Adenosine
A look at the Chemistry of DNA
A look at the Chemistry of DNA
A look at the Chemistry

DNA
A look at the Chemistry

DNA
A look at the Chemistry of DNA
DNA
A look at the Chemistry
A look at the Chemistry

DNA
A look at the Chemistry

DNA
DNA
A look at the Chemistry

Diagram of DNA molecule with chemical structures.
A look at the Chemistry of DNA
DNA

A look at the Chemistry
A Look at the Chemistry

DNA
Forming the second H-bond in an already restricted pair does not
require paying the entropy price a second time.

Bringling the two side chains together requires an entropic price
as this is more than twice as good.

This is for hydrogen-bonding in biology, whenever possible.

The "Two-Fer" Principle
Think about alternate resonance forms for the amido group.

There is also an electronic argument as this is more than twice as good.

Try to get "two for the price of one" for hydrogen-bonding in biology, whenever possible.

The "Two-Fer" Principle
Hydrogen Bonding in Nucleic Acid Bases
Hydrogen Bonding in Nucleic Acid Bases
Hydrogen Bonding in Nucleic Acid Bases
Hydrogen Bonding in Nucleic Acid Bases
Hydrogen Bonding in Nucleic Acid Bases
What forces are important?
What forces are important?
What forces are important?

Hydrogen Bonding

Electrostatics
What forces are important?

Electrostatics

Surface & Stacking

Burial of Hydrophobic

Hydrogen Bonding
Base Pairing

(Donors matched to Acceptors)
Base Pairing (Donors matched to Acceptors)
Base Pairing

(Donors matched to Acceptors)
Base Pairing

(Donors matched to Acceptors)
Base Pairing
(Donors matched to Acceptors)
Base Pairing
(Donors matched to Acceptors)

Good base pairing
Watson-Crick Pairing

Good base pairing

(Donors matched to Acceptors)

Base Pairing
but anti-Watson-Crick orientation
Watson-Crick facing
Good base pairing

(Donors matched to acceptors)
Base Pairing
Base Pairing
(Donors matched to Acceptors)
Base Pairing

(Donors matched to Acceptors)
Good base pairing

(A) Base Pairing

(Donors matched to Acceptors)
Good base pairing

WC-Hoogsteen facing

Base Pairing

(T Donors matched to Acceptors)
Bad Base Pairing
(Donors not matched to Acceptors)
Bad Base Pairing

(Donors to Acceptors with terrible angles)
Wild (but good) Base Pairing
Wild (but good) Base Pairing
Wild (but good) Base Pairing

(G-quartet)
(Telomeres)
Ten H-Bonds

AT Base Pair

Ten H-Bonds
(hydrophobic-core/stacking-interactions)

Burial of hydrophobic surface drives helix formation
Flat faces are nonpolar

(hydrophobic core / stacking interactions)

Burial of hydrophobic surface drives helix formation
Edges are very polar (can H-bond)
Flat faces are nonpolar

(hydrophobic core / stacking interactions)
Bural of hydrophobic surface drives helix formation
Other chemical constraints
Furanose Sugar Ring
Furanose Sugar Ring
Furanose Sugar Ring
Furanose Sugar Ring
<table>
<thead>
<tr>
<th>Minor Gutter Groove Width</th>
<th>4.5 Å</th>
<th>4.6 Å</th>
<th>4.7 Å</th>
<th>4.8 Å</th>
<th>4.9 Å</th>
<th>5.0 Å</th>
<th>5.1 Å</th>
<th>5.2 Å</th>
<th>5.3 Å</th>
<th>5.4 Å</th>
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<tbody>
<tr>
<td>Major Gutter Groove Width</td>
<td>+ 1.0 Å</td>
<td>+ 1.2 Å</td>
<td>+ 1.4 Å</td>
<td>+ 1.6 Å</td>
<td>+ 1.8 Å</td>
<td>+ 2.0 Å</td>
<td>+ 2.2 Å</td>
<td>+ 2.4 Å</td>
<td>+ 2.6 Å</td>
<td>+ 2.8 Å</td>
<td>+ 3.0 Å</td>
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<tr>
<td>Pitch per Turn of Helix</td>
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<td>2.7 Å</td>
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<td>3.9 Å</td>
<td>4.1 Å</td>
<td>4.3 Å</td>
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<td>Base Pairs per Helix Repeat</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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<table>
<thead>
<tr>
<th>Helix Type</th>
<th>Z-B</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
</table>

TABLE 6.2 A Comparison of the Structural Properties of A, B, and Z DNAs as Derived from Single-Crystal X-Ray Analyses
This polymerase is good at bypassing lesions in the DNA. This has been suggested by biochemical studies that recognize the incoming substrate dNTP.

A crystal structure from July 2004 shows that an error-correction (and Hoogsteen-WC base pairing to Hoogsteen-prone) DNA polymerase uses.

Letters to Nature

Replisome by human DNA polymerase-1 occurs by

and Anand K. Agarwal, T. Nair, E. Johnson, Satya Prakash, Louise Prakash.
Lesions in the DNA.

This polymerase is good at bypassing lesions and has been suggested to use such a pairing.

This suggests biochemical studies that recognize the incoming substrate dNTP.

Hoogsteen-WC base pairing to Hoogsteen-strand DNA polymerase uses a crystal structure from July 2004.

But perhaps not... Hoogsteen vindicated.

Letters to Nature
Why is Watson-Crick so good?
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Why is Watson-Crick so good?
Why is Watson-Crick so good?
Why is Watson-Crick so good?
Minor Groove

Major Groove

Why is the major groove so good?
Why is the major groove so good?
Why is the major groove so good?
Why is the major groove so good?
Supercoiling
RNA Splicing
The image depicts a biochemical reaction involving the ATP (adenosine triphosphate) molecule. ATP is a key energy carrier in cells, and this reaction illustrates the role of ATP in cellular processes. The diagram shows the transfer of a phosphate group from ATP to another molecule, which is a common event in metabolic reactions, particularly in the process of translation in biology, where proteins are synthesized from mRNA.