Two strands, one double helix

DNA consists of two polynucleotide strands wound around each other. Its structure both protects information and allows a complementary copy to be made.



Two separate strands

1. BACKBONES OUTSIDE

Each strand has an alternating deoxyribose-phosphate backbone. The two coloured curves represent these backbones.

2. BASES INSIDE

Bases attach to sugars and point towards the interior. Opposing bases form complementary pairs: A with T, and C with G.

3. MATCHED PARTNERS

Each standard pair contains one purine and one pyrimidine, giving a consistent width. The strands are complementary, not identical.

Helix schematic: grey rungs represent base pairs, not individual hydrogen bonds. Ends are left open; the diagram is not to scale.



2 hydrogen bonds



3 hydrogen bonds

Each dashed line above represents one hydrogen bond, not an atom-by-atom structural formula. Complementary base pairing means that one strand determines the base sequence of the other.

C-G has three hydrogen bonds; A-T has two. For otherwise comparable DNA, a higher C-G content generally increases the temperature needed to separate the strands. Base stacking also contributes to DNA stability.

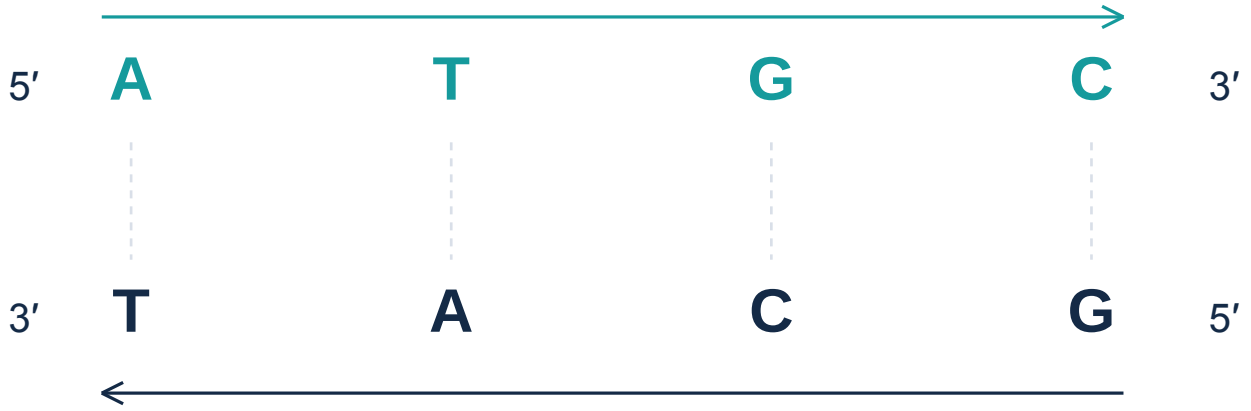
Helix organisation: NHGRI, Double Helix.
Pairing and hydrogen bonds: OpenStax Biology 2e, section 3.5.

Scope: Cambridge Biology 9700 syllabus, section 6.1, outcome 3, p. 24.

Antiparallel means opposite directions

A strand has a 5-prime end and a 3-prime end. These names refer to numbered carbon positions in deoxyribose, not to the number of bases or strands.

1. ALIGN COMPLEMENTARY BASES



Arrows show each strand in its own 5′ to 3′ direction.

2. COMPLEMENT THE BASES AND REVERSE THE END LABELS

Opposite A write T; opposite T write A; opposite G write C; opposite C write G. When the top strand runs from 5-prime to 3-prime left to right, the paired strand runs from 3-prime to 5-prime left to right.

3. REPORT A SEQUENCE IN THE REQUESTED DIRECTION

The lower strand above reads TACG from left to right, but that is its 3-prime to 5-prime direction. To report it from 5-prime to 3-prime, read from right to left:

5′-GCAT-3′

The molecule has not changed: only the direction used to write its sequence has changed. Always keep the end labels with the bases. Both strands contain deoxyribose and phosphate.

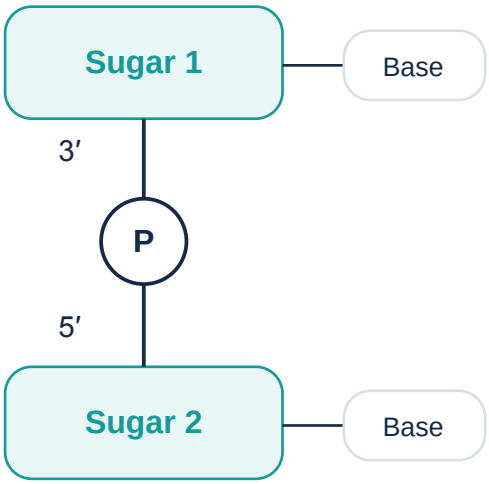
Strand polarity and antiparallel structure: Alberts et al., Structure and Function of DNA.
Complementary base identities: NHGRI, Base Pair.

Scope: Cambridge Biology 9700 syllabus, section 6.1, outcome 3, p. 24.

Along a strand or between strands?

Phosphodiester bonds build each backbone. Hydrogen bonds link complementary bases across the two strands. The distinction explains how DNA can open without breaking into nucleotides.

1. A PHOSPHATE BRIDGES TWO SUGARS



Component schematic; connecting oxygen atoms and other groups are omitted.

A phosphodiester linkage connects the 3-prime position of one deoxyribose to the 5-prime position of the next, through phosphate and oxygen atoms.

These strong covalent links form the repeating sugar-phosphate backbone. Bases are attached to sugars; phosphodiester bonds do not join the paired bases.

2. COMPARE THE TWO BOND TYPES

BOND	LOCATION	ROLE
Phosphodiester	Within each strand	Connects nucleotides into a backbone.
Hydrogen	Between paired bases on opposite strands	Helps hold the two strands together.

When the strands separate for copying or reading, hydrogen bonds between bases are disrupted. The covalent backbones remain intact. Each separated strand can then act as a template through complementary pairing.

Nucleotide linking: OpenStax Biology 2e, section 3.5.
DNA architecture and information copying: Alberts et al., Structure and Function of DNA.

Scope: Cambridge Biology 9700 syllabus, section 6.1, outcome 3, p. 24.