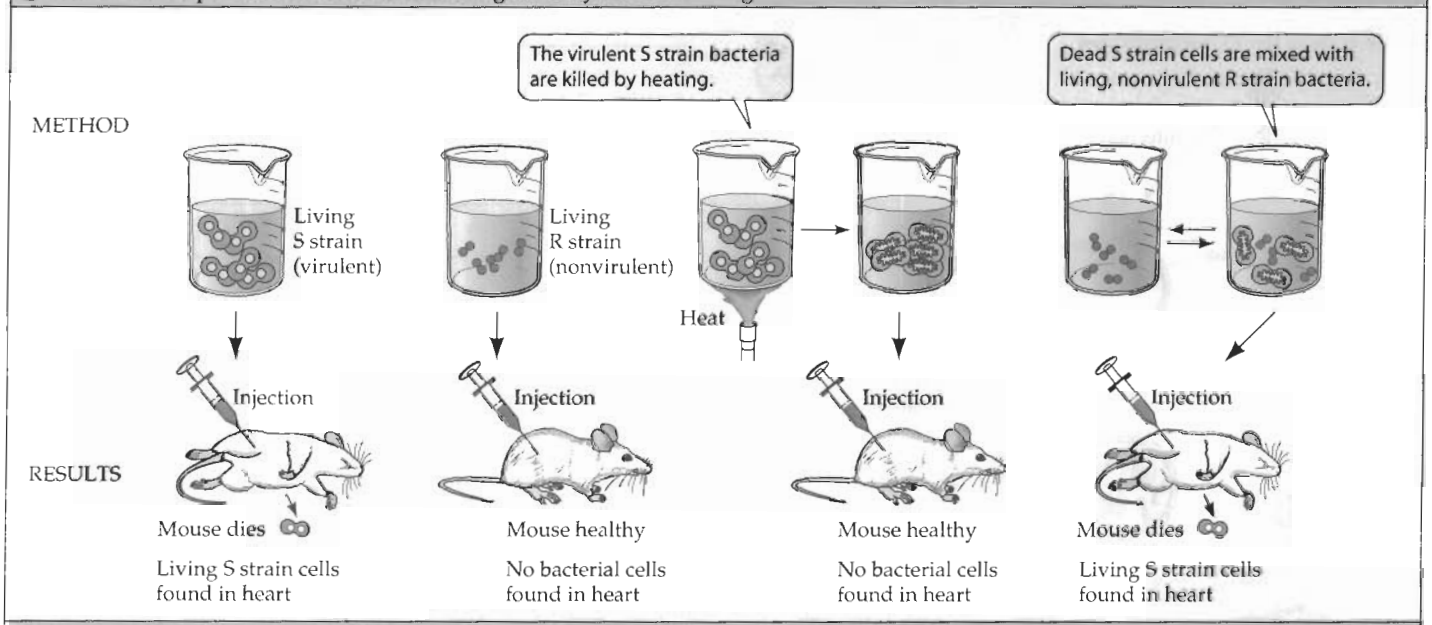
11 DNA and Its Role in Heredity

EXPERIMENT

Question: Can the presence of dead bacterial cells genetically transform living bacterial cells?

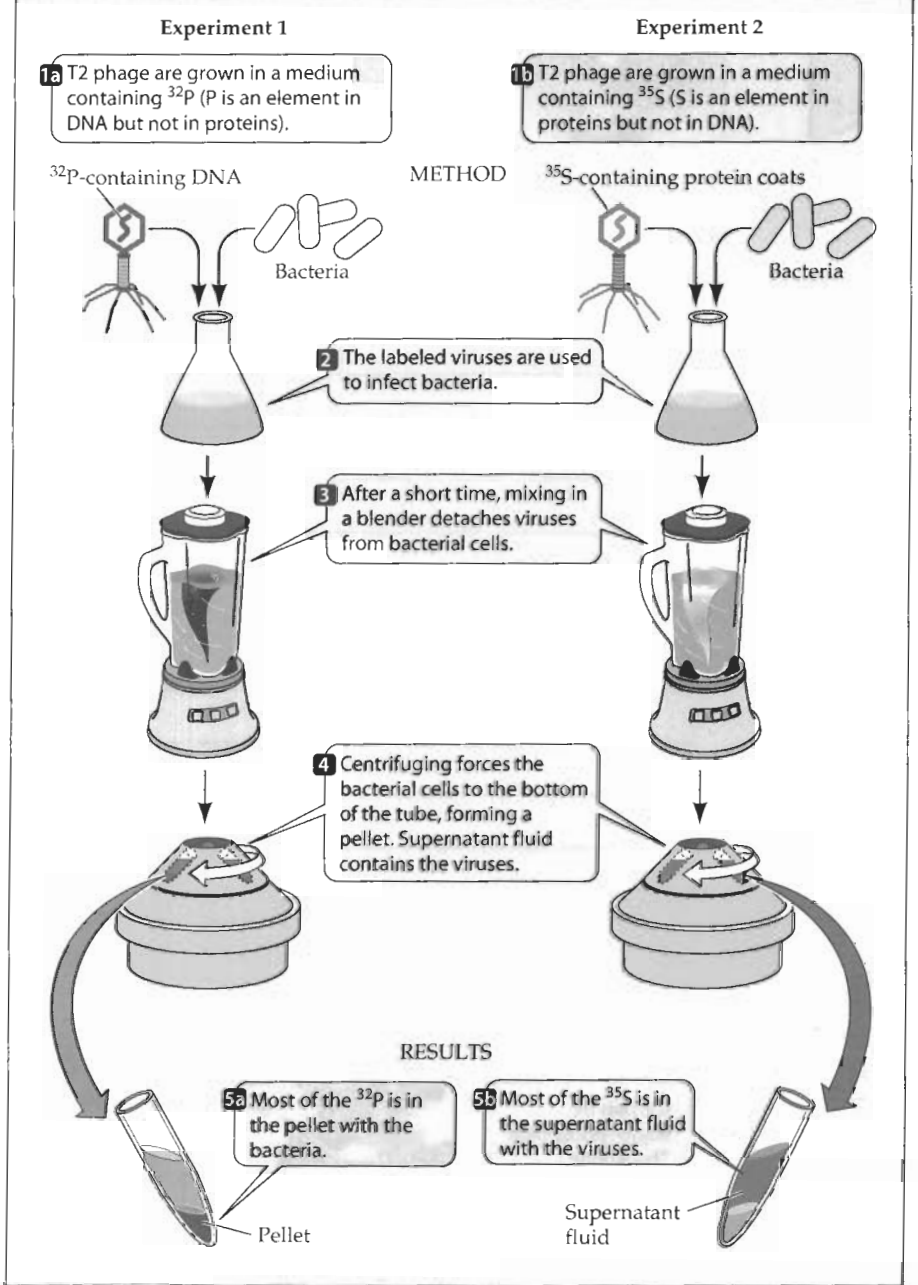


Conclusion: A chemical component from one cell is capable of genetically transforming another cell.

11.1 Genetic Transformation of Nonvirulent Pneumococci *(Page 214)*

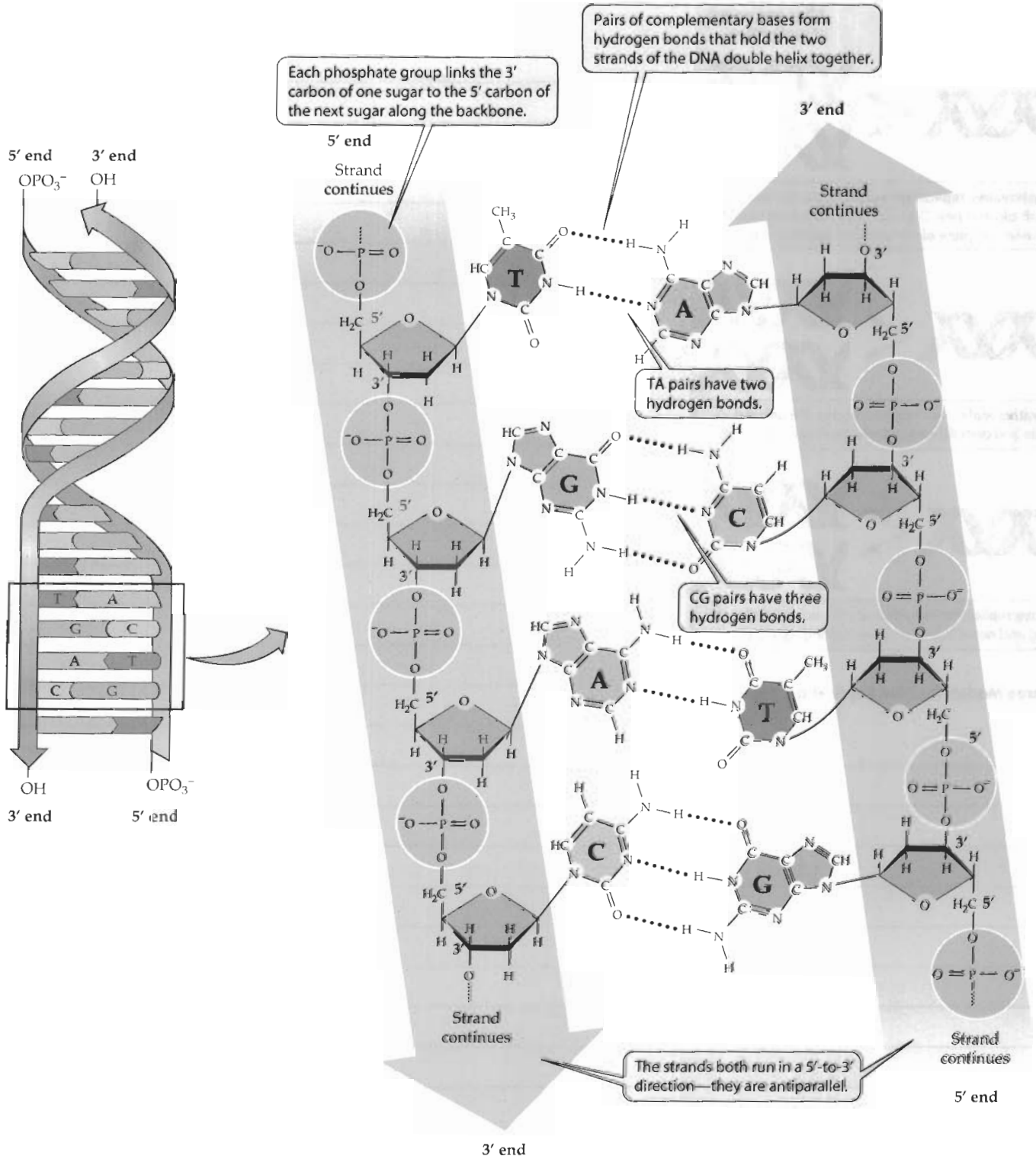
EXPERIMENT

Question: Which component of a bacteriophage—DNA or protein—is the hereditary material that enters a bacterial cell to direct the assembly of new virus particles?

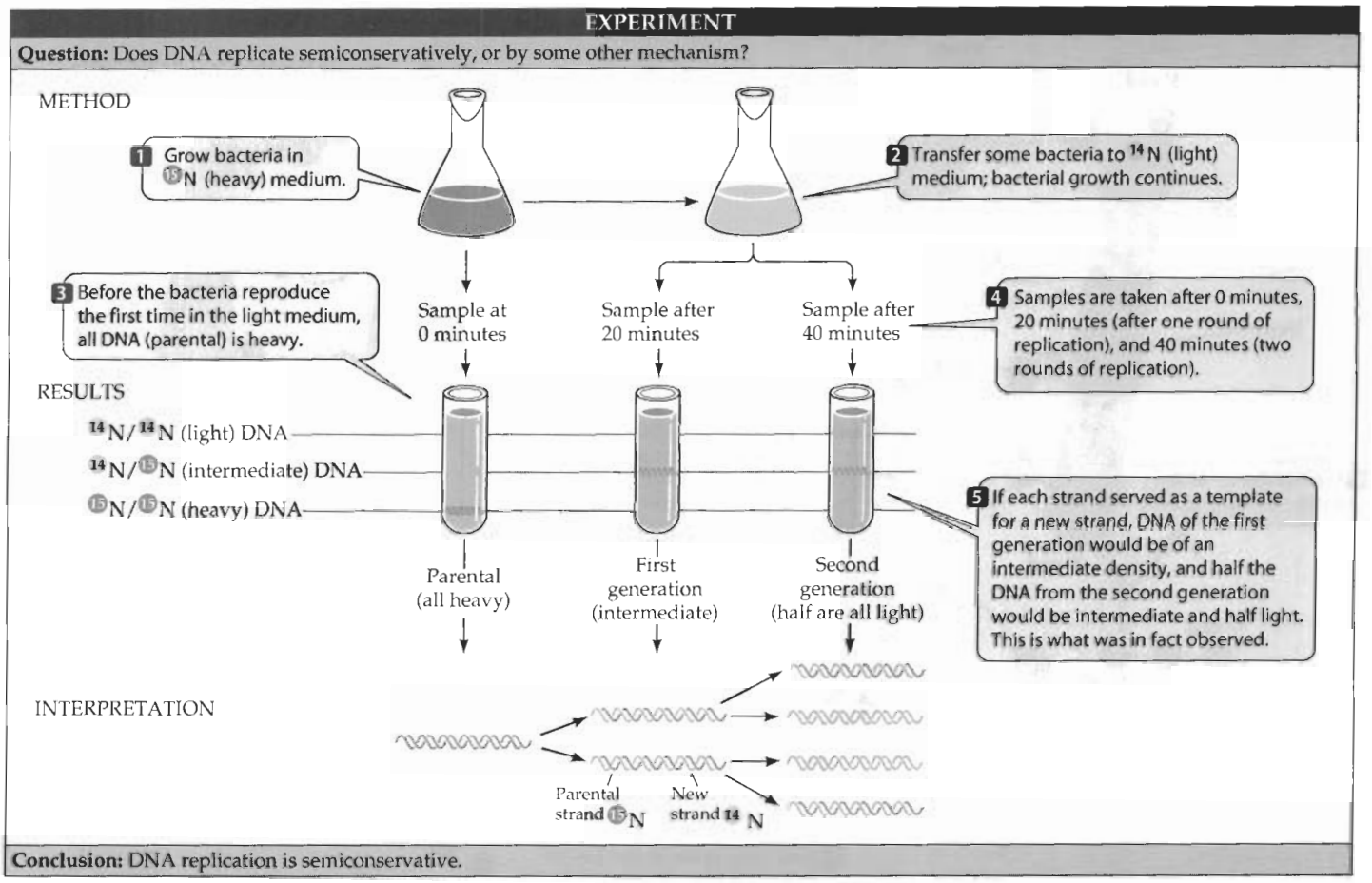


Conclusion: DNA, not protein, enters bacterial cells and directs the assembly of new viruses.

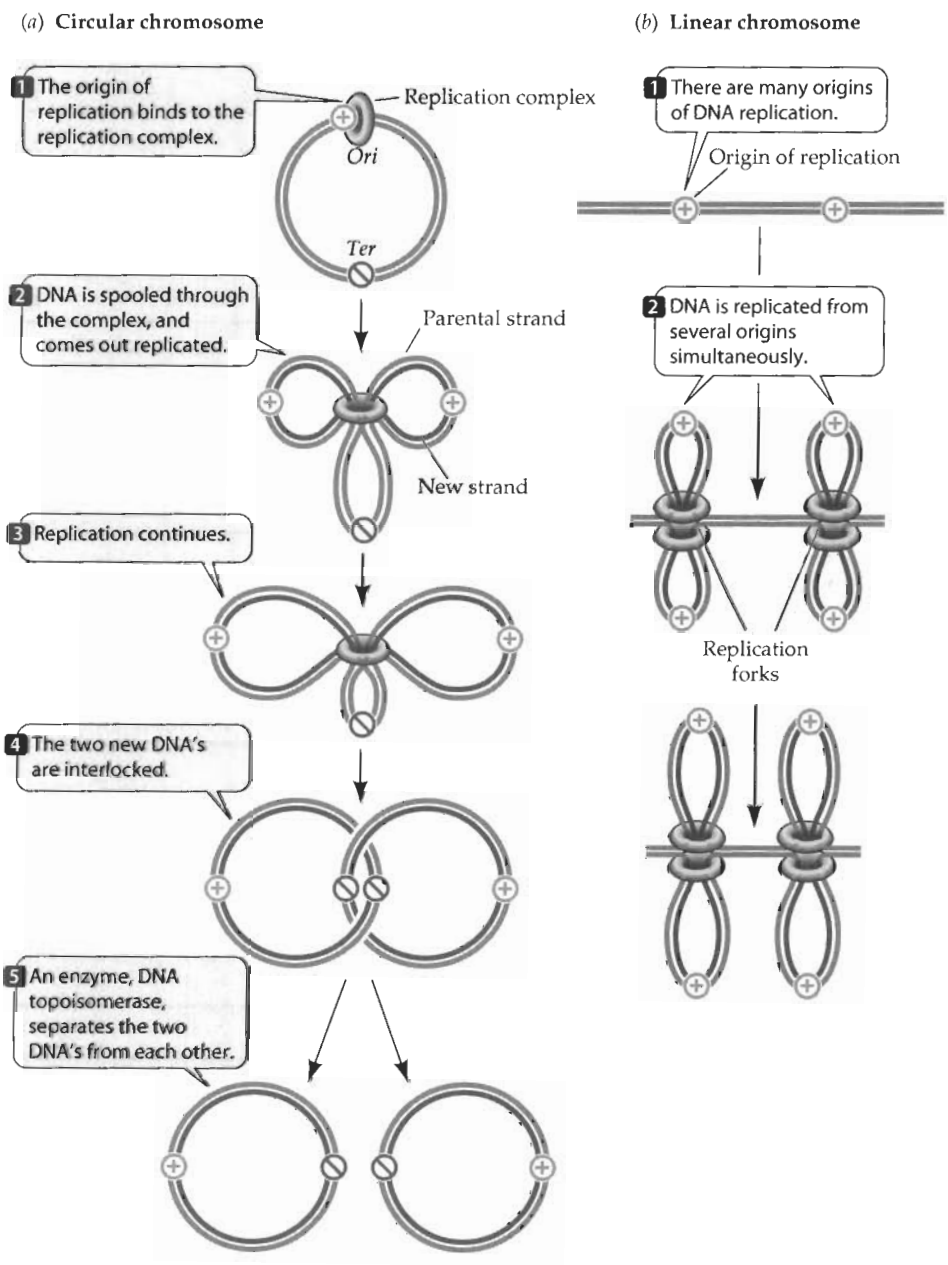
11.3 The Hershey–Chase Experiment *(Page 216)*



11.7 Base Pairing in DNA Is Complementary *(Page 219)*

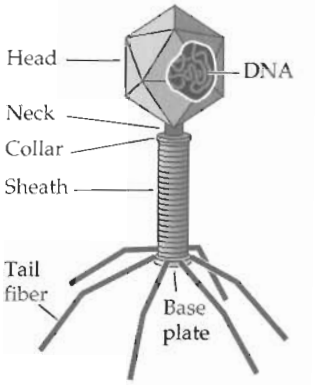


11.9 The Meselson–Stahl Experiment *(Page 221)*

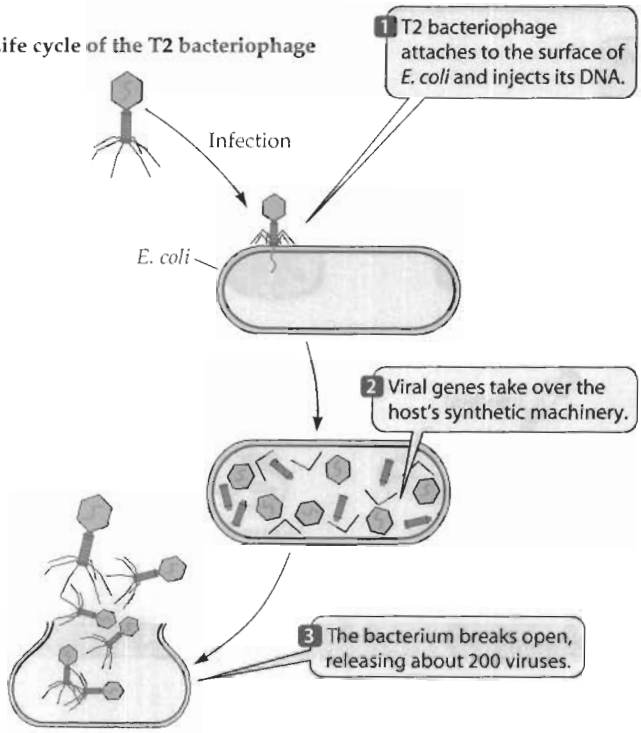


11.12 Replication in Small Circular and Large Linear Chromosomes *(Page 224)*

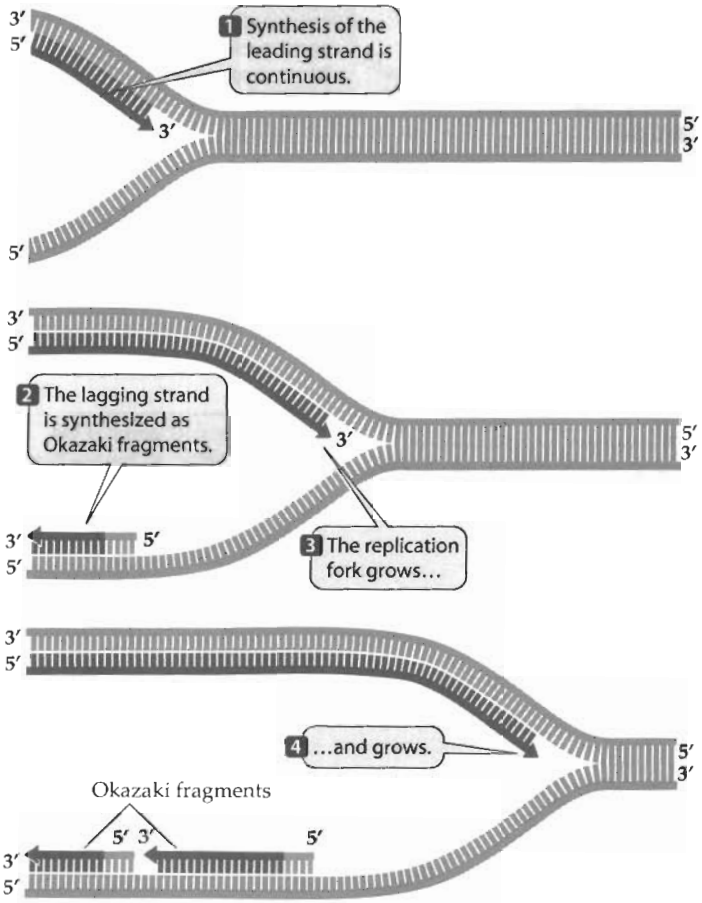
(*a*) **The virus: T2 bacteriophage**



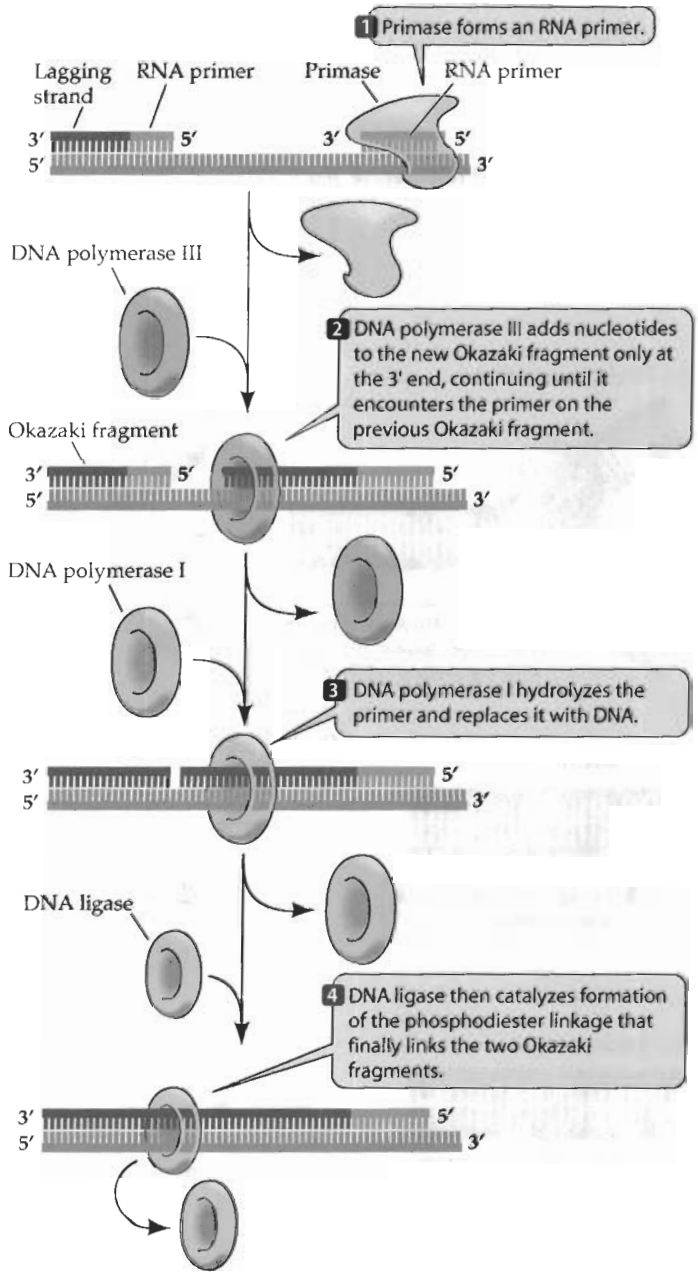
(*b*) **Life cycle of the T2 bacteriophage**



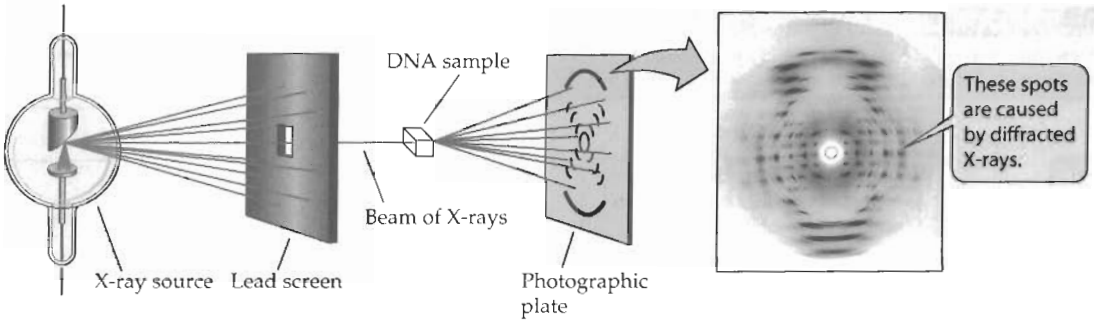
11.2 T2 and the Bacteriophage Reproduction Cycle *(Page 215)*



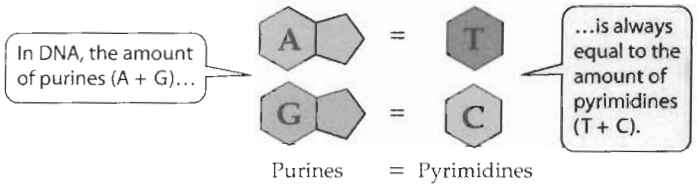
11.16 The Two New Strands Form in Different Ways *(Page 225)*



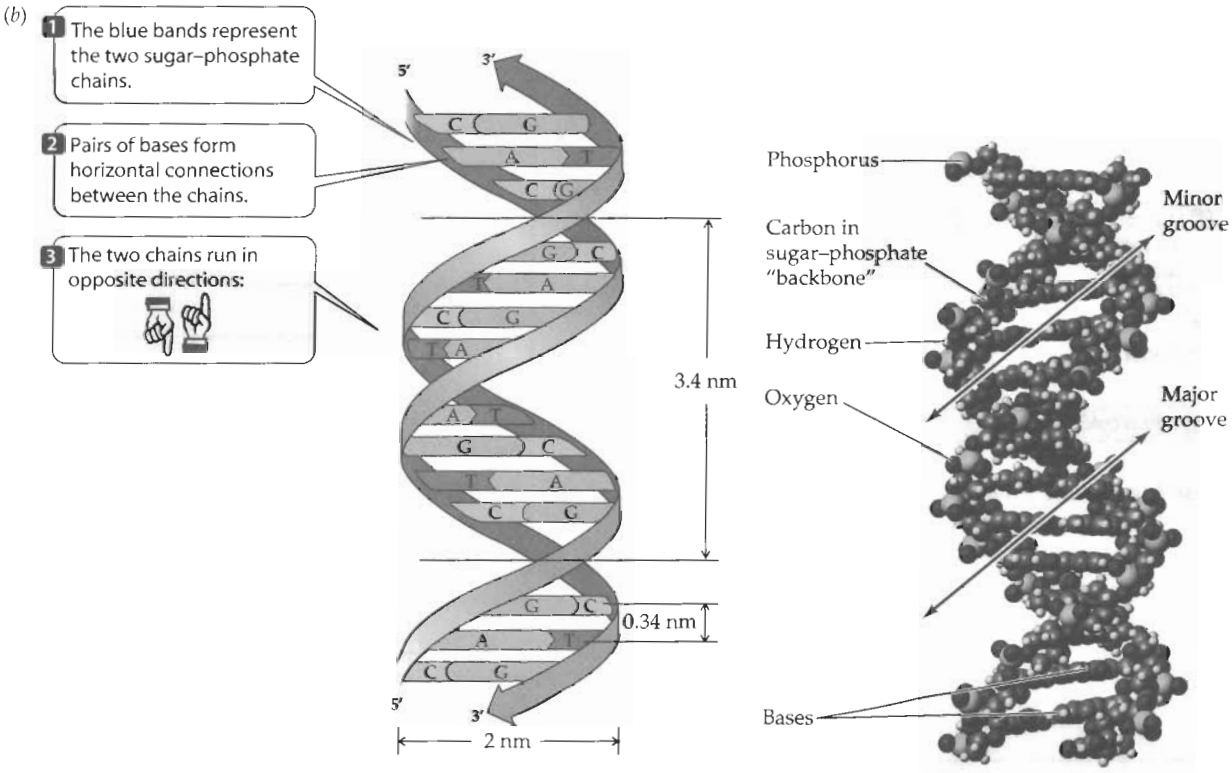
11.17 The Lagging Strand Story *(Page 226)*



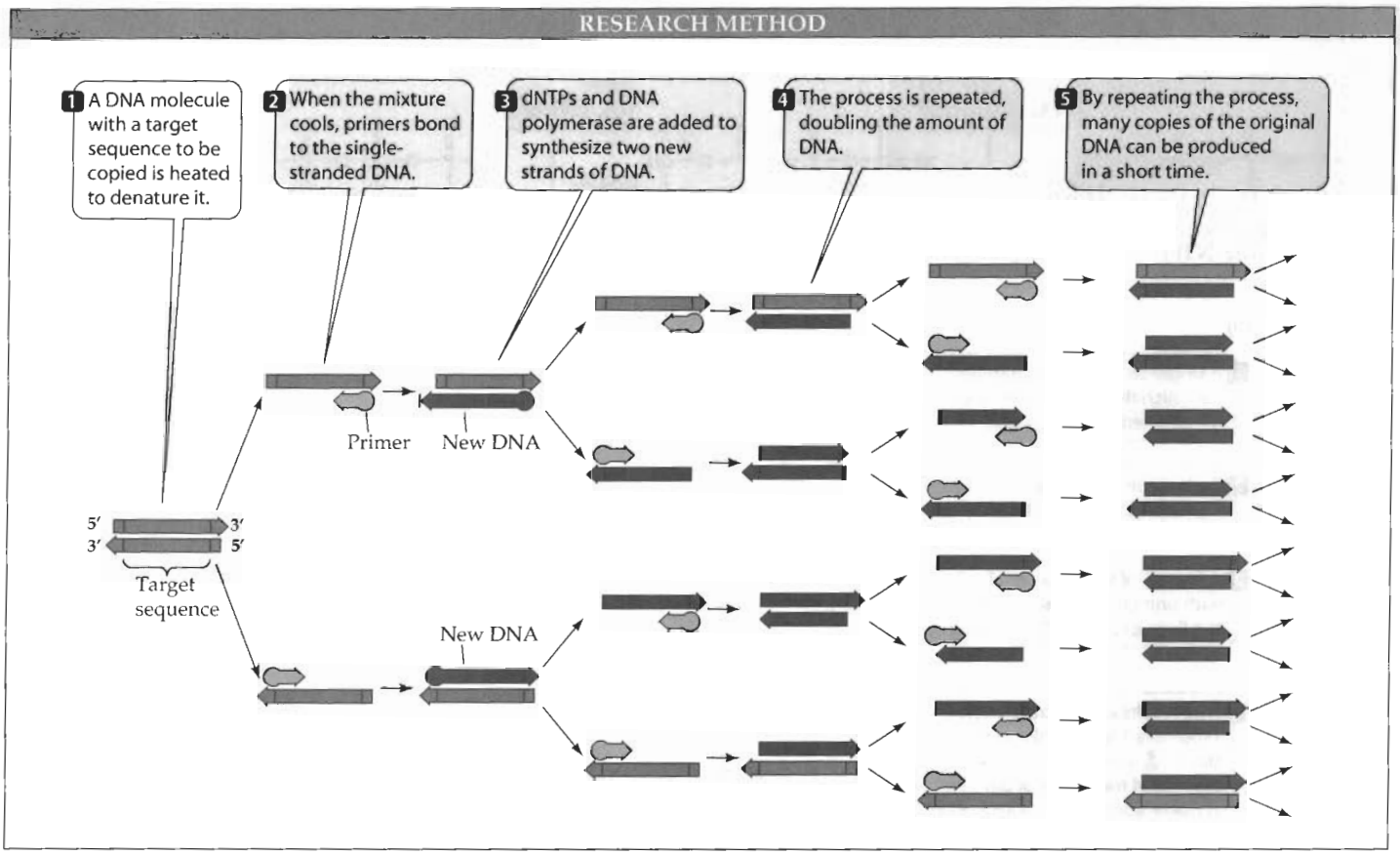
11.4 X-Ray Crystallography Revealed the Basic Helical Structure of the DNA Molecule *(Page 217)*



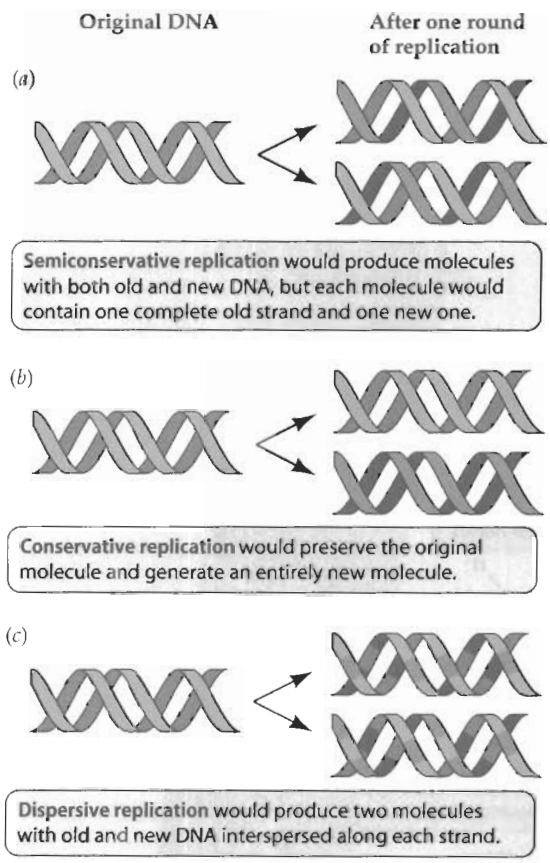
11.5 Chargaff's Rule *(Page 217)*



11.6 DNA Is a Double Helix *(Page 218)*



11.20 The Polymerase Chain Reaction *(Page 229)*



11.8 Three Models for DNA Replication *(Page 220)*

RESEARCH METHOD

(a)

Base (A, U, G, or C)

Ribonucleoside triphosphate (NTP)

Base (A, T, G, or C)

Deoxyribonucleoside triphosphate (dNTP)

Base (A, T, G, or C)

Dideoxyribonucleoside triphosphate (ddNTP)

Absence of OH at 3′ position means that additional nucleotides cannot be added.

(b)

1 A single-stranded DNA fragment is isolated for which the base sequence is to be determined (the template).

2 Each of the 4 ddNTP's is bound to a fluorescent dye.

3 A sample of this unknown DNA is combined with primer, DNA polymerase, 4 dNTP's, and the fluorescent ddNTP's. Synthesis begins.

4 The results are illustrated here by what binds to a T in the unknown strand. If ddATP A is picked up, synthesis stops. A series of fragments of different lengths is made, each ending with a ddNTP.

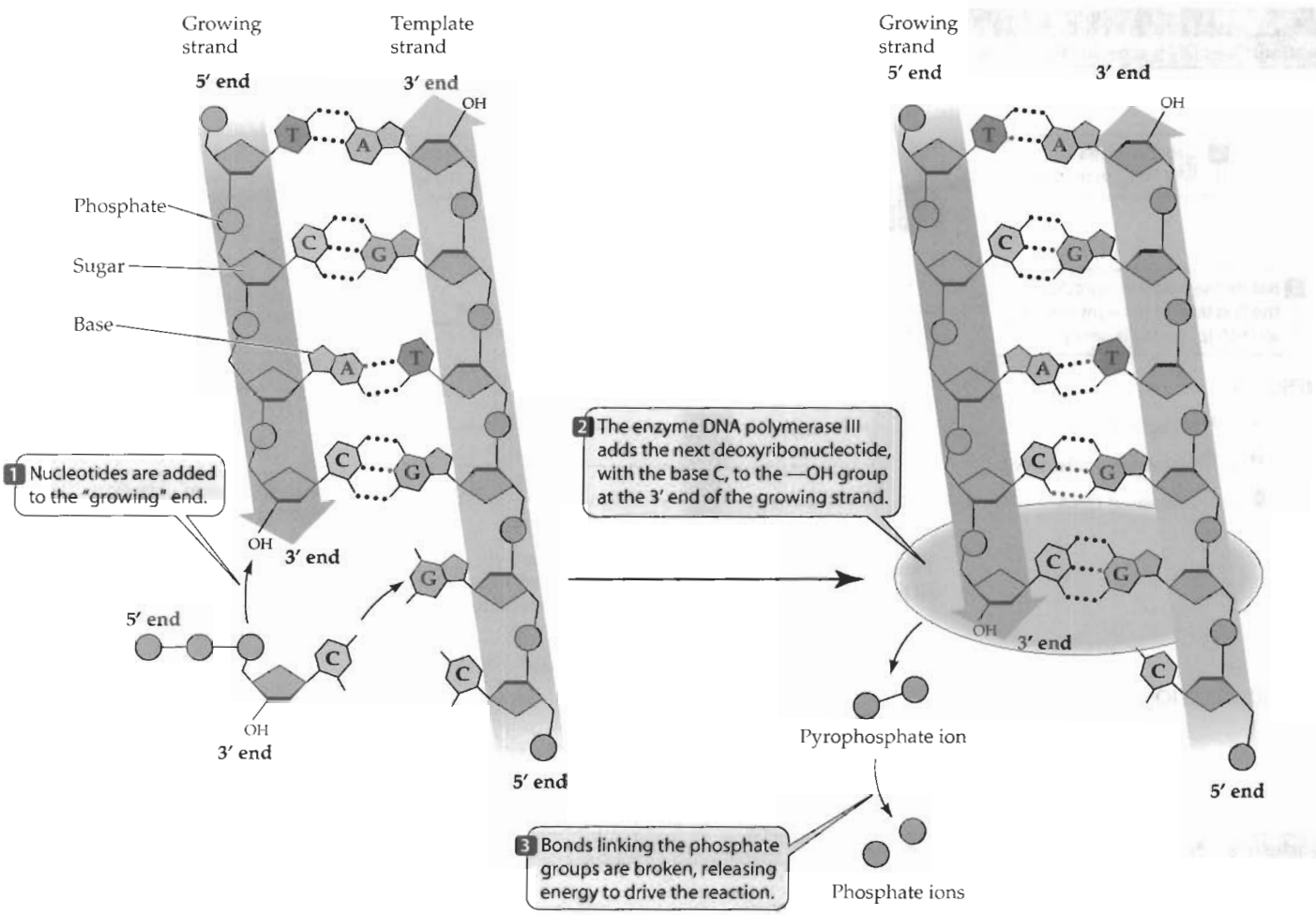
5 The newly synthesized fragments of various lengths are separated by electrophoresis.

6 Each strand fluoresces a color that identifies the ddNTP that terminated the strand. The color at the end of each fragment is detected by a laser beam.

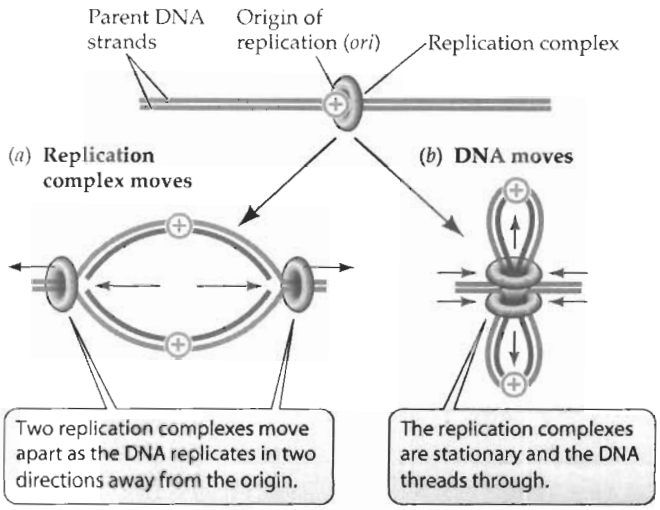
7 The sequence of the newly synthesized strand of DNA can now be deduced...

8 ...and converted to the sequence of the template strand.

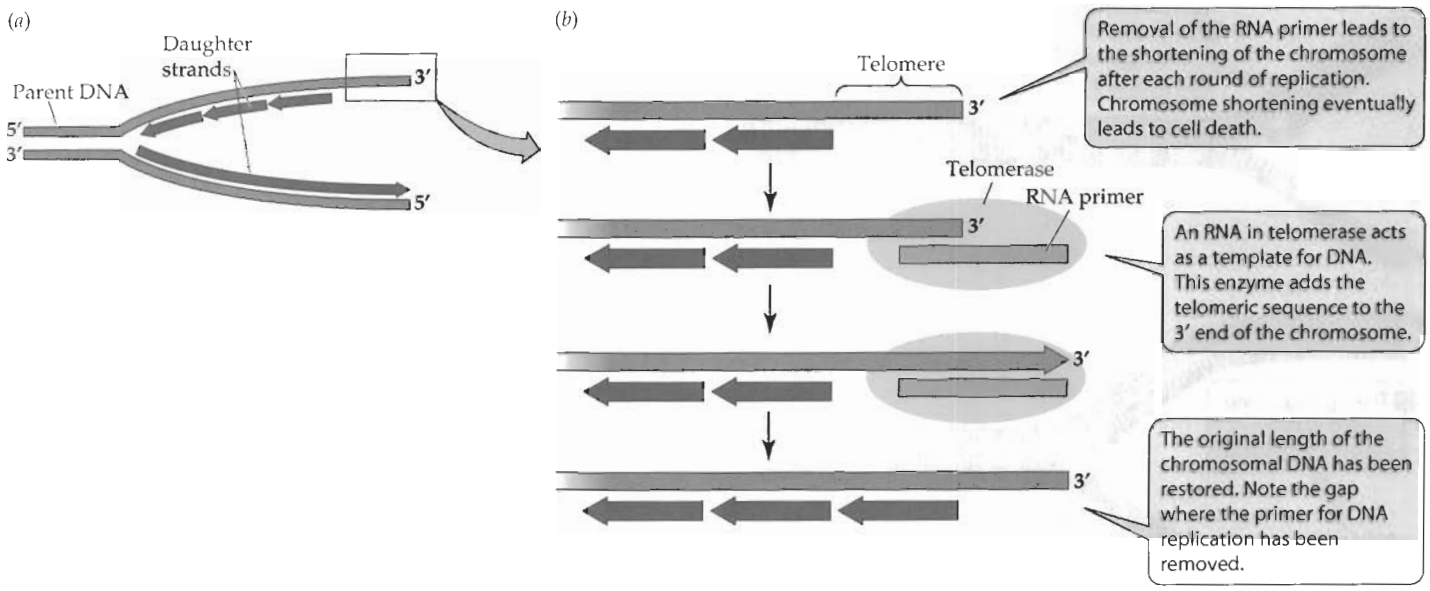
11.21 Sequencing DNA *(Page 230)*



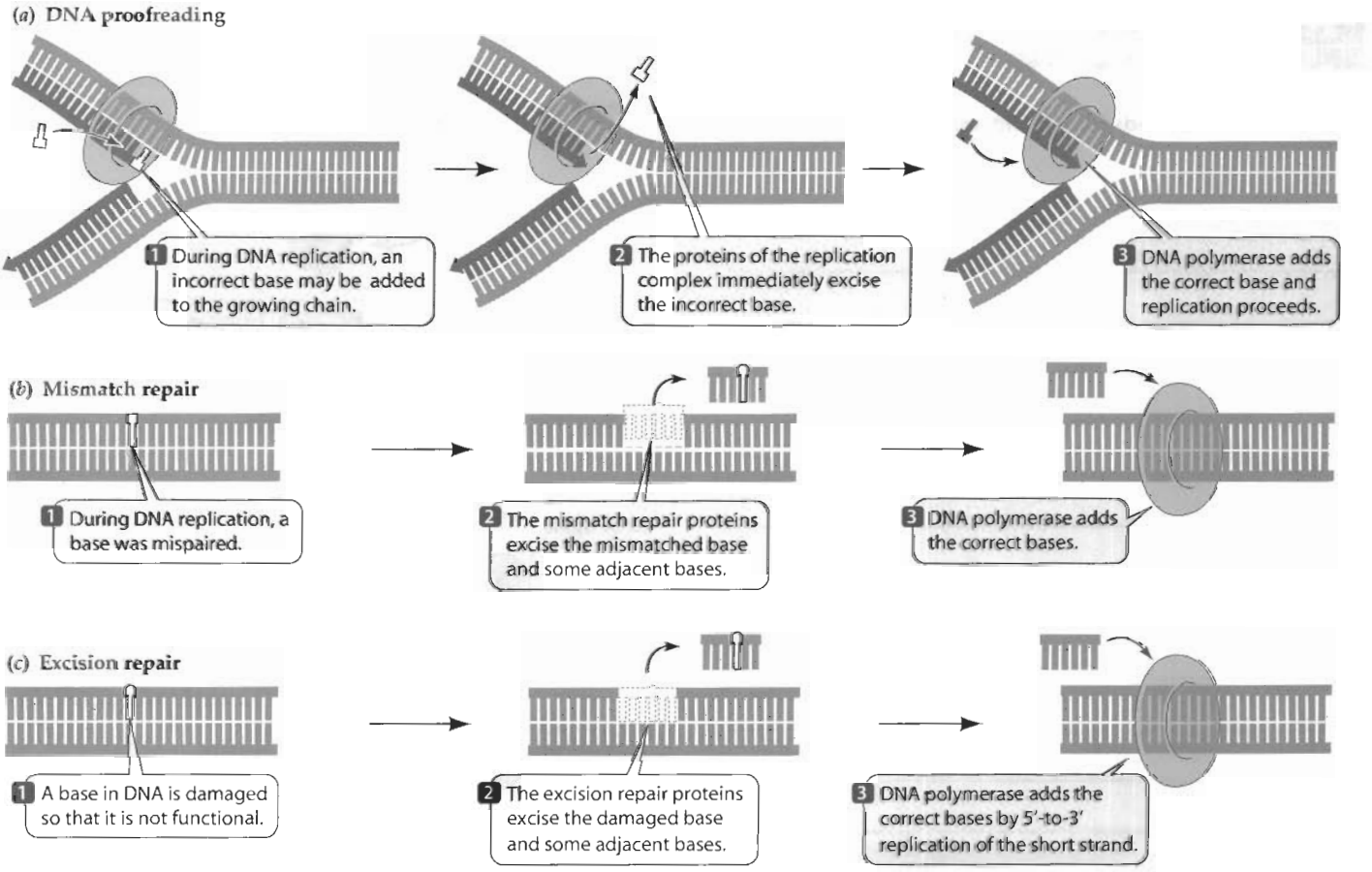
11.10 Each New DNA Strand Grows from its 5′ End to its 3′ End *(Page 223)*



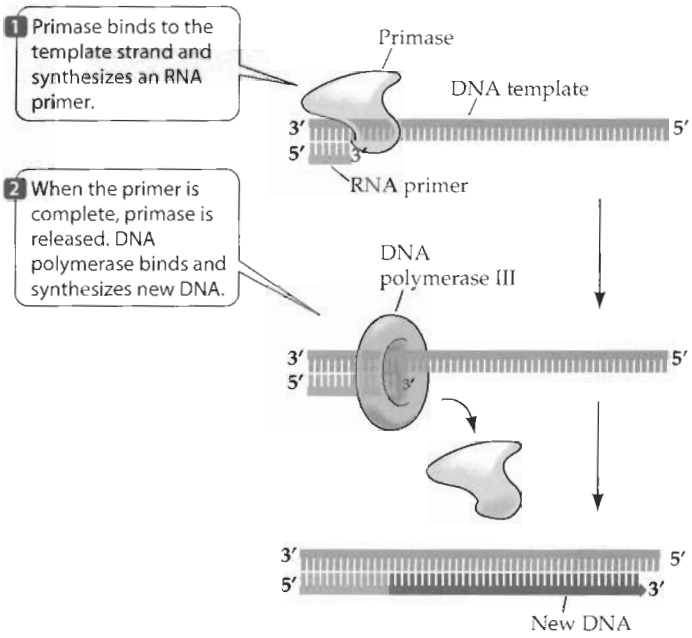
11.11 Two Views of DNA Replication *(Page 223)*



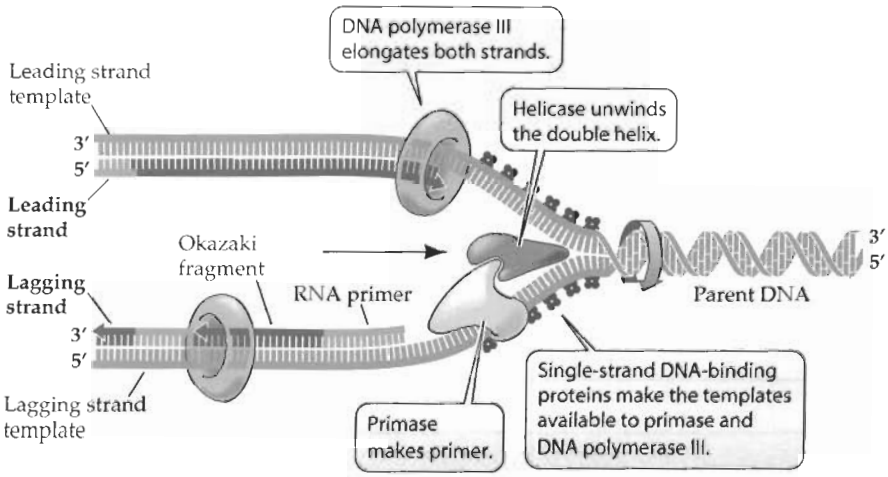
11.18 Telomeres and Telomerase *(Page 227)*



11.19 DNA Repair Mechanisms *(Page 228)*



11.14 No DNA Forms without a Primer *(Page 225)*



11.15 Many Proteins Collaborate at the Replication Fork *(Page 225)*