

AP BIOLOGY

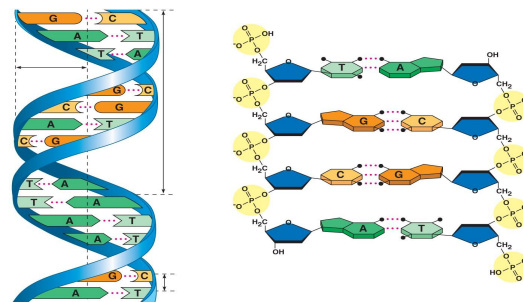
TOPIC REVIEW GUIDE: MOLECULAR GENETICS #1 DNA STRUCTURE AND REPLICATION

KEY CONCEPTS:

- DNA is the genetic material
- Many proteins work together in DNA replication and repair
- A chromosome consists of a DNA molecule packet together with proteins
- Understanding DNA structure and replication makes genetic engineering possible

READ:

- Chapter 16



KEY TERMS: Here is a list of key terms and concepts you will hear about and see during the chapter readings. Get to know them!

Frederick Griffith
Transformation
Avery, McCarty, & MacLeod
Hershey & Chase
Erwin Chargraff
Maurice Wilkins
Rosalind Franklin

James Watson
Francis Crick
Double helix
Deoxyribose
Adenine
Thymine
Cytosine
Chromosome

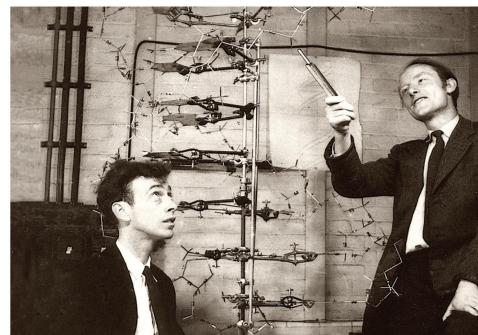
Guanine
Semiconservative replication
Replication bubble / fork
Helicase
Single-strand binding proteins (SSB)
Primase
DNA polymerase I & III
Chromatin

DNA ligase
Leading strand
Lagging strand
Okazaki fragments
Telomeres
Telomerase
Histones
Nucleosome

QUESTIONS FOR YOUR BILL:

DNA as the Genetic Material

1. Explain why researchers originally thought protein was the genetic material.
2. Explain how the experiments performed by the following scientists provided evidence that DNA is the genetic material:
 - a. *Frederick Griffith*
 - b. *Oswald Avery, Maclyn McCarty, and Colin MacLeod*
 - c. *Alfred Hershey and Martha Chase*
3. A fly has the following percentages of nucleotides in its DNA: 27.3% A, 27.6% T, 22.5% G, and 22.5% C. How do these numbers demonstrate Chargaff's rules?
4. How did Watson and Crick's model explain the basis for Chargaff's rules?
5. Explain how the work done by *Rosalind Franklin* and *Maurice Wilkins* helped inform Watson and Crick's model of the structure of DNA.
6. Based on Watson and Crick's work, diagram the double helix structure of DNA. Include the following:
 - a. at least one A,T,C,G per strand
 - b. make sure to show the anti-parallel orientation of both strands
 - c. labels of 5' to 3', 3' to 5', deoxyribose sugar, phosphate, nitrogen bases (adenine, cytosine, guanine, and thymine), pyrimidine, purine, covalent bonds, hydrogen bonds



DNA Replication and Repair

7. Explain and/or diagram the experiment conducted by Meselson and Stahl. How did the results of their experiment demonstrate the semi-conservative model of DNA replication was the accurate model?
8. Create a "cartoon strip" that illustrates the process of DNA replication. Add captions where it is necessary to clarify key points. Include the following information:
 - a. the role of the *origins of replication* and *replication forks*.
 - b. what energy source drives the polymerization of DNA.
 - c. distinguish between the *leading strand* and the *lagging strand*.
 - d. the roles of *DNA ligase*, *DNA polymerases I and III*, *RNA primer*, *primase*, *helicase*, *Okazaki fragments*, and *single-strand binding proteins (SSB)*.
9. How does replication of the leading strand differ from replication of the lagging strand? Why can't both strands of DNA be replicated in the same fashion?
10. Explain the roles of DNA polymerase, *mismatch repair enzymes*, and *nuclease* in DNA *proofreading* and repair.
11. Why are telomeres necessary during the replication of eukaryotic chromosomes?
12. Explain the possible significance of telomerase in germ cells and cancerous cells.

Bacterial and Eukaryotic Chromosomes

13. Make a drawing that compares a bacterial chromosome and a eukaryotic chromosome.
14. Describe the structure of a *nucleosome*, the basic unit of DNA packing in eukaryotic cells.
15. What two properties distinguish *heterochromatin* and *euchromatin*?
16. What are chromosomes and how does it differ from chromatin? During what part of the cell cycle are chromosomes formed? Why?

SUPPLEMENTARY RESOURCES: Click the links below for more information to help you learn more about this lesson.

Interactives

- **McGraw-Hill 3D Animation:** [DNA Replication 3D Animation](#)
- **Pearson's BioCoach Activity:** [DNA Structure and Replication](#)
- DNA From the Beginning: [Molecules of Genetics](#)
- Wiley Biology: [DNA Replication Animation](#) (the one used in class)
- Nobelprize.org: [DNA – The Double Helix Game](#)
- Nobelprize.org: [The Nobel Prize in Physiology or Medicine 1962—Watson, Crick and Wilkins](#)

Lectures

- TED Talk: [James Watson – How I Discovered DNA](#)
- Bozeman Biology's "[DNA & RNA Part 1](#)" video.
- Bozeman Biology's "[DNA & RNA Part 2](#)" video.
- Bozeman Biology's "[DNA Replication](#)" video.
- Crash Course Biology's video: [DNA Structure & Replication](#)

HYPERLINK

"http://www.youtube.com/watch?v=8kK2zjRV0M&list=PL3EED4C1D684D3ADF&index=10&feature=plpp_video"