
18. Which of the following is NOT correct concerning the initiation of bacterial replication?
 - a. It initiates at an *oriC* sequence.
 - b. Two separate replisomes are loaded at the origin.
 - c. The strands are separated at GC-rich regions.
 - d. Replication proceeds bidirectionally.
 - e. There is one unique termination site.
19. ____ is a ____ that forms ____ H⁺ bonds with _____.
 - a. Guanine, purine, 3, cytosine
 - b. Thymine, purine, 2, adenine
 - c. Adenine, purine, 3, thymine
 - d. Cytosine, pyrimidine, 2, guanine
 - e. Uracil, pyrimidine, 3, guanine
20. In the process of bonding two nucleotides, ____ is released.
 - a. a molecule of water
 - b. a phosphate group
 - c. a hydroxyl group
 - d. an oxygen molecule
 - e. a hydrogen molecule
21. What function does the β subunit of DNA polymerase III provide?
 - a. priming activity
 - b. topoisomerase activity
 - c. helicase activity
 - d. proofreading activity
 - e. clamp binding activity
22. According to Chargaff's rules, if the DNA of a species contains 20% thymine, what percent of guanine will it contain?
 - a. 80%
 - b. 30%
 - c. 60%
 - d. 20%
 - e. 40%
23. Which of the following is true of standard Watson-Crick base-pairing in a molecule of DNA?
 - a. Purines base pair with purines.
 - b. Pyrimidines base pair with pyrimidines.
 - c. Purines base pair with pyrimidines.
 - d. All bases can potentially base pair.
 - e. More than one of the above are correct.
24. Which of the following statements best describes why synthesis of the lagging strand is discontinuous?
 - a. DNA polymerase can synthesize DNA only in the 3'-5' direction.
 - b. DNA polymerase requires a primer to initiate synthesis.
 - c. DNA polymerase can synthesize DNA only in the 5'-3' direction.
 - d. DNA polymerase is not a processive enzyme.
 - e. DNA polymerase III has only 5'-3' exonuclease activity.
25. The main eukaryotic replication polymerase is a complex of two enzymes that work together known as ____ and _____.
 - a. DNA pol beta, DNA pol delta
 - b. DNA pol alpha, DNA pol beta
 - c. DNA pol beta, DNA pol epsilon
 - d. DNA pol delta, DNA pol epsilon
 - e. DNA pol alpha, DNA pol delta

26. Which of the following statements best describes why DNA replication requires a helicase enzyme?
- The newly created daughter strand needs to be wound into a double helix.
 - Separation of parental DNA strands creates positive supercoils in front of the fork.
 - Complementary strands of the parental DNA need to be separated to create new daughter strands.
 - Primers need to base-pair with the template for synthesis to begin.
 - Single-strands of DNA because hydrophobic bases are exposed to water.
27. DNA replication is called semiconservative because _____ of the original duplex appears in the new duplex.
- none
 - most
 - half
 - hardly any
 - all
28. Since the first nucleotide cannot be linked in a newly synthesized strand in DNA replication, _____ is required.
- a DNA primer
 - DNA polymerase
 - ligase
 - an RNA primer
 - helicase
29. Excision repair is considered to be a nonspecific repair pathway because
- undamaged bases on the complementary strand of DNA are removed also.
 - the bases on the complementary strand are used for resynthesis.
 - it can be carried out by replicative polymerases alone.
 - DNA replication itself activates this pathway.
 - bases surrounding the damaged base are also removed from the DNA.
30. Which of the following features of the DNA helix contribute(s) to its stability?
- hydrogen bonding between bases
 - the presence of a 3'-OH group
 - the presence of a 2'-OH group
 - proportion of the nitrogenous bases
 - phosphodiester backbone