Chapter 13 Review

READING TOOLBOX

1. **Word Parts** Use the Word Parts exercise to identify and then understand the enzymes described in this chapter.
2. **Concept Mapping** Make a concept map that shows the structure of DNA and the way that DNA replicates. Try to include the following words in your concept map: *nucleotides, purine, pyrimidine, double helix, replication, transfer RNA, ribosomal RNA, gene expression, DNA polymerases,* and *gene.*

Using Key Terms

Use each of the following terms in a separate sentence.

3. *nucleotide*
4. *DNA replication*

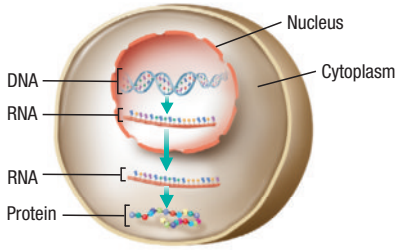
For each pair of terms, explain how the meanings of the terms differ.

5. *transcription* and *translation*
6. *gene* and *DNA*
7. *DNA helicase* and *DNA polymerase*

Understanding Key Ideas

8. What is the function of DNA?
   a. DNA creates genetic material.
   b. DNA controls all of the aspects of an organism's behavior.
   c. DNA enables organisms to pass on genetic information to their offspring.
   d. DNA enables organisms to produce offspring that are identical to their parents.
9. If the sequence of nitrogenous bases in one strand of DNA is GAGTC, what is the sequence of bases in the complementary strand of DNA?
   a. AGACT c. ATACG
   b. TCTGA d. CTCAG
10. Which of the following bases pairs with uracil in an RNA molecule?
    a. adenine c. thymine
    b. guanine d. cytosine
11. What was the significance of Frederick Griffith's experiments with DNA?
    a. Griffith showed that DNA has a double-helix structure.
    b. Griffith disproved the idea that DNA contained genetic material.
    c. Griffith discovered that genetic material could be transferred between cells.
    d. Griffith demonstrated that viruses could inject their DNA into bacterial cells.
12. What does the process of transcription produce?
    a. tRNA c. mRNA
    b. RNA d. DNA

Use the diagram to answer the following question.



13. This illustration shows a eukaryotic cell. Where does translation occur in this cell?
    a. in the DNA c. in the nucleus
    b. in the cytoplasm d. in the ribosome

Explaining Key Ideas

14. **Identify** the roles that proteins play in DNA replication.
15. **Compare** the structure of RNA with that of DNA.
16. **Determine** the kinds of events that can cause complications in gene expression.
17. **Relate** the role of codons to the sequence of amino acids that results after translation.

Assignment Guide

Section	Questions
1	3, 6, 8, 9, 11, 18, 24, 26, 29, 30, 31
2	4, 7, 14, 19, 20, 21, 22
3	5, 10, 12, 13, 15, 16, 17, 23, 25, 27, 28

Review

Reading Toolbox

1. DNA helicase: an enzyme that acts on the DNA helix configuration to break bonds between the nitrogen bases

   DNA polymerase: an enzyme that helps add nucleotides to form a new DNA molecule

   RNA polymerase: an enzyme that adds nucleotides as it reads the code of the gene
2. See previous page for answer to concept map.

Using Key Terms

3. Sample answer: *Nucleotides* form the backbone of the DNA staircase.
4. Sample answer: *DNA replication* creates two identical DNA molecules.
5. *Transcription* takes place in the nucleus and produces mRNA; *translation* takes place on the ribosome and involves mRNA, tRNA, and amino acids.
6. A *gene* is a section of *DNA* that codes for a polypeptide.
7. *DNA helicase* "unzips" a DNA molecule, breaking bonds; *DNA polymerase* makes bonds by joining nucleotides to existing bases while "proofreading" for accuracy.

Understanding Key Ideas

8. c 9. d 10. a 11. c
12. c 13. b

Explaining Key Ideas

14. DNA helicase breaks hydrogen bonds, allowing the DNA strands to disconnect. DNA polymerase bonds nucleotides to the exposed base pairs while proofreading the strand to eliminate mistakes.
15. RNA has ribose rather than deoxyribose. It contains the base uracil rather than thymine, and it is a single, rather than a double, strand.
16. Variations, mistakes, feedback, and other complex interactions among any parts of the processes of protein synthesis can affect gene expression.
17. The sequence of codons on mRNA determines the sequence of amino acids in translation.

Using Science Graphics

18. b

Critical Thinking

19. replication would not occur

20. In eukaryotic cells, DNA replication occurs simultaneously in about 100 sections per chromosome, compared with only two replication forks in prokaryotes. There is more room for error.

21. A replication fork is a place where the strands of DNA are separated, allowing for the addition of new nucleotides by DNA polymerase.

22. Eukaryotic chromosomes are much longer than prokaryotic chromosomes, and need multiple replication forks. If eukaryotic cells used only one replication fork, it would take 33 days to replicate a single chromosome.

23. mRNA carries the code for making a protein from DNA (a gene). tRNA translates the codons by delivering the correct amino acids to join into a polypeptide.

24. Watson and Crick used Chargaff's research to determine the base-pairing. They used the X-ray diffraction photograph from Franklin and Wilkins to determine the physical arrangement of the bases in nucleotide strands that formed a double helix.

25. Accept all reasonable answers. For example, different protein combinations produce different traits.

Writing for Science

26. Make sure students accurately acknowledge contributors.

Methods of Science

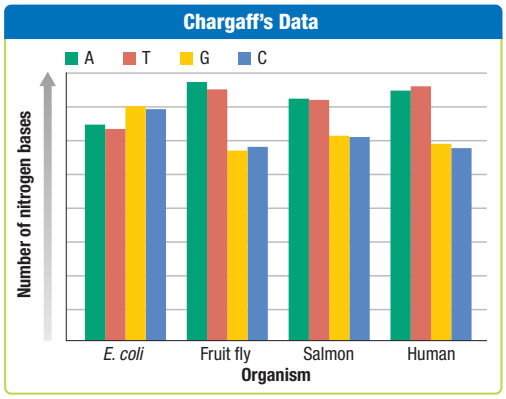
27. It is advantageous to have only one start signal so that protein synthesis begins only at a specific location. There are multiple stop codons so that if a point mutation occurs, protein synthesis can still stop.

Alternative Assessment

28. Make sure that students understand that the purpose of this exercise is to show the sophistication of gene expression.

Using Science Graphics

Use the table to answer the following question.



18. Chargaff collected data involving bases in DNA. Which of the following ratios most accurately expresses the relationship between adenine and thymine in DNA?

a. 1:2 **c.** 2:1
b. 1:1 **d.** 1:4

Critical Thinking

19. Predicting Outcomes What would happen if the enzymes that keep DNA strands separated during the replication process were not present?

20. Recognizing Relationships How might the process of DNA replication in eukaryotic cells lead to more errors than the process of DNA replication in prokaryotic cells does?

21. Relating Concepts How does a replication fork enable the process of DNA replication?

22. Justifying Conclusions Why does DNA replication in eukaryotic cells involve multiple replication forks?

23. Contrasting Functions Contrast the roles of mRNA and tRNA in the process of protein synthesis.

24. Evaluating Viewpoints How did Watson and Crick build on the discoveries of other scientists to determine the structure of DNA?

25. Proposing Alternative Hypotheses Propose one possible exception to the formula of "one gene → one protein → one trait."

Writing for Science

26. Speech Writing Imagine that you are asked to introduce Watson, Crick, and Wilkins at the Nobel Prize ceremony in 1962. Write a speech that details the work that contributed to the discovery of the structure of DNA.

Methods of Science

27. Forming Hypotheses Recall that mRNA has one start codon and three stop codons. Based on what you know about the process of gene expression, hypothesize why it would be beneficial to have only one start codon but three stop codons involved in this process.

Alternative Assessment

28. Brochure Human blood types are examples of the complex results of genes. Make a brochure entitled "A Guide to Human Blood Types for Blood Donors." Use reference sources to find out about the major blood types. Be sure to find out and explain why each blood type matters for blood-donating purposes and what the genetic determinants of each blood type are.

Math Skills

Use the table to answer the following questions.

Percentage of Each Nitrogen Base

	A	T	G	C
Human	30.4	30.1	19.6	19.9
Wheat	27.3	27.1	22.7	22.8
E. coli	24.7	23.6	26.0	25.7

29. Ratios What is the ratio of purines to pyrimidines?

30. Percentages Within each organism, which nucleotides are found in similar percentages?

31. Do the ratio and percentages in the previous two questions follow Chargaff's rule?

Math Skills

29. 1 to 1

30. For all three organisms, the adenine to thymine ratio is the same; the guanine to cytosine ratio is the same.

31. yes