

# 8.2 Structure of DNA

**KEY CONCEPT** DNA structure is the same in all organisms.

## DNA is composed of four types of nucleotides.

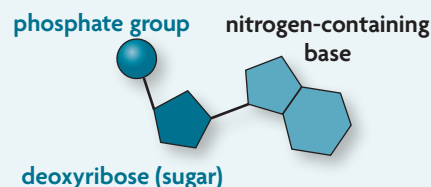
Since the 1920s scientists have known the chemical parts of the DNA molecule. DNA is a very long polymer, or chain of repeating units. The units, or monomers, that make up DNA are called **nucleotides** (NOO-klee-oh-TYDZ). Each nucleotide has three parts: a phosphate group, a base, and a sugar.

There are four different types of DNA nucleotides: cytosine (C), thymine (T), adenine (A), and guanine (G). All of the nucleotides contain a phosphate group and a deoxyribose sugar. They differ in their nitrogen-containing bases, as shown in the table below.

Notice that thymine (T) and cytosine (C) have nitrogen-containing bases with a single-ring structure. Adenine (A) and guanine (G) are bases with a double-ring structure. A single molecule of human DNA is made of billions of nucleotides.

### VISUAL VOCAB

The small units, or monomers, that make up a strand of DNA are called **nucleotides**. Nucleotides have three parts.



- phosphate group: one phosphorus with four oxygens
- deoxyribose: ring-shaped sugar
- nitrogen-containing base: a single or double ring built around nitrogen atoms and carbon atoms

### THE FOUR NITROGEN-CONTAINING BASES OF DNA

PYRIMIDINES = SINGLE RING			PURINES = DOUBLE RING		
Name of Base	Structural Formula	Model	Name of Base	Structural Formula	Model
thymine			adenine		
cytosine			guanine		



Circle the names of the four nucleotides shown in the table above.

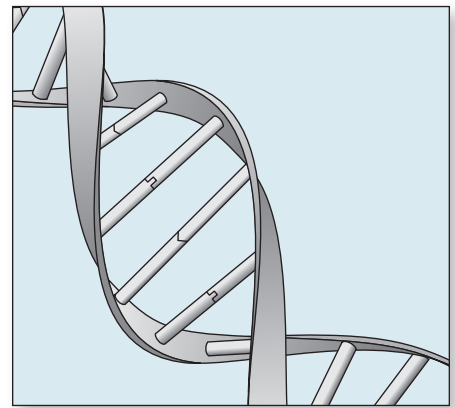
## Watson and Crick developed an accurate\* model of DNA's three-dimensional structure.

For a long time, scientists hypothesized that DNA in all organisms was made up of equal amounts of the four nucleotides. Then Erwin Chargaff found that the proportion of the bases differs from organism to organism. In the DNA of each organism, the amount of A equals the amount of T, and the amount of C equals the amount of G.

Then in the early 1950s, the scientists Rosalind Franklin and Maurice Wilkins used x-rays to make a kind of photograph of DNA molecules. These photographs did not show what DNA looks like, but they showed patterns that gave clues about DNA's structure.

Around the same time, the scientists James Watson and Francis Crick were working together to figure out DNA structure, too. Based on the work of other scientists, they hypothesized that DNA might have a spiral, or helix (HEE-lihks), shape. Watson and Crick saw Franklin's photos and used the information to complete their model of DNA structure.

In April 1953 Watson and Crick published their DNA model in a paper in the journal *Nature*. They found that nucleotides fit together in a **double helix**. Two strands of DNA wrap around each other like a twisted ladder.



Watson and Crick's model showed DNA in the shape of a double helix.



What new information did Watson and Crick contribute to science? \_\_\_\_\_

## Nucleotides always pair in the same way.

Each side of the DNA double helix is a long strand of phosphates and sugars, connected by covalent bonds. The two sides of the double helix are held to each other by hydrogen bonds that form between the bases in the middle. Each individual hydrogen bond is weak, but together they are strong enough to hold the shape of DNA. The bases of the two DNA strands always bond according to the **base pairing rules**: T pairs with A, and C pairs with G.

The bases pair in this way because of hydrogen bonds. Notice that A and T form two hydrogen bonds, whereas C and G form three.

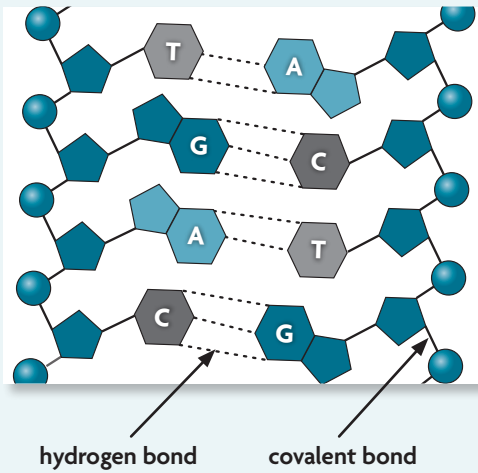
To help remember the rules of base pairing, notice that the letters G and C have a similar shape. Once you know that G and C pair together, you know that A and T also pair together. If the sequence of bases on one DNA strand is CTGA, the other DNA strand will be GACT.

### \* ACADEMIC VOCABULARY

**accurate** correct

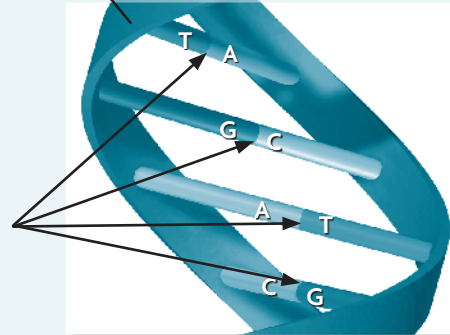
## BASE PAIRING RULES

The **base pairing rules** describe how **nucleotides** form pairs in DNA. **T** always pairs with **A**, and **G** always pairs with **C**.



This ribbonlike part represents the **phosphate groups** and **deoxyribose sugar** molecules that make up DNA's "backbone."

The nitrogen-containing bases bond in the middle to form the rungs of the DNA ladder.



What sequence of bases would pair with GTACG?

### 8.2 Vocabulary Check

nucleotide      base pairing rules  
double helix

### Mark It Up

Go back and highlight each sentence that has a vocabulary word in **bold**.



- Label the drawing at the right with the terms *nucleotide*, *base pairing rules*, and *double helix*. Write each term and draw a line that connects the term to the appropriate part of the drawing.

### 8.2 The Big Picture

- What are the three different parts of a nucleotide? \_\_\_\_\_
- What are the names of the four nucleotides? \_\_\_\_\_
- Use the base pairing rules to write the sequence that would pair with the following sequence: TCACGTA \_\_\_\_\_

