

Section
11.1

DNA: The Molecule of Heredity



SC.F.2.4.2 The student knows that every cell contains a “blueprint” coded in DNA molecules that specify how proteins are assembled to regulate cells. Also covers SC.F.1.4.1, SC.F.1.4.5, SC.G.1.4.3

Before You Read

Have you ever used a combination to open a lock? Most combination locks have the numbers 1 through 50. With those numbers there are many possible combinations. Imagine a combination lock with just the numbers 1 through 4 on it. On the lines below write as many combinations of those four numbers as you can think of. This will help you understand how DNA can carry so much information.

Read to Learn

STUDY COACH

Mark the Text **Identify**

Details Highlight each question head. Then use another color to highlight the answer to the question.

Reading Check

1. What three items form a nucleotide?

What is DNA?

Living things contain proteins. Your skin, muscles, and bones contain protein. All the actions you perform such as eating, running, and thinking depend on proteins called enzymes. How is this related to DNA? Within DNA is the information for life. DNA contains the instructions to make all the different proteins an organism needs.

How can DNA hold all that information?

DNA can contain amazing amounts of information because of its structure. It is a very long molecule made up of repeating units called nucleotides. Each nucleotide is made up of a simple sugar, a phosphate group, and a nitrogenous base. A **nitrogenous base** is a carbon ring structure that contains one or more atoms of nitrogen. In DNA, there are four of these bases: adenine (A), guanine (G), cytosine (C), and thymine (T). Because each nucleotide contains just one of these nitrogenous bases, there are only four different nucleotides in DNA. ✓

Nucleotides join together to form long chains, or strands. The phosphate groups and the sugar form the backbone of the strand and the nitrogenous bases stick out like the teeth of a zipper.

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DNA: The Molecule of Heredity, *continued***What does the DNA molecule look like?**

In 1953, James Watson and Francis Crick published a paper correctly describing the shape of a DNA molecule for the first time. They said that DNA is made of two strands of nucleotides held together by the nitrogenous bases, the parts that stick out like zipper teeth. Adenine on one strand always joins with thymine on the other strand. Likewise, guanine always joins with cytosine. They also noted that DNA was shaped like a long zipper that is twisted into a coil like a spring. Something twisted into a coil is called a **helix**. DNA is made of two strands that are twisted into a coil, so it is called a **double helix**. The figure at the right shows an example of a double helix.

How can DNA do so much with so little?

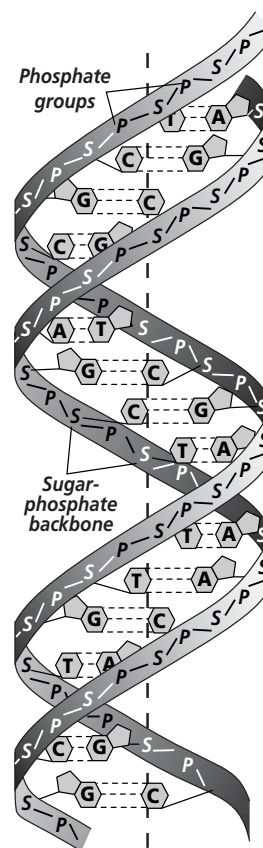
If every organism is made up of the same four nucleotides, how can organisms be so different from one another? The key to variety in organisms is the sequence, or order, of the four nucleotides. For example, a nucleotide sequence of A-T-T-G-A-C carries different information than the sequence T-C-C-A-A-A. It is the sequence of nucleotides that forms the unique genetic information for every organism. In a similar way, words that have the same letters but in different order have different meanings. TEA is not the same as EAT or ATE.

Replication of DNA

For most organisms to reproduce, a sperm cell and an egg cell, both produced through meiosis, must unite to form a fertilized egg. From one fertilized egg, an organism with millions of cells is produced through mitosis. Each cell in that organism has a copy of the DNA that was in the original fertilized egg. As you may recall, before a cell can divide, it must first make a copy of its chromosomes. The DNA in the chromosomes is copied in a process called **DNA replication**. If the DNA did not make a copy of itself, new cells would have only half the amount of DNA of their parents and could not grow and reproduce successfully. Species could not survive. All organisms replicate DNA. ✓

How does DNA replicate?

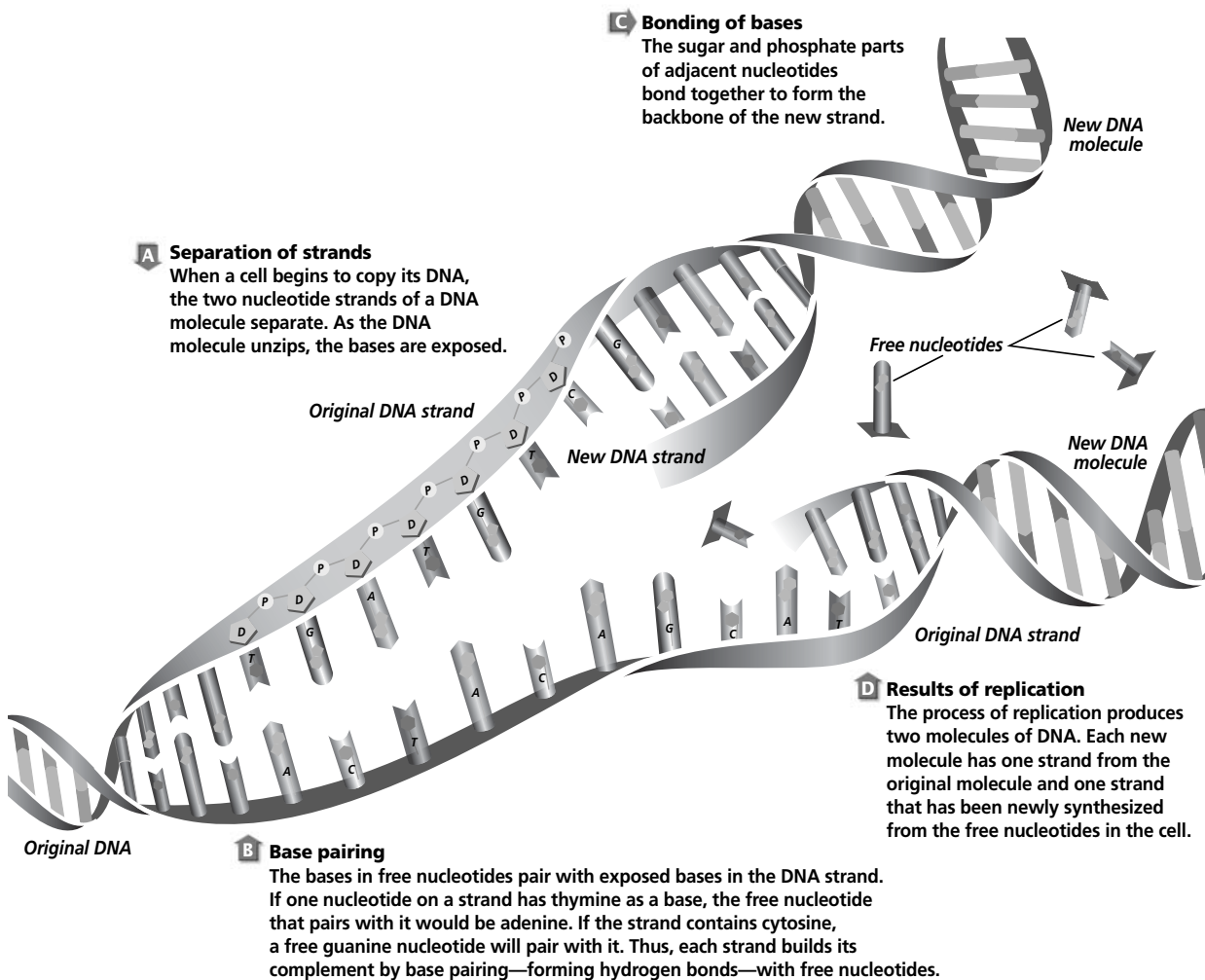
Remember that a DNA molecule is made of two strands of nucleotides joined together like a zipper at the nitrogenous bases. As you know, adenine on one strand always pairs with thymine on the other strand. In the same way, guanine on one strand always

**✓ Reading Check**

2. What is the purpose of DNA replication?

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DNA: The Molecule of Heredity, *continued*

Think it Over

3. Analyze When one DNA molecule replicates, how many new DNA molecules are formed? (Circle your choice.)

- a. one
- b. two
- c. four

pairs with cytosine on the other strand. During replication, the DNA molecule unzips and separates. As the DNA unzips, nucleotides that are floating free in the cell attach to the unzipped chains. On the unzipped strand where there is guanine, cytosine will attach. The original DNA molecule continues to unzip until every base has become a pair and a new DNA molecule is formed. In this way the original DNA strand serves as a pattern or template to make a new DNA molecule. Each new strand formed is a complement of one of the original strands. The result is two DNA molecules, each is the same as the parent molecule. The figure above shows how DNA replicates.

When all of the DNA in all the chromosomes has been replicated, the cell can divide, passing on the genetic information to the new cell.

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DNA: The Molecule of Heredity, *continued*

► After You Read

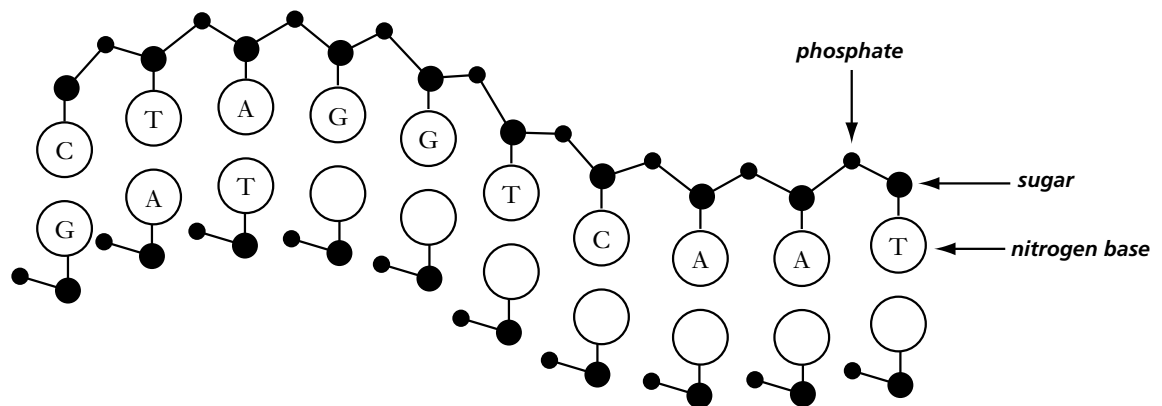
Mini Glossary

DNA replication: process in which the DNA in the chromosome is copied

double helix: shape of a DNA molecule consisting of two strands of nucleotides that are twisted into a coil and held together by the nitrogenous bases

nitrogenous base: carbon ring structure found in DNA molecules that contains one or more atoms of nitrogen

1. Read the key terms and definitions in the Mini Glossary above. Use each term in a sentence that shows your understanding of the term.



2. Moving from left to right, write the letters (A, T, C, or G) in the empty circles of the bases that will pair with the bases on the top strand. The first three pairs have been completed for you.
3. Circle the letter of the correct statement below.
- The illustration above is of a DNA molecule unzipping.
 - The illustration above is of a DNA strand replicating.



Visit the Glencoe Science Web site at **science.glencoe.com** to find your biology book and learn more about DNA: the molecule of heredity.