

15.2 Recombinant DNA

Lesson Objectives

- ☐ Explain how scientists manipulate DNA.
- ☐ Describe the importance of recombinant DNA.
- ☐ Define transgenic and describe the usefulness of some transgenic organisms to humans.

Lesson Summary

Copying DNA Genetic engineers can transfer a gene from one organism to another to achieve a goal, but first, individual genes must be identified and separated from DNA. The original method (used by Douglas Prasher) involved several steps:

- ▶ Determine the amino acid sequence in a protein.
- ▶ Predict the mRNA code for that sequence.
- ▶ Use a complementary base sequence to attract the predicted mRNA.
- ▶ Find the DNA fragment that binds to the mRNA.

Once scientists find a gene, they can use a technique called the **polymerase chain reaction** to make many copies.

- ▶ Heat separates the DNA into two strands.
- ▶ As the DNA cools, primers are added to opposite ends of the strands.
- ▶ DNA polymerase adds nucleotides between the primers, producing two complementary strands. The process can be repeated as many times as needed.

Changing DNA **Recombinant DNA** molecules contain DNA from two different sources. Recombinant-DNA technology can change the genetic composition of living organisms.

- ▶ **Plasmids** are circular DNA molecules found in bacteria and yeasts; they are widely used by scientists studying recombinant DNA, because DNA joined to a plasmid can be replicated.
- ▶ A **genetic marker** is a gene that is used to differentiate a cell that carries a recombinant plasmid from those that do not.

Transgenic Organisms **Transgenic** organisms contain genes from other species. They result from the insertion of recombinant DNA into the genome of the host organism. A **clone** is a member of a population of genetically identical cells.

Copying DNA

For Questions 1–5, complete each statement by writing in the correct word or words.

1. Genetic engineers can transfer _____ from one organism to another.
2. As a first step toward finding a gene, Douglas Prasher studied the _____ sequence of part of a protein.
3. Prasher next found the _____ base sequence that coded for the protein.

4. Using the technique of _____, Prasher matched the mRNA to a DNA fragment that contained the gene for GFP.
5. Southern blot analysis uses _____ probes to bind to fragments with complementary base sequences.
6. **THINK VISUALLY** Make a sketch to show the steps in the polymerase chain reaction (PCR) method of copying genes. Label each part of your sketch.

Changing DNA

For Questions 7–10, write the letter of the correct answer on the line at the left.

- _____ 7. Why is DNA ligase so important in recombinant DNA technology?
- A. It causes DNA to make multiple copies of itself.
 - B. It joins two DNA fragments together.
 - C. It shapes bacterial DNA into a circular plasmid.
 - D. It cuts DNA into restriction fragments.
- _____ 8. A recombinant plasmid can be used to
- A. prevent nondisjunction at meiosis.
 - B. double the number of chromosomes in a plant cell.
 - C. cut DNA into restriction fragments.
 - D. transform a bacterium.

9. What do genetic engineers use to create the "sticky ends" needed to splice two fragments of DNA together?
- A. an amino acid sequence
 - B. DNA ligase
 - C. restriction enzymes
 - D. mRNA
10. Why must a genetically engineered plasmid contain a genetic marker?
- A. to prevent the construction of an artificial chromosome
 - B. to separate cells that contain recombinant DNA from those that do not
 - C. to produce multiple copies of the recombined plasmid after heat treatment
 - D. to break apart the circular plasmid and introduce another DNA fragment
11. Give a reason why a plasmid is useful for DNA transfer.

Transgenic Organisms

12. Complete the flowchart about how a transgenic plant is produced, using *Agrobacterium* as an example.

Agrobacterium can cause tumors in plants. The part of the DNA that causes tumors is deactivated and replaced with _____ DNA.

The _____ bacteria are placed in a dish with plant cells.
The bacteria infect the plant cells.

Inside a plant cell, *Agrobacterium* inserts part of its DNA into the host cell
_____.

A _____ is generated from the transformed cell.

13. What is a transgenic organism?

14. What can happen when DNA is injected into the nucleus of an animal's egg cell?

15. How is a DNA molecule constructed so that it will eliminate a particular gene?

16. What is a clone?

17. What kinds of mammals have been cloned in recent years?

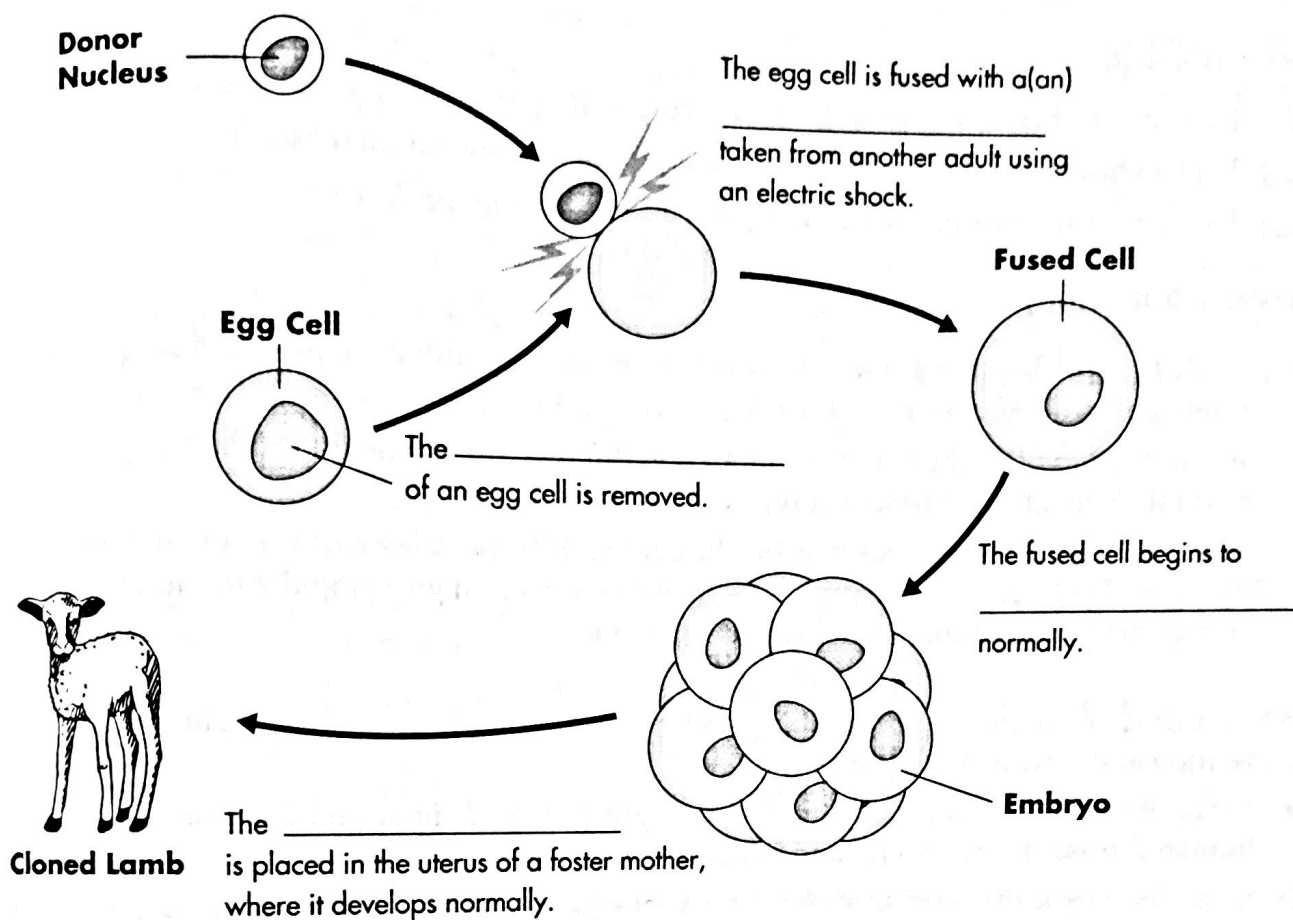
For Questions 18–22, write *True* if the statement is true. If the statement is false, change the underlined word to make the statement true.

- _____ 18. An organism that contains one or more genes from another species is inbred.
- _____ 19. Transgenic organisms can be made by inserting recombinant DNA into the genome of the host organism.
- _____ 20. Examining the properties of a transgenic organism allows scientists to discover the function of the transferred chromosome.
- _____ 21. Plant cells will sometimes take up DNA on their own if their cell walls are absent.
- _____ 22. Carefully designed DNA molecules can achieve gene replacement.

On the lines below, write *T* next to an example of a transgenic organism, and *C* next to an example of a clone.

- _____ 23. A goat that produces spider's silk in its milk
- _____ 24. A plant that is grown from a cell into which *Agrobacterium* has incorporated recombinant DNA
- _____ 25. A lamb that is born with the same DNA as a donor cell
- _____ 26. A colony of bacteria that grows from one bacterium
- _____ 27. A bacterium that can produce human insulin

28. **THINK VISUALLY** Complete the sentences in the diagram below to show the steps in cloning a sheep.



Apply the Big Idea

29. The most successful heart transplants occur when proteins in the donor heart closely match those of the recipient's original heart. If the proteins don't match, the recipient's immune system may reject the transplanted organ. Scientists would like to develop a strain of transgenic pigs that could provide donor hearts for humans. How might such an animal be developed? How might cloning help provide hearts for human recipients?
