GUIDED READING - ***Ch. 16 – MOLECULAR BASIS OF INHERITANCE*** **NAME:** _____

- **Please print out these pages and HANDWRITE the answers directly on the printouts.** *Typed work or answers on separate sheets of paper will not be accepted.*
- **Importantly, guided readings are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you read. You are not to share them with another students or work together on filling it out. Please report any dishonest behavior to your instructor to be dealt with accordingly.*
- **Get in the habit of writing legibly, neatly, and in a NORMAL, MEDIUM-SIZED FONT.** *AP essay readers and I will skip grading anything that cannot be easily and quickly read so start perfect your handwriting.*
- **Please SCAN documents properly and upload them to Archie.** *Avoid taking photographs of or uploading dark, washed out, side ways, or upside down homework. Please use the scanner in the school's media lab if one is not at your disposal and keep completed guides organized in your binder to use as study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** *Though all the answers are in your textbook, you should try to put answers in your own words, maintaining accuracy and the proper use of terminology, rather than blindly copying the textbook whenever possible.*

DNA is the genetic material [2].

1. What are the **two chemical components of chromosomes**? [2]

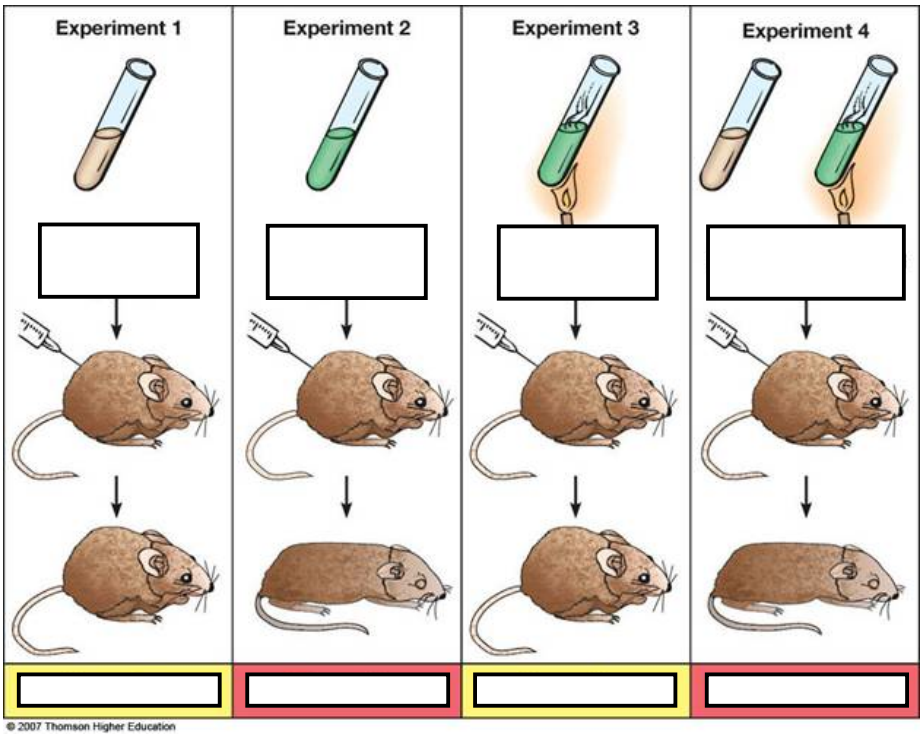
2. Why did researchers originally **think that protein was the genetic material**? [2]

3. Distinguish between **the virulent and non-virulent strains of *Streptoccoccus pneumoniae*** studied by Frederick Griffith. [2]

4. What was the **purpose of Frederick Griffith's studies**? Why did he conduct this study?[2]

5. a. Explain **Griffith's experiment** in **DETAIL.** [2]

b. Label this figure summarizing the experiment you described above in which **Griffith** became aware that **hereditary information could be transmitted between two organisms** in an unusual manner.



6. Think: How did Griffith's experiment rule out the possibility that the R cells could have simply used the pre-existing capsules of the dead S cells to become pathogenic instead of making their own capsules post-transformation? [1]

7. Now that you understand the concept, define the term **transformation**? [2]

8. a. ***To most scientists, three main candidates were the possible culprits of the bacterial transformation Griffith observed: DNA, RNA, and proteins.*** What did **Oswald Avery** determine to be the **transforming factor**? [2]

   b. Describe **Avery, MacLeod, and McCarty**'s experimental approach to determining the identity of Griffith's transforming factor. [2]

c. Despite Avery, Macleod, and McCarty's work, scientists remained skeptical that DNA was the transforming factor and holder of hereditary material.

9. a. What is a **bacteriphage**?

b. Sketch a **T2 bacteriphage** and label its head, tail sheath, tail fiber, and DNA. [2]

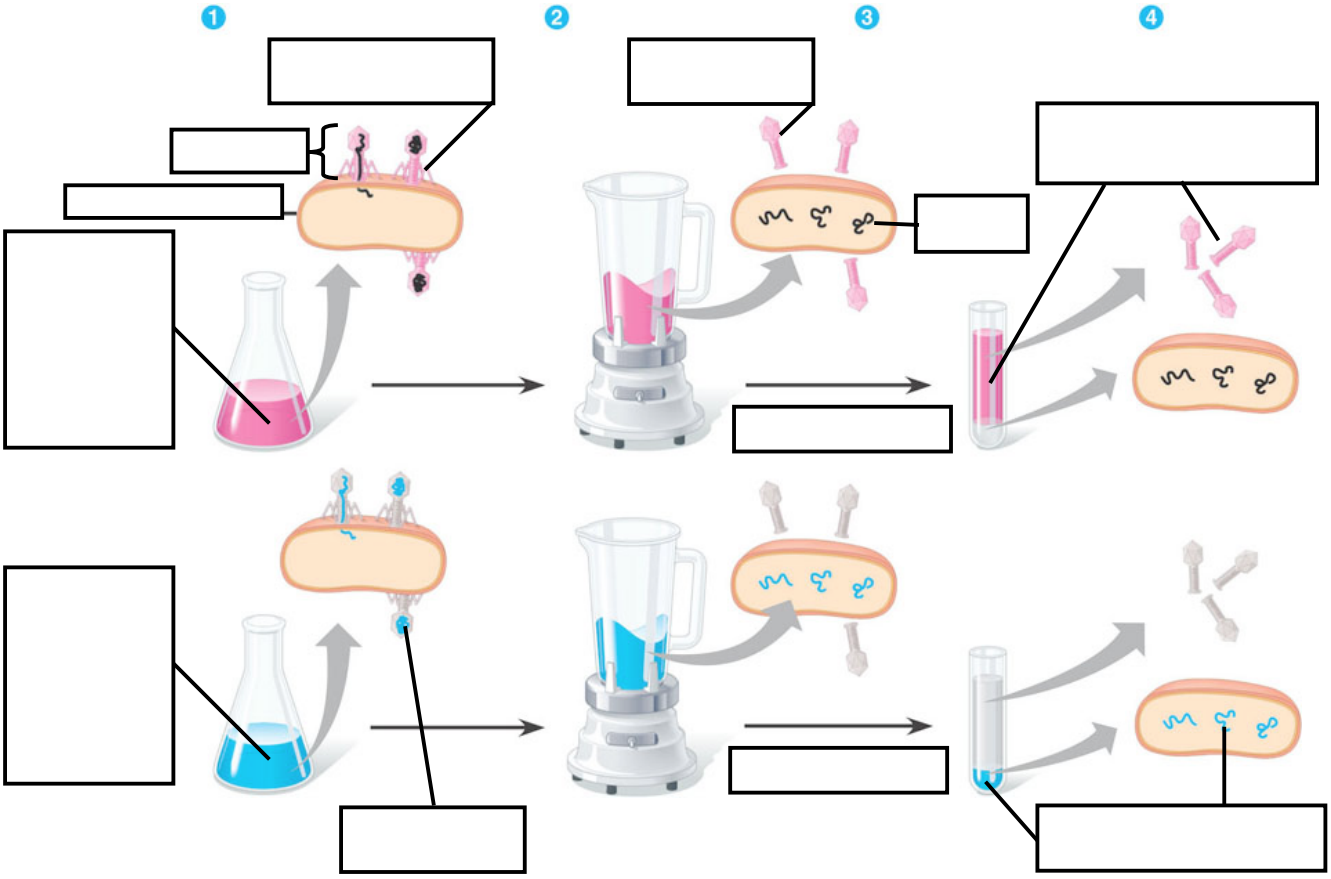
10. How does a **bacteriophage or phage destroy a bacterial cell**? *Look ahead to Chapter 19, Figure 19.5, to explain this better. [2]*

11. a. In their experiment, Hershey and Chase needed to "**label" DNA and viral proteins** so they could be distinguished. How did they "label" each of these? [2]

b. Explain why they chose each **radioactive tag** in light of the chemical composition of DNA and protein. [2]

c. Explain the elegant **experiment performed by Hershey and Chase in 1952** that provided powerful **evidence that nucleic acids are the hereditary material**?

d. Label the accompanying diagram illustrating the elegant Hershey and Chase experiment.



12. a. How did **Chargraff**'s results on the base composition of DNA from different organisms further support the conclusion that DNA is the genetic material?

b. What are **Chargaff's rules**? [2]

c. How did he arrive at his rules? [2]

13. A fly has the following percentages of nucleotides in its DNA: 27.9% A, 27.6% T, 22.5% G, and 22.5% C. How do these numbers demonstrate Chargaff's rules? [1]

14. Another species of fly has DNA that consists of 35.5% adenine and 14.5% guanine. Use Chargaff's rules to deduce the percentages of thymine and cytosine. [2]

15. List the **three components of a nucleotide**. [2]

16. Who **built the first model of DNA** and shared the 1962 Nobel Prize for discovery of its structure? [2]

17. Why was **Rosalind's Franklin's work** essential to the understanding of the structure of DNA? [2]

18. Distinguish between the structure of **pyrimidines** and **purines**. [2]

19. a. Which **nucleotides pair up in a DNA double helix?**

    b. Why do the nucleotides pair as they do?

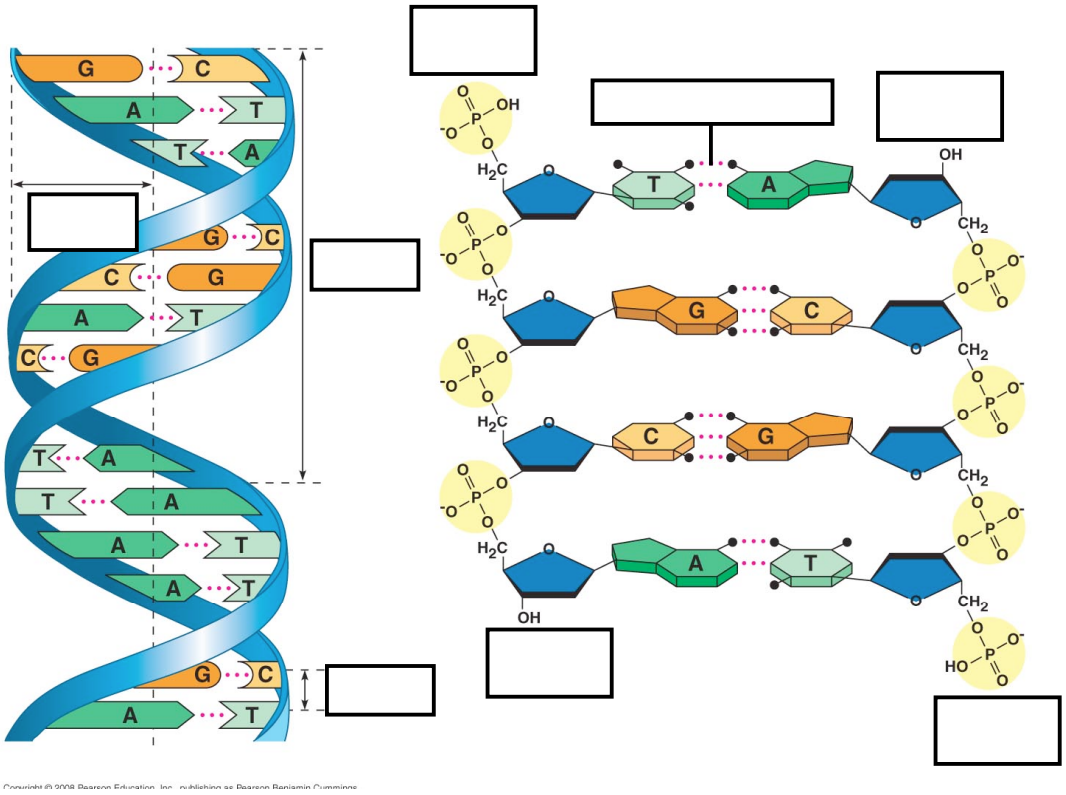
20. Explain the **base-pairing rule**. [2]

21. How did Watson and Crick's model explain the basis for Chargaff's rules? [1]

22. Name the five nitrogenous bases, and put a checkmark in the correct column for each base. Also indicate if the base is found in DNA (D), RNA(R), or both (B). [2]

Nitrogenous Base	Purine	Pyrimidine	D, R or B

23. a. Label the structure below.



b. Describe the structure of DNA relative to each of the following: [2]

a. Distance across the molecule _____

b. Components of the backbone _____

c. Components of the rungs _____

24. Explain what is meant by the **5′ and 3′ ends of the nucleotide**. [2]

25. What do we mean when we say the two strands of DNA are anti-parallel? [2]

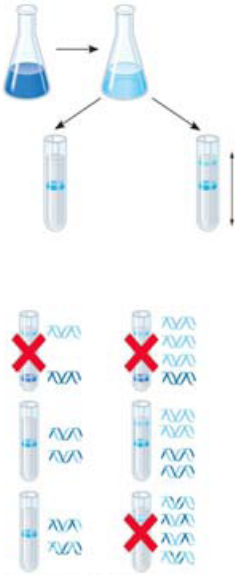
Many proteins work together in DNA replication and repair [2].

26. What is meant by the term that DNA replication is **semiconservative**? [3]

27. Who performed the experiments that elucidated the correct mechanism of DNA replication? [2]

28. a. How did Meselson and Stahl create "heavy" DNA for experiments?

    b. Use Figure 16.11 to explain in detail how **Meselson and Stahl confirmed the semiconservative mechanism of DNA replication**. [2] *(Include a description of the expected and observed light/heavy/hybrid density DNA bands found after centrifugation in the test tubes, where each band was located in the test tubes, and what these bands meant in reference to DNA's method of replication).*



29. Define the **Origin of Replication**.

30. How does the **replication of Eukaryotic DNA** differ from that of **Bacterial DNA** and why? *Include a sketch illustrating the difference to accompany your explanation.*

31. What is s a **Replication Fork**?

32. What is the function of the enzyme **Helicase**?

33. What are the function of the proteins referred to as **Single-Stranded Binding Proteins or SSBPs**?

34. Explain the purpose of **Topoisomerase (DNA Gyrase).**

35. What are **DNA polymerases**?

36. a. What is the role of the enzyme **Primase?**

Why is it **needed for DNA replication** in the first place if we already have DNA Polymerase?

37. **In eukaryotes there exist at least 11 DNA Polymerases** so far discovered. For prokaryotes, the picture is slightly simpler. Describe the functions of the two main **DNA Polymerases in Bacteria: DNA pol III and DNA Pol I**.

    a. DNA Polymerase III

    b. DNA Polymerase I

38. What is the purpose of using **nucleotide triphosphates** for DNA replication? Explain.

39. What is the difference between the **ATP used for energy and the ATP used in replication**?

40. In your own words, what is meant by the statement "**the two strands of DNA in a double helix are antiparallel**"?

41. a. In what **direction** does a **daughter DNA strand grow**?

    b. Why?

42. Distinguish between the **leading** and **the lagging strands during DNA replication**. [2]

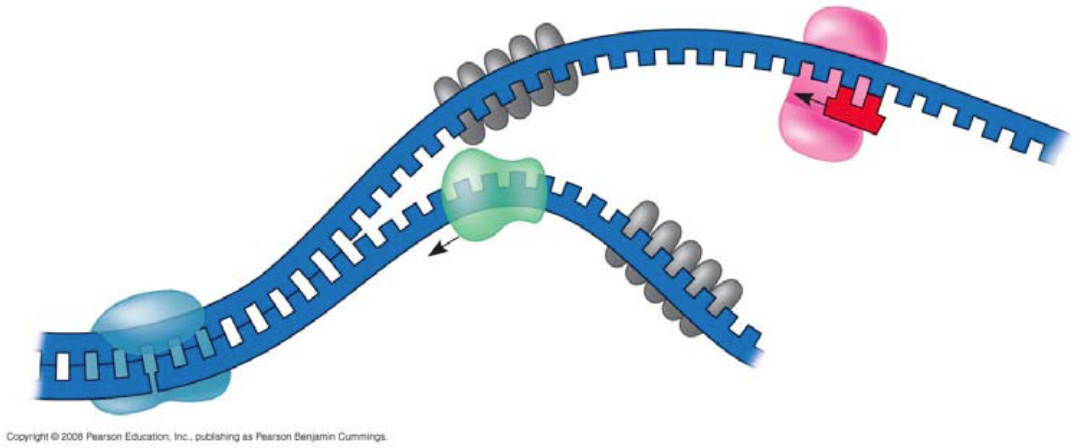
43. a. What are **Okasaki fragments**? [2]

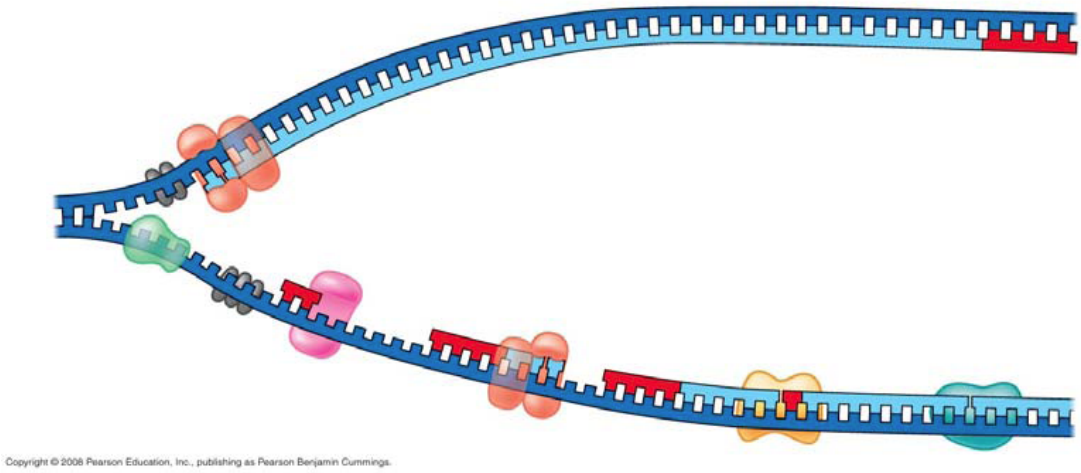
    b. How are they welded together? [2]

44. Now let's review and see what you have committed to memory… Which enzyme (or protein) does the following?

    a. Untwists and separates strands of DNA _____
    b. Holds DNA strands apart _____
    c. Synthesizes RNA primer _____
    d. Adds DNA nucleotides to new strand _____
    e. Relieves strain caused by unwinding _____
    f. Joins DNA fragments together _____
    g. Removes RNA primer and replaces with DNA _____

45. Label the diagrams below illustrating the **synthesis of the leading and lagging strands during DNA replication**. Include the *3' and 5' ends of parent and daugther strands, RNA primer, primase, SSBP, topoisomerase (DNA gyrase), helicase, leading strand, lagging strand, DNA pol I, DNA pol III, DNA ligase, parental DNA*, and *new daughter DNA*.





46. *Put it all together!* Explain in detail the steps that occur in the synthesis of a new strand of DNA.

47. a. What is the **error rate of eukaryotic DNA polymerase**?

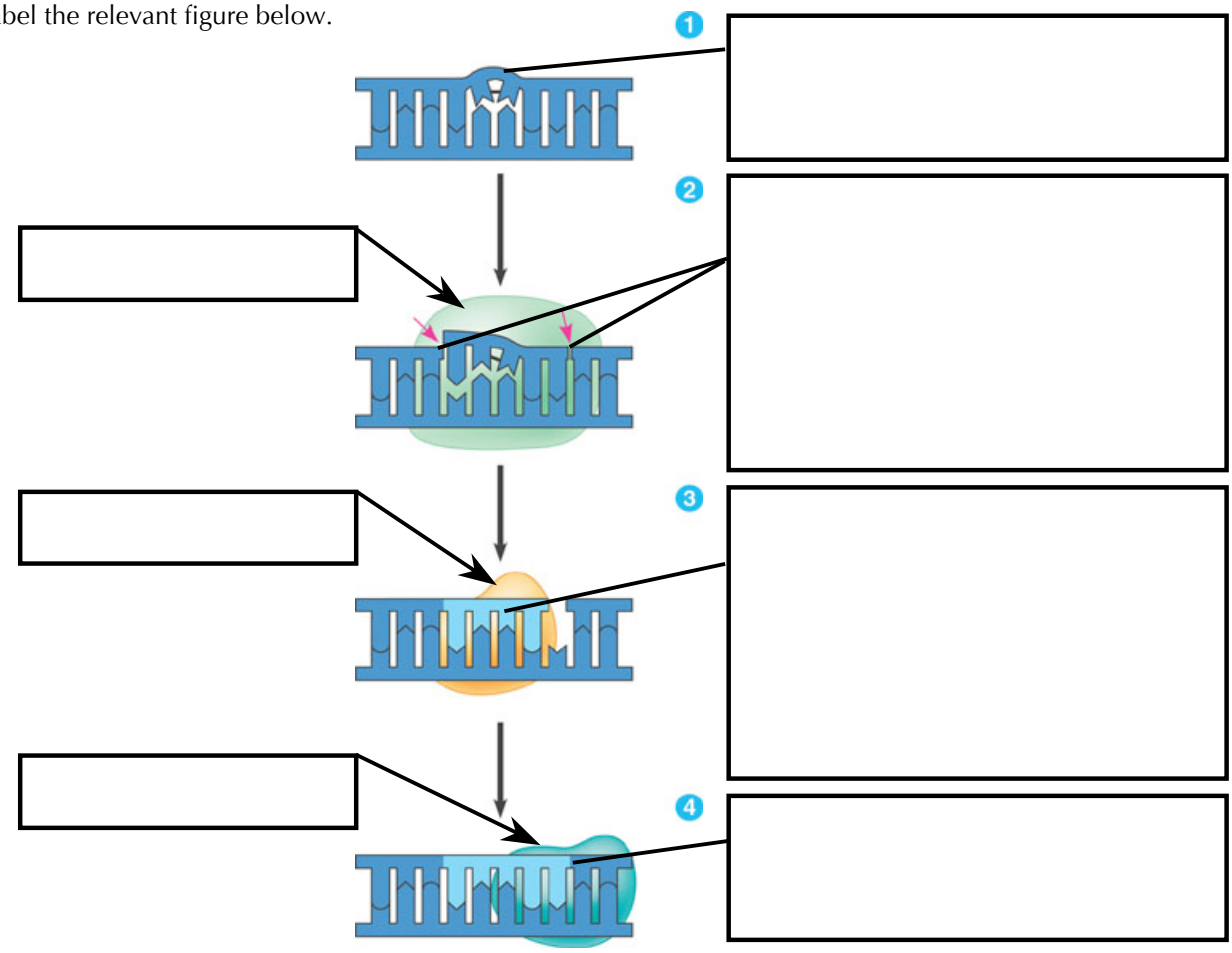
b. Explain the **characteristic of DNA polymerase allows for such a low error rate**.

48. What is '**mismatch repair'**?

49. What is a **thymine dimer**?

50. a. What is '**nucleotide excision repair**'?

b. Label the relevant figure below.



51. To review, summarize the roles of each of the following enzymes in DNA proofreading and repair.

    a. DNA polymerase

    b. Nuclease

    c. Ligase

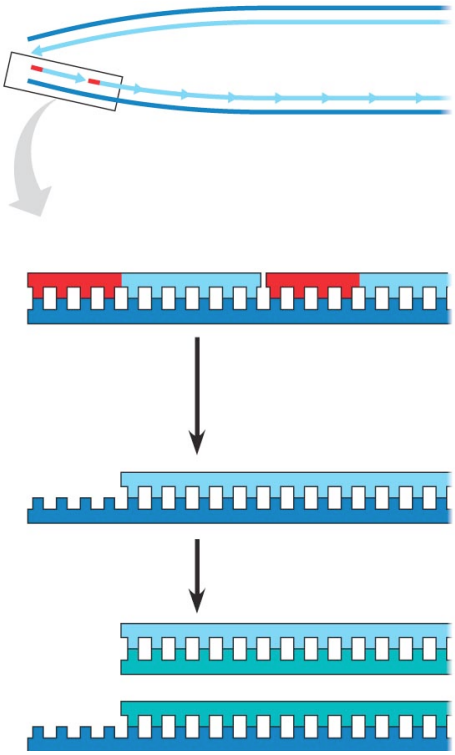
    d. Repair Enzymes

52. a. What are **telomeres**?

    b. Why are they important?

    c. Make a sketch of a chromosome and label the telomeres.

53. Why are **progressively shorter and staggered (unevenly-ended) DNA molecules produced with each successive round of DNA replication**? *(Make sure you thoroughly understand this concept!)*



54. How and where does **telomerase** play a role? [3]

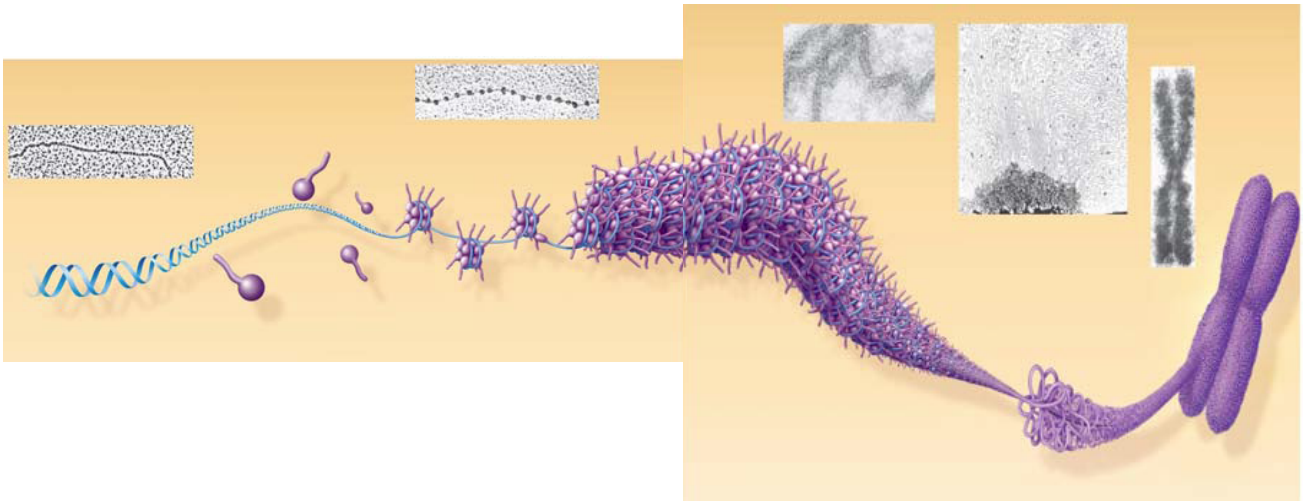
55. Why are **cancer cells immortal**, but most **body cells have limited life span**? [2]

***A chromosome consists of a DNA molecule packed together with proteins** [2].*

56. What is the **nucleoid**?

57. What is **chromatin**?

58. On the diagrams below, identify the following: *30-nm fiber, metaphase chromosome, double helix, histone proteins, nucleosomes, protein scaffold*, and *looped domains (300-nm fiber)*. [2]



59. What two properties distinguish **Heterochromatin from Euchromatin**? [1] *(Be sure to include the definition of both terms).*

60. Describe the structure of a **nucleosome**, the basic unit of DNA packing in eukaryotic cells. [1]

61. Outline the current model for the progressive **packaging of DNA** starting with the double helix molecule and ending with its coiling and folding into a metaphase chromosome.

62. Think: Although the proteins that cause the E. coli chromosome to coil are not histones, what property would you expect them to share with histones, given their ability to bind to DNA? [1]

63. Please answer the Self-Quiz at the end of your chapter. *Do your best to try it from memory first in order to test how well you grasped the material.*

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____

9.

References

1. Campbell *et al*. (2008). AP* Edition Biology. 8th Ed. San Francisco: Pearson Benjamin Cummings.

2. Adapted from Fred and Theresa Holtzclaw

3. Adapted from L. Miriello