# Chapter 12 Study Guide

## Study Tip

Have students make a glossary for the Vocabulary terms in which they use their own words for the definitions. Also, encourage students to use illustrations or mnemonics to help them remember meanings.

## Thinking Visually

**1.** The mRNA enters the cytoplasm and attaches to a ribosome.

**2.** The tRNA anticodon matches with the mRNA codon in the ribosome. The ribosome assembles the amino acids brought by tRNA.

# Chapter 12 Assessment

## Reviewing Content

| | | | |
|---|---|---|---|
| **1.** c | **4.** c | **7.** b | **10.** b |
| **2.** d | **5.** a | **8.** c | |
| **3.** b | **6.** d | **9.** b | |

## Understanding Concepts

**11.** Genes carry information from one generation to the next, determine heritable characteristics, and are replicated easily.

**12.** DNA is a long molecule made up of nucleotides. Each nucleotide has three parts: a 5-carbon sugar called deoxyribose, a phosphate group, and a nitrogenous base. The four nitrogenous bases are adenine and guanine, which are purines, and cytosine and thymine, which are pyrimidines.

**13.** The two strands of DNA are held together by hydrogen bonds between certain bases—A and T, and G and C—which explained Chargaff's rules.

**14.** Base pairing is the principle that hydrogen bonds form only between certain base pairs—A and T, and C and G. In DNA replication, base pairing ensures that the complementary strands produced are identical to the original strands.

**15.** A prokaryote has a single, circular DNA molecule that contains nearly all of the cell's genetic information.

**16.** DNA separates into two strands, then produces two new complementary strands following the rules of base pairing. Each new DNA molecule has one strand from the original molecule and one new strand.

# Chapter 12 Study Guide

## 12–1 DNA

### Key Concepts

- Avery and other scientists discovered that DNA is the nucleic acid that stores and transmits the genetic information from one generation of an organism to the next.
- Hershey and Chase concluded that the genetic material of the bacteriophage was DNA.
- Watson and Crick's model of DNA was a double helix, in which two strands were wound around each other.

### Vocabulary

transformation, p. 288 • bacteriophage, p. 289
nucleotide, p. 291 • base pairing, p. 294

## 12–2 Chromosomes and DNA Replication

### Key Concept

- During DNA replication, the DNA molecule separates into two strands, then produces two new complementary strands following the rules of base pairing. Each strand of the double helix of DNA serves as a template, or model, for the new strand.

### Vocabulary

chromatin, p. 296 • histone, p. 296
replication, p. 299 • DNA polymerase, p. 299

## 12–3 RNA and Protein Synthesis

### Key Concepts

- There are three main types of RNA: messenger RNA, ribosomal RNA, and transfer RNA.
- During transcription, RNA polymerase binds to DNA and separates the DNA strands. RNA polymerase then uses one strand of DNA as a template from which nucleotides are assembled into a strand of RNA.
- During translation, the cell uses information from messenger RNA to produce proteins.

### Vocabulary

gene, p. 300 • messenger RNA, p. 301
ribosomal RNA, p. 301
transfer RNA, p. 301 • transcription, p. 301
RNA polymerase, p. 301 • promoter, p. 301
intron, p. 302 • exon, p. 302 • codon, p. 302
translation, p. 304 • anticodon, p. 304

## 12–4 Mutations

### Key Concept

- Mutations are changes in genetic material. Gene mutations result from changes in a single gene. Chromosomal mutations involve changes in whole chromosomes.

### Vocabulary

mutation, p. 307 • point mutation, p. 307
frameshift mutation, p. 307 • polyploidy, p. 308

## 12–5 Gene Regulation

### Key Concepts

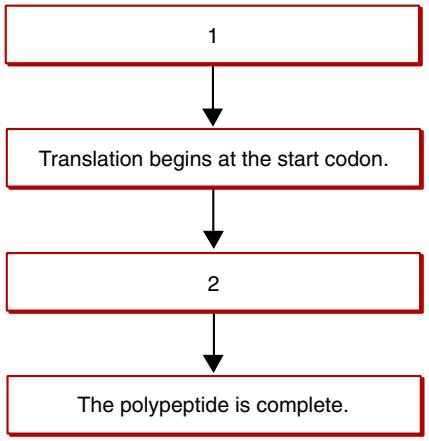
- The *lac* genes are turned off by repressors and turned on by the presence of lactose.
- Most eukaryotic genes are controlled individually and have regulatory sequences that are much more complex than those of the *lac* operon.

### Vocabulary

operon, p. 309 • operator, p. 310
differentiation, p. 312 • hox gene, p. 312

## Thinking Visually

Using the information in this chapter, complete the following flowchart about protein synthesis:




## CHAPTER RESOURCES

**Print:**

- ***Teaching Resources,*** Chapter Vocabulary Review, Graphic Organizer
- ***Chapter Tests: Levels A and B,*** Chapter 12 Test

**Technology:**

- ***iText,*** Chapter 12 Assessment
- ***Computer Test Bank,*** Chapter 12 Test

# Chapter 12 Assessment

Interactive textbook with assessment at PHSchool.com

## Reviewing Content

*Choose the letter that best answers the question or completes the statement.*

1. The process by which one strain of bacteria is apparently changed into another strain is called
   **a.** transcription. **c.** transformation.
   **b.** translation. **d.** replication.

2. Bacteriophages are
   **a.** tiny bacteria. **c.** coils of RNA.
   **b.** enzymes. **d.** viruses.

3. A nucleotide does NOT contain
   **a.** a 5-carbon sugar.
   **b.** polymerase.
   **c.** a nitrogen base.
   **d.** a phosphate group.

4. In prokaryotes, DNA molecules are located in the
   **a.** nucleus. **c.** cytoplasm.
   **b.** ribosome. **d.** histone.

5. The diagram below shows the process of DNA
   **a.** replication. **c.** translation.
   **b.** transcription. **d.** transformation.

6. The main enzyme involved in linking individual nucleotides into DNA molecules is
   **a.** transfer RNA. **c.** RNA polymerase.
   **b.** ribose. **d.** DNA polymerase.

7. The process by which the genetic code of DNA is copied into a strand of RNA is called
   **a.** translation. **c.** transformation.
   **b.** transcription. **d.** replication.

8. In messenger RNA, each codon specifies a particular
   **a.** nucleotide. **c.** amino acid.
   **b.** purine. **d.** pyrimidine.

9. Changes in the DNA sequence that affect genetic information are known as
   **a.** replications. **c.** transformations.
   **b.** mutations. **d.** prokaryotes.

10. An expressed gene is one that
    **a.** functions as a promoter.
    **b.** is transcribed into RNA.
    **c.** codes for only one amino acid.
    **d.** is made of mRNA.

## Understanding Concepts

11. As scientists tried to discover the nature of genes, what three critical gene functions had they identified?

12. Describe the components and structure of a DNA nucleotide.

13. Explain how Chargaff's rules helped Watson and Crick model DNA.

14. What is meant by the term *base pairing*? How is base pairing involved in DNA replication?

15. Describe the appearance of DNA in a typical prokaryotic cell.

16. Explain the process of replication. When a DNA molecule is replicated, how do the new molecules relate to the original molecule?

17. Describe the relationship between DNA, chromatin, histones, and nucleosomes.

18. What is the difference between exons and introns?

19. What is a codon?

20. What is an anticodon? How does it function?

21. If a code on a DNA molecule for a specific amino acid is CTA, what would be the messenger RNA codon? The transfer RNA anticodon?

22. Explain why controlling the proteins in an organism controls the organism's characteristics.

23. Name two major types of mutations. What do they have in common? How are they different? Give an example of each.

24. Describe how a TATA box helps position RNA polymerase in a eukaryotic cell.

25. Describe the role of an operon in a prokaryotic cell, and give an example of how an operon works.

## HOMEWORK GUIDE

| Section: | Questions: |
|---|---|
| Section 12–1 | 1–3, 11–14, 26, 27, 32 |
| Section 12–2 | 4–6, 15–17, 28 |
| Section 12–3 | 7, 8, 18–22, 24, 29–31, 34, 35 |
| Section 12–4 | 9, 23, 33 |
| Section 12–5 | 10, 25 |

Interactive Textbook

If your class subscribes to the iText, your students can go online to access an interactive version of the Student Edition and a self-test.

**(Continued from page 314)**

**17.** Nucleosomes are made up of DNA wrapped around histones. Chromatin is long chains of tightly coiled nucleosomes.

**18.** Pre-RNA contains introns that must be removed before RNA becomes active. The remaining RNA, the exons, or expressed sequences, are the actual genetic message that is used to assemble proteins.

**19.** A codon consists of three consecutive nucleotides that specify a single amino acid that is to be added to a polypeptide.

**20.** An anticodon consists of the three bases on the tRNA molecule that are complementary to an mRNA codon. Anticodons determine which tRNA binds to the codon on mRNA, and thus which amino acid is attached to the polypeptide chain.

**21.** GAU; CUA

**22.** Proteins are responsible for catalyzing and regulating chemical reactions, as well as regulating the rate and pattern of growth. These actions help determine an organism's characteristics.

**23.** Gene and chromosomal; both change the DNA sequence that affects genetic information. Gene mutations involve a change in one or several nucleotides in a single gene, whereas chromosomal mutations involve changes in the number or structure of whole chromosomes. Examples should reflect those given in Section 12–4.

**24.** The TATA box marks a point just before the point at which transcription begins.

**25.** An operon regulates gene expression. In the *lac* operon, the *lac* genes are turned off by a repressor that binds to the operator, blocking RNA polymerase from the promoter. When lactose is present, it binds to the repressor, causing it to release from the operator, allowing RNA polymerase to transcribe the *lac* genes.

Chapter 12 Assessment

## Critical Thinking

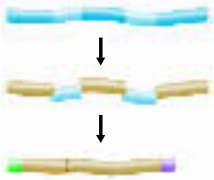
26. **Interpreting Graphics** Look back at Griffith's experiment, shown in **Figure 12–2.** Describe the occasion in which the bacterial DNA withstood conditions that killed the bacteria. Describe what happened to the DNA from that point until the end of the experiment.

27. **Using Models** Evaluate Watson and Crick's model of the DNA molecule. How adequately does it represent the structure of DNA?

28. **Using Analogies** Is photocopying a document similar to DNA replication? Think of the original materials, the copying process, and the final products. Explain how the two processes are alike. Identify major differences.

29. **Applying Concepts** Suppose you start with two DNA strands: ACCGTCAC and TCGCACGT. Use the "rules" of base pairing to list the bases on messenger RNA strands transcribed from those DNA strands.

30. **Predicting** Examine the first intron in the diagram below. What difference would result in the protein produced by the messenger RNA if that intron were not removed but instead functioned as an exon?



31. **Using Analogies** The word *transcribe* means "to write out," and the word *translate* means "to express in another language." Review the meanings of *transcription* and *translation* in genetics. How do the technical meanings of these words relate to meanings of the words in ordinary language?

32. **Inferring** Rosalind Franklin's X-ray patterns showed that the distance between the two phosphate-sugar "backbones" of a DNA molecule is the same throughout the length of the molecule. How did that information help Watson and Crick determine how the bases are paired?

33. **Comparing and Contrasting** How does the possible impact of a chromosomal mutation that occurs during meiosis differ from that of a similar event that occurs during mitosis of a body cell not involved in reproduction?

34. **Predicting** A researcher identifies the nucleotide sequence AAC in a long strand of RNA inside a nucleus. In the genetic code, AAC codes for the amino acid asparagine. When that RNA becomes involved in protein synthesis, will asparagine necessarily appear in the protein? Explain.

35. **Connecting Concepts** Recall what you learned about mitosis in Chapter 10 and meiosis in Chapter 11. Describe what happens to a cell's DNA during each of these processes.

## Writing in Science

Recall that Gregor Mendel concluded that factors, which we now call genes, determine the traits that are passed from one generation to the next. Imagine that you could send a letter backwards in time to Mendel. Write a letter to him in which you explain what a gene consists of in molecular terms. In your letter, you will need to explain, briefly, what DNA and proteins are. (*Hints:* Your explanation can be simple; you do not have to include the details of transcription and translation. Review Chapter 2 for the definition of protein.)

### Performance-Based Assessment

**Make a Model** Make a three-dimensional model representing protein synthesis. Your "protein" should be a sequence of three different amino acids. Show the DNA molecule and the related RNA molecules that would be involved in producing your protein.

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## Critical Thinking

**26.** Griffith heated a culture of the disease-causing strain, which killed the bacteria but did not destroy the DNA. When he mixed the heat-killed, disease-causing bacteria with the live, harmless bacteria, the DNA from the disease-causing bacteria was picked up by the live bacteria. The disease-causing DNA began replicating and was passed on to new bacteria cells. The new bacteria cells were disease-causing because of their DNA. These bacteria caused pneumonia in the mice.

**27.** Watson and Crick's model includes all the components of DNA arranged in such a way as to explain Chargaff's rules and X-ray evidence, and provide a mechanism for replication.

**28.** DNA replication is similar to photocopying because an exact duplicate is made. DNA replication is different because the strands are templates for the production of two DNA molecules. Each new molecule contains half the original molecule. In photocopying, the copy is an entirely new image and the original is preserved intact.

**29.** UGGCAGUG; AGCGUGCA

**30.** Additional amino acids would be added to the protein, and it would probably not function properly in the cell.

**31.** In genetics, transcription is the process by which a complementary strand of RNA is produced from DNA. It is similar to its meaning in ordinary language in that the order of DNA nucleotides is written out. In genetics, translation refers to the decoding of the RNA "message" into an amino acid sequence. In ordinary language, it refers to the similar process of converting one language into another.

**32.** Adenine and guanine are larger than cytosine and thymine. The equal distance between the backbones suggested that a small base must always be paired with a large base.

**33.** Chromosomal mutations that occur during meiosis affect the gametes and could appear in the offspring. Mitotic chromosomal mutations will affect only a few body cells.

**34.** No, asparagine will not necessarily appear in the protein. The sequence may be part of two adjacent codons that specify different amino acids, or it may be part of an intron.

**35.** During mitosis, the cell's DNA is replicated and each daughter cell receives a copy. Each new cell has the same amount of DNA as the original cell. During meiosis, the cell's DNA is also replicated. But two divisions result in four daughter cells that have half the chromosome number of the original cell.