

## Section 12–3 RNA and Protein Synthesis

### (pages 300–306)



#### Key Concepts

- What are the three main types of RNA?
- What is transcription?
- What is translation?

### The Structure of RNA (page 300)

1. List the three main differences between RNA and DNA.
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
2. What is the importance of the cell's ability to copy a single DNA sequence into RNA?
 

\_\_\_\_\_

\_\_\_\_\_

### Types of RNA (pages 300–301)

3. What is the one job in which most RNA molecules are involved? \_\_\_\_\_
4. Complete the 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)

5. 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.

### RNA Editing (page 302)

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

### The Genetic Code (pages 302–303)

9. Proteins are made by joining \_\_\_\_\_ into long chains called polypeptides.
10. How can only four bases in RNA carry instructions for 20 different amino acids?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
11. What is a codon? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
12. Circle the letter of the number of possible three-base codons.  
a. 4                      b. 12                      c. 64                      d. 128
13. Is the following sentence true or false? All amino acids are specified by only one codon. \_\_\_\_\_
14. 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)

15. What occurs during the process of translation? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
16. Where does translation take place? \_\_\_\_\_  
\_\_\_\_\_

17. Circle the letter of each sentence that is true about translation.
- a. Before translation occurs, messenger RNA is 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.
18. 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
_____ 19. Master plan	a. DNA
_____ 20. Goes to the ribosomes in the cytoplasm	b. RNA
_____ 21. Blueprint	
_____ 22. Remains in the nucleus	

### Genes and Proteins (page 306)

23. Many proteins are \_\_\_\_\_, which catalyze and regulate chemical reactions.
24. 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)

### Key Concept

- What are mutations?

### Introduction (page 307)

1. What are mutations? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
2. Is the following sentence true or false? Chromosomal mutations result from changes in a single gene. \_\_\_\_\_

### Kinds of 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. Complete the 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		

6. 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.

**Significance of Mutations (page 308)**

7. Mutations that cause dramatic changes in protein structure are often \_\_\_\_\_.
8. Mutations are a source of \_\_\_\_\_ in a species.
9. What is polyploidy? \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

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

### Key Concepts

- How are *lac* genes turned off and on?
- How are most eukaryotic genes 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? \_\_\_\_\_

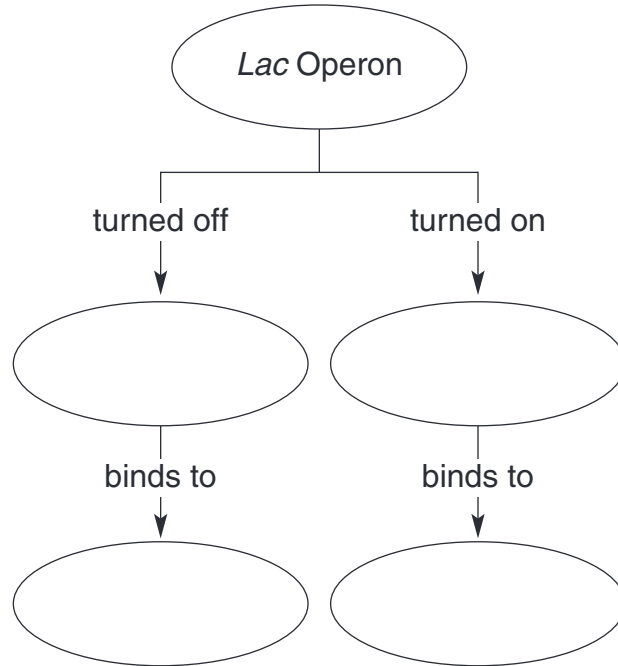
5. What is the function of the genes in the *lac* operon? \_\_\_\_\_

6. Circle the letter of each sentence that is true about lactose.

- Lactose is a simple sugar.
- To use lactose for food, *E. coli* must take lactose across its cell membrane.
- The bond between glucose and galactose must be broken in order for *E. coli* to use lactose for food.
- Proteins encoded by the genes of the *lac* operon are needed only when *E. coli* is grown on a medium containing glucose.

7. What turns the *lac* operon off and on? \_\_\_\_\_

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



9. How does the repressor protein prevent transcription? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

10. How does lactose cause the *lac* operon to turn on? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

11. 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)**

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

\_\_\_\_\_

13. How are eukaryotic genes usually controlled? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

14. What is the function of the TATA box? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
15. Eukaryotic promoters are usually found just \_\_\_\_\_ the TATA box, and they consist of a series of short \_\_\_\_\_ sequences.
16. List three ways in which proteins that bind to enhancer sequences of a gene can work to regulate gene expression.
- a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
17. Why is gene regulation in eukaryotes more complex than in prokaryotes? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **Development and Differentiation (page 312)**

18. What role do the hox genes play in the development of an organism? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
19. 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.
20. Why do common patterns of genetic control for development exist among animals?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**Chapter 12 DNA and RNA****Vocabulary Review**

**Matching** *In the space provided, write the letter of the definition that best matches each term.*

- |                           |   |
|---------------------------|---|
| _____ 1. base pairing     | a. making a protein using messenger RNA                         |
| _____ 2. nucleotide       | b. having extra sets of chromosomes                             |
| _____ 3. histone          | c. hydrogen bonding between adenine and thymine                 |
| _____ 4. transcription    | d. sequence in messenger RNA that is cut out                    |
| _____ 5. intron           | e. cells specializing in structure and function                 |
| _____ 6. translation      | f. carries amino acids to the ribosome during protein synthesis |
| _____ 7. transfer RNA     | g. unit of DNA  |
| _____ 8. promoter         | h. copying part of DNA into RNA                                 |
| _____ 9. mutation         | i. change in the genetic material                               |
| _____ 10. polyploidy      | j. group of genes that work together                            |
| _____ 11. operon          | k. DNA sequence that binds RNA polymerase                       |
| _____ 12. differentiation | l. protein that binds DNA into tight coils                      |

**Completion** *Fill in the blanks with terms from Chapter 12.*

13. A \_\_\_\_\_ is a type of virus that infects bacteria.
14. Eukaryotic chromosomes contain both DNA and protein, tightly packed together to form a substance called \_\_\_\_\_.
15. The duplication of DNA is called \_\_\_\_\_.
16. The principal enzyme involved in DNA replication is \_\_\_\_\_ because it joins individual nucleotides to produce a DNA molecule.
17. DNA sequences that code for proteins are called \_\_\_\_\_.
18. A \_\_\_\_\_ consists of three consecutive nucleotides that specify a single amino acid.
19. Gene mutations, known as \_\_\_\_\_, occur at a single point in the DNA sequence.
20. Differentiation of cells and tissues in the embryo is controlled by \_\_\_\_\_.