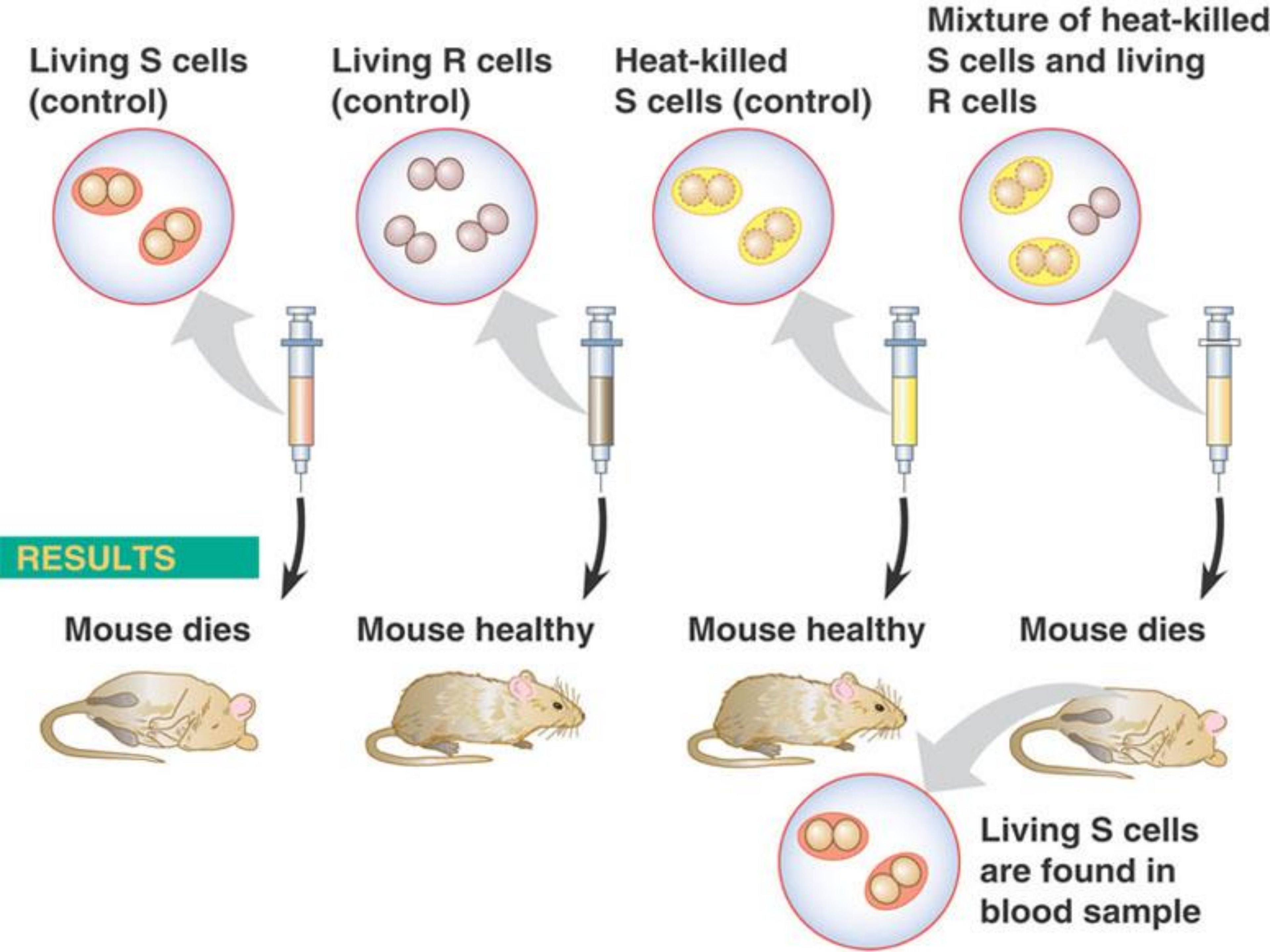
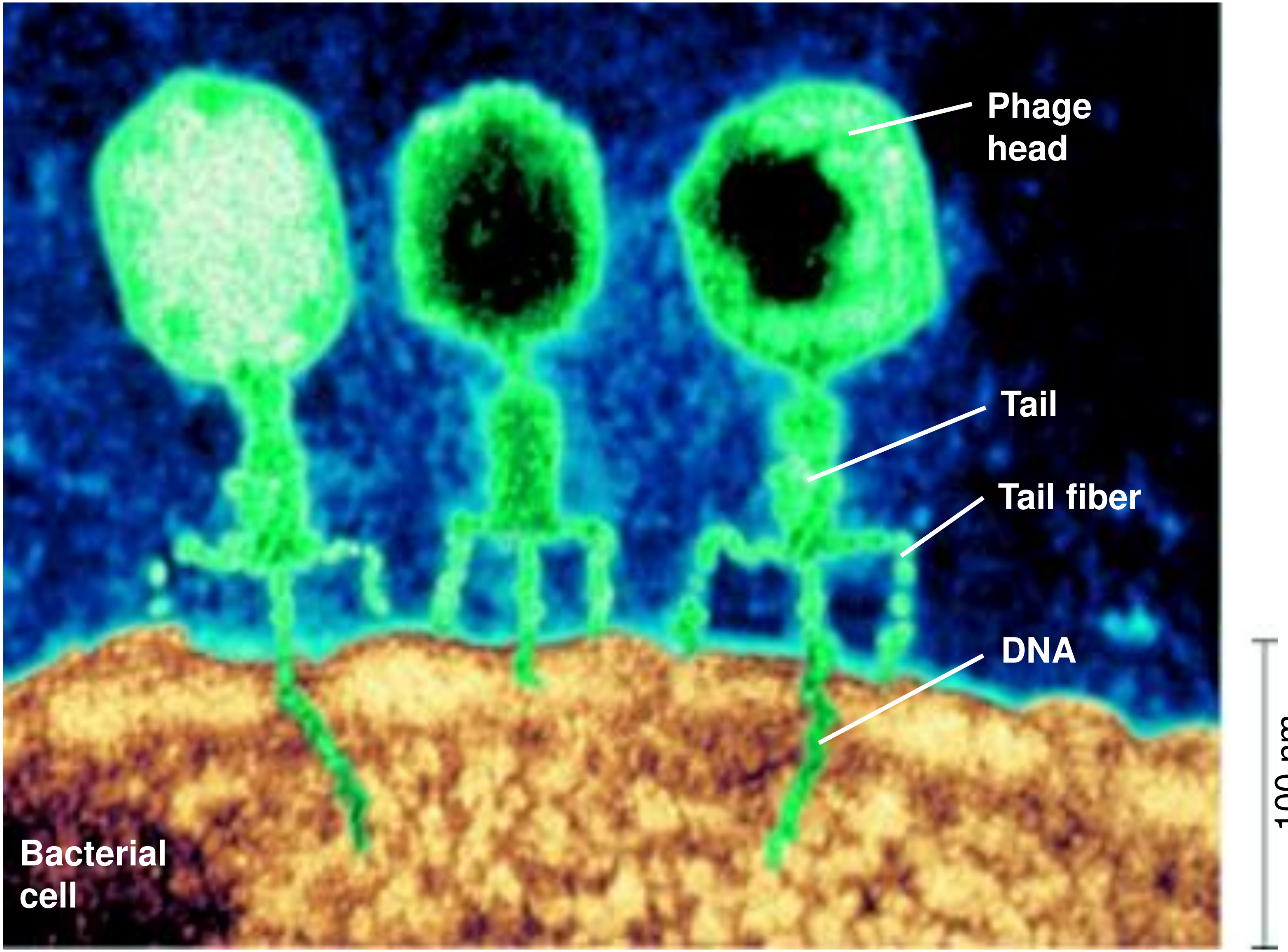
# The Molecular basis of Inheritance



Living S cells (control)
Living R cells (control)
Heat-killed S cells (control)
Mixture of heat-killed S cells and living R cells
RESULTS
Mouse dies
Mouse healthy
Mouse healthy
Mouse dies
Living S cells are found in blood sample

- Griffith called the phenomenon transformation
  - Now defined as a change in genotype and phenotype due to the assimilation of external DNA by a cell

# Bacteriophages

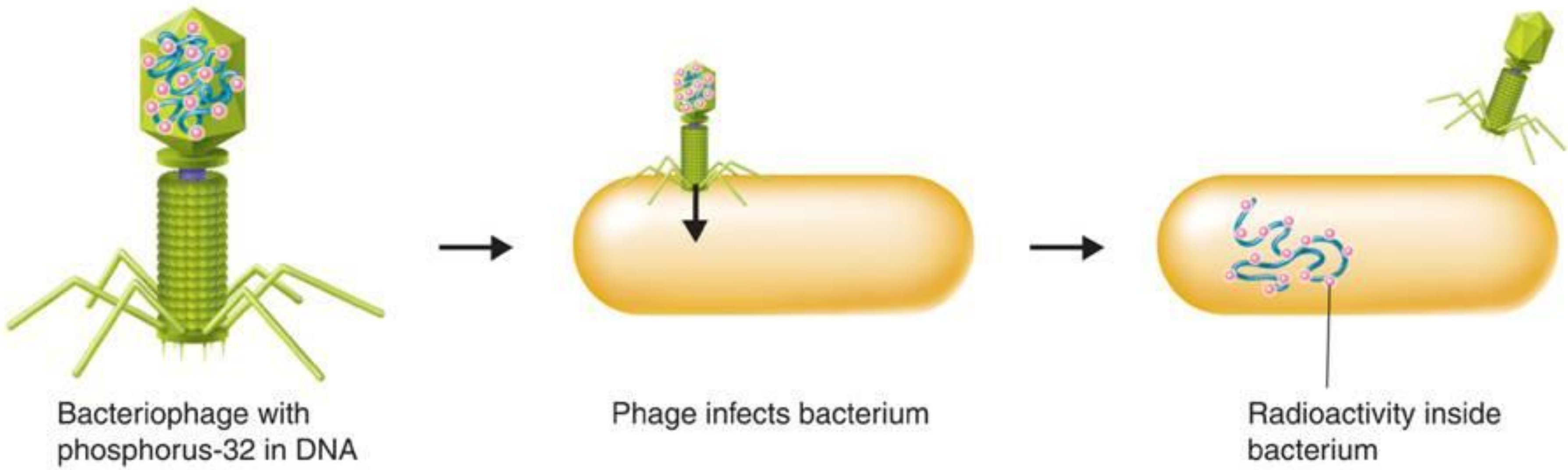



re 16.3

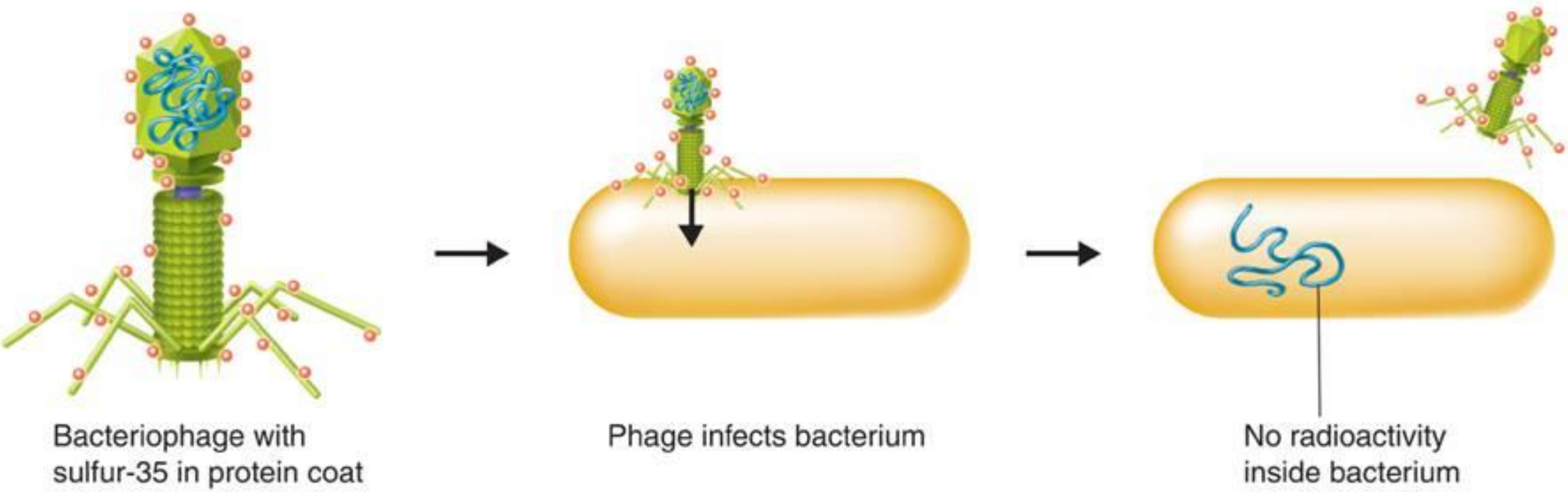
# The Hershey-Chase Experiment

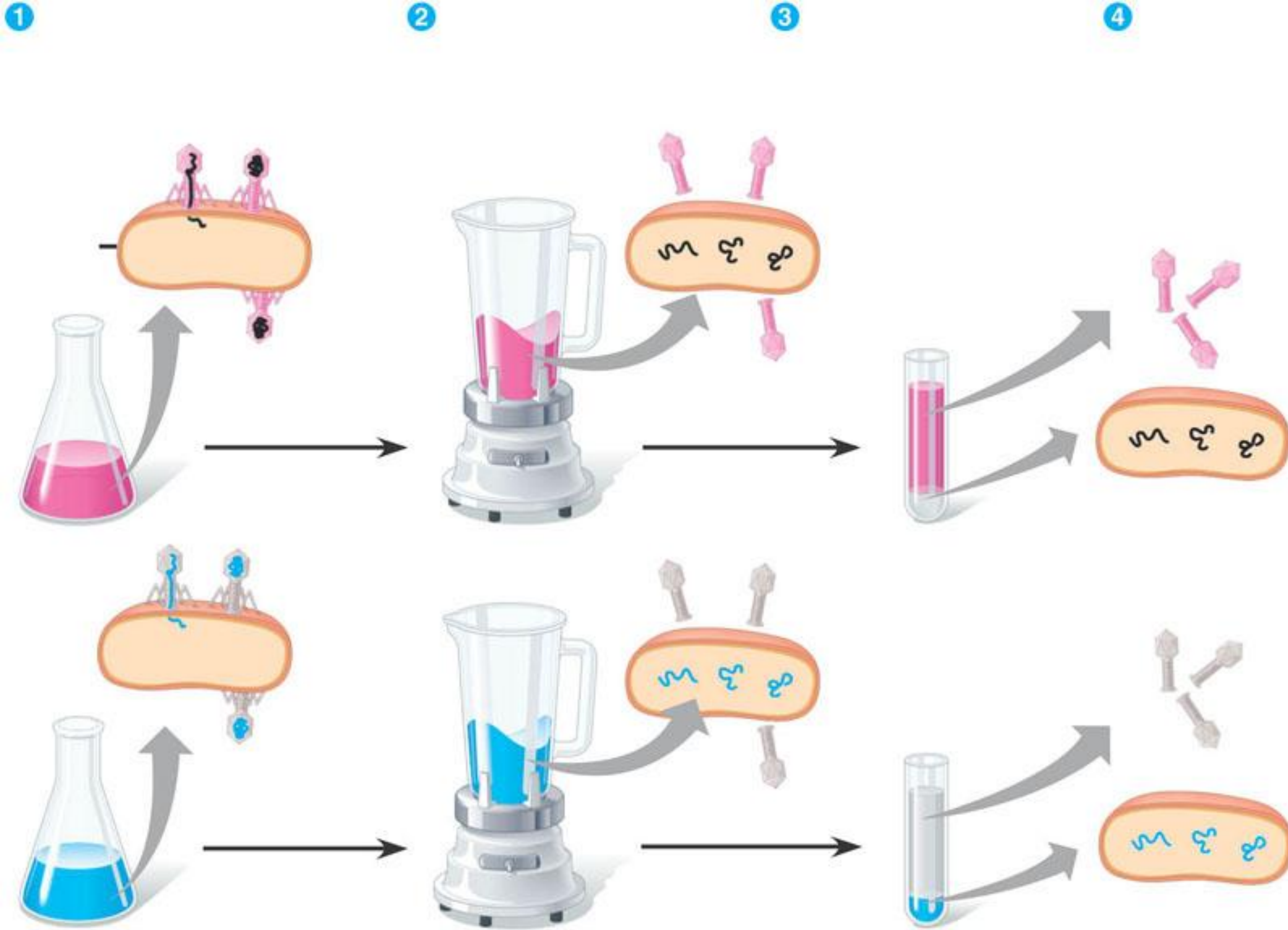
Alfred Hershey and Martha Chase studied viruses—nonliving particles smaller than a cell that can infect living organisms.

- Hershey and Chase studied viruses that infect bacteria, or bacteriophages. They performed 2 experiments.
  - Experiment 1: They tagged viral DNA with radioactive Phosphurus.



- Hershey and Chase studied viruses that infect bacteria, or bacteriophages. They performed 2 experiments.
  - Experiment 2: They tagged viral proteins with radioactive Sulphur.




1
2
3
4

# *Additional Evidence That DNA Is the Genetic Material*

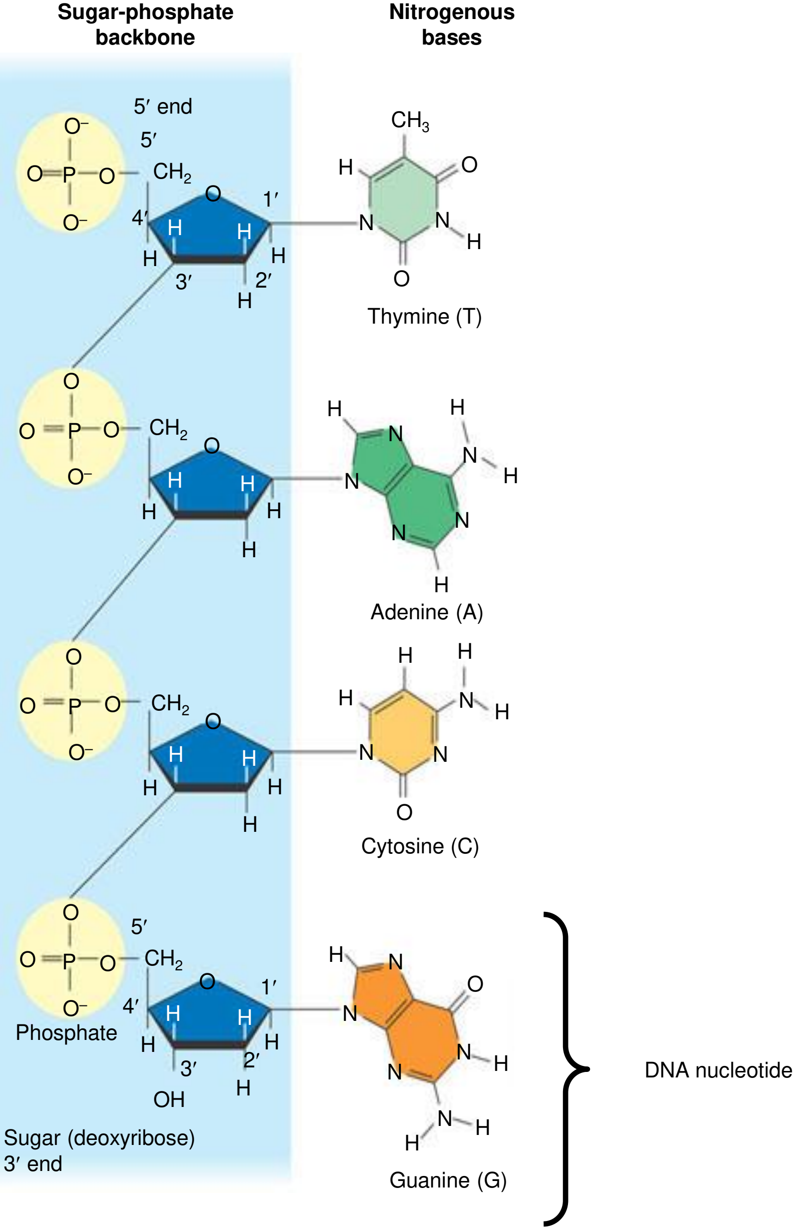
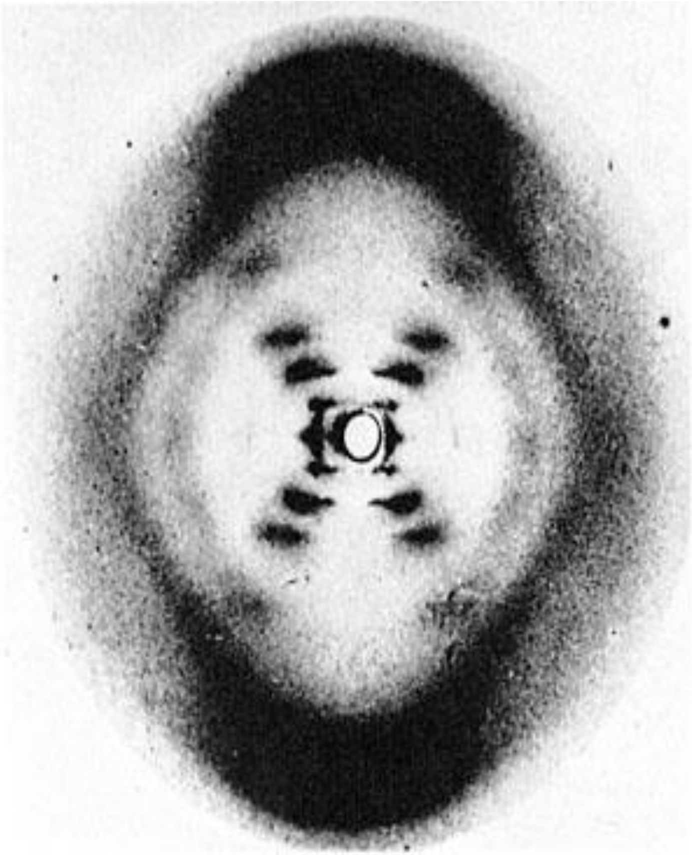



**Figure 16.5**

# Rosalind Franklin

(a) Rosalind Franklin



(b) Franklin's X-ray diffraction Photograph of DNA

6 a, b

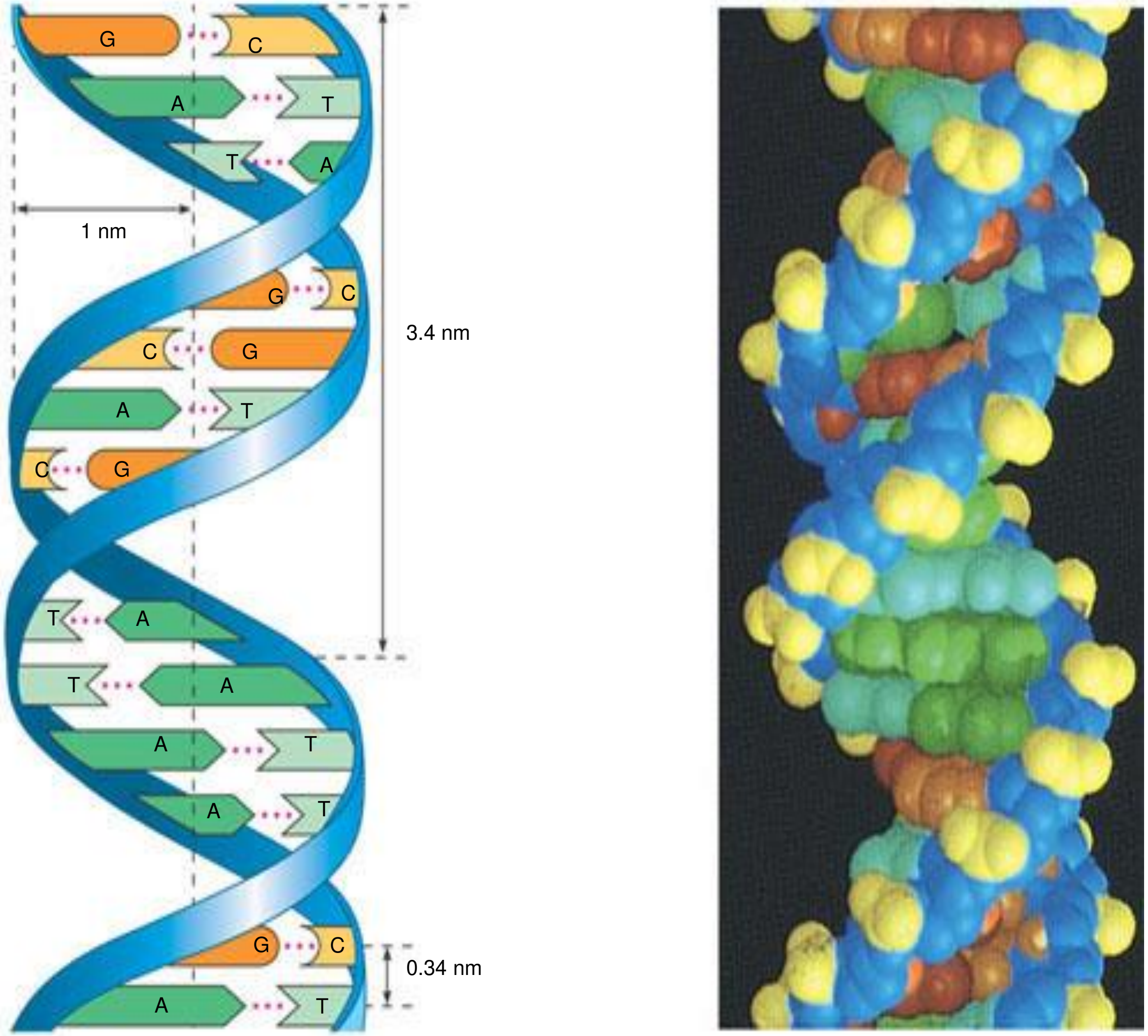
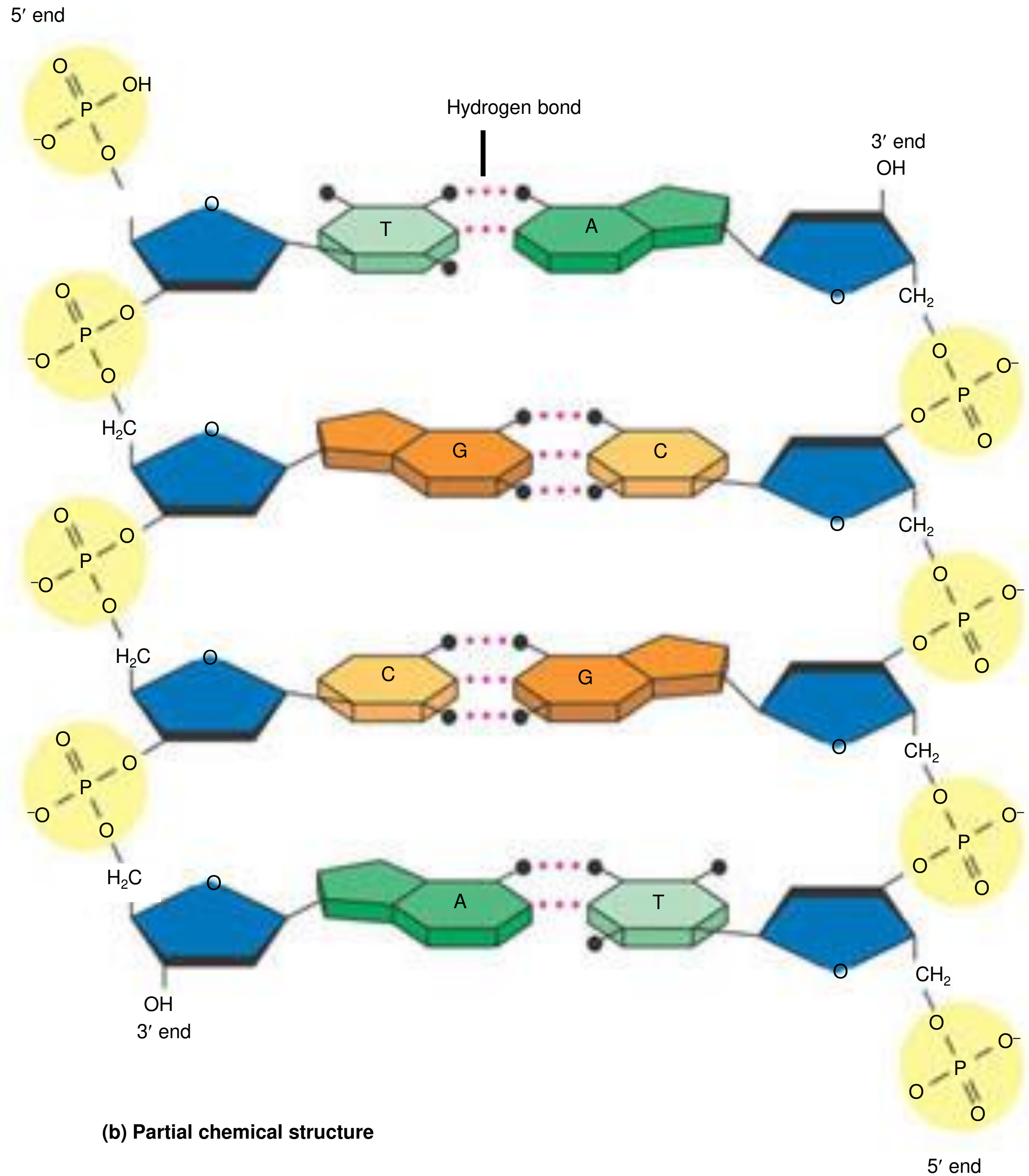



**Figure 16.7a, c**

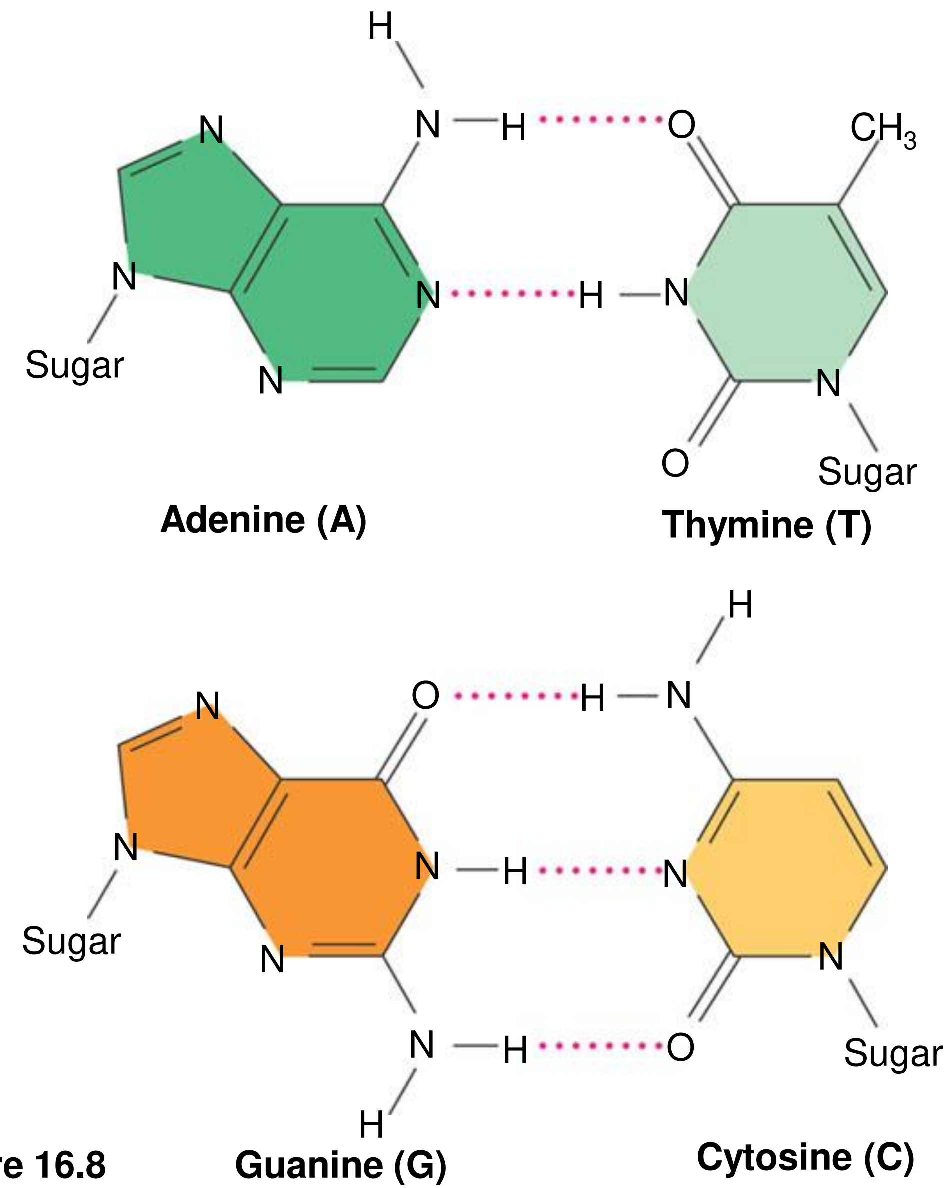
**(a) Key features of DNA structure**

**(c) Space-filling model**




(b) Partial chemical structure

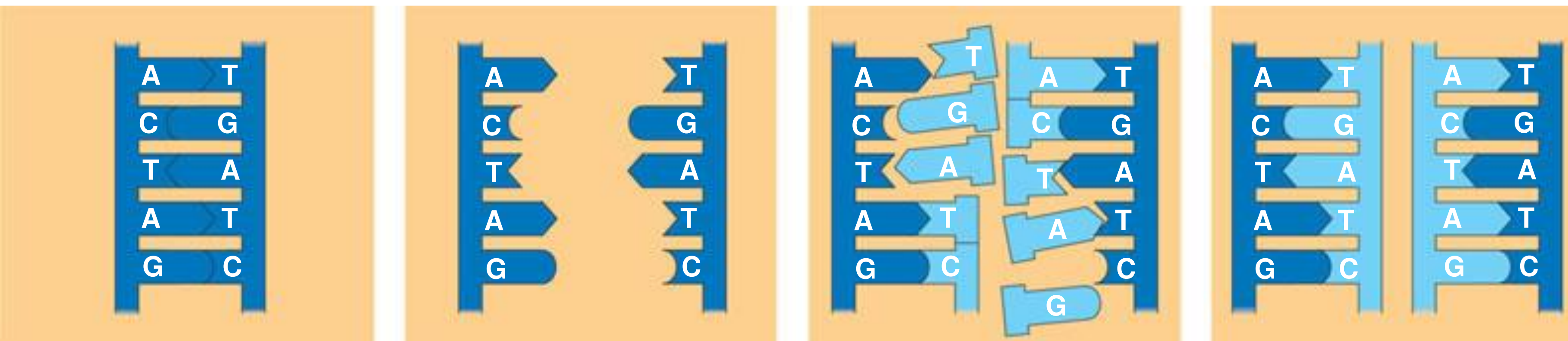
**Figure 16.7b**



H
N
H
O
CH3
N
N
N
H
N
Sugar
N
N
O
Sugar
Adenine (A)
Thymine (T)
H
O
H
N
N
N
N
H
N
Sugar
N
N
N
H
O
H
Sugar
Guanine (G)
Cytosine (C)


Figure 16.8

- In DNA replication
  - The parent molecule unwinds, and two new daughter strands are built based on base-pairing rules




**(a)** The parent molecule has two complementary strands of DNA. Each base is paired by hydrogen bonding with its specific partner, A with T and G with C.

**(b)** The first step in replication is separation of the two DNA strands.

**(c)** Each parental strand now serves as a template that determines the order of nucleotides along a new, complementary strand.

**(d)** The nucleotides are connected to form the sugar-phosphate backbones of the new strands. Each "daughter" DNA molecule consists of one parental strand and one new strand.

**Figure 16.9 a–d**

# DNA replication is semiconservative

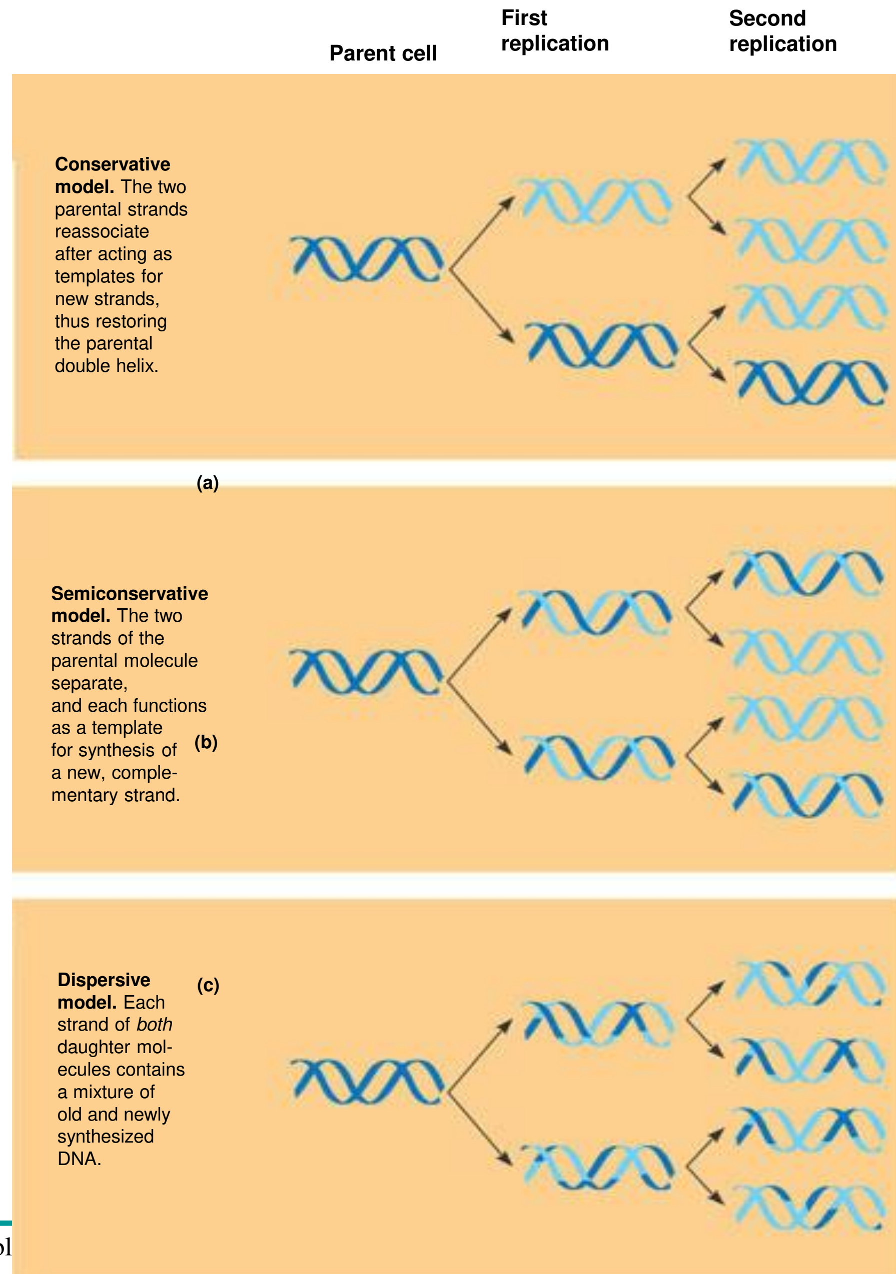
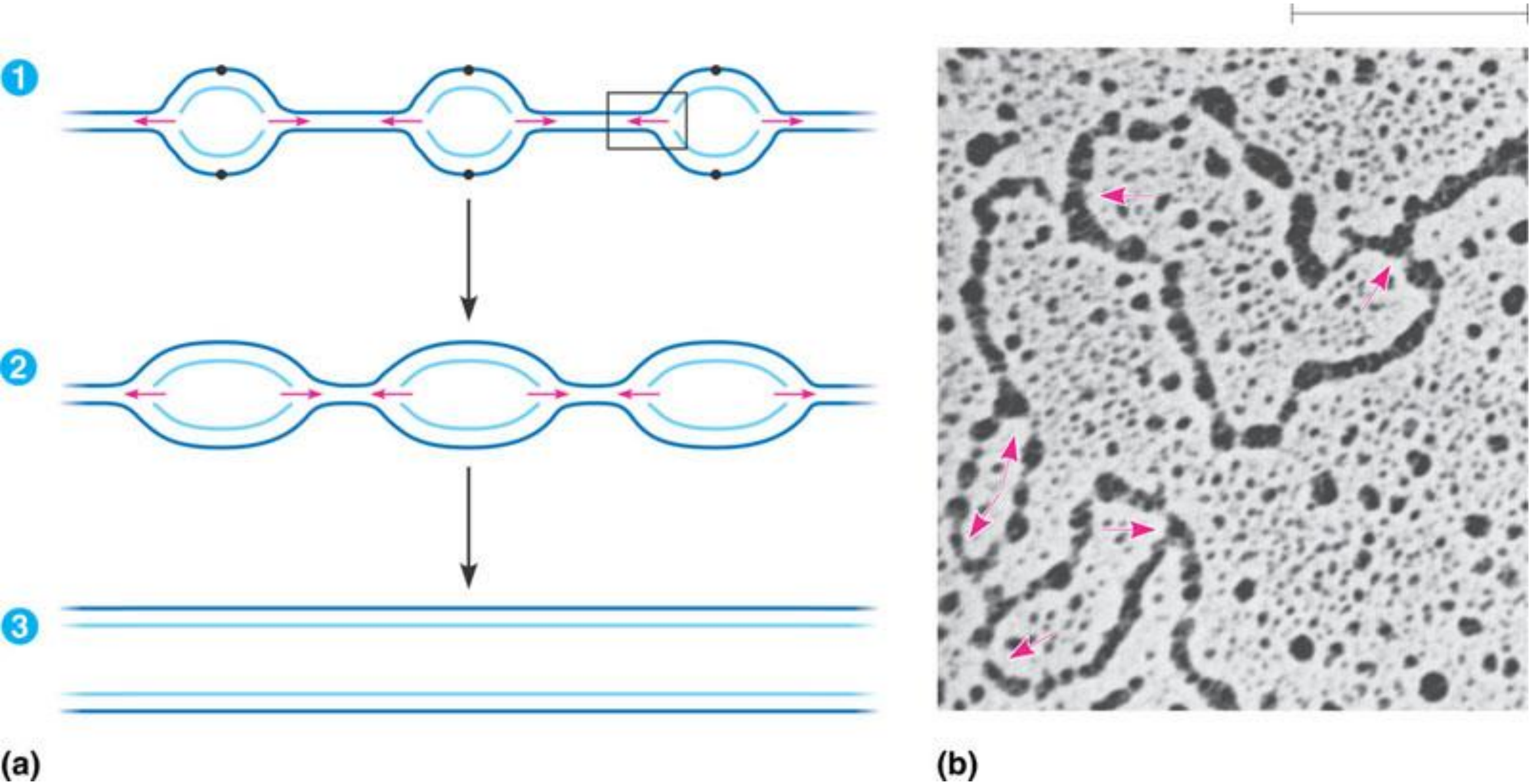


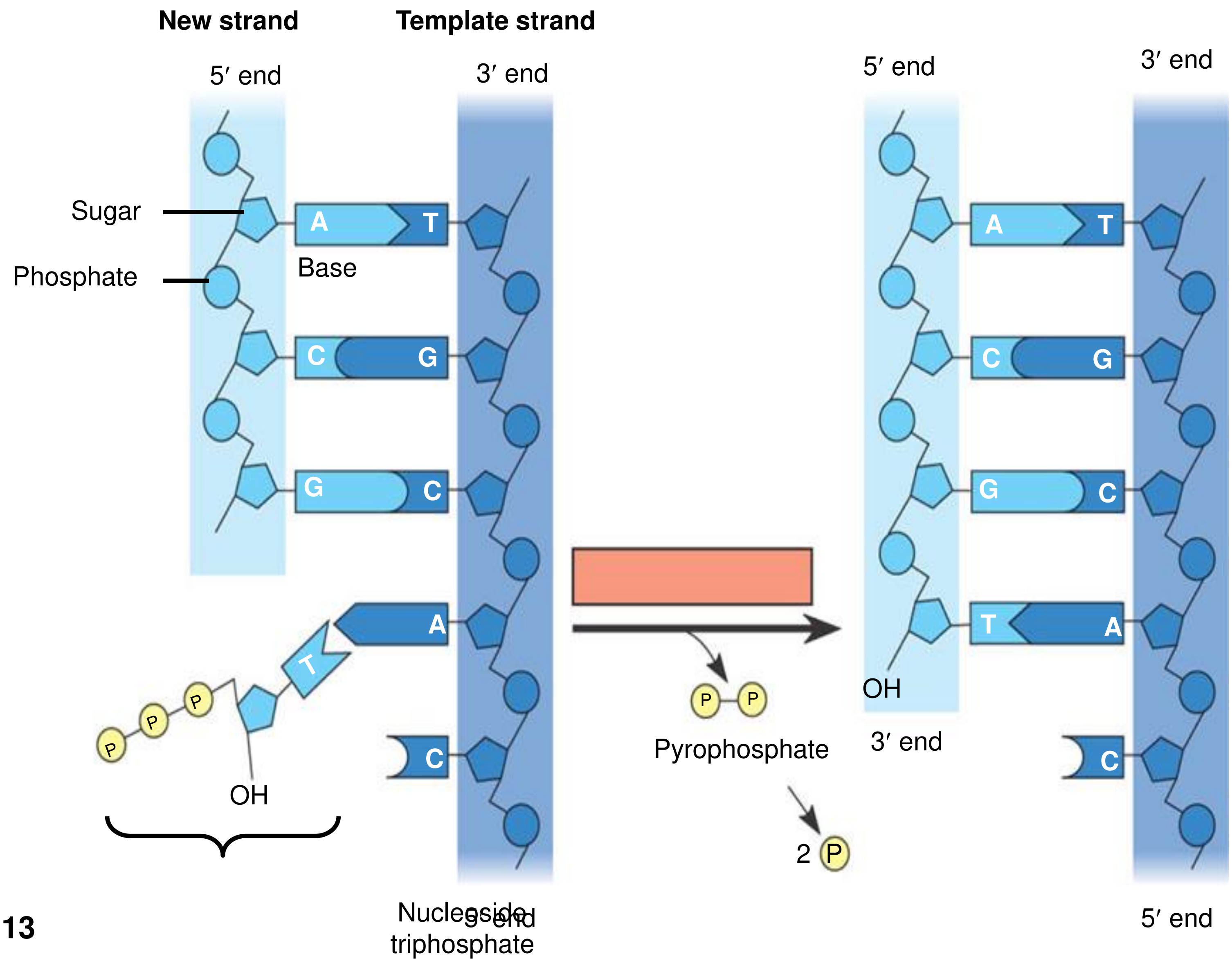

Figure 16.10 a–c

# Meselson-Stahl Experiment

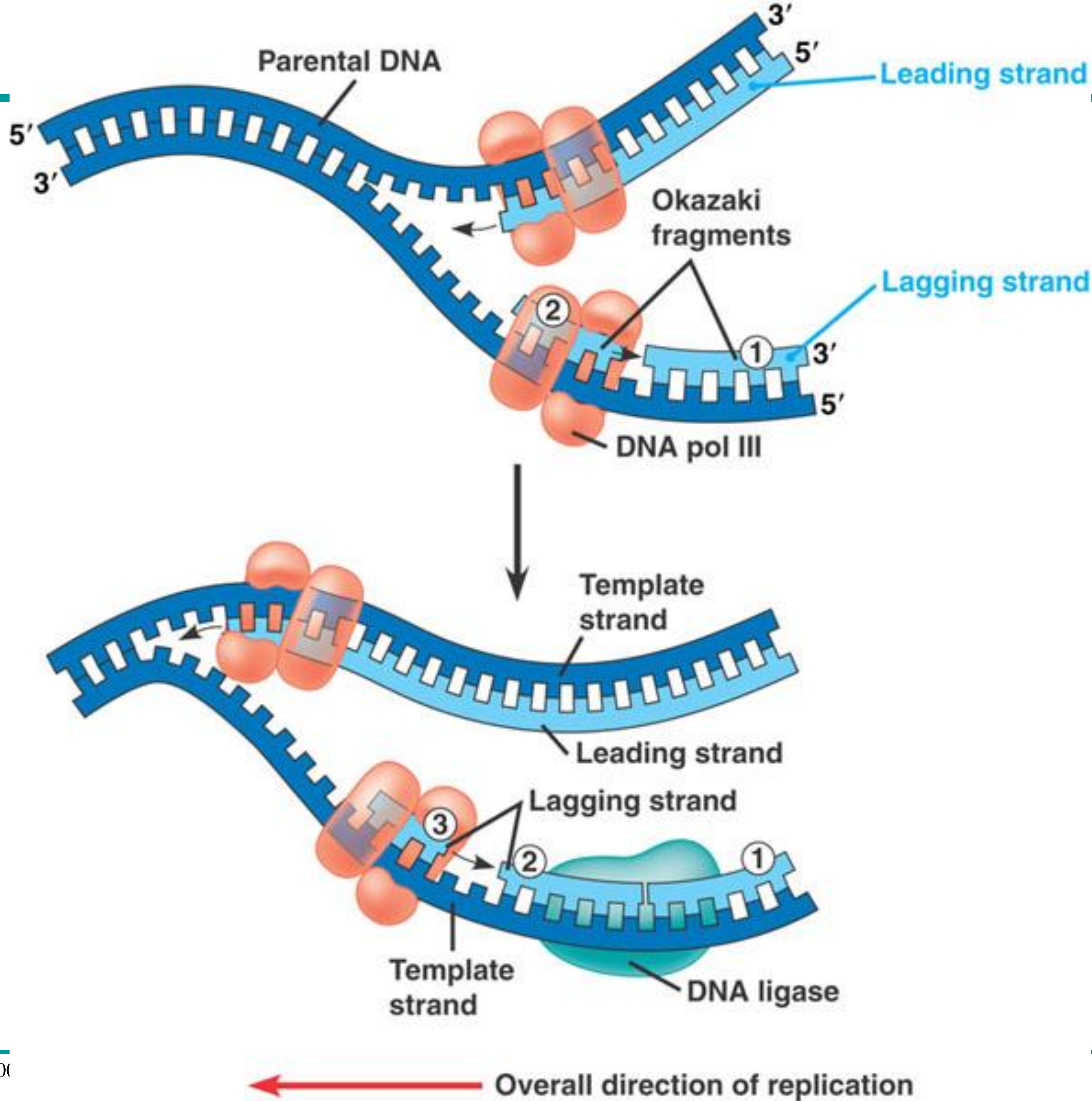
- E. coli were grown for several generations in a medium with $^{15}N$.
- The DNA of the resuling cells had a higher density (was heavier).
- E. coli cells with only $^{15}N$ in their DNA were put back into a $^{14}N$ medium and were allowed to divide only once.
- DNA was then extracted from a cell and was compared to DNA from $^{14}N$ DNA and $^{15}N$ DNA.
- It was found to have exactly an intermediate density. This supported the idea of semiconservative replication.
- The DNA was intermediate in density because it had an all $^{15}N$ DNA strand and an all $^{14}N$ DNA strand. The all $^{15}N$ strand was one of the original strands in the original cell. The all $^{14}N$ strand was a newly synthesized strand.

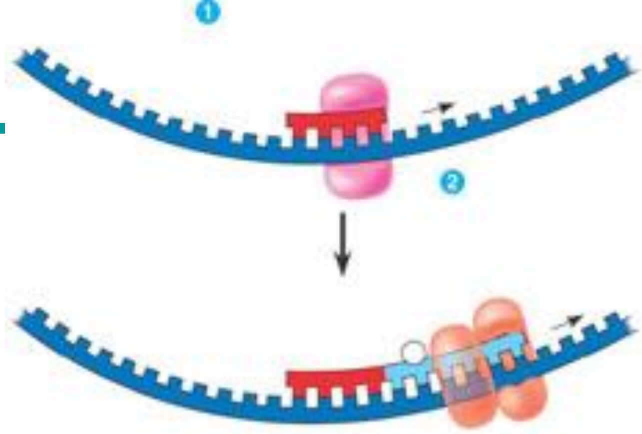

1
2
3
(a)
(b)

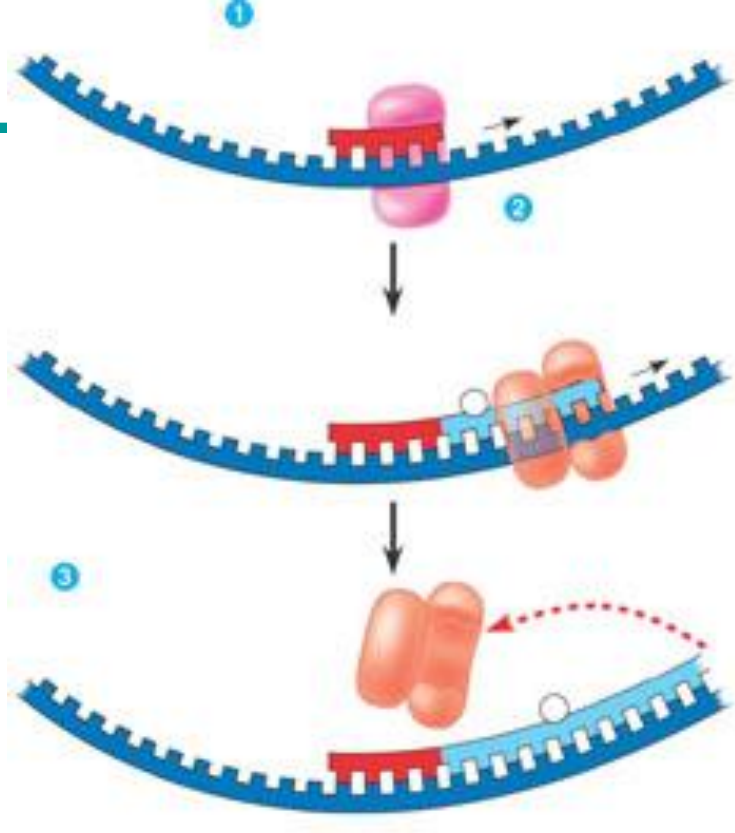
# *Elongating a New DNA Strand*

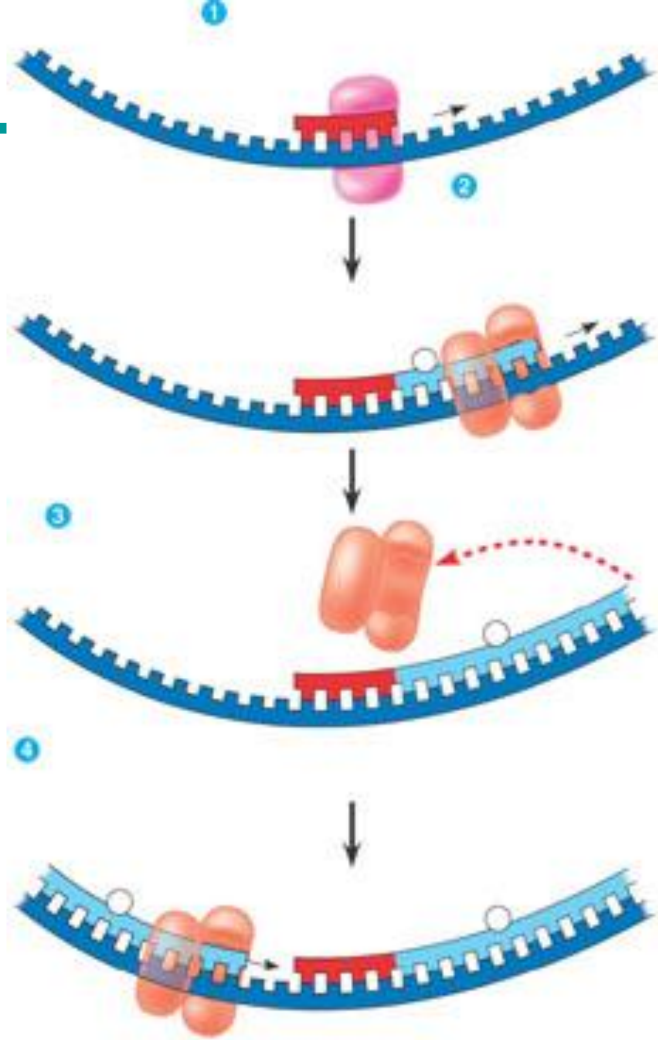



ure 16.13


Parental DNA
3′
5′
Leading strand
5′
3′
Okazaki
fragments
Lagging strand
2
1
3′
5′
DNA pol III
Template
strand
Leading strand
Lagging strand
3
2
1
Template
strand
DNA ligase
Overall direction of replication


1
2


1
2
3


1
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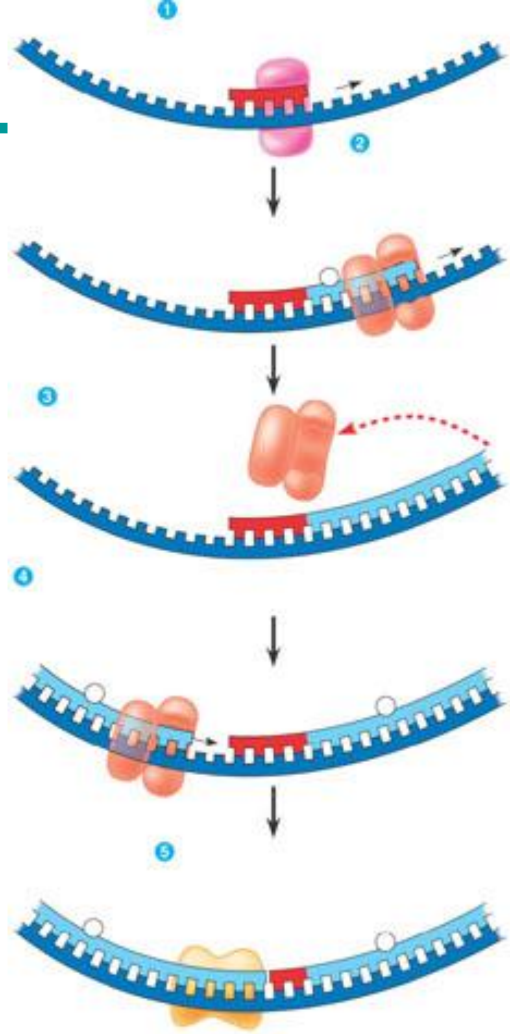
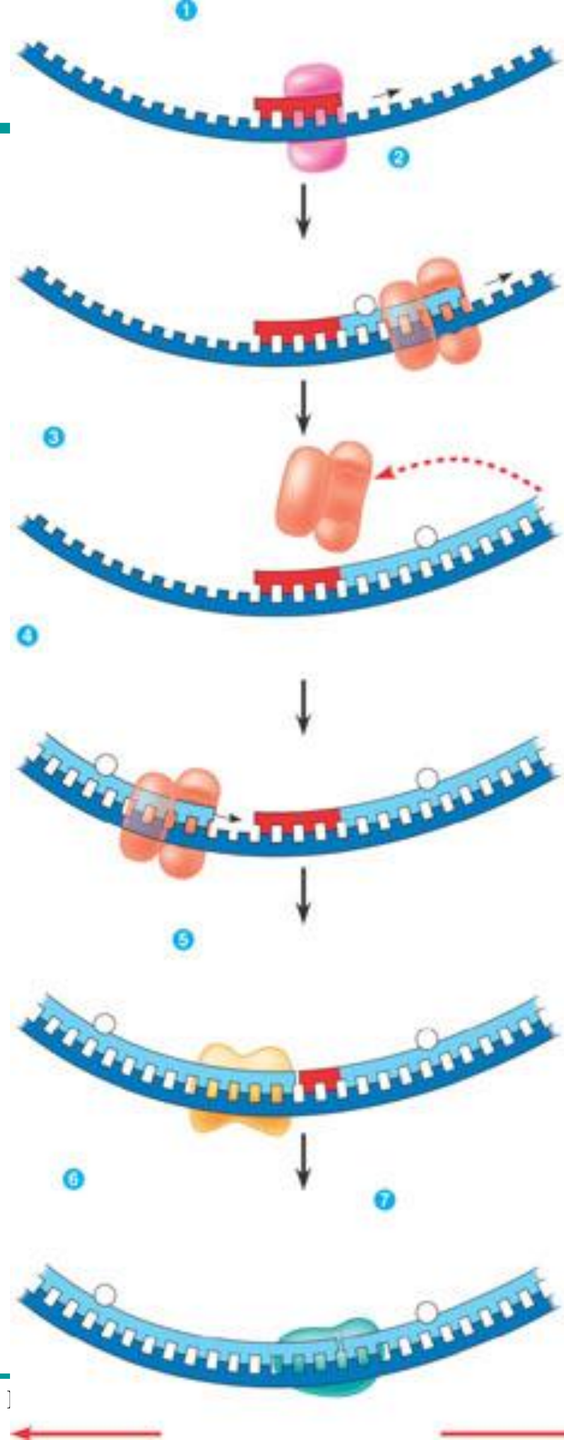
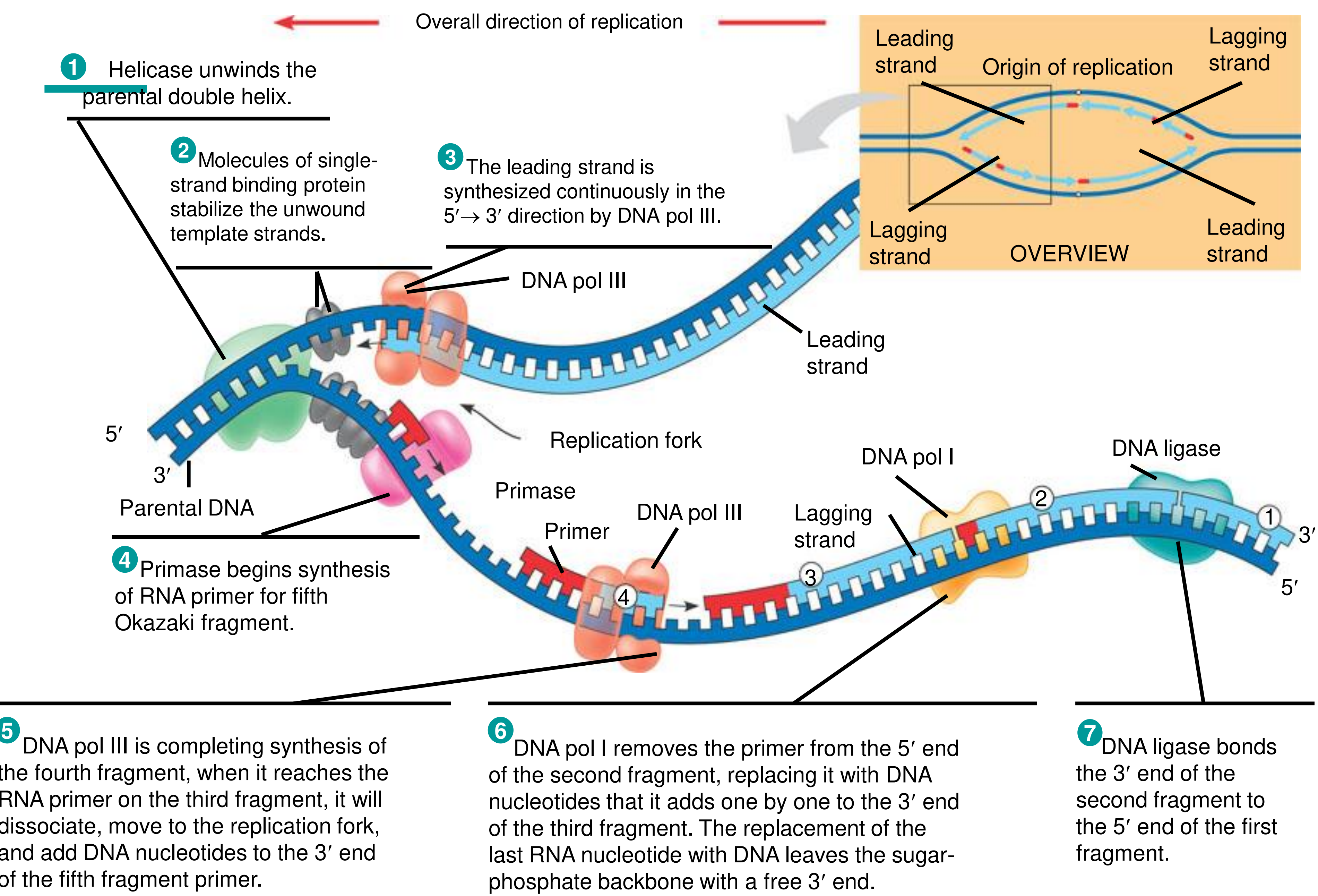

1
2
3
4
5




Overall direction of replication
1 Helicase unwinds the parental double helix.
2 Molecules of single-strand binding protein stabilize the unwound template strands.
3 The leading strand is synthesized continuously in the 5′→ 3′ direction by DNA pol III.
Leading strand
Origin of replication
Lagging strand
Lagging strand
OVERVIEW
Leading strand
DNA pol III
Leading strand
5′
3′
Parental DNA
Replication fork
Primase
DNA pol I
DNA ligase
Primer
DNA pol III
Lagging strand
2
1
3′
3
4
5′
4 Primase begins synthesis of RNA primer for fifth Okazaki fragment.
5 DNA pol III is completing synthesis of the fourth fragment, when it reaches the RNA primer on the third fragment, it will dissociate, move to the replication fork, and add DNA nucleotides to the 3′ end of the fifth fragment primer.
6 DNA pol I removes the primer from the 5′ end of the second fragment, replacing it with DNA nucleotides that it adds one by one to the 3′ end of the third fragment. The replacement of the last RNA nucleotide with DNA leaves the sugar-phosphate backbone with a free 3′ end.
7 DNA ligase bonds the 3′ end of the second fragment to the 5′ end of the first fragment.

**igure 16.16**

# Proofreading and Repairing DNA

- DNA polymerases proofread newly made DNA
  - Replacing any incorrect nucleotides
- In mismatch repair of DNA
  - Repair enzymes correct errors in base pairing

# nucleotide excision repair

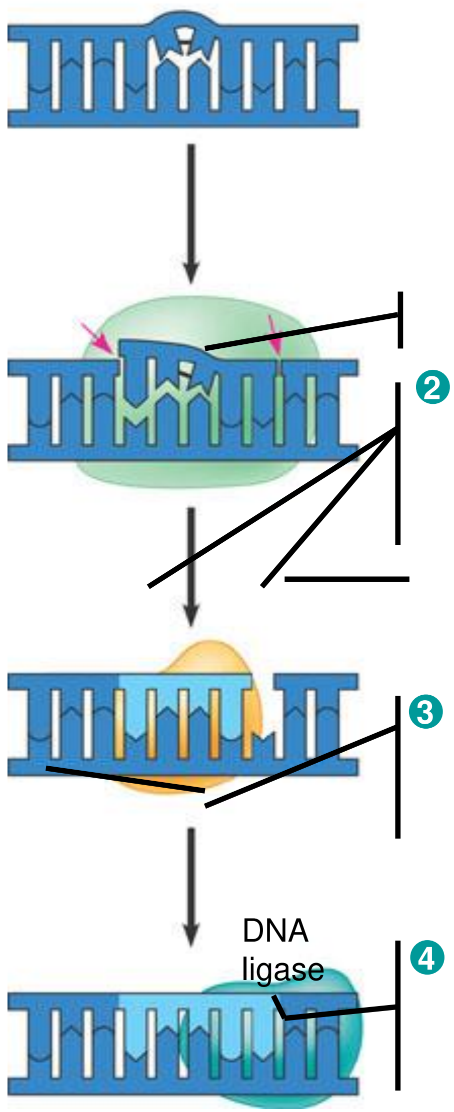



Figure 16.17

# Replicating the Ends of DNA Molecules

- The ends of eukaryotic chromosomal DNA
  - Get shorter with each round of replication

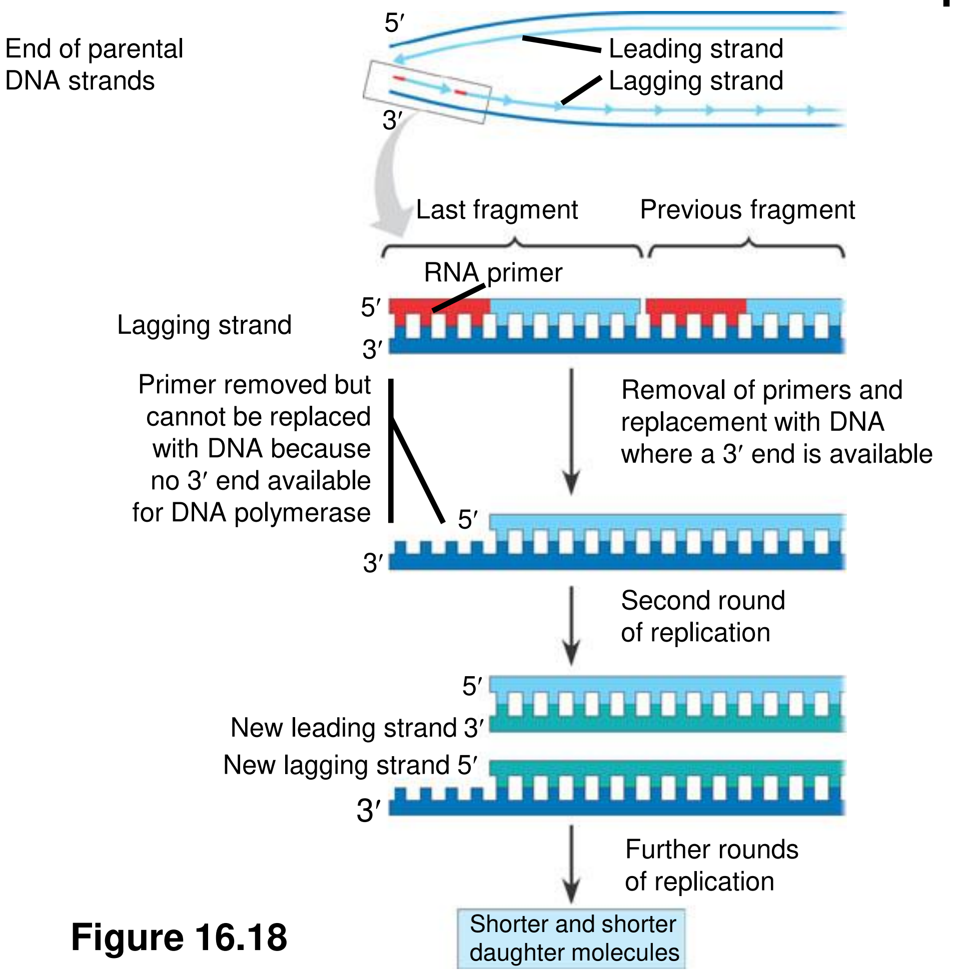



**Figure 16.18**

- Eukaryotic chromosomal DNA molecules
  - Have at their ends nucleotide sequences, called telomeres, that postpone the erosion of genes near the ends of DNA molecules

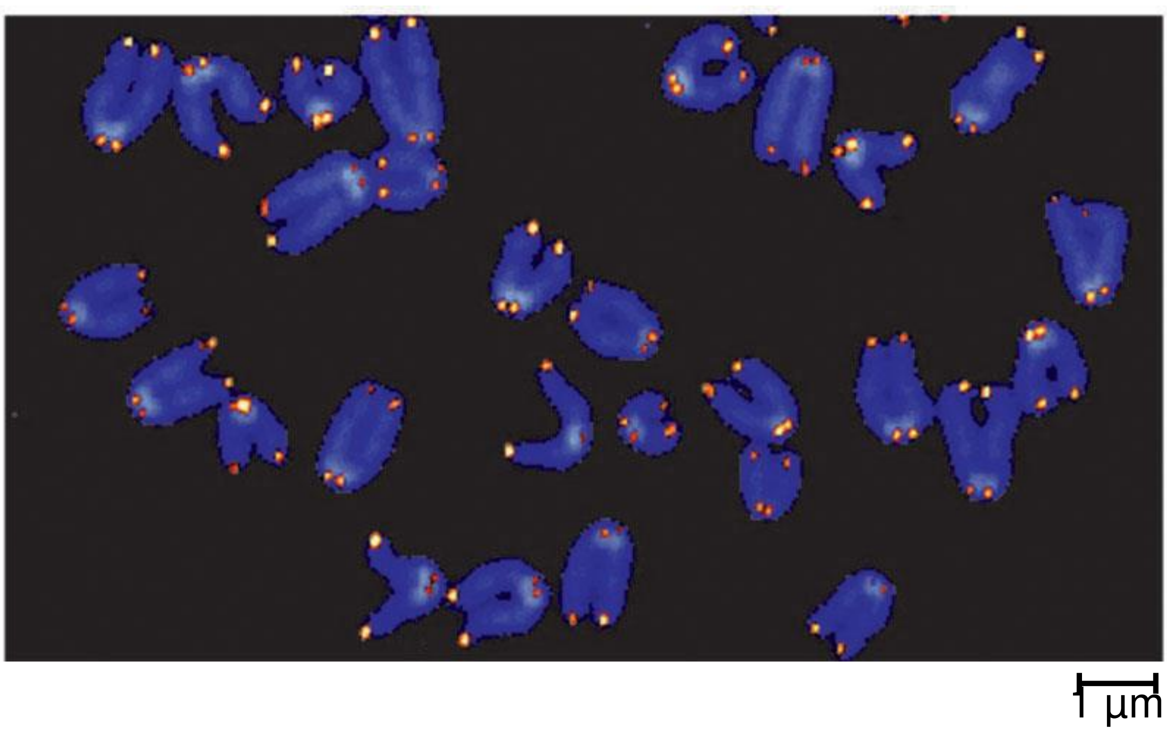



**Figure 16.19**

- If the chromosomes of germ cells became shorter in every cell cycle
  – Essential genes would eventually be missing from the gametes they produce
- An enzyme called telomerase
  – Catalyzes the lengthening of telomeres in germ cells