AP Biology **Name:** **P:**

Chapter 13 Reading Guide: The Molecular Basis of Inheritance

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

1. Of all of nature's molecules, why are nucleic acids so unique?

DNA is the genetic material

2. Early in the race to identify the molecular structure of chromosomes, protein was consider a more likely candidate. Why did protein have the early advantage?

3. What was the key factor in determining the identity of DNA?
    a. What was studied that lead to early understandings of the role of DNA?

4. Read and STUDY figure 13.2.
    a. Explain what Griffith did.

    b. What did he conclude based on this experiment?

5. Define the term transformation.

6. Briefly describe what Oswald Avery did and what he concluded.

7. Give a brief account of what a virus is and how it reproduces. (HMM…would it be considered alive?)

8. What is a bacteriophage?

9. Read and STUDY figure 13.3 and 13.4.
   a. Give the details of T2. What is/was known about T2

   b. What question was the Hershey and Chase experiment designed to answer?

   c. Explain what Hershey and Chase did.

      i. If you were going to radioactively tag DNA and protein? What radioactive elements would you use for each and why?

   d. What were the results of their experiment?

   d. What did they conclude?

10. What additional evidence did Erwin Chargaff provide? BE DETAILED!

11. How does evidence from mitosis support that DNA is the genetic material? BE DETAILED!!!

12. James Watson and Francis Crick were the ones to uncover the 3-D structure of DNA. Describe how their work relied on the work of other scientists.

13. The key to the discovery of the 3-D structure was a technique called X-ray diffraction.
    a. Give a brief description of X-ray diffraction.

    b. What important information did Watson glean from his glance at photo 51 (the x-ray diffraction of DNA made by Rosalind Franklin)?

14. Where are the sugar-phosphates and the nitrogenous bases located in the double helix?
    a. From a FUNCTIONAL GROUP standpoint, why does this make sense?

15. Why are the bases paired: C-G and A-T?
    a. How does this pairing support Chargaff's rules?

Many proteins work together in DNA replication and repair

16. At the end of their paper announcing the 3-D structure of DNA, Watson and Crick indicated that the structure hints at a mechanism for making copies of DNA.
    a. Read and STUDY figure 13.9 (a BASIC concept) then use a picture with the following sequence of DNA to explain how replication occurs.

TACGGTA
ATGCCAT

17. Name and explain the three models of replication.

18. Read and STUDY figure 13.11. What did Meselson and Stahl do to identify which method of replication was correct?

19. Where does replication begin?
    a. How is the "beginning" different in prokaryotes and eukaryotes?

20. What are DNA Polymerases? What do they do?

21. Explain what nucleoside triphosphates are and why they are important.

22. What does the term "antiparallel" mean about DNA?

23. How does the antiparallel structure of the double helix affect replication? BE SPECIFIC about the structure and "sidedness" of a nucleotide.
    a. What is meant by the term "leading strand"?
    b. What is meant by the term "lagging strand"? How is this related to Okazaki fragments?

24. What is DNA ligase? What is its function?

25. What is a primer? Why is it necessary? What lays down the primer?
    a. How many primers are necessary for prokaryotic replication?
    b. How many primers are needed for the leading strand? How is it different for the lagging strand?

26. Contrast the functions of DNA polymerase I and DNA Polymerase III.

27. Many other proteins are involved in the replication of DNA. For each of the following, identify its function.
    a. Helicase

    b. topoisomerase

    c. single-stranded binding proteins

28. Read and STUDY figure 13.14, 13.15, and 13.16. Summarize the steps involved in replication (BE DETAILED and make sure that you contrast replication of the leading and lagging strands). Use a picture if helpful.

29. KNOW TABLE 16.1!!!!!

16.1a

Table 16.1 Bacterial DNA Replication Proteins and Their Functions

Protein	Function
Helicase 	Unwinds parental double helix at replication forks
Single-strand binding protein 	Binds to and stabilizes single-stranded DNA until it is used as a template
Topoisomerase 	Relieves overwinding strain ahead of replication forks by breaking, swiveling, and rejoining DNA strands
Primase 	Synthesizes an RNA primer at 5′ end of leading strand and at 5′ end of each Okazaki fragment of lagging strand

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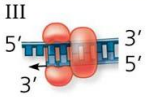
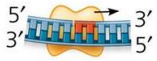
16.1b

Table 16.1 Bacterial DNA Replication Proteins and Their Functions

Protein	Function
DNA pol III 	Using parental DNA as a template, synthesizes new DNA strand by adding nucleotides to an RNA primer or a pre-existing DNA strand
DNA pol I 	Removes RNA nucleotides of primer from 5′ end and replaces them with DNA nucleotides
DNA ligase 	Joins Okazaki fragments of lagging strand; on leading strand, joins 3′ end of DNA that replaces primer to rest of leading strand DNA

30. What is the “replication machine”?
    a. How does it remain stationary during replication?

31. If the error rate during replication is 1 in 100,000 base pairs why aren’t there more errors in the final copy of DNA?

32. How is DNA proofread and repaired? BE DETAILED!!!!
    a. What is “mismatch” repair?
    b. What is a “nuclease”?

33. What is “excision repair”?

34. Explain how excision repair is used in your skin cells and what happens to someone with xeroderma pigmentosum.

35. Why do linear DNA molecules have problems replicating the ends of their DNA? What is the consequence of this problem?

36. What is a telomere? What is its function?
    a. How may this be related to aging?
    b. How can it possibly protect from cancer?

37. How does the telomeric DNA of an older individual compare to that of a younger individual?

38. How is the telomere of chromosomes protected in germ cells?

A chromosome consists of a DNA molecule packed together with proteins

39. What is the average “base-pair” length of a single human chromosome? What would its length be if completely stretched out?

40. What are histones?
    a. How does their structure (think functional groups) explain their behavior with DNA?

41. What is a nucleosome?

42. What is responsible for the second level of DNA packing?
    b. Explain what happens in this level of packing. (study figure 13.21) – include looped domains, scaffold proteins,

43. Distinguish between heterochromatin and euchromatin. When do chromosomes consists of heterochromatin?
    c. How does heterochromatin contribute to gene expression?

Understanding DNA structure and replication makes genetic engineering possible

44. For what are cloned genes useful? Be sure to look at figure 13.22!!!!

45. Why are bacterial plasmids widely used?

46. How were restriction endonucleases discovered?
    a. What do they do?

    b. How are they related to the following terms:
        i. Restriction fragments
        ii. Sticky ends
        iii. DNA ligase
        iv. Cloning vector

47. What properties of molecules are exploited in the process of gel electrophoresis?

48. Study figure 13.25 and describe the Polymerase Chain Reaction.
    a. For what is it used?

    b. What are some of the advantages of this procedure?