

A photograph of three penguins walking on a sandy beach. The penguins are black on top and white on the bottom, with a distinctive yellow stripe on their heads. They are walking from left to right. The background is a soft-focus view of the ocean waves. The text is overlaid on the image.

Biology: Life on Earth

Eighth Edition

Lecture for Chapter 9

Molecules of Heredity

Section 9.4 Outline

- **9.4 How Does DNA Replication Ensure Genetic Constancy During Cell Division?**
 - Replication of DNA Is a Critical Event in a Cell's Life
 - Replicated DNA Is Half New and Half Old

DNA Replication

- All cells come from pre-existing cells
- Cells reproduce by dividing in half
- Each of two daughter cells gets an exact copy of parent cell's genetic information
- Duplication of the parent cell DNA is called **replication**

DNA Replication

- **STEP 1**
- DNA replication begins when **DNA helicases** separate the two strands
 - Hydrogen bonds between bases are broken

DNA Replication

- **STEP 2**
- A second strand of new DNA is synthesized along each separated strand by **DNA polymerases**, which position **free nucleotides** across from complementary nucleotides

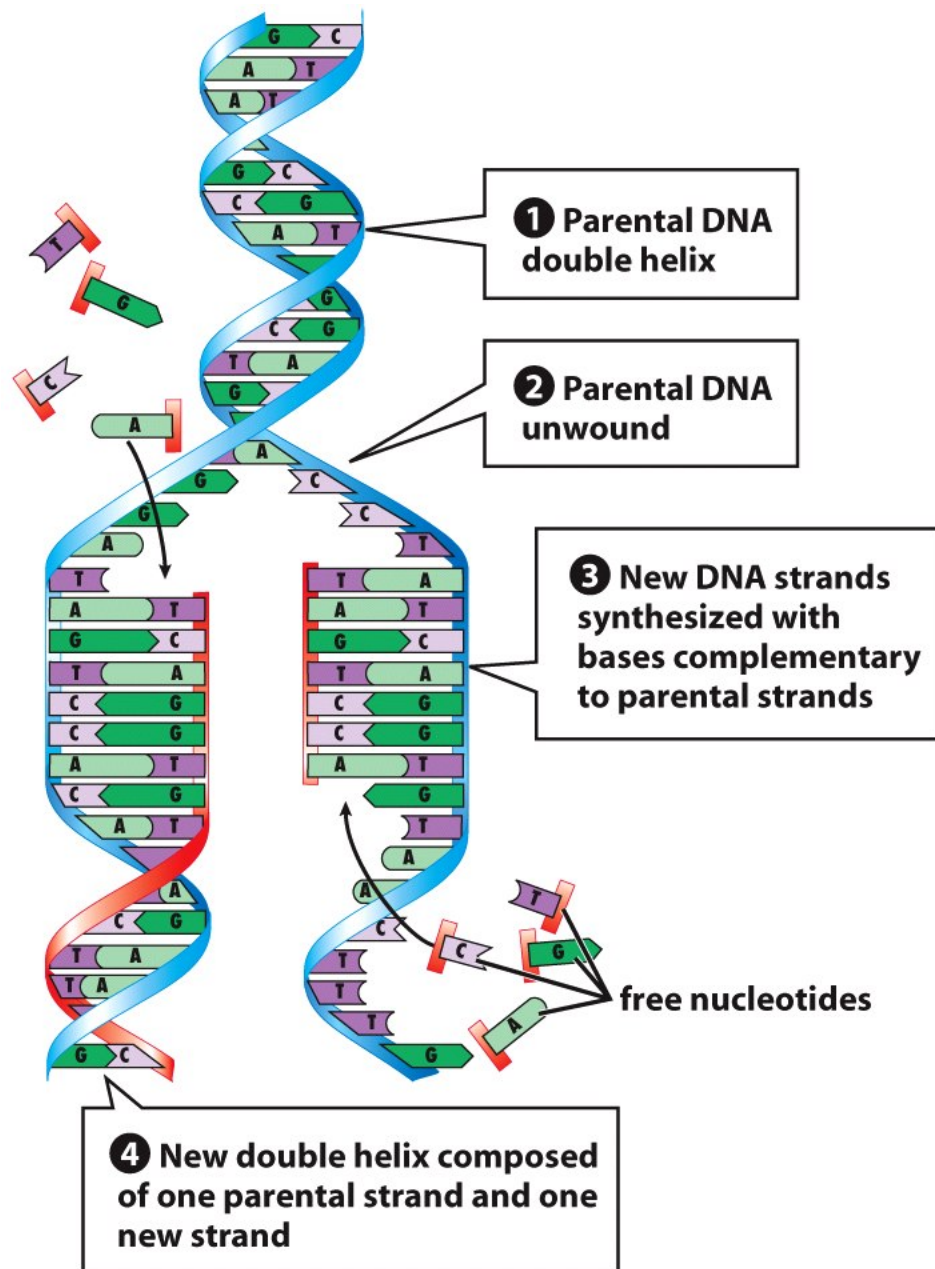


Figure 9-6 Biology: Life on Earth, 8/e
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DNA Replication

- Base pairing is the foundation of DNA replication
 - An adenine on one strand pairs with a thymine on the other strand; a cytosine pairs with guanine
 - If one strand reads ATG, the other reads TAC

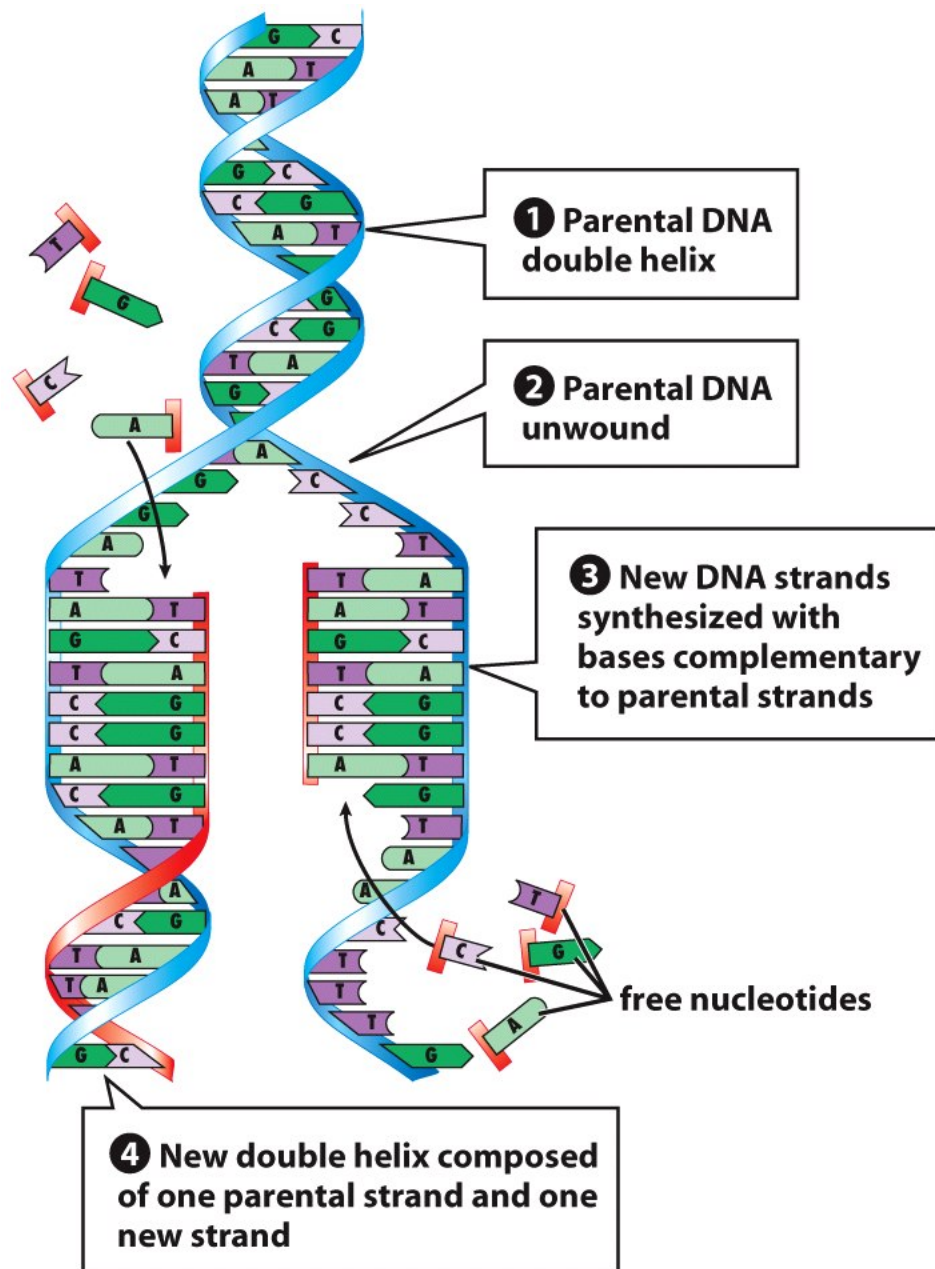


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DNA Replication

- The two resulting DNA molecules have one old parental strand and one new strand (**semiconservative replication**)

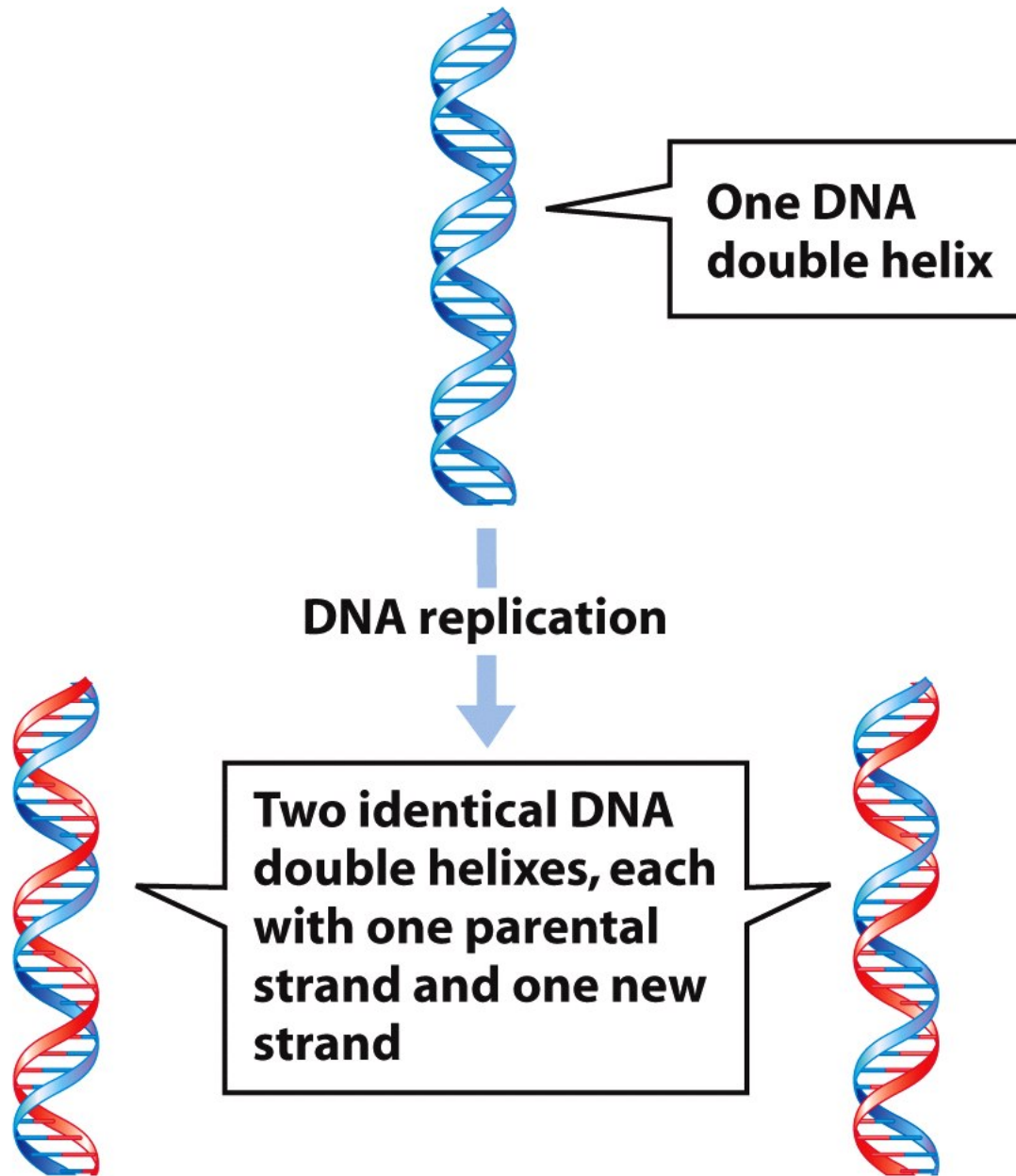


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Section 9.5 Outline

- **9.5 How Do Mutations Occur?**
 - Accurate Replication and Proofreading Produce Almost Error-Free DNA
 - Mistakes Do Happen
 - Mutations Range from Changes in Single Nucleotides to Movements of Large Pieces of Chromosomes
 - Mutations May Have Varying Effects on Function

Replication And Proofreading

- During replication, DNA polymerase mismatches nucleotides once every 10,000 base pairs
- DNA repair enzymes “proofread” each new daughter strand, replacing mismatched nucleotides
- However...

Mistakes Do Happen

DNA is damaged in a number of ways

- Spontaneous chemical breakdown at body temperature
- Certain chemicals (some components of cigarette smoke)

Mistakes Do Happen

- UV light from the sun causes DNA damage
 - DNA damage leads to uncontrollable cell division and skin cancer

Types of Mutations

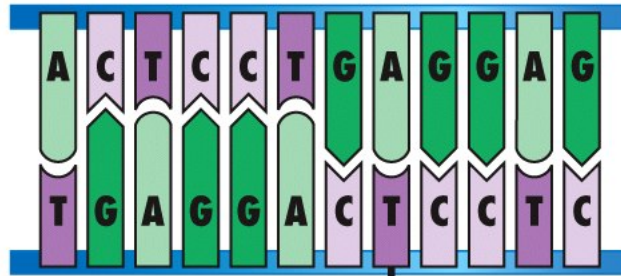
- **Point mutation** - individual nucleotide in the DNA sequence is changed
- **Insertion mutation** - one or more nucleotide pairs are inserted into the DNA double helix
- **Deletion mutation** - one or more nucleotide pairs are removed from the double helix

Types of Mutations

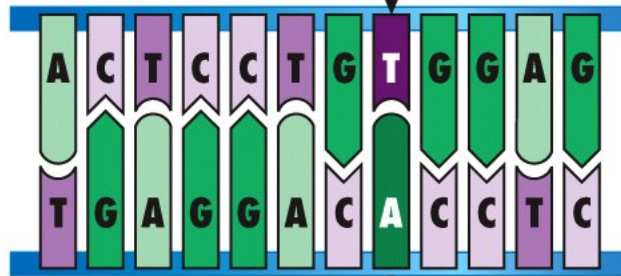
- **Inversion** - piece of DNA is cut out of a chromosome, turned around, and re-inserted into the gap
- **Translocation** - chunk of DNA (often very large) is removed from one chromosome and attached to another

Nucleotide substitution

original DNA sequence



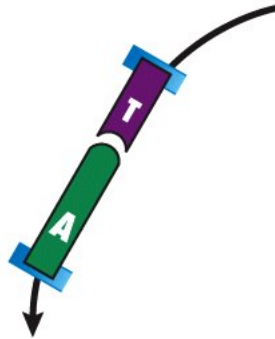
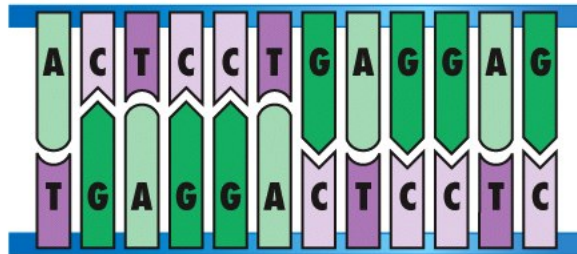
substitution



nucleotide pair changed from
A-T to T-A

Insertion mutation

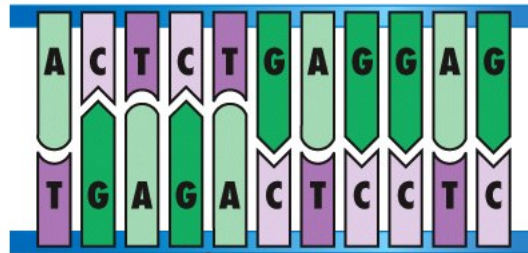
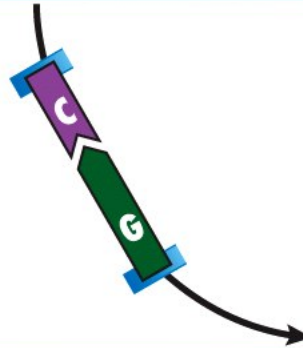
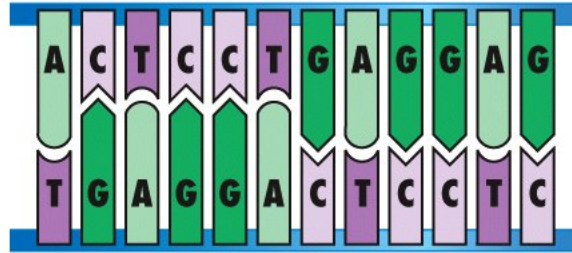
original DNA sequence



T-A nucleotide pair
inserted

Deletion mutation

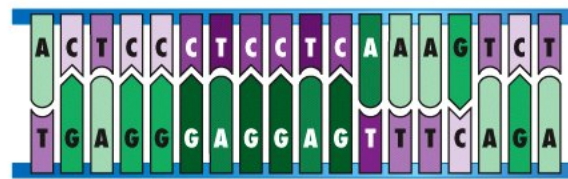
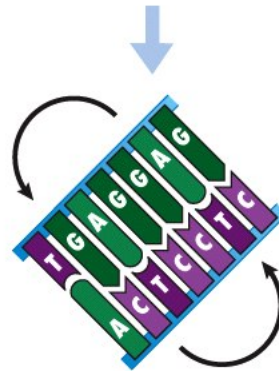
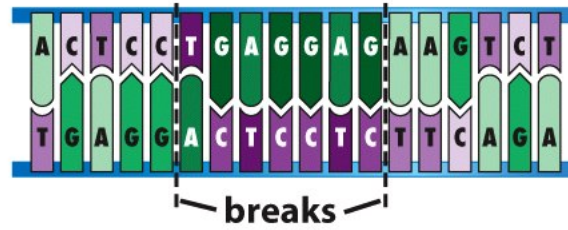
original DNA sequence



C-G nucleotide pair
deleted

Inversion

original DNA sequence



DNA segment inverted

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Translocation

original DNA sequences

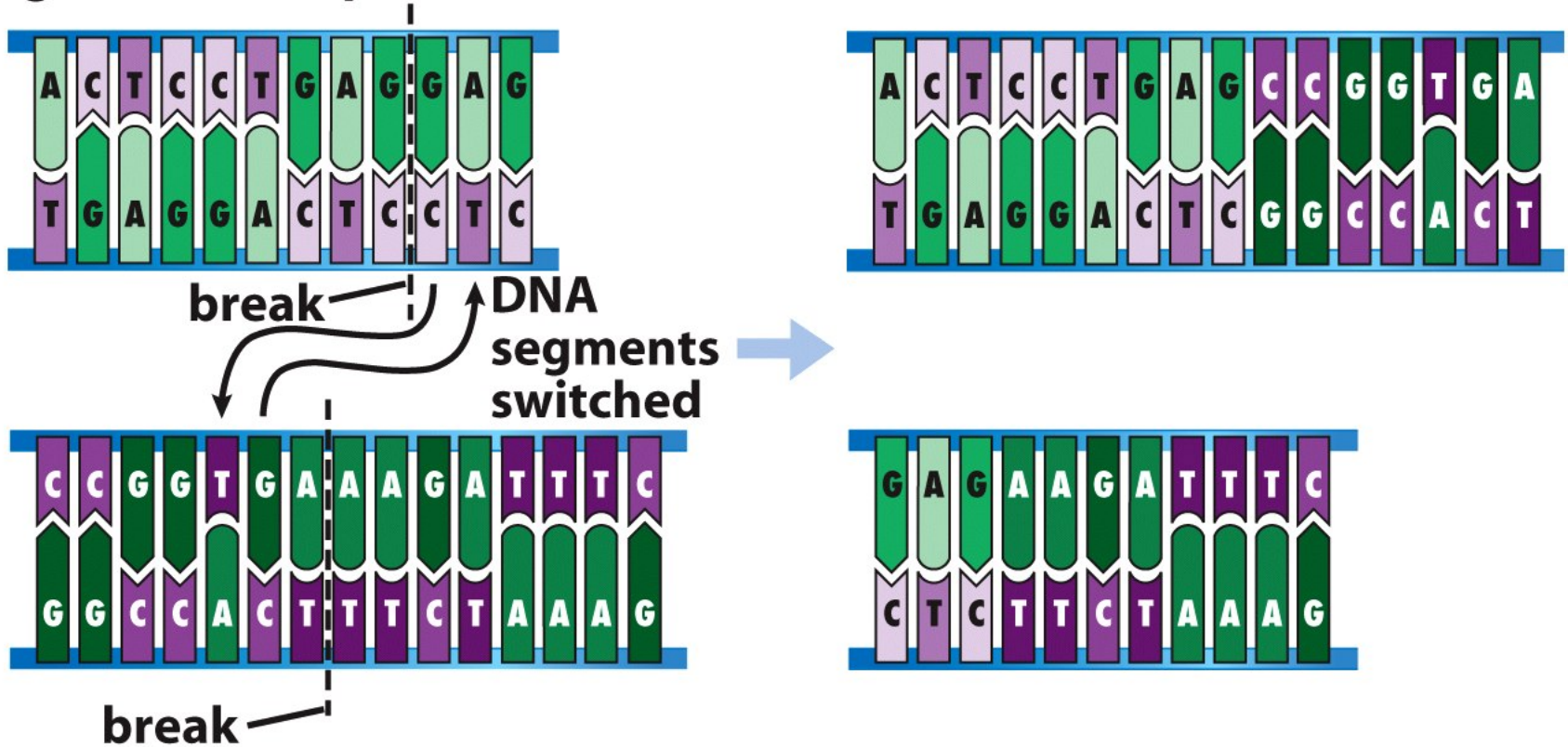


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