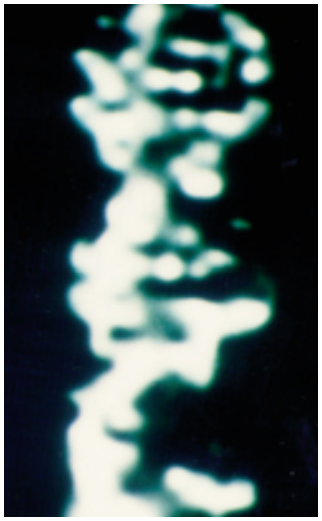


FIGURE 22 The double helix of DNA can be seen by using scanning tunneling microscopy (STM).

extension

Historical Chemistry

Go to **go.hrw.com** for full-length article on the discovery of the structure of DNA.

Keyword: HC6BIOX

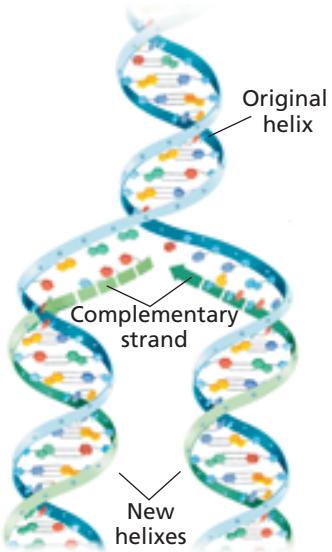
Nitrogenous Base Pairs

In the DNA double helix, base pairing exists only between A–T and between C–G, as you saw in **Figure 21.** The reason is that the pairing between one single-ringed base and one double-ringed base provides the correct orientation for the hydrogen bonds to form between the two sides of the DNA ladder. One thymine and one adenine form a link between the two strands of a DNA molecule that is exactly the same size as the link formed by one cytosine and one guanine.

The double-helix configuration of DNA, shown in **Figure 22,** can be seen by using a scanning tunneling microscope (STM). The discovery of the relative quantities of the nitrogenous bases A, T, G, and C present in DNA was the key to determining the three-dimensional molecular structure. Analysis of DNA from different organisms reveals that the amounts of A and T are the same and that the amounts of G and C are the same for all members of the same species. In humans, DNA is about 30% A, 30% T, 20% G, and 20% C.

The interaction between base pairs accounts for the ability of DNA to replicate, as you will see in the next section. Just as combinations of the 26 letters of the alphabet form words that tell a story in a novel, combinations of the four-letter alphabet of A, T, G, and C form the *genes* that define our heredity. Each gene is a section of DNA that contains a specific sequence of four bases (A, G, T, and C) and encodes instructions for protein synthesis. As of 2004, researchers with the Human Genome Project had discovered that the human body contains about 20 000 to 25 000 genes.

FIGURE 23 DNA replicates when its double helix unwinds and becomes single stranded. The single strands are used as a template for the formation of new complementary strands.



DNA Replication

Like the two sides of a zipper, the two strands of the double helix of DNA are not identical. Instead, the two strands are complements of each other. Thus, a base on one strand is paired through hydrogen bonding to its complementary base on the other strand. For example, if one strand sequence is AGCTC, the complementary strand sequence will be TCGAG.

Each time a cell divides, an exact copy of the DNA of the parent cell is reproduced for the daughter cells. *The process by which an identical copy of the original DNA is formed is called* **DNA replication.** As replication begins, a portion of the two strands of the original DNA unzips, as shown in **Figure 23.** Each strand can then act as a template for the synthesis of a new, complementary strand. The result is two new DNA molecules, which have the same base pair sequence as the original double helix.