

Chapter 12

DNA and RNA

Section 12–1 DNA (pages 287–294)

This section tells about the experiments that helped scientists discover the relationship between genes and DNA. It also describes the chemical structure of the DNA molecule.

Griffith and Transformation (pages 287–289)

1. What did Frederick Griffith want to learn about bacteria? _____

2. The strain of bacteria that caused pneumonia grew into _____ colonies on culture plates; harmless bacteria produced colonies with _____ edges.
3. Circle the letter of each sentence that is true about Griffith's experiment.
 - a. Mice injected with bacteria from smooth colonies died.
 - b. Mice injected with bacteria from rough colonies died.
 - c. Mice injected with heat-killed bacteria from smooth colonies died.
 - d. Mice injected with a mixture of bacteria from heat-killed smooth colonies and live rough colonies died.
4. What result from Griffith's experiment suggested that the cause of pneumonia was not a chemical poison released by the disease-causing bacteria? _____

5. What is transformation? _____

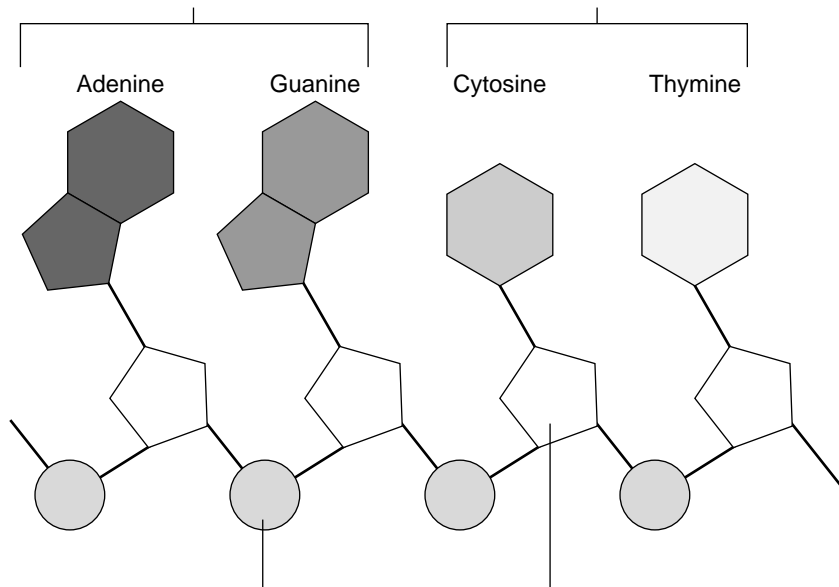
6. What hypothesis did Griffith form from the results of his experiments? _____

Avery and DNA (page 289)

7. Is the following sentence true or false? Avery and his colleagues thought that the molecule required in transformation might also be the molecule of the gene. _____
8. Briefly describe how Avery and his group determined which molecule was most important for transformation? _____

Chapter 12, DNA and RNA (continued)

21. Identify the parts of a nucleotide in the diagram below. Label the bases as purines or pyrimidines.



22. Is the following sentence true or false? Adenine and guanine are larger molecules than cytosine and thymine because they have two rings in their structure. _____
23. What forms the backbone of a DNA chain? _____
-
24. Is the following sentence true or false? The nucleotides must be joined together in a specific order. _____
25. According to Chargaff's rules, the percentages of _____ are equal to thymine and the percentages of _____ are equal to guanine in the DNA molecule.
26. Rosalind Franklin's work with X-ray diffraction showed that the DNA molecule is shaped like a(an) _____ and contains _____ strands.
27. How did Francis Crick and James Watson try to understand the structure of DNA? _____
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28. How did Watson and Crick describe the structure of DNA? _____
-
29. Is the following sentence true or false? According to the principle of base pairing, hydrogen bonds could form only between adenine and cytosine. _____

Section 12–2 Chromosomes and DNA Replication (pages 295–299)

This section describes how DNA is packaged to form chromosomes. It also tells how the cell duplicates its DNA before cell division.

DNA and Chromosomes (pages 295–296)

- Circle the letter of the location of DNA in prokaryotic cells.
a. nucleus b. mitochondria c. cytoplasm d. vacuole
- Is the following sentence true or false? Most prokaryotes contain a single, circular DNA molecule. _____
- Eukaryotic DNA is generally located in the cell _____ in the form of a number of chromosomes.
- Is the following sentence true or false? All organisms have the same number of chromosomes. _____
- Is the following sentence true or false? The *E. coli* chromosome is longer than the diameter of an individual *E. coli* bacterium.

- Circle the letter of each sentence that is true about chromosome structure.
 - The DNA in eukaryotic cells is very loosely packed.
 - Prokaryotic cells contain more DNA than eukaryotic cells.
 - A human cell contains more than 1 meter of DNA.
 - The DNA of the smallest human chromosome is nearly 10 times as long as many bacterial chromosomes.
- Eukaryotic chromosomes contain both DNA and protein, packed together to form _____.
- What are histones? _____

- Why are individual chromosomes visible only during mitosis? _____

- Is the following sentence true or false? Changes in chromatin structure and histone-DNA binding may be associated with changes in gene activity. _____
- List two roles of nucleosomes.
 - _____

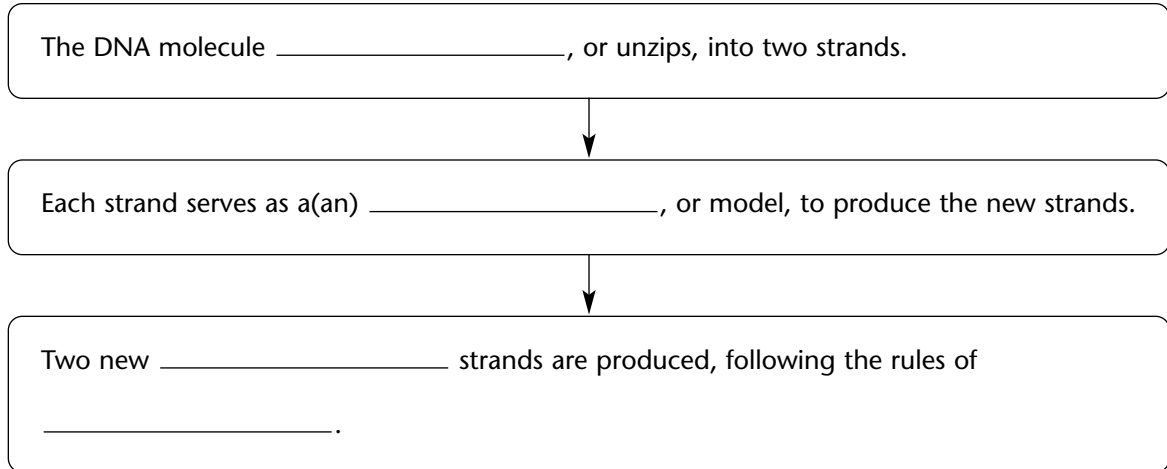
 - _____

Chapter 12, DNA and RNA (continued)

DNA Replication (pages 297–299)

12. What occurs during the process of replication? _____

13. Complete the flowchart to describe the process of DNA replication.



14. Is the following sentence true or false? In eukaryotic chromosomes, DNA replication begins at a single point in the chromosome and proceeds in two directions. _____

15. The sites where DNA replication and separation occur are called _____.

16. What occurs when a molecule of DNA is “unzipped”? _____

17. What is the complimentary strand of bases for a strand with the bases TACGTT? _____

18. Is the following sentence true or false? Each DNA molecule resulting from replication has one original strand and one new strand. _____

19. List two major roles of DNA polymerase in the process of DNA replication.

a. _____

b. _____

Reading Skill Practice

The illustrations in textbooks can help you better understand a difficult concept. Look at Figure 12–10 on page 297. List in order, beginning with DNA, the levels of organization of eukaryotic DNA to form chromosomes. Do your work on a separate sheet of paper.

Section 12–3 RNA and Protein Synthesis (pages 300–306)

This section describes RNA and its role in transcription and translation.

The Structure of RNA (page 300)

1. List the three main differences between RNA and DNA.
 - a. _____
 - b. _____
 - c. _____
2. Is the following sentence true or false? RNA is like a disposable copy of a DNA segment. _____
3. What is the importance of the cell's ability to copy a single DNA sequence into RNA? _____

Types of RNA (pages 300–301)

4. What is the one job in which most RNA molecules are involved? _____

5. Complete the compare-and-contrast table about the types of RNA.

TYPES OF RNA

Type	Function
	Carries copies of the instructions for assembling amino acids from DNA to the rest of the cell
Ribosomal RNA	
	Transfers each amino acid to the ribosome to help assemble proteins.

Transcription (page 301)

6. Circle the letter of each sentence that is true about transcription.
 - a. During transcription, DNA polymerase binds to RNA and separates the DNA strands.
 - b. RNA polymerase uses one strand of DNA as a template to assemble nucleotides into a strand of RNA.
 - c. RNA polymerase binds only to DNA promoters, which have specific base sequences.
 - d. Promoters are signals in RNA that indicate to RNA polymerase when to begin transcription.

Chapter 12, DNA and RNA (continued)

RNA Editing (page 302)

7. Many RNA molecules from eukaryotic genes have sections, called _____, edited out of them before they become functional. The remaining pieces, called _____, are spliced together.
8. Is the following sentence true or false? RNA editing occurs in the cytoplasm of the cell. _____
9. What are two explanations for why some RNA molecules are cut and spliced?
- a. _____

- b. _____

The Genetic Code (pages 302–303)

10. Proteins are made by joining _____ into long chains called polypeptides.
11. How can only four bases in RNA carry instructions for 20 different amino acids? _____

12. What is a codon? _____

13. Circle the letter of the number of possible three-base codons.
a. 4 b. 12 c. 64 d. 128
14. Is the following sentence true or false? All amino acids are specified by only one codon. _____
15. Circle the letter of the codon that serves as the “start” codon for protein synthesis.
a. UGA b. UAA c. UAG d. AUG

Translation (pages 303–305)

16. What occurs during the process of translation? _____

17. Where does translation occur? _____

18. Circle the letter of each sentence that is true about translation.
- a. Before translation can occur, messenger RNA must be transcribed from DNA in the nucleus.
 - b. Translation occurs in the nucleus.
 - c. It is the job of transfer RNA to bring the proper amino acid into the ribosome to be attached to the growing peptide chain.
 - d. When the ribosome reaches a stop codon, it releases the newly formed polypeptide and the mRNA molecule.

19. What is an anticodon? _____

The Roles of RNA and DNA (page 306)

Match the roles with the molecules. Molecules may be used more than once.

Roles	Molecules
_____ 20. Master plan	a. DNA
_____ 21. Goes to the ribosomes in the cytoplasm	b. RNA
_____ 22. Blueprint	
_____ 23. Remains in the nucleus	

Genes and Proteins (page 306)

24. Many proteins are _____, which catalyze and regulate chemical reactions.
25. Is the following sentence true or false? Genes are the keys to almost everything that living cells do. _____

Reading Skill Practice

A flowchart is useful for organizing the steps in a process. Make a flowchart that shows the steps in the process of translation. Look at Figure 12–18 on pages 304–305 for help. For more information about flowcharts, see Appendix A. Do your work on a separate sheet of paper.

Section 12–4 Mutations (pages 307–308)

This section describes and compares gene mutations and chromosomal mutations.

Introduction (page 307)

1. What are mutations? _____

Chapter 12, DNA and RNA *(continued)*

2. Is the following sentence true or false? Chromosomal mutations result from changes in a single gene. _____

Gene Mutations (pages 307–308)

3. Mutations that occur at a single point in the DNA sequence are _____ mutations.
4. A mutation involving the insertion or deletion of a nucleotide is a(an) _____ mutation.
5. Circle the letter of each sentence that is true about gene mutations.
- a. Point mutations affect just one nucleotide.
 - b. The substitution of one nucleotide for another in the gene never affects the function of the protein.
 - c. Point mutations that involve the insertion or deletion of a nucleotide change the reading frame of the genetic message.
 - d. Frameshift mutations affect every amino acid that follows the point of the mutation.

Chromosomal Mutations (page 308)

6. Complete the compare-and-contrast table of types of chromosomal mutations.

CHROMOSOMAL MUTATIONS

Type	Description	Examples
		ABC•DEF → AC•DEF
Duplication		
	Part of a chromosome becomes oriented in the reverse of its usual direction	
Translocation		

Section 12-5 Gene Regulation (pages 309-312)

This section explains how some genes in prokaryotes and eukaryotes are controlled.

Introduction (page 309)

1. Label the parts of a typical gene in the diagram below.



2. Where does RNA polymerase bind? _____

3. Is the following sentence true or false? The actions of DNA-binding proteins help to determine whether a gene is turned on or turned off. _____

Gene Regulation: An Example (pages 309-310)

4. What is an operon? _____

5. What is the function of the genes in the *lac* operon? _____

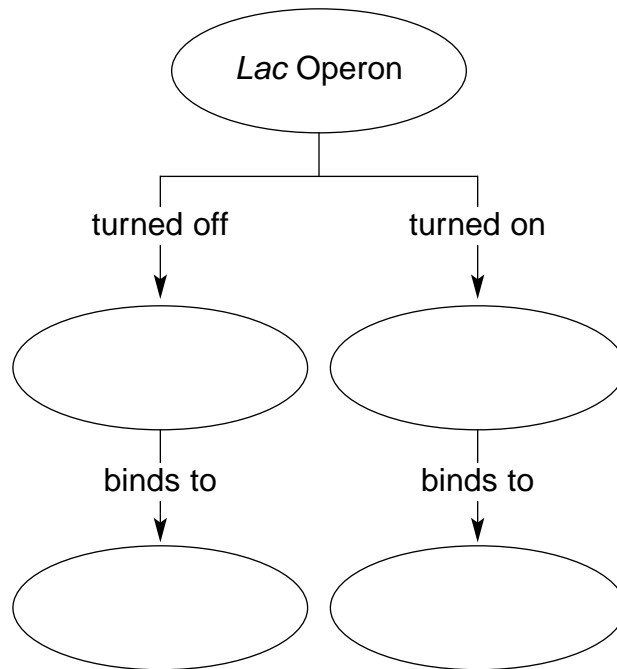
6. Circle the letter of each sentence that is true about lactose.
 - a. Lactose is a simple sugar.
 - b. To use lactose for food, *E. coli* must take lactose across its cell membrane.
 - c. The bond between glucose and galactose must be broken in order for *E. coli* to use lactose for food.
 - d. Proteins encoded by the genes of the *lac* operon are needed only when *E. coli* is grown on a medium containing glucose.
7. Circle the letter of the number of genes in the *lac* operon found in *E. coli*.

a. 1	b. 2	c. 3	d. 4
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Chapter 12, DNA and RNA (continued)

8. What turns the *lac* operon off and on? _____

9. Complete the concept map to show how the *lac* operon is regulated.



10. How does the repressor protein prevent transcription? _____

11. How does lactose cause the *lac* operon to turn on? _____

12. Circle the letter of each sentence that is true about gene regulation in prokaryotic genes.
- a. The *lac* operon is the only example of genes regulated by repressor proteins.
 - b. Many other genes are regulated by repressor proteins.
 - c. Some genes are regulated by proteins that enhance the rate of transcription.
 - d. Cells cannot turn their genes on and off as needed.

Eukaryotic Gene Regulation (page 311)

13. Is the following sentence true or false? Operons are frequently found in eukaryotes. _____

14. How are eukaryotic genes usually controlled? _____

15. What is the function of the TATA box? _____

16. Eukaryotic promoters are usually found just _____
the TATA box, and they consist of a series of short
_____ sequences.

17. List three ways in which proteins that bind to enhancer sequences
of a gene can work to regulate gene expression.
a. _____
b. _____
c. _____

18. Why is gene regulation in eukaryotes more complex than in
prokaryotes? _____

Regulation and Development (page 312)

19. What role do the hox genes play in the development of an
organism? _____

20. Circle the letter of each sentence that is true about hox genes.
a. A mutation in a hox gene has no effect on the organs that
develop in specific parts of the body.
b. In fruit flies, a mutation affecting the hox genes can replace a
fly's antennae with a pair of legs.
c. The function of the hox genes in humans seems to be almost
the same as it is in fruit flies.
d. A copy of the gene that controls eye growth in mice does not
function in fruit flies.

21. Why do common patterns of genetic control for development
exist among animals? _____

Chapter 12, DNA and RNA (continued)

WordWise

Answer the questions by writing the correct vocabulary term in the blanks. Use the circled letter from each term to find the hidden word. Then, write a definition for the hidden word.

1. What is the substance that is made up of DNA and protein tightly packed together?

___ o ___ ___ ___ ___ ___ ___ ___

2. What are the three bases on the tRNA molecule that are complimentary to mRNA?

___ ___ ___ o ___ ___ ___ ___ ___

3. What is the process in which one strain of bacteria has been changed into another?

___ ___ ___ ___ o ___ ___ ___ ___ ___ ___ ___ ___

4. What is a change in the DNA sequence that affects genetic information?

___ ___ o ___ ___ ___ ___ ___

5. What is a group of genes that is operated together?

___ ___ ___ ___ o ___

6. What are the intervening sequences of RNA molecules that are cut out before the messenger RNA leaves the nucleus?

___ ___ ___ ___ ___ o ___

7. What is the region of DNA to which RNA polymerase binds?

___ ___ ___ ___ ___ ___ o ___

Hidden Word: ___ ___ ___ ___ ___ ___ ___

Definition: _____
