

## How does an understanding of DNA help us investigate living things?

Use with textbook pages 8–21.

### The Structure of DNA

DNA and RNA are examples of large biological molecules called **nucleic acids**. They are made up of repeating sub-units called **nucleotides**. Each nucleotide consists of a sugar, a phosphate group, and a nitrogen-containing base. These **nitrogenous bases** in DNA are thymine (T), cytosine (C), adenine (A), and guanine (G). Thymine always pairs up with adenine, and cytosine always pairs up with guanine. This pairing up is known as **complementary base pairing**. DNA is shaped like a twisted ladder called a double helix. The nitrogenous bases make up the steps of the ladder. The sugar and phosphate group make up the sides.

### The Function of DNA

DNA stores all the genetic information in segments called **genes**. Genes contain instructions for making proteins, which are molecules made up of sub-units called **amino acids**. DNA is passed on from the biological parents to their offspring. The complete DNA sequence in each cell is called the **genome**.

### Chromosomes

DNA usually exists in the form of **chromatin**. During cell division, the chromatin condenses into distinct structures called **chromosomes**. A human body cell has 46 chromosomes, or 23 pairs. The biological father supplies 23 chromosomes, while the biological mother supplies the other 23 chromosomes. Of the 23 pairs, 22 pairs are called **autosomes**. The last pair is the **sex chromosomes**, which are the X chromosome and the Y chromosome. A person who has two X chromosomes is considered to be a genetic female. A person who has an X chromosome and a Y chromosome is a genetic male. A **karyotype** is a photograph of the 23 pairs of chromosomes, arranged by length.

### DNA Replication

During DNA **replication**, one of the DNA strands acts as a template for the formation of its complementary strand. The end result is two DNA molecules that are identical to the original molecule. The instructions for a protein are copied onto an RNA molecule, which is then used to make the protein.

### Biodiversity

**Biodiversity** may be classified into three types. **Species diversity** is the variety and abundance of a group of organisms that can interbreed in a given area. **Genetic diversity** can be seen in the variety of characteristics that are expressed within a species.

**Ecosystem diversity** is evident in the many different types of ecosystems on Earth.



## The Structure and Function of DNA

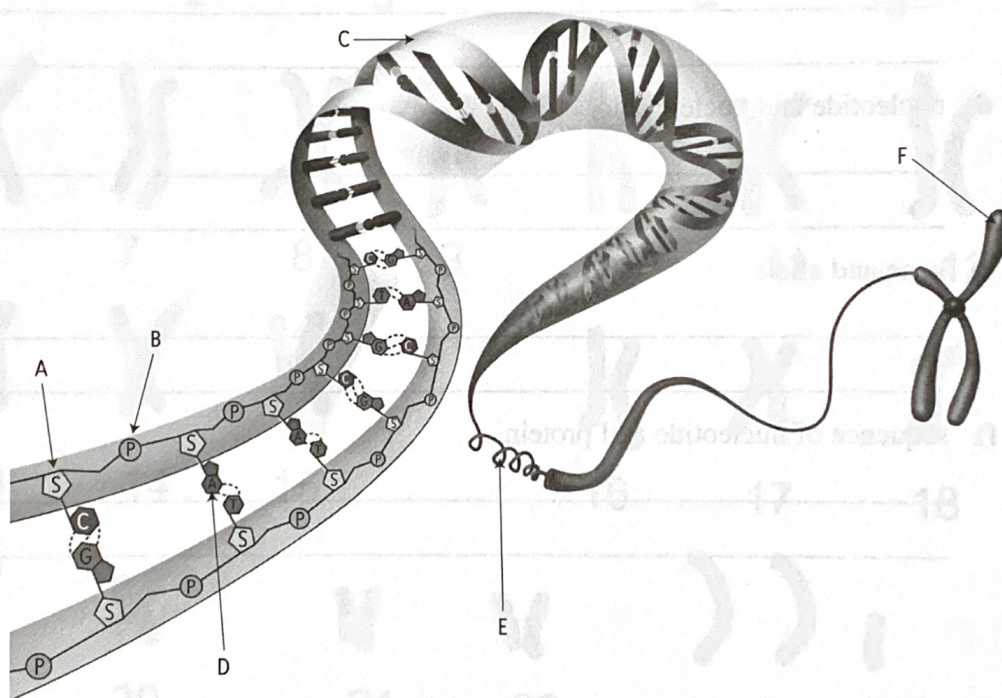
Use with textbook pages 10-15.

1. The diagram below shows the relationships among DNA, chromatin, and chromosomes. Label the diagram with the following terms:

chromatin  
chromosome  
DNA double helix

nitrogenous base  
phosphate group  
sugar

You might find it helpful to refer to Figure 1.2 and Figure 1.3 in your textbook.



- A. \_\_\_\_\_  
B. \_\_\_\_\_  
C. \_\_\_\_\_  
D. \_\_\_\_\_  
E. \_\_\_\_\_  
F. \_\_\_\_\_



2. Describe how the following are related to each other.

a) DNA and RNA

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b) adenine and thymine

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c) complementary base pairing and hydrogen bonds

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d) nucleotide and nucleic acid

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e) gene and allele

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f) sequence of nucleotide and protein

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### DNA Replication

During DNA replication, one of the DNA strands acts as a template for the synthesis of a new strand. The end result is two DNA molecules that are identical to the original molecule. The process is called semi-conservative replication because each new DNA molecule contains one original strand and one newly synthesized strand.

### Protein Synthesis

Protein synthesis is the process by which cells build proteins. It involves two main stages: transcription and translation. Transcription is the process of copying a segment of DNA into a messenger RNA (mRNA) molecule. Translation is the process of using the mRNA molecule to synthesize a protein. The sequence of nucleotides in the mRNA determines the sequence of amino acids in the protein.



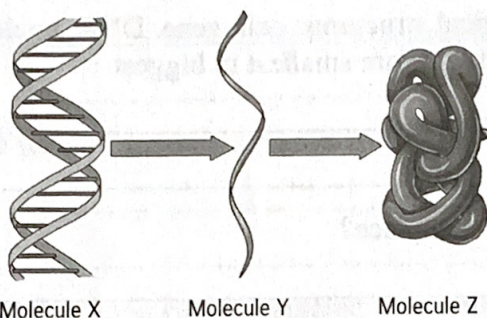
**DNA Replication**

Use with textbook page 16.

1. Consider the following biological structures: cell, gene, DNA, nucleotide, chromosome, nucleus. Rank them from smallest to biggest.  
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\_\_\_\_\_
2. Where does DNA replication take place?  
\_\_\_\_\_
3. When does DNA replication take place?  
\_\_\_\_\_
4. Assume that the sequence of bases in one strand of a DNA molecule is G-A-C-T-T-A-C-G-T-A-C-C. What is the sequence of complementary bases in the other strand of DNA during DNA replication?  
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5. What is the result of DNA replication? How does each strand in the new molecule compare to the other?  
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\_\_\_\_\_  
\_\_\_\_\_
6. Consider the following analogy: The genetic code—the set of instructions that determines all the traits of an organism—may be compared to a book. Still using this analogy, what could the following be compared to?
  - a) chapters in the book  
\_\_\_\_\_
  - b) sentences in the book  
\_\_\_\_\_
  - c) letters in the book  
\_\_\_\_\_



7. Identify Molecules X, Y, and Z. Describe how each molecule contributes to the development of an organism.



- a) Name of Molecule X \_\_\_\_\_
- b) Name of Molecule Y \_\_\_\_\_
- c) Name of Molecule Z \_\_\_\_\_
- d) Function of Molecule X \_\_\_\_\_
- e) Function of Molecule Y \_\_\_\_\_
- f) Function of Molecule Z \_\_\_\_\_

8. How are genes involved in the production of proteins?

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