Chapter 15 Review

READING TOOLBOX

1. **Analogies** Complete the following analogy:

   genetic disorder : protein :: diabetes : ___

2. **Concept Map** Construct a concept map that differentiates the major processes of gene manipulation. Try to use the following terms: *cloning, genes, organisms, PCR, recombinant, engineering, SCNT,* and *asexual reproduction.*

Using Key Terms

3. Use the following terms in the same sentence: *restriction enzyme, DNA polymorphisms,* and *DNA fingerprint.*

Complete each of the following sentences by choosing the correct word from the word bank.

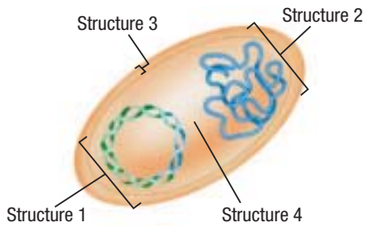
Genomics
Bioinformatics
Electrophoresis

4. ___ is the use of computers with biological data.
5. ___ is the separation of molecules using electricity.
6. ___ is the study of entire genomes.

Understanding Key Ideas

7. One of the surprising discoveries of the Human Genome Project was that
   - **a.** the human genome consists of only about 25,000 genes.
   - **b.** about 99% of the human genome codes for proteins.
   - **c.** each gene encodes only a single protein.
   - **d.** DNA is found in the nucleus of cells.
8. A DNA microarray is an important tool because it
   - **a.** can cure cancer.
   - **b.** identifies an individual.
   - **c.** makes tumor cells glow green.
   - **d.** shows which genes are active in a cell.
9. An organism that has been given a new gene through genetic engineering can be called any of the following *except*
   - **a.** transgenic.
   - **b.** sequenced.
   - **c.** recombinant.
   - **d.** genetically modified.
10. The Southern blot process is used to analyze
    - **a.** RNA.
    - **b.** DNA.
    - **c.** mRNA.
    - **d.** protein.
11. What do linkage mapping methods identify?
    - **a.** only genes that are inherited together
    - **b.** the exact nucleotide sequence of a chromosome
    - **c.** the relative position of genes along a chromosome
    - **d.** the exact number of base pairs between specific genes

This diagram shows a cell with recombinant DNA. Use the diagram to answer the following questions.



12. Which part of this cell is recombinant DNA?
    - **a.** structure 1
    - **b.** structure 2
    - **c.** structure 3
    - **d.** structure 4
13. The most appropriate term to describe this cell is
    - **a.** *somatic.*
    - **b.** *totipotent.*
    - **c.** *transgenic.*
    - **d.** *nongenetic.*

Explaining Key Ideas

14. **Identify** an application of gene technologies in human health care.
15. **Describe** how cloning can be used to produce embryonic stem cells.
16. **Identify** a risk associated with growing genetically modified cereal crops on farms.
17. **Describe** how a scientist could use gene recombination and cloning to produce a human protein.
18. **Compare** genomic libraries to EST libraries.

Assignment Guide

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

Review

Reading Toolbox

1. insulin
2. See previous page for answer to concept map.

Using Key Terms

3. *Restriction enzymes* can be used to make a *DNA fingerprint,* which will reveal *DNA polymorphisms* among individuals.
4. Bioinformatics
5. Electrophoresis
6. Genomics

Understanding Key Ideas

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

Explaining Key Ideas

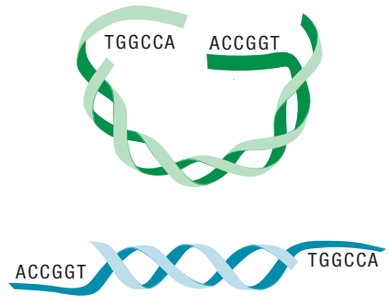
14. Answers might include insulin production, genetic counseling, vaccines, or gene therapy.
15. The nucleus of a somatic cell can be placed in an enucleated egg cell; when it divides, the new cells are clones of the somatic cells.
16. Genes from a modified crop may spread to a wild species and become part of a genome for which it was not intended.
17. First, the scientist would isolate the gene that codes for the human protein, splice it into plasmids, and induce bacteria to take up the plasmids. Then, the scientist would place the bacteria in culture medium to allow the cells to divide. Next, the scientist would screen for bacteria that have the gene and culture more of these. As the gene is expressed in the bacteria, the protein will be produced and can be harvested from the culture.
18. A genomic library contains all the DNA in the genome of a particular organism; an EST library contains only the expressed genes in an organism's genome.

Using Science Graphics

19. c 20. b

Using Science Graphics

This diagram shows two pieces of DNA that originated in two different organisms. Use the diagram to answer the following questions.



19. The single-stranded segments that stick out at the end of each DNA piece are called *sticky ends* because the strands form pairs that are
- **a.** identical.
- **b.** denatured.
- **c.** complementary.
- **d.** double stranded.

20. From the diagram, you can tell that each of these DNA segments has been
- **a.** taken up by a bacterium.
- **b.** cut by a restriction enzyme.
- **c.** denatured by a polymerase enzyme.
- **d.** recombined to make a genetically modified organism.

Critical Thinking

21. Forming Reasoned Opinions A student says that the Human Genome Project is a purely scientific pursuit and that there is no need to worry about ethical questions because science can answer any question. Do you agree with this statement? Explain.

22. Evaluating Complex Issues In the United States, government regulations require researchers to contain experimental GMOs inside a laboratory and to ensure that the organism cannot survive outside the lab. Why do you think that these strict regulations are in place?

23. Relating Concepts Scientists often use PCR before performing other DNA manipulation processes, such as Southern blot or sequencing. Why?

24. Making Inferences Should communication be an important aspect of bioinformatics? Explain.

Methods of Science

25. Critiquing Procedures The earlier method of DNA sequencing used four separate batches of radioactively tagged nucleotides. These nucleotides were added to four separate batches of the same DNA fragments, each of which were run through the termination and sorting steps. The newer method uses one mixture of four fluorescent, color-coded nucleotides mixed together and run in one batch. In what ways is the newer process more efficient?

Writing for Science

26. Script Your geneticist friend has just e-mailed you with exciting news: She has produced the first crop of glow-in-the-dark cotton! She has asked you to help think of ways to sell the cotton or to make new products from it. Help out your friend by writing a script for a television commercial that will help sell the cotton or products made from it.

Technology Skills

27. Visual Communication Create a slide show, cartoon, or animation that illustrates what happens in the PCR cycle. Present your project to your class, or display it on the internet.

Alternative Assessment

28. Veggie Invention Would people eat more broccoli if it were pink? Would they eat butter-flavored corn on the cob or orange-flavored spinach? Invent an idea for a new fruit or vegetable that could encourage people to eat more fruits and vegetables. Create an advertisement for your new item, and present it to your class. Be sure to consider the potential benefits of the new item and any negative reactions that people might have to it.

Math Skills

29. Rates Suppose a scientist wants to search for a specific gene from a complete genome sequence. Looking at printed sequences, a trained scientist can search through about 1,000 bases per minute. At this rate, estimate the amount of time it would take to search for a 1000-base-pair gene in the *Drosophila* genome, which contains 80,000,000 base pairs.

Critical Thinking

21. Sample answer: I disagree. The HGP raises many ethical questions that cannot be answered by science, such as the emotional aspects of what make us human.

22. The regulations are prompted by concerns that GMOs might cause disease or harm the environment. By limiting their survival outside the lab, scientists are preventing the organisms from possibly harming people or other organisms and interfering in food chains.

23. Often the amount of DNA available for analysis is so limited that PCR is needed to amplify it for analysis.

24. Sample answer: Yes, information needs to be shared with the research community and the public in order to promote understanding and facilitate progress.

Methods of Science

25. Being able to use four color-coded fluorescent tags side-by-side allows researchers to read the entire sequence of a piece of DNA at once.

Writing for Science

26. Sample ad: "Want to be the 'light' of the party? Wear a Glo-Clo™ T-shirt and be prepared for 'enlightening' conversation.

Technology Skills

27. Student products should show the thermal cycling steps: denaturing and exposing bases, adding primers, and adding nucleotides with DNA polymerase. Each new cycle needs to start with the previous end products.

Alternative Assessment

28. Student products should show novel modifications of existing fruits and vegetables, propose potential benefits, and address dangers or concerns.

Math Skills

29. 1000 bp × 60 min/h × 8 h/day = 480,000 bp/day. To examine an 80,000,000 bp sequence, divide by 480,000 bp/day. It would take 166 days to examine them all!