

The **double helix model** is the description of the three-dimensional structure of DNA (deoxyribonucleic acid).¹ It depicts DNA not as a flat ladder, but as two long strands twisted around each other like a spiral staircase.²

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This model was first published in 1953 and is considered one of the most significant discoveries in the history of biology because it revealed how genetic information is stored and copied.³

1. The Structure: A Twisted Ladder⁴

If you imagine a ladder twisted into a spiral, the double helix has two main parts:

- **The Backbone (The Rails):** The outside of the helix is formed by alternating **sugar** (deoxyribose) and **phosphate** molecules.⁵ This "sugar-phosphate backbone" provides the structural framework.
- **The Base Pairs (The Rungs):** Inside the helix, connecting the two backbones, are pairs of nitrogenous bases.⁶ These bases hold the two strands together using hydrogen bonds.⁷

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2. Key Rules of the Model

The double helix is highly specific in how it is built. Three chemical rules are essential to its function:

- **Complementary Base Pairing:** The "rungs" are not random.⁸ A base on one strand always pairs with a specific partner on the other strand:⁹
 - **Adenine (A)** always pairs with **Thymine (T)**.¹⁰
 - **Cytosine (C)** always pairs with **Guanine (G)**.¹¹
 - *Why this matters:* This means if you know the sequence of one strand (e.g., A-C-T-G), you automatically know the sequence of the other (T-G-A-C).¹² This is the secret to how DNA copies itself.
- **Antiparallel Strands:** The two strands run in opposite directions.¹³ Chemical direction is measured from the ¹⁴\$5'\$ (five-prime) end to the ¹⁵\$3'\$ (three-prime) end.¹⁶ In the

double helix, one strand runs ¹⁷5' to 3' while the other runs ¹⁸3' to 5'.¹⁹
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- **Right-Handed Twist:** In nature (specifically B-DNA, the most common form), the helix twists to the right, completing a full turn roughly every 10.5 base pairs.²⁰

3. The Discovery

The discovery of the double helix is a famous (and controversial) story of scientific competition:

- **Watson & Crick:** James Watson and Francis Crick are credited with proposing the model in 1953.²¹ They built physical models (using cardboard and metal plates) to fit the chemical pieces together.²²
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- **Rosalind Franklin:** Her work was crucial but often overlooked at the time.²³ She was an expert in X-ray crystallography and captured **Photo 51**, a famous X-ray image that clearly showed the "X" pattern characteristic of a helix.²⁴ Watson used this data (shown to him without her permission by Maurice Wilkins) to confirm the helical structure.²⁵
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- **The Nobel Prize:** In 1962, Watson, Crick, and Wilkins were awarded the Nobel Prize.²⁶ Franklin had passed away four years earlier and was not eligible for the posthumous award, though modern science recognizes her as a co-discoverer.

Summary of Components

Component	Description
Nucleotide	The basic building block, consisting of one sugar, one phosphate, and one base.
Hydrogen Bonds	Weak bonds that hold the A-T and C-G base pairs together (like a zipper).
Sugar-Phosphate	The structural "rails" that protect the genetic code inside.

Would you like me to explain how the Double Helix "unzips" to replicate itself?