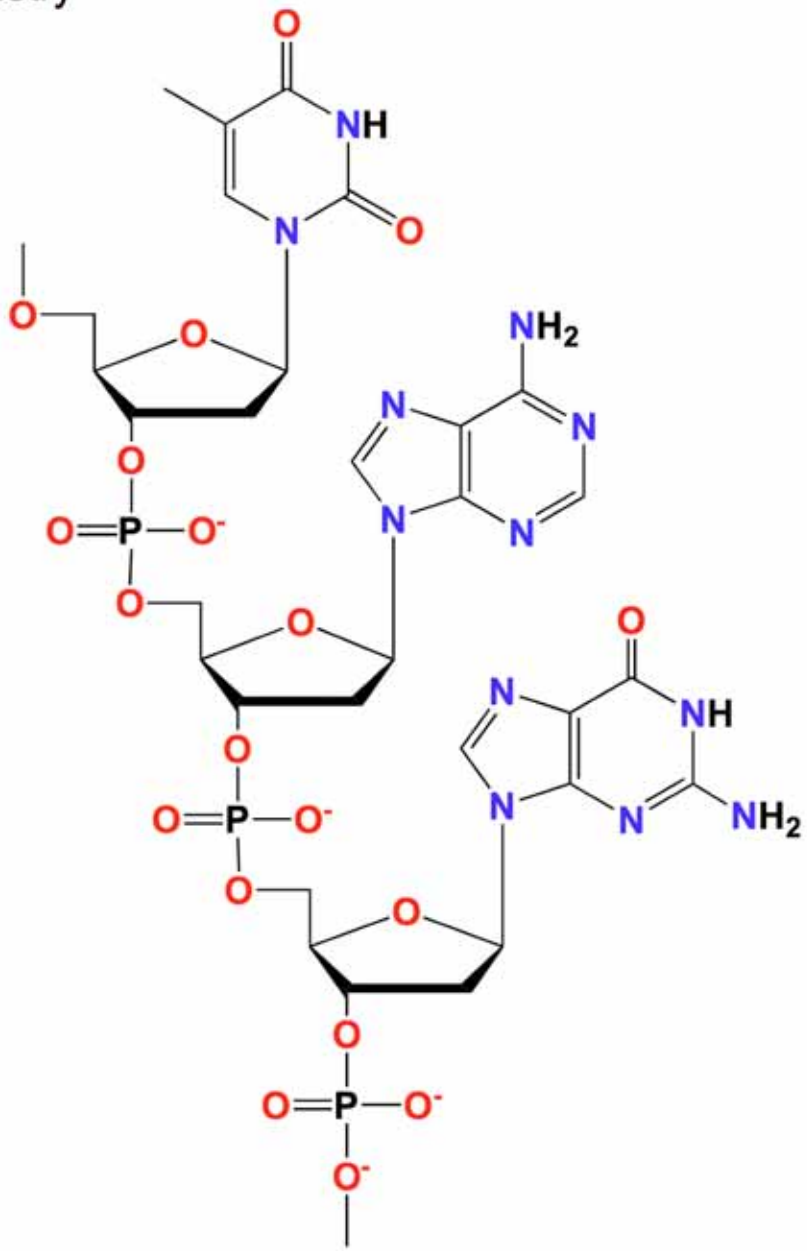
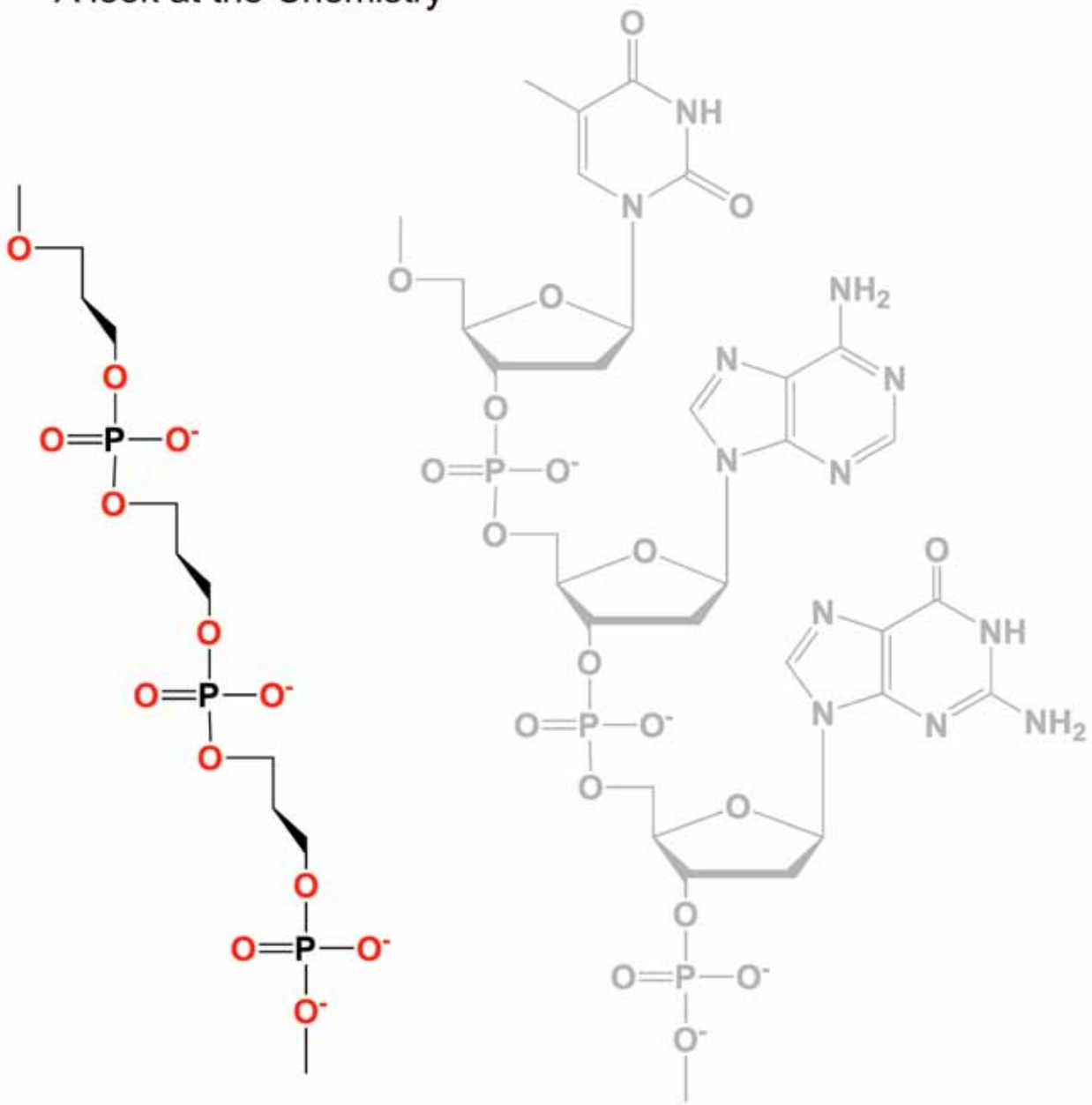
DNA

A look at the Chemistry



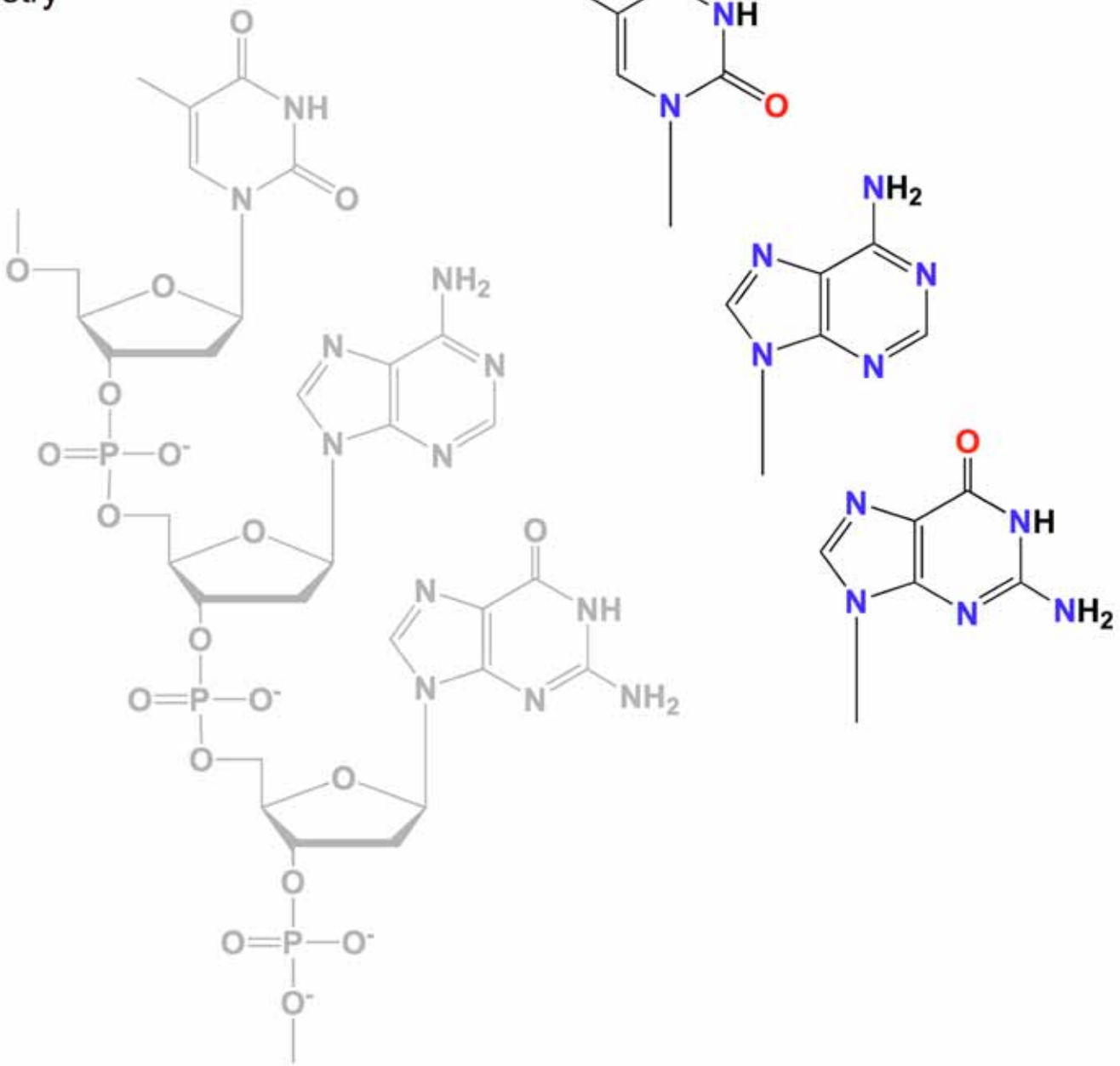
DNA

A look at the Chemistry



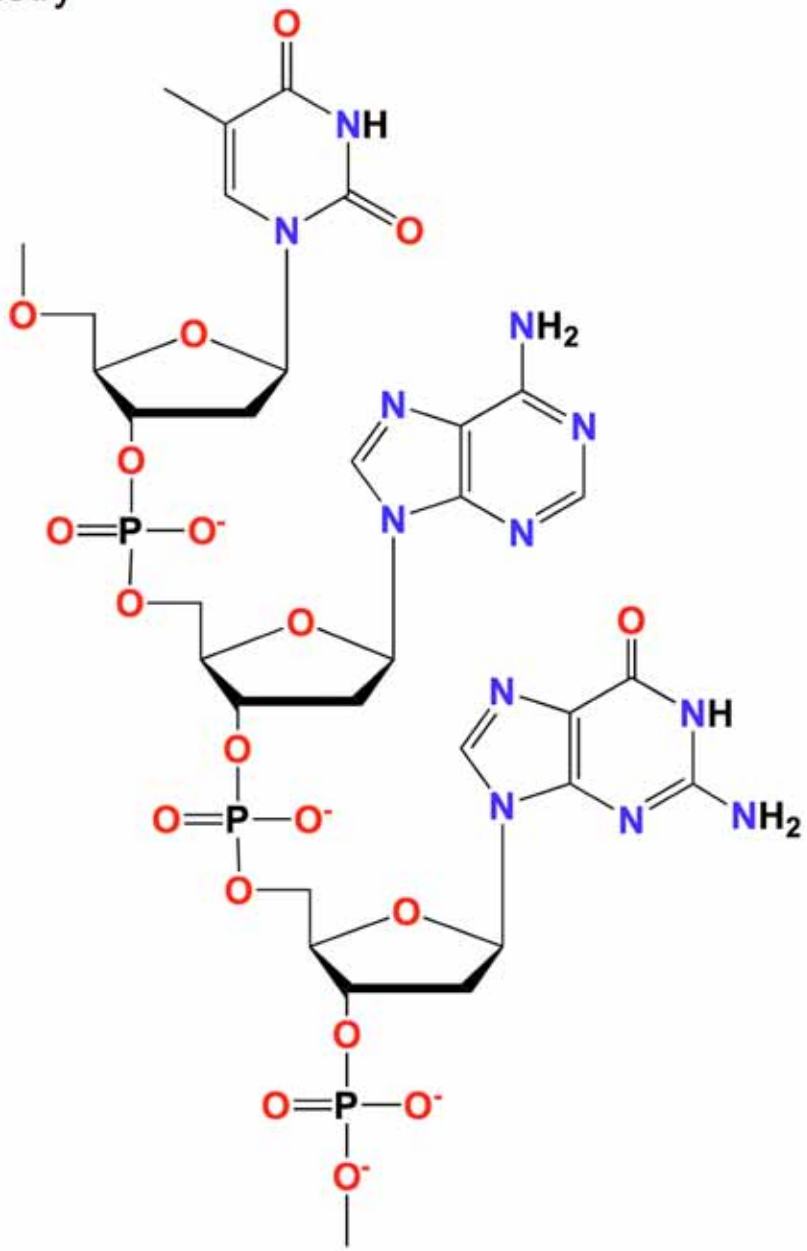
DNA

A look at the Chemistry



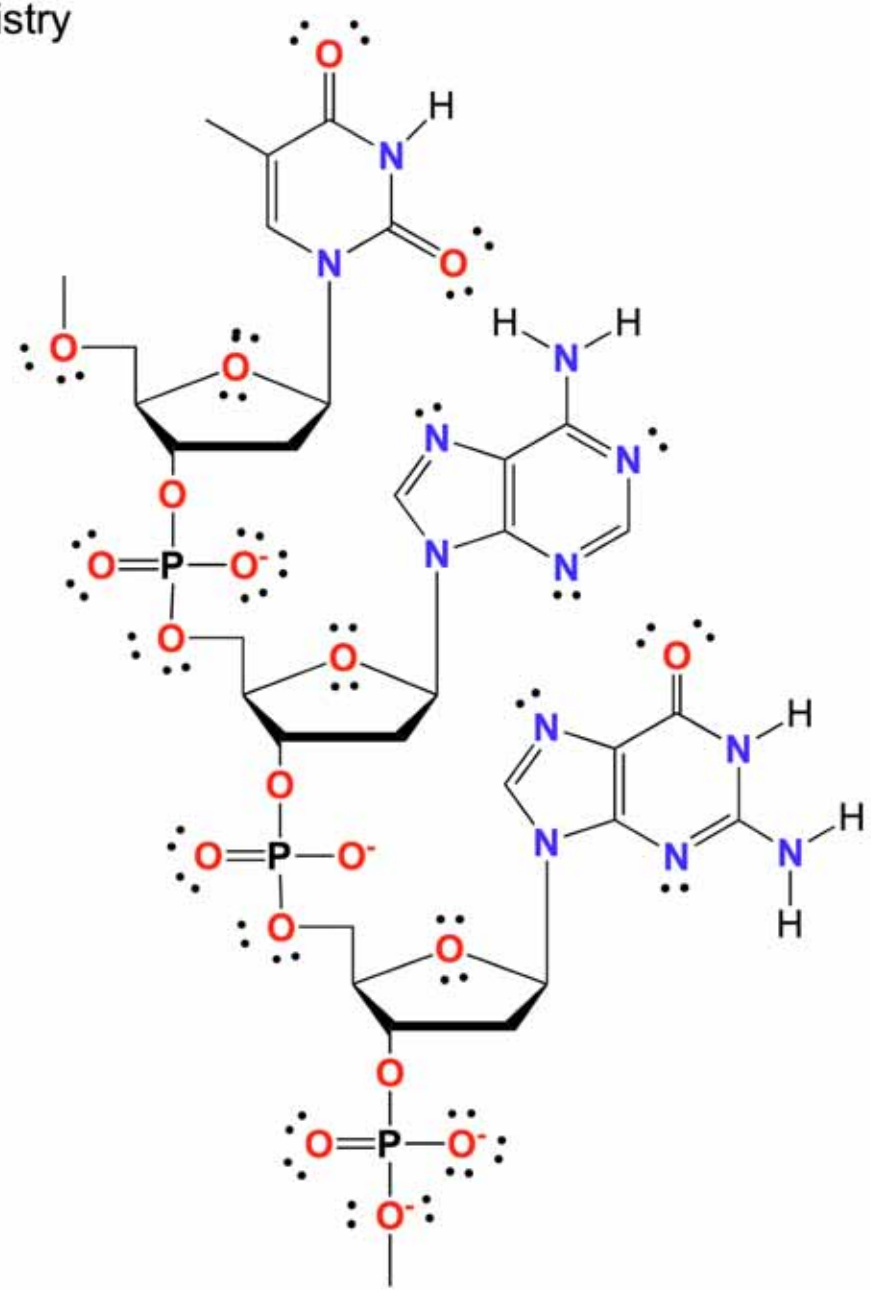
DNA

A look at the Chemistry



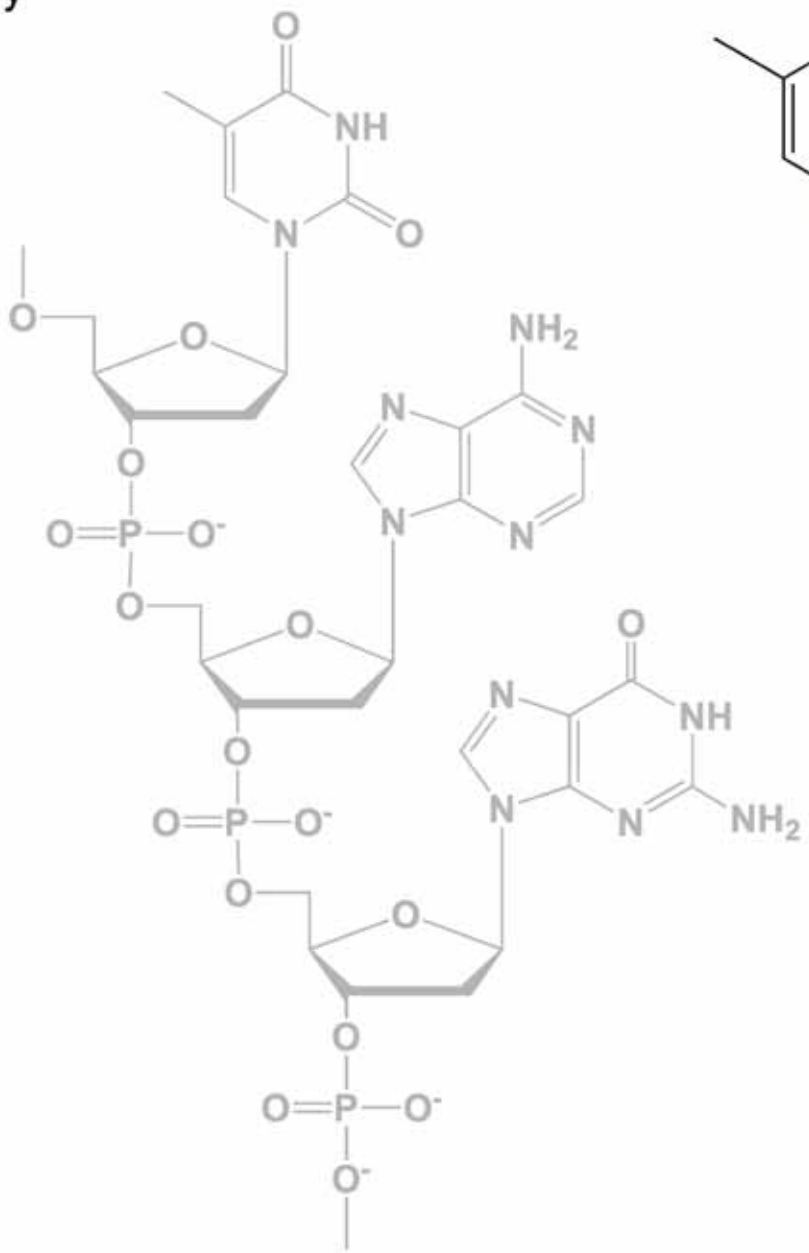
DNA

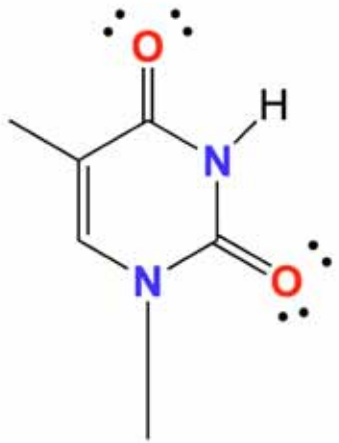
A look at the Chemistry



DNA

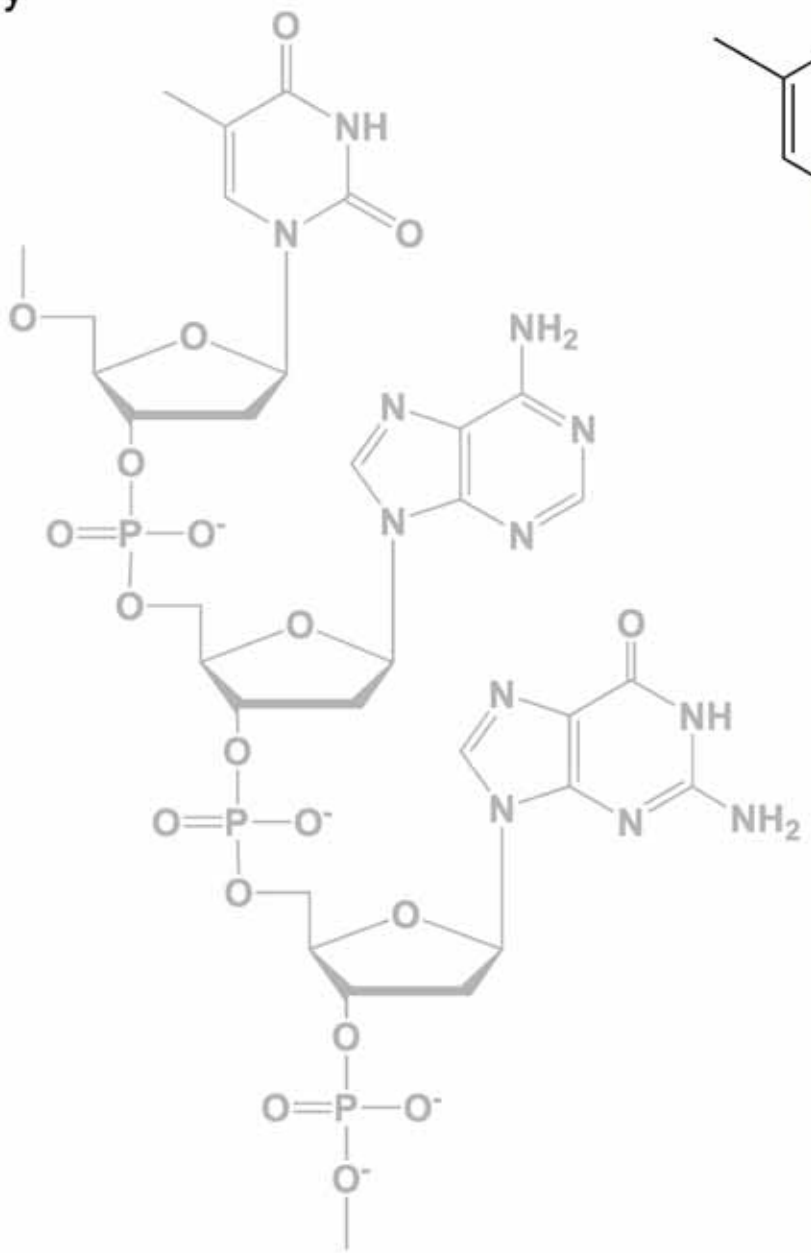
A look at the Chemistry

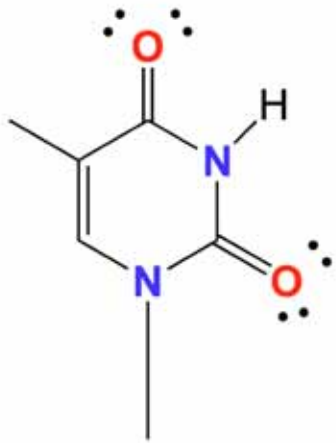


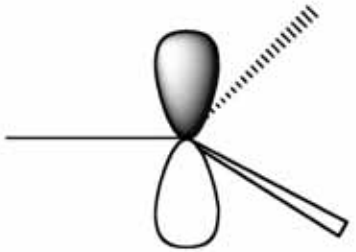


DNA

A look at the Chemistry

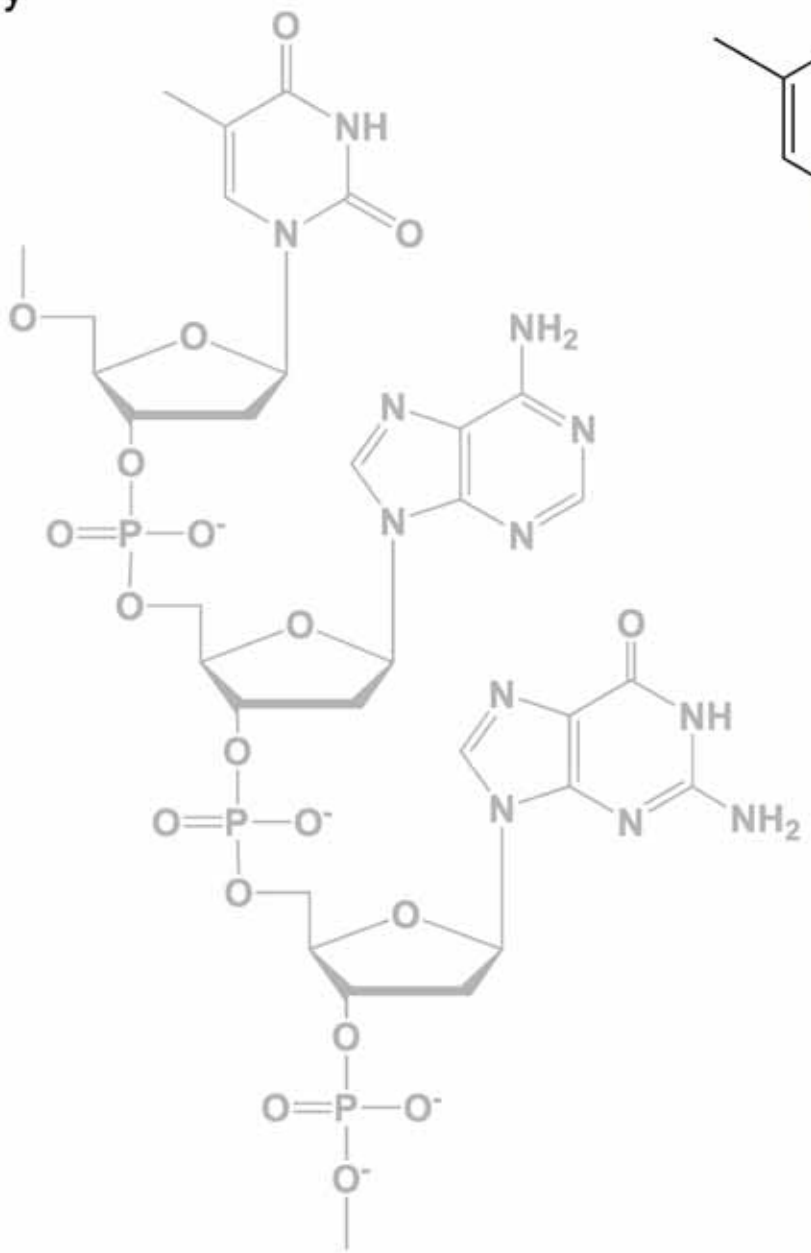


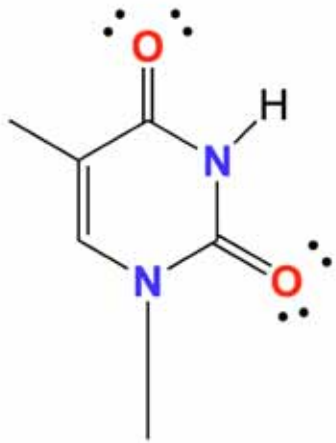


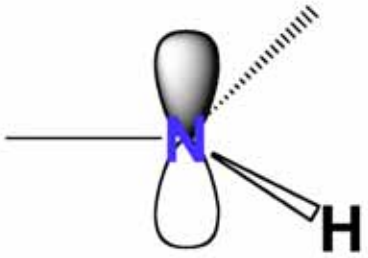


DNA

A look at the Chemistry

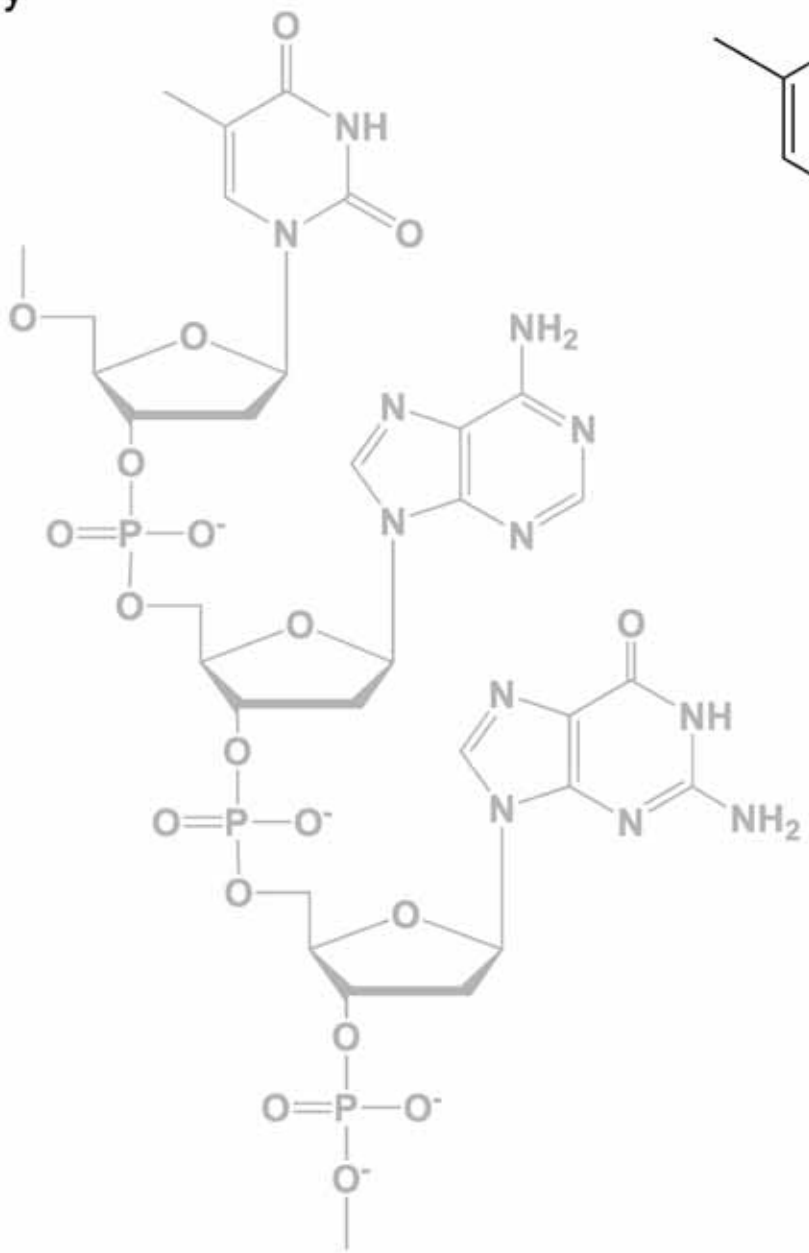


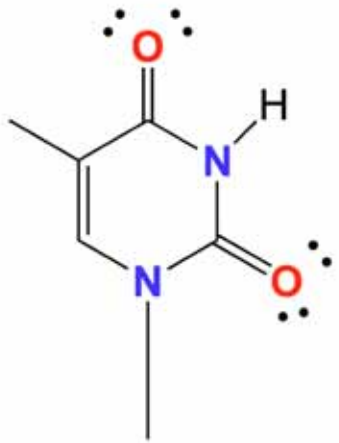


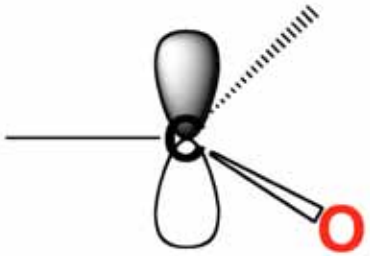


DNA

A look at the Chemistry

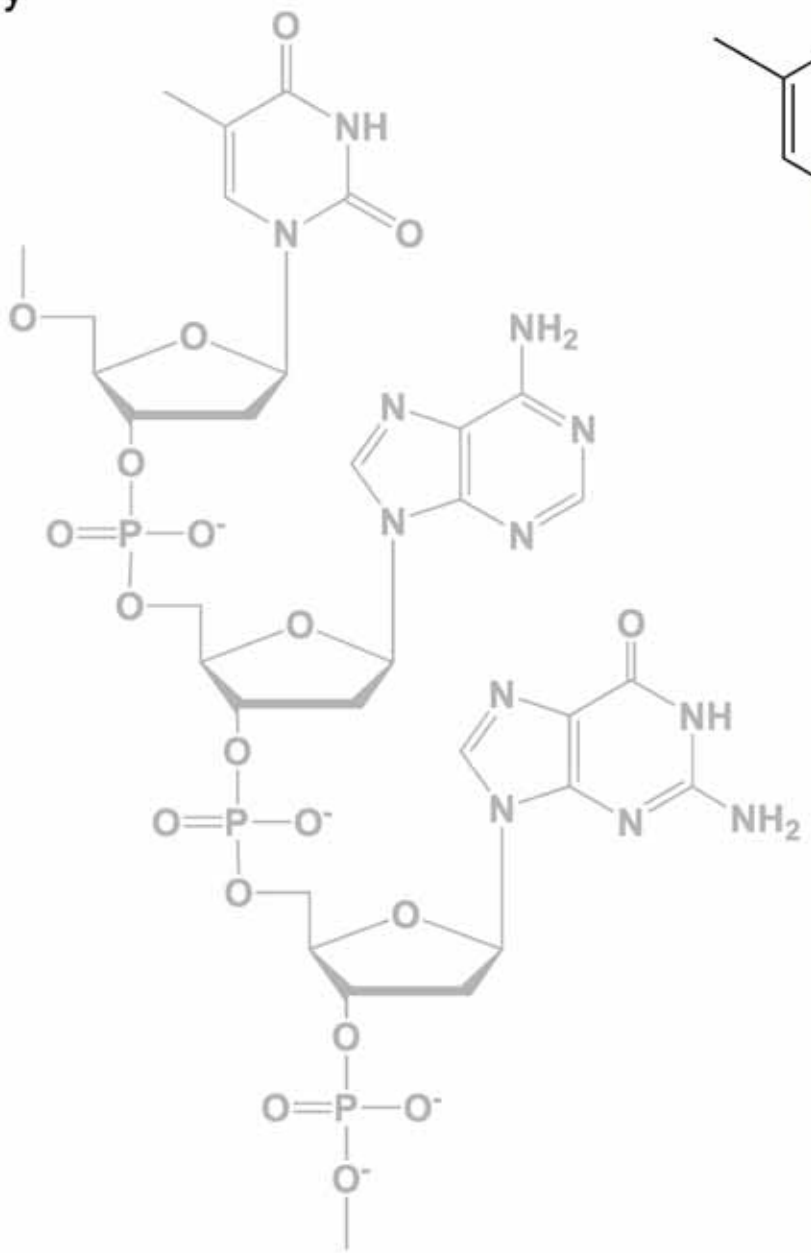


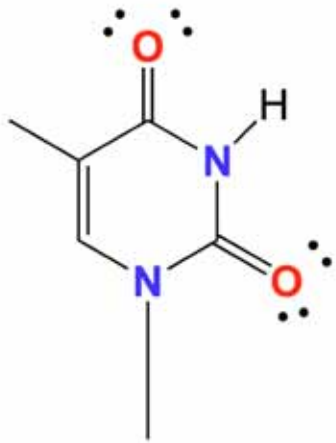


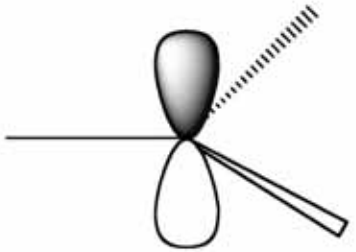


DNA

A look at the Chemistry

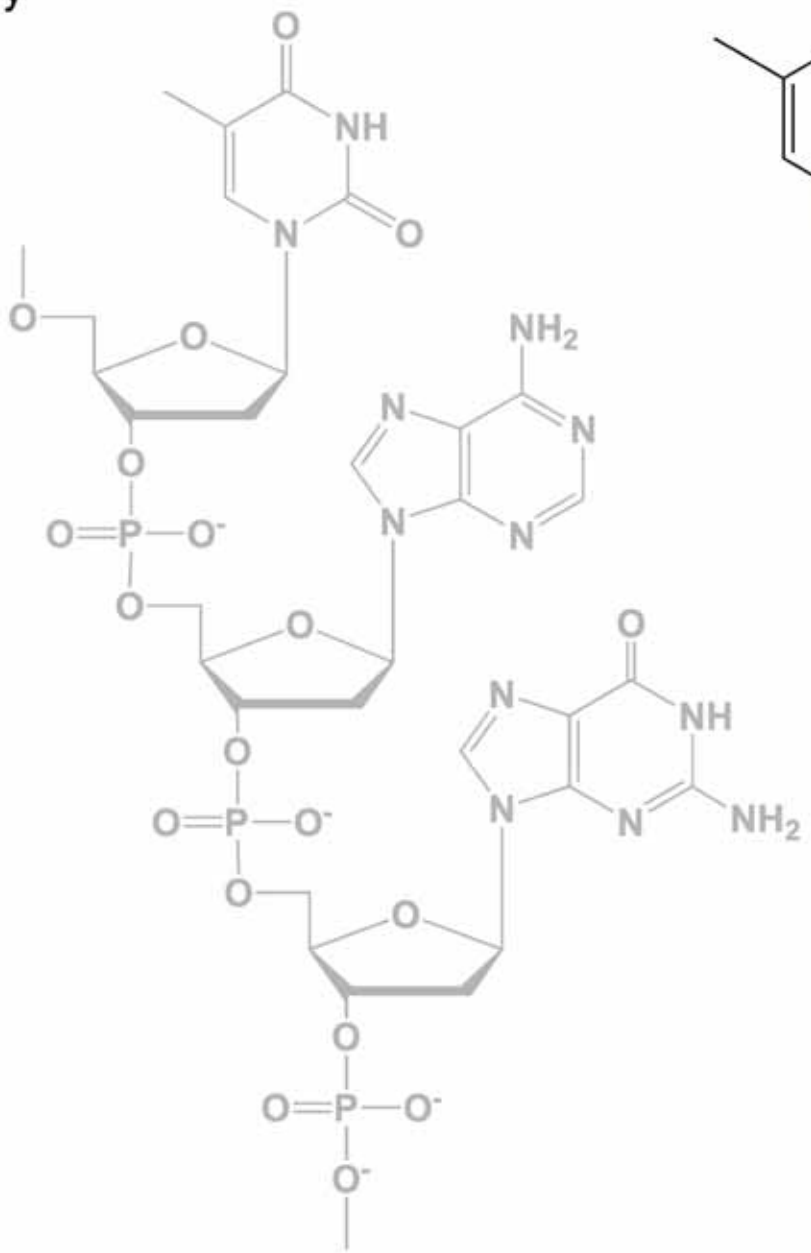


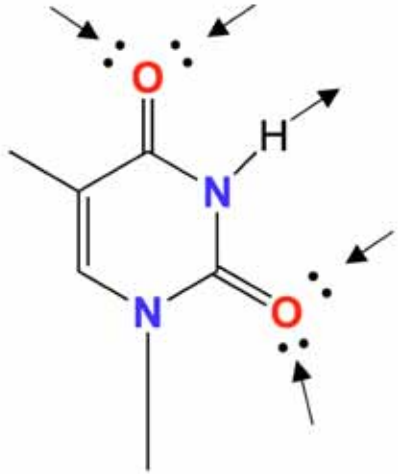


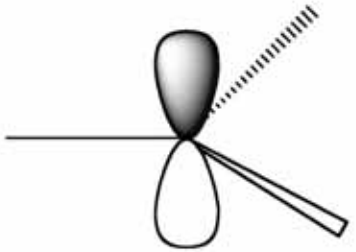


DNA

A look at the Chemistry

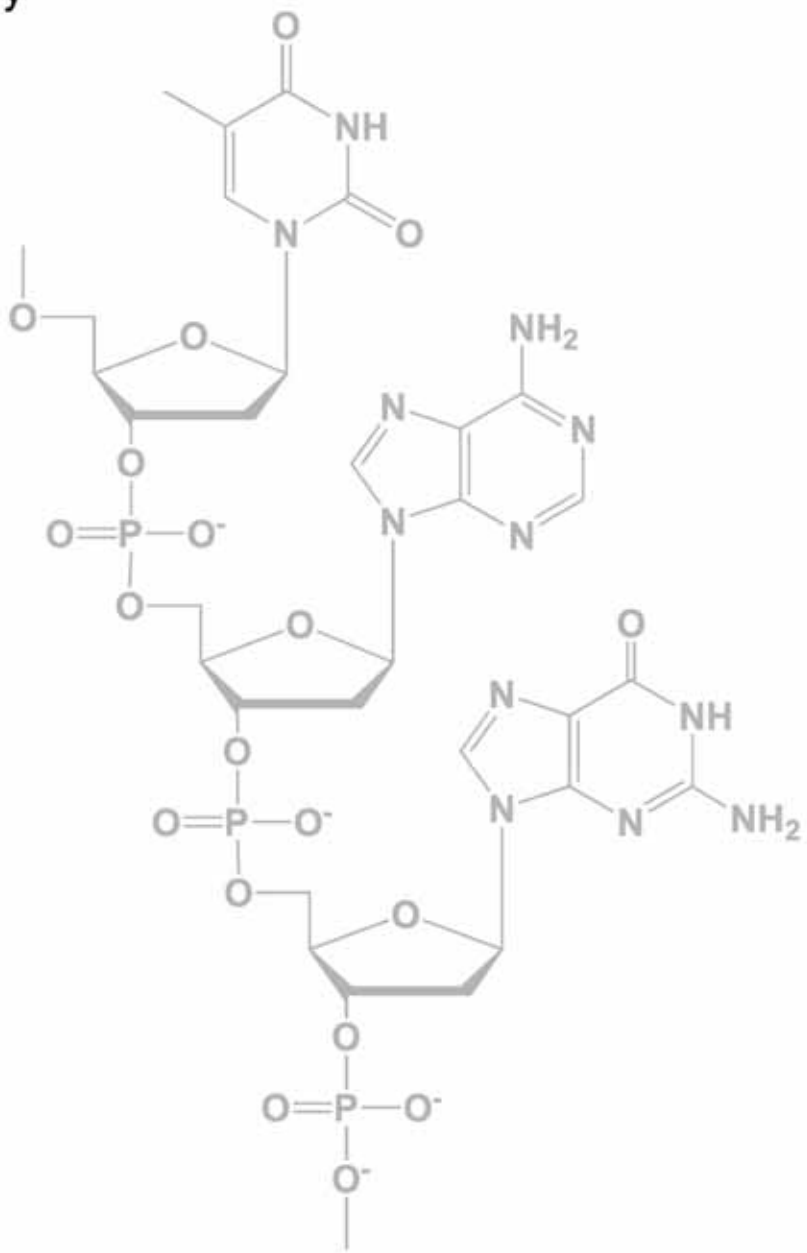


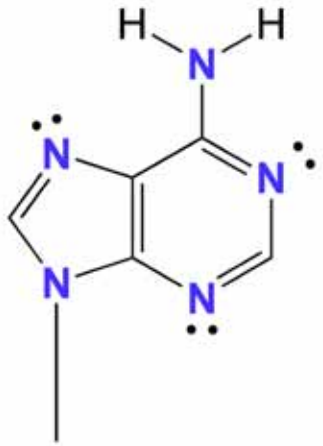


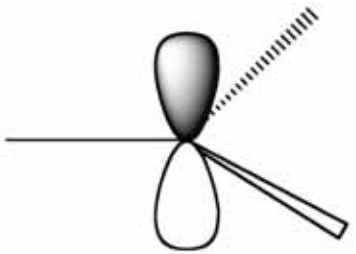


DNA

A look at the Chemistry

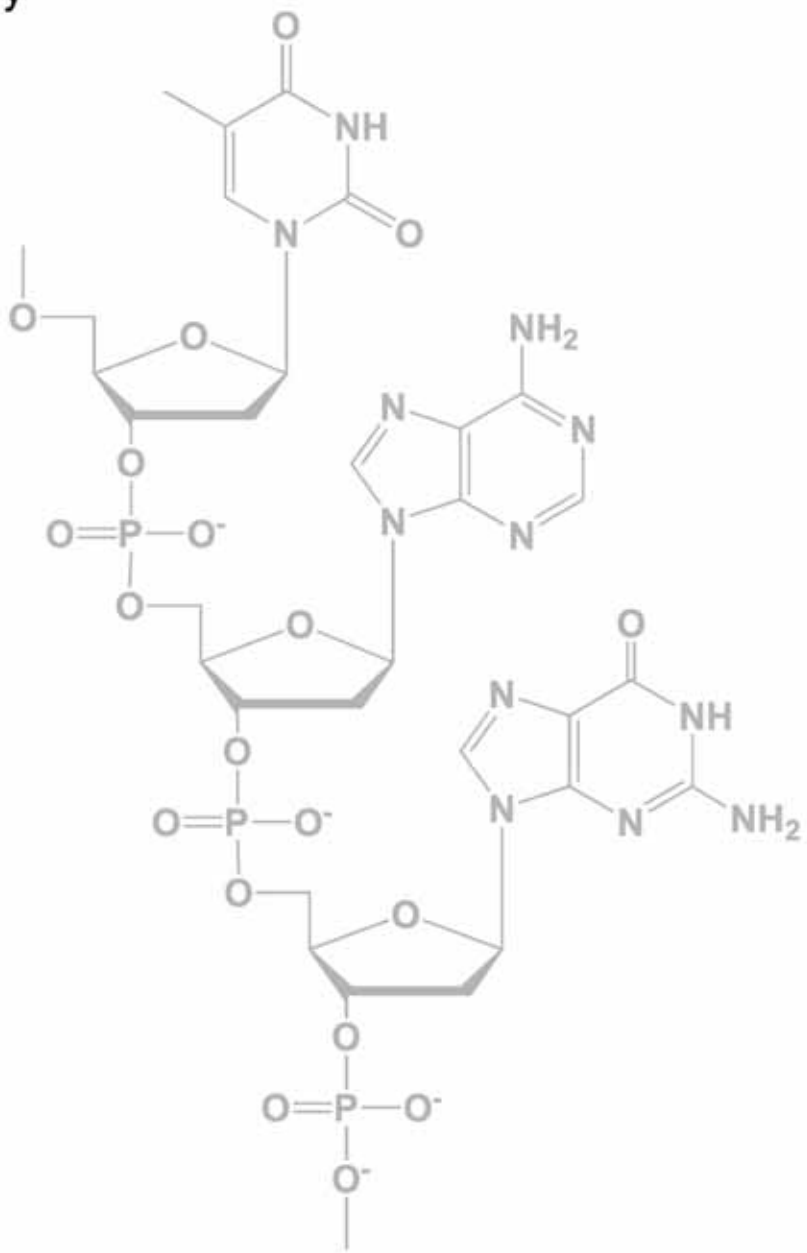


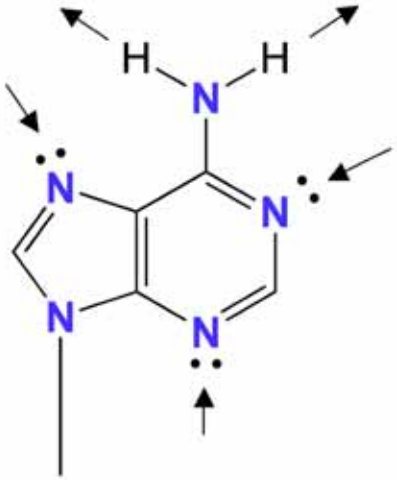


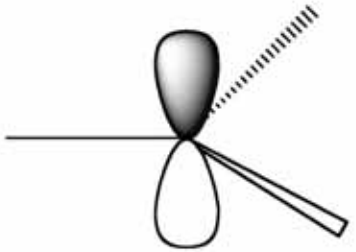


DNA

A look at the Chemistry

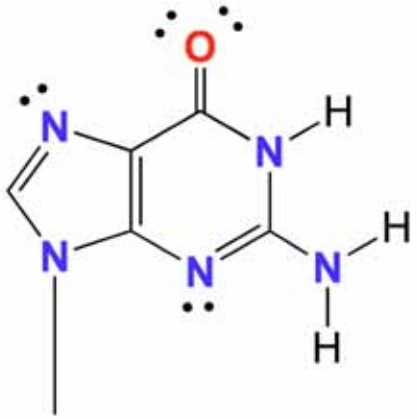


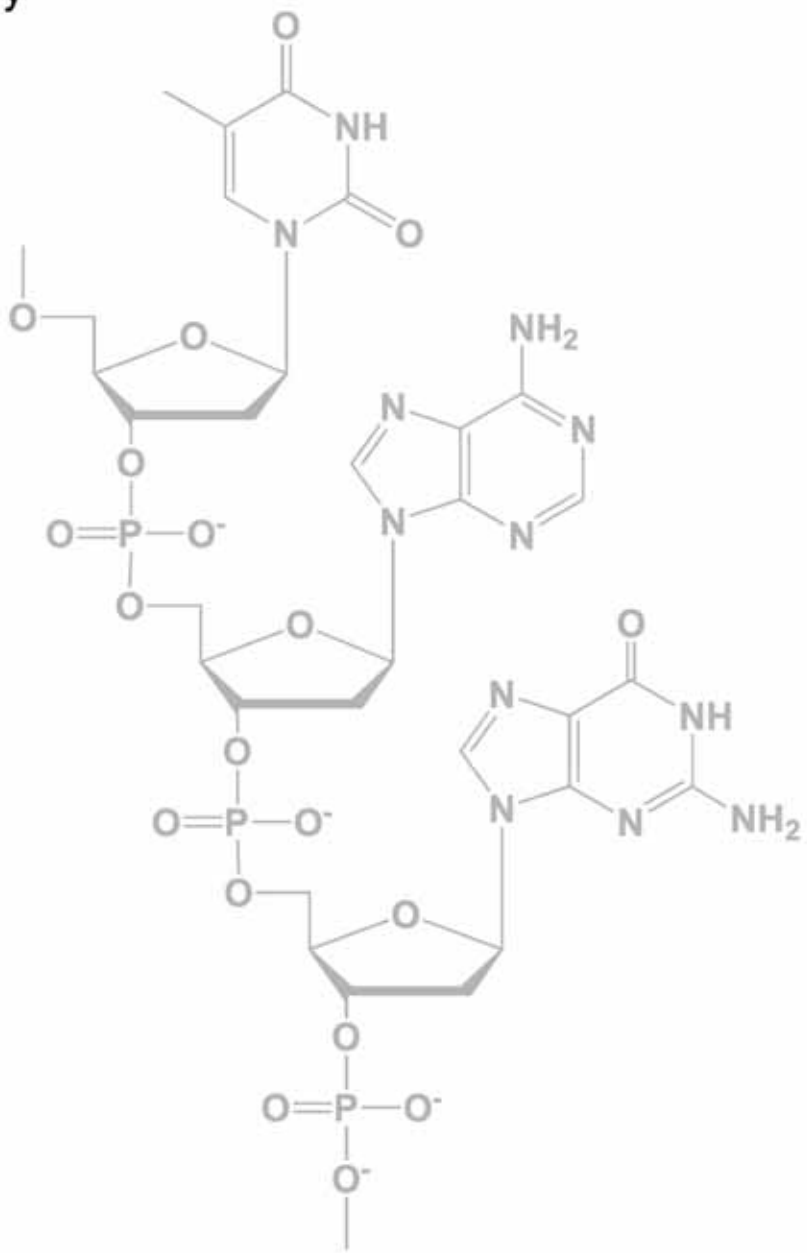


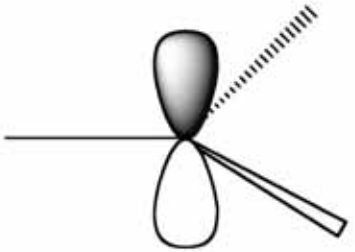


DNA

A look at the Chemistry

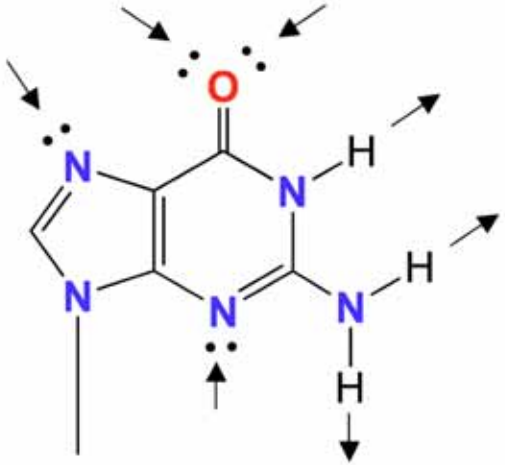


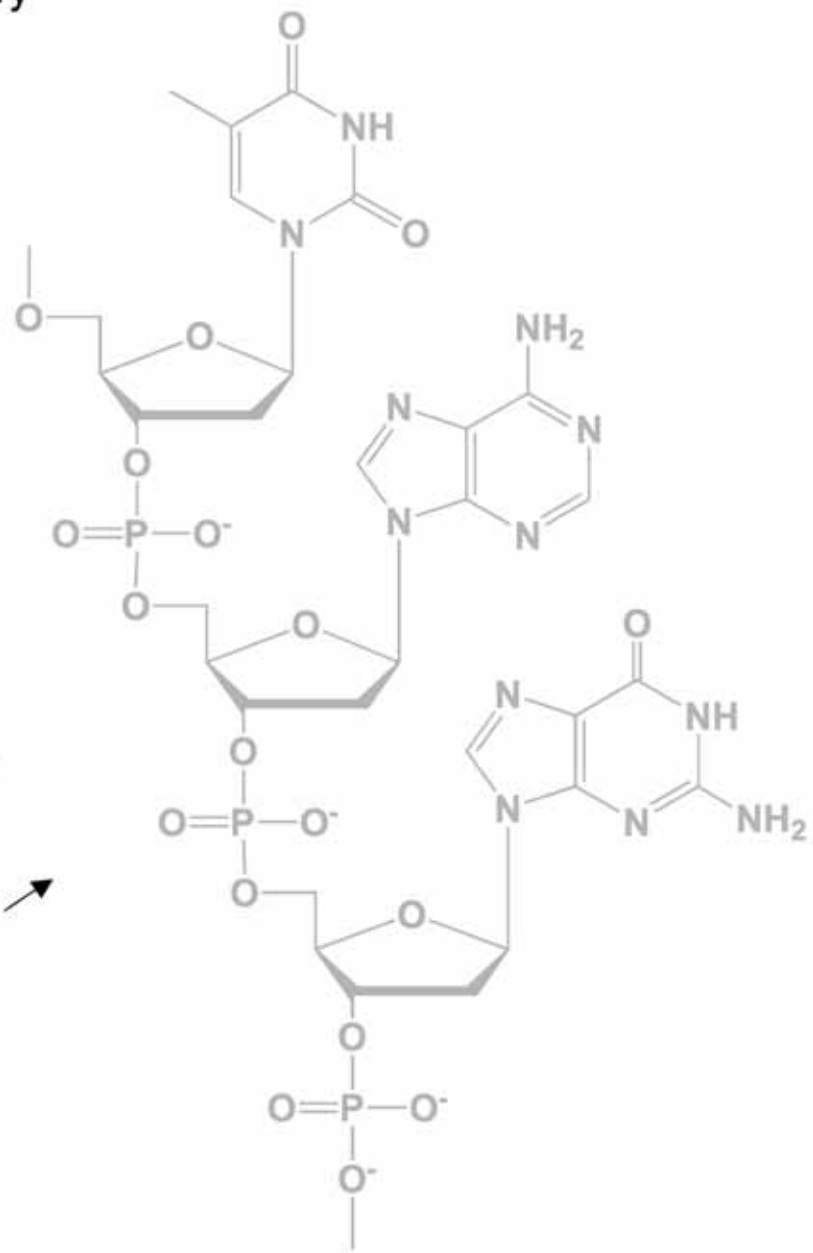


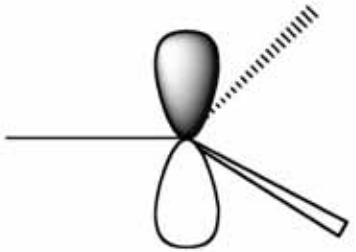


DNA

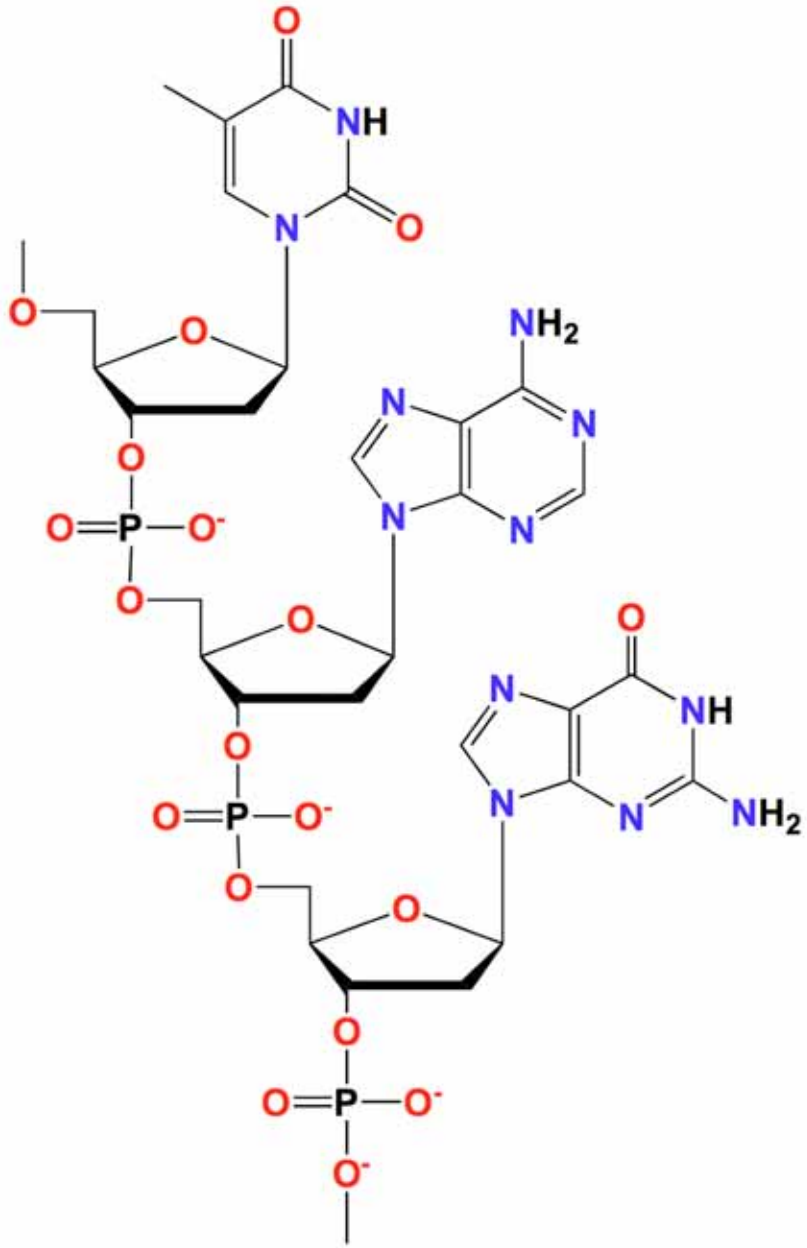
A look at the Chemistry







What forces are important?



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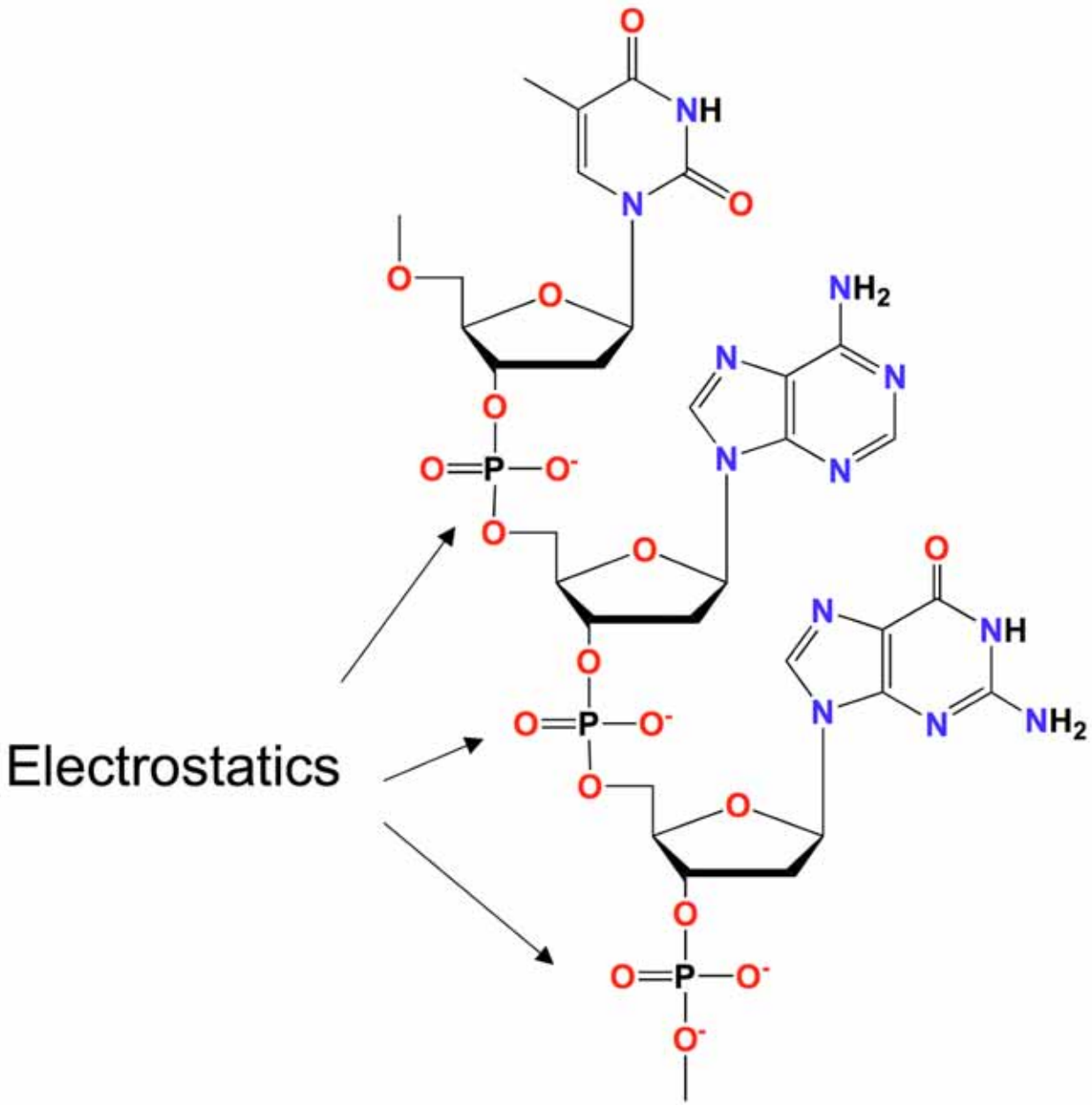
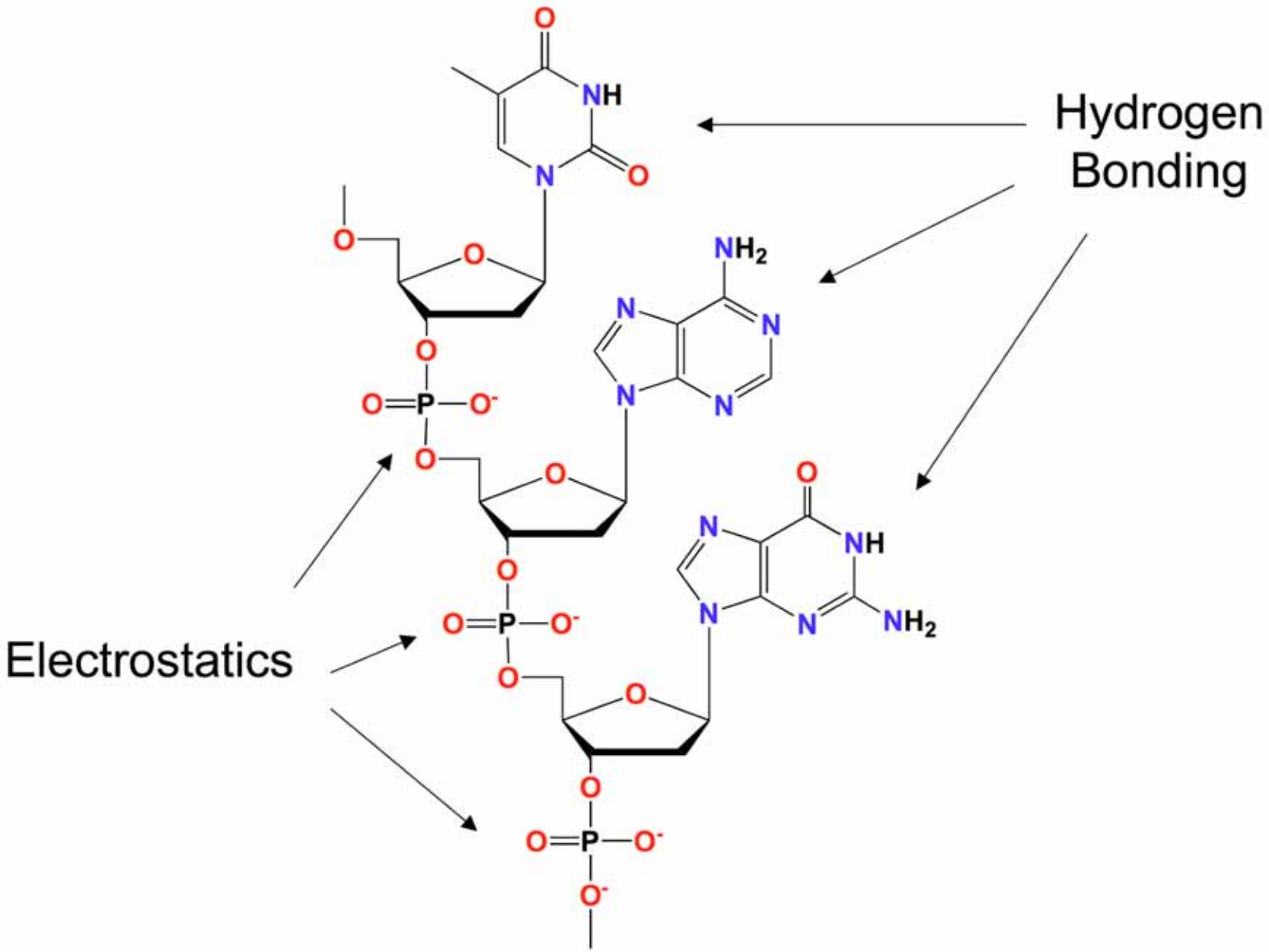
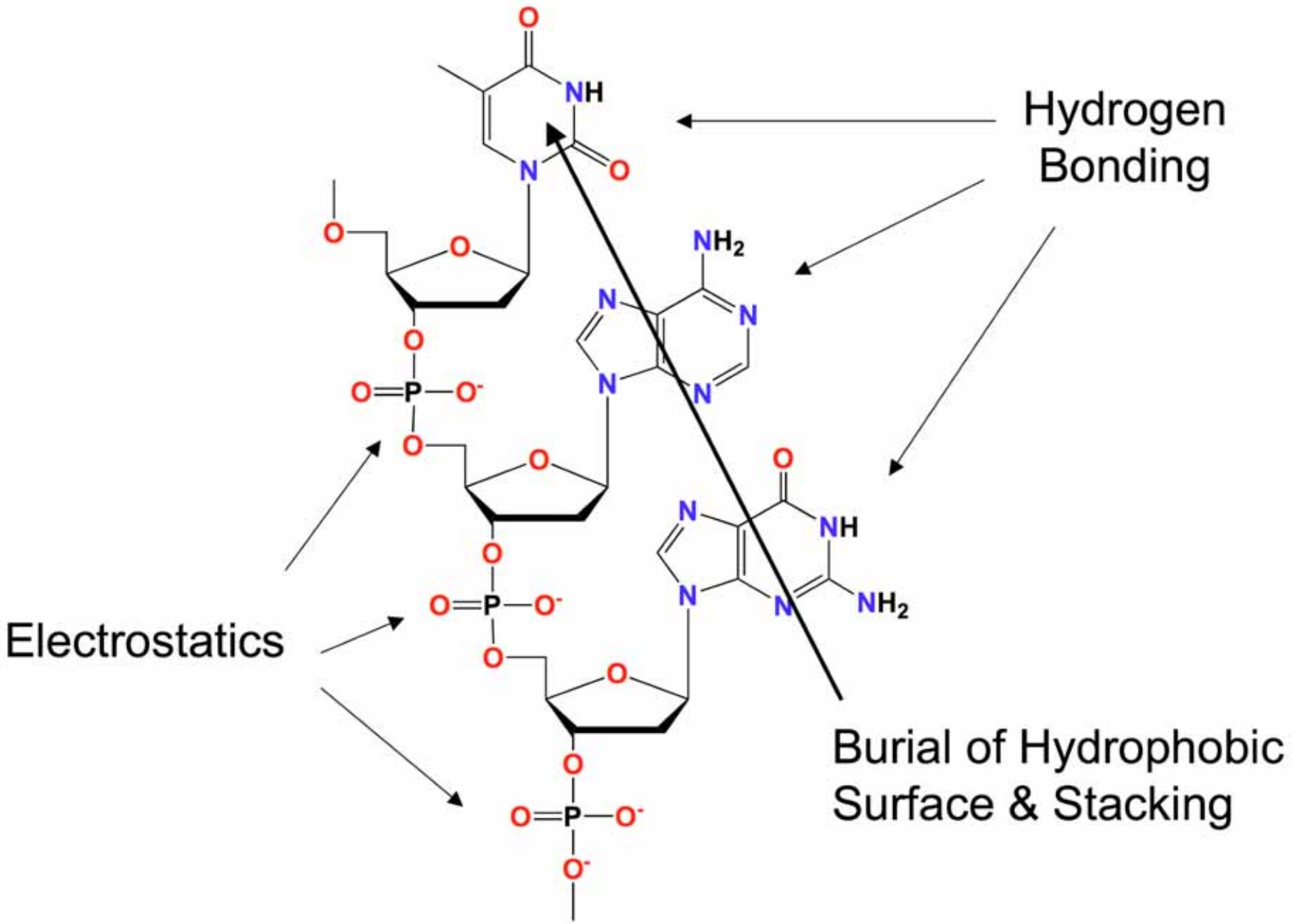


What forces are important?



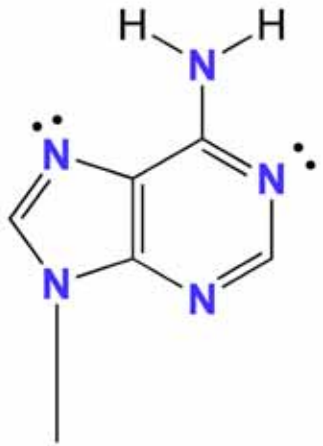
What forces are important?

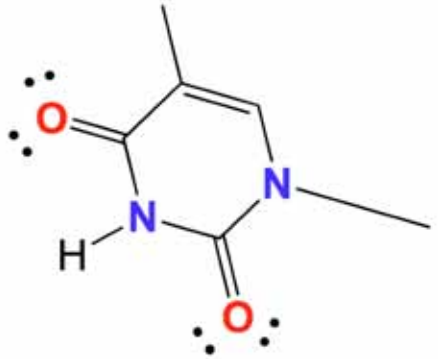


Base Pairing

(Donors matched to Acceptors)

A

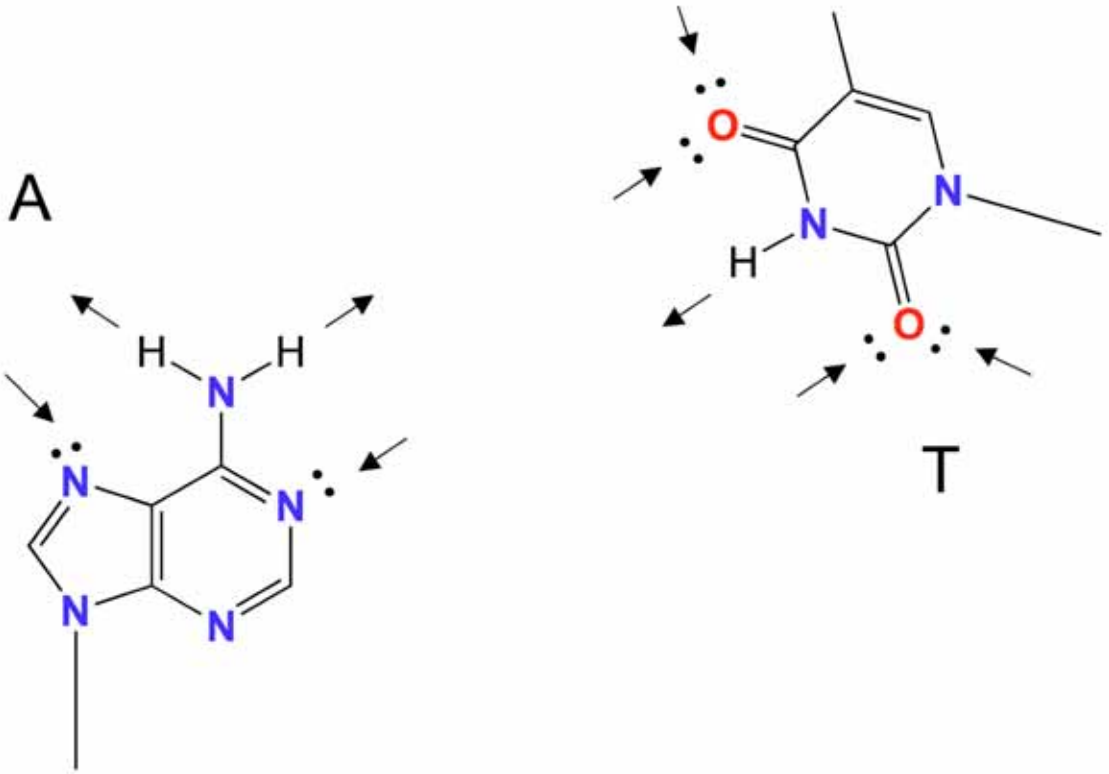




T

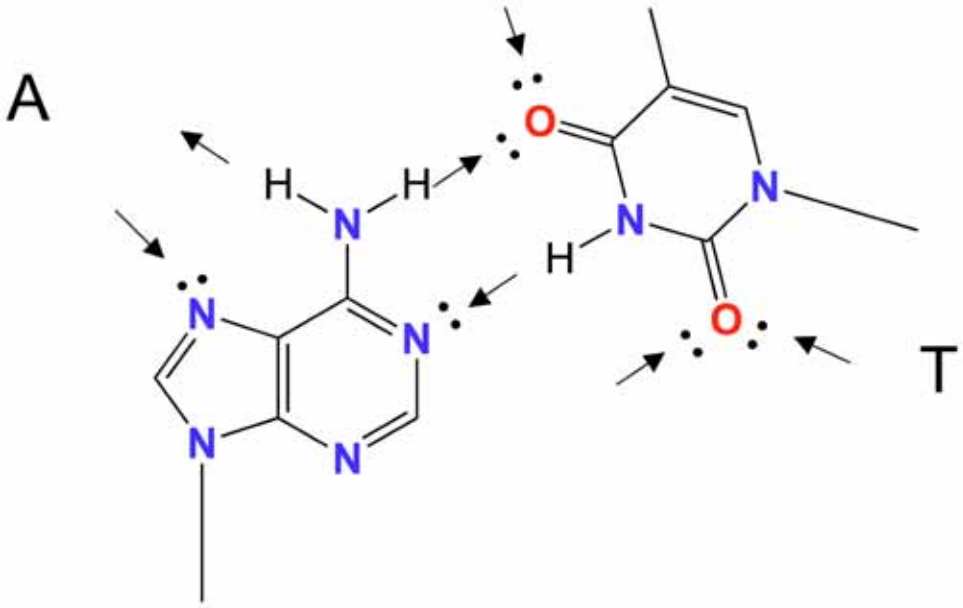
Base Pairing

(Donors matched to Acceptors)



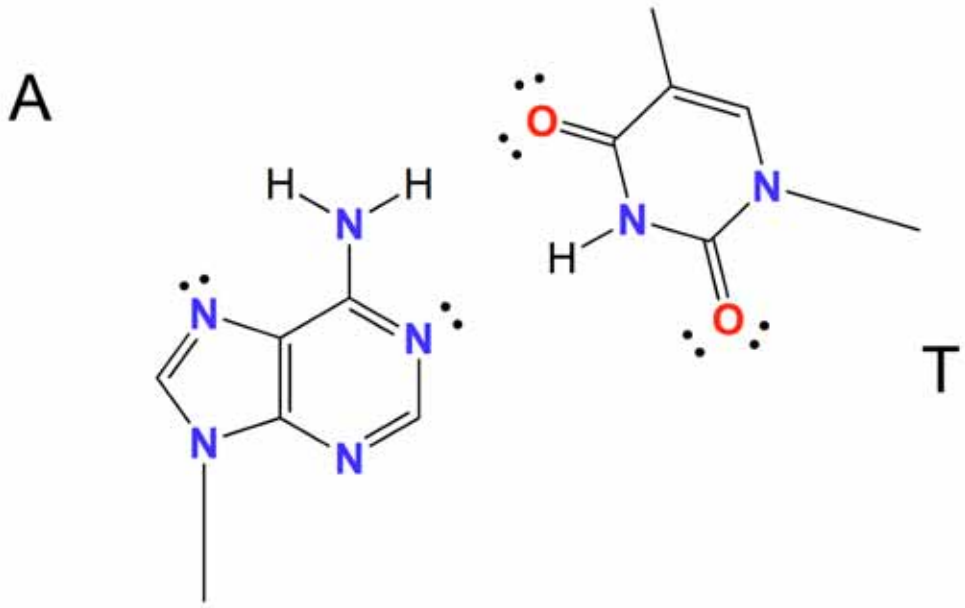
Base Pairing

(Donors matched to Acceptors)



Base Pairing

(Donors matched to Acceptors)

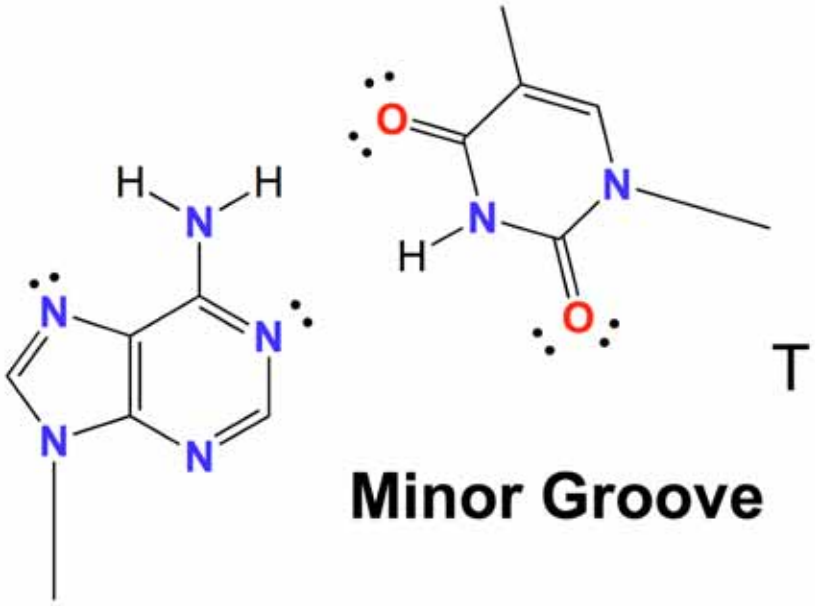


Base Pairing

(Donors matched to Acceptors)

Major Groove

A

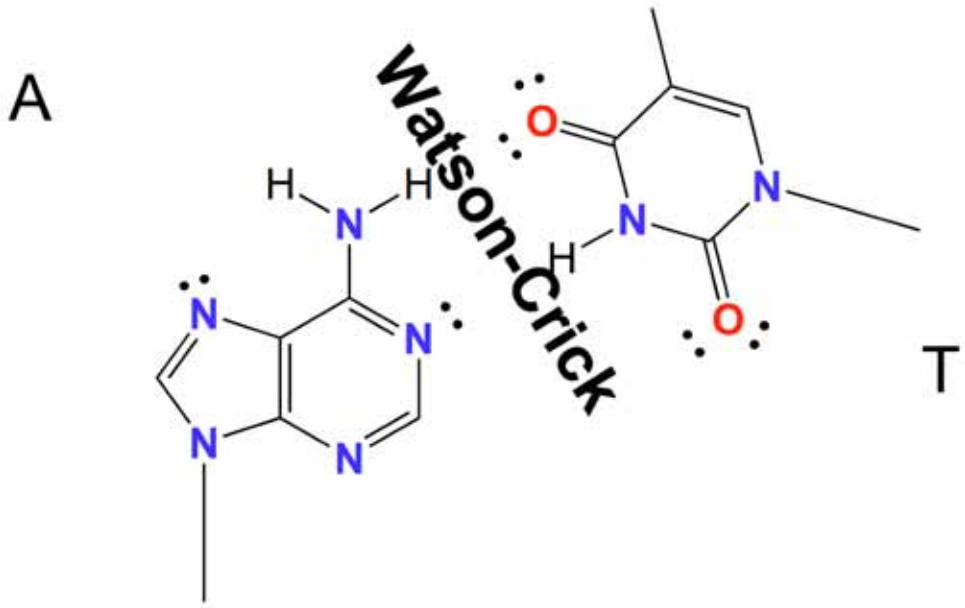


T

Minor Groove

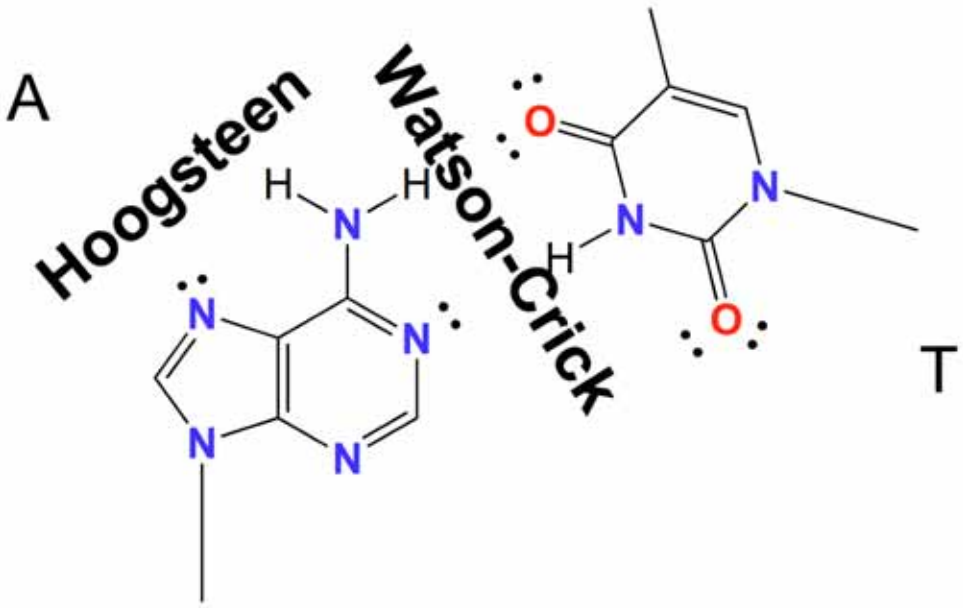
Base Pairing

(Donors matched to Acceptors)



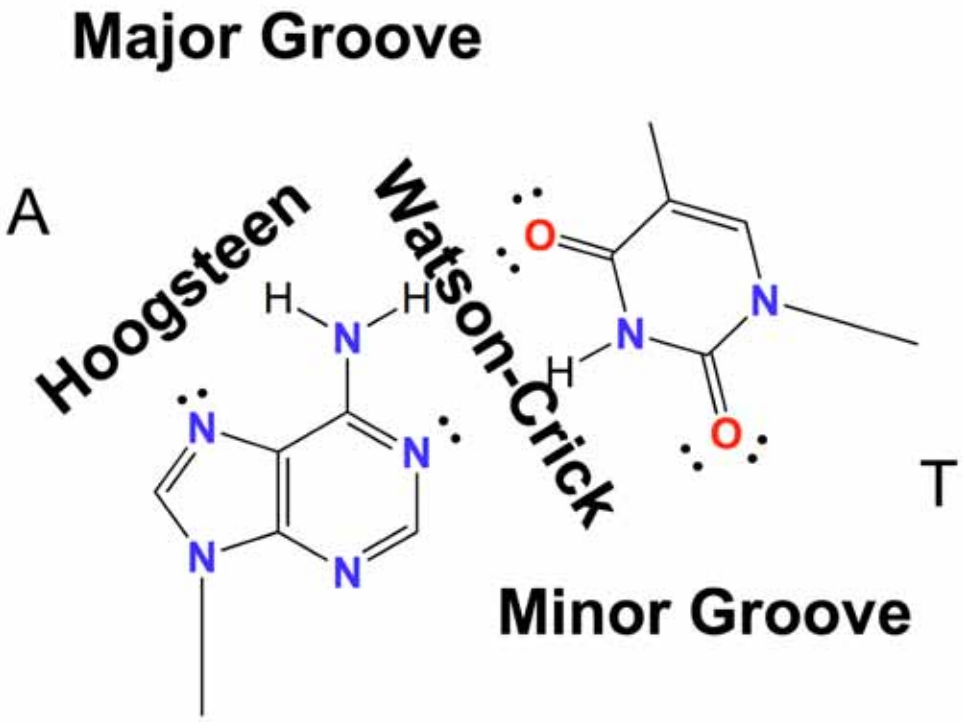
Base Pairing

(Donors matched to Acceptors)



Base Pairing

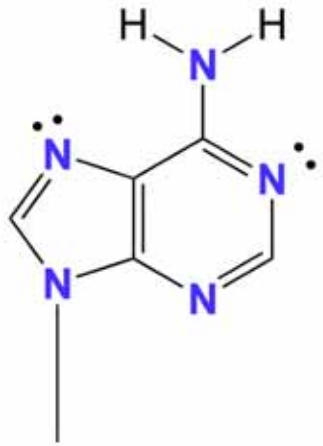
(Donors matched to Acceptors)

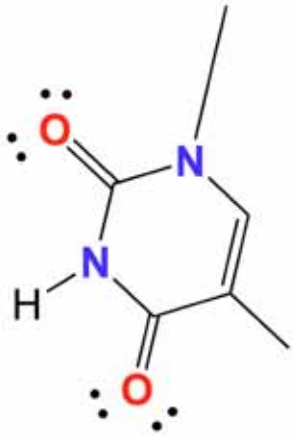


Base Pairing

(Donors matched to Acceptors)

A



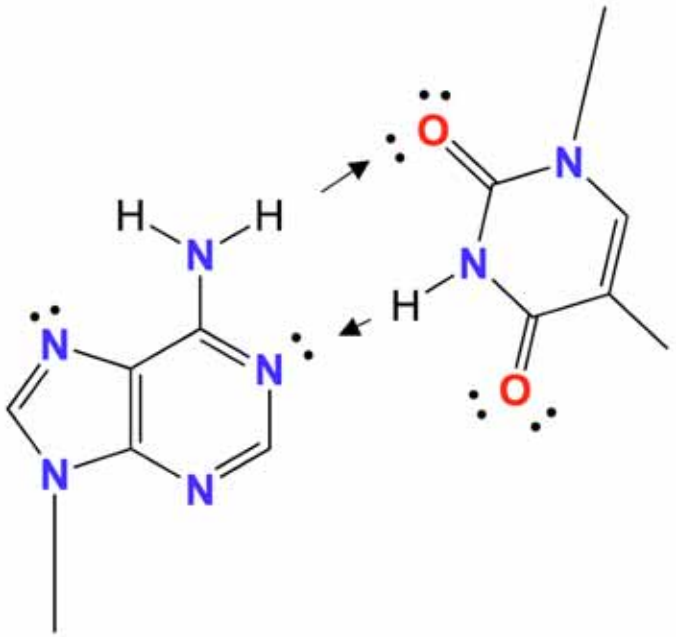


T

Base Pairing

(Donors matched to Acceptors)

A

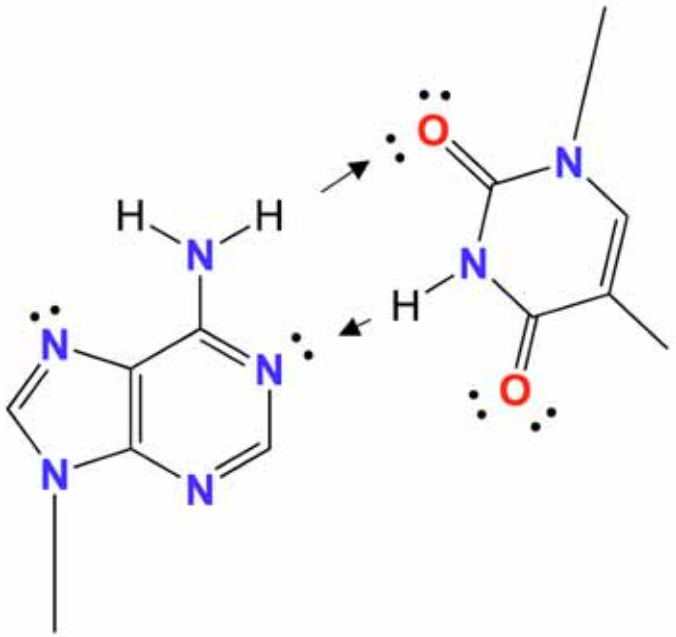


T

Base Pairing

(Donors matched to Acceptors)

A



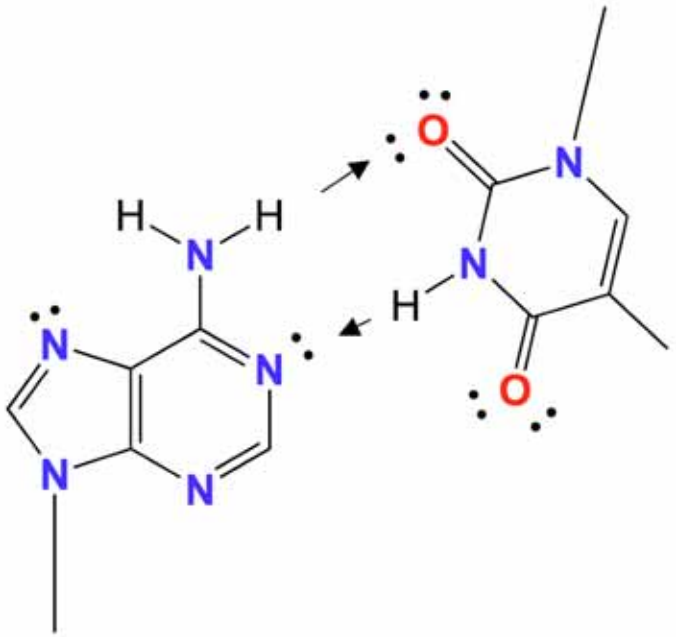
T

Good base pairing

Base Pairing

(Donors matched to Acceptors)

A

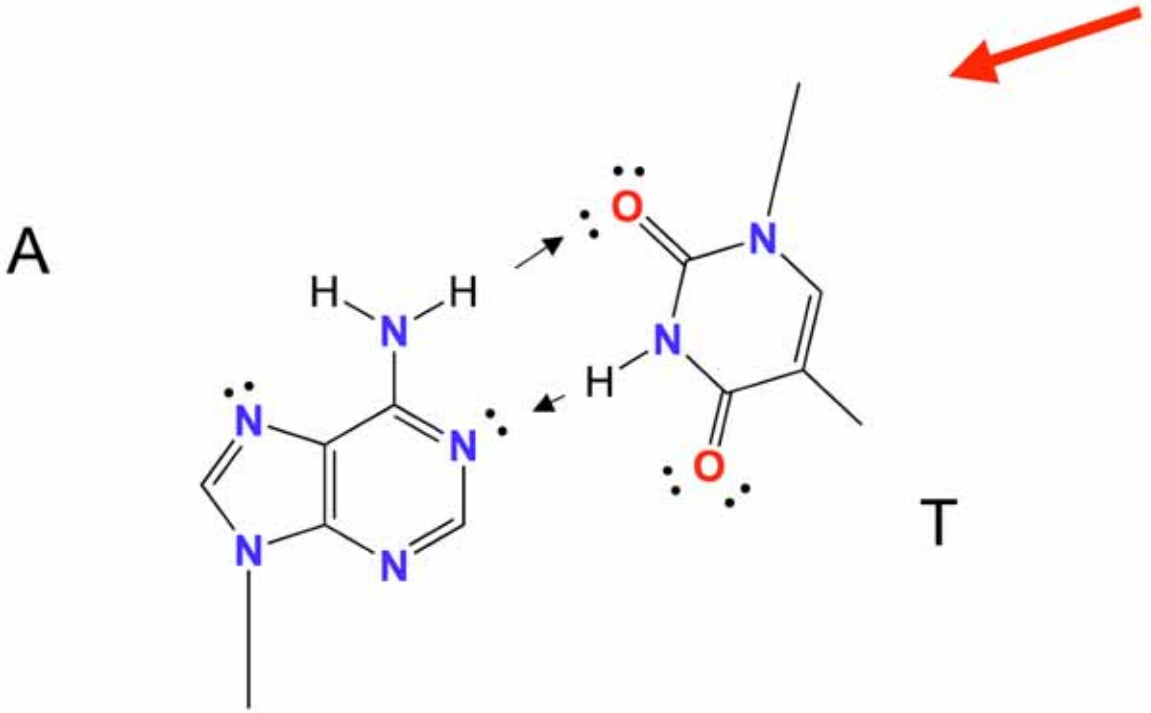


T

Good base pairing
Watson-Crick facing

Base Pairing

(Donors matched to Acceptors)

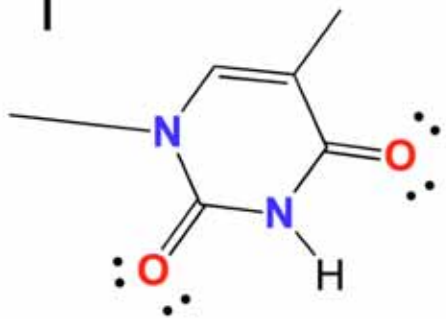


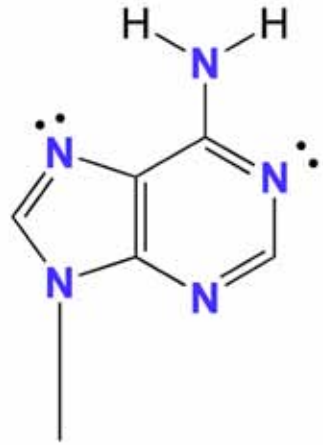
Good base pairing
Watson-Crick facing
but *Anti-Watson-Crick* orientation

Base Pairing

(Donors matched to Acceptors)

T



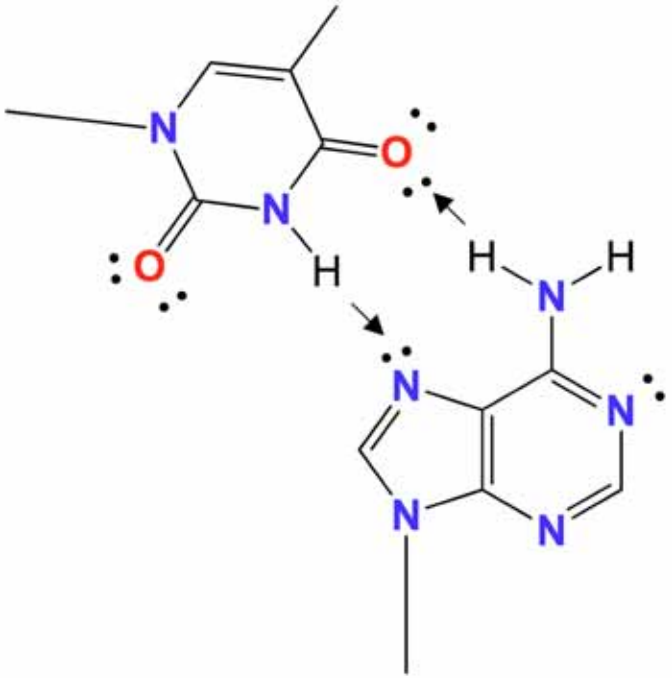


A

Base Pairing

(Donors matched to Acceptors)

T

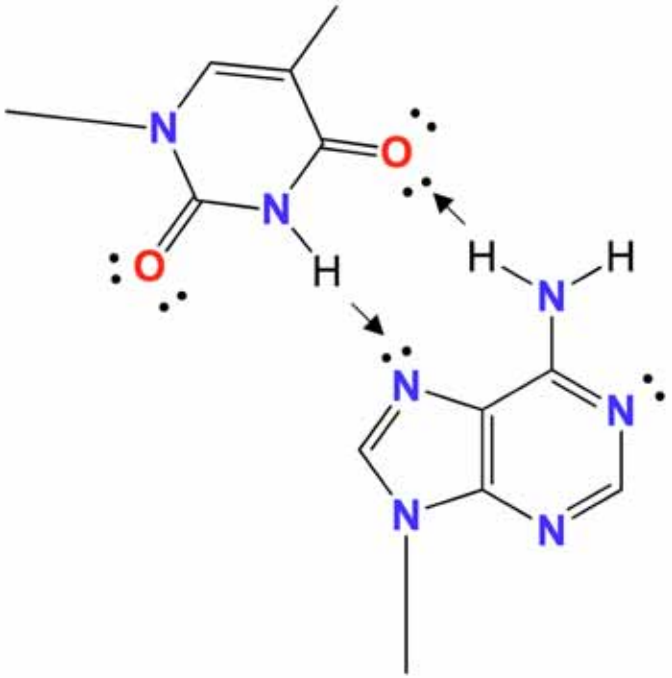


A

Base Pairing

(Donors matched to Acceptors)

T



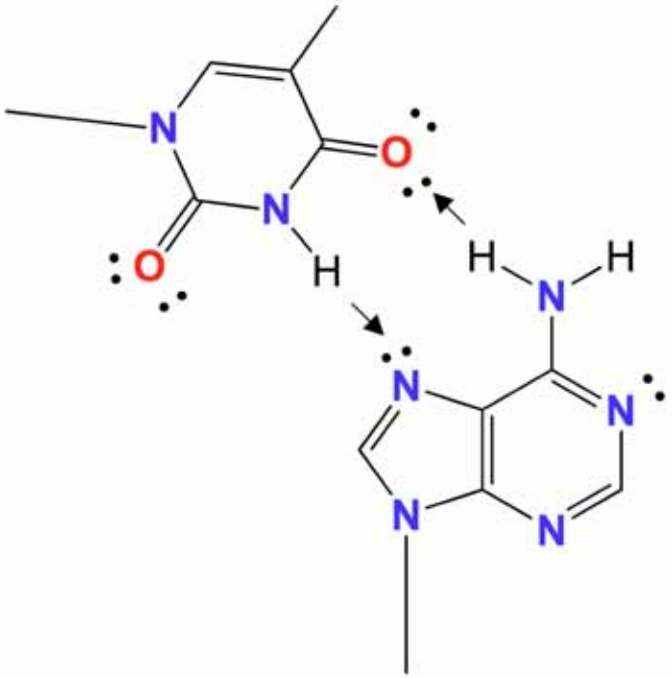
A

Good base pairing

Base Pairing

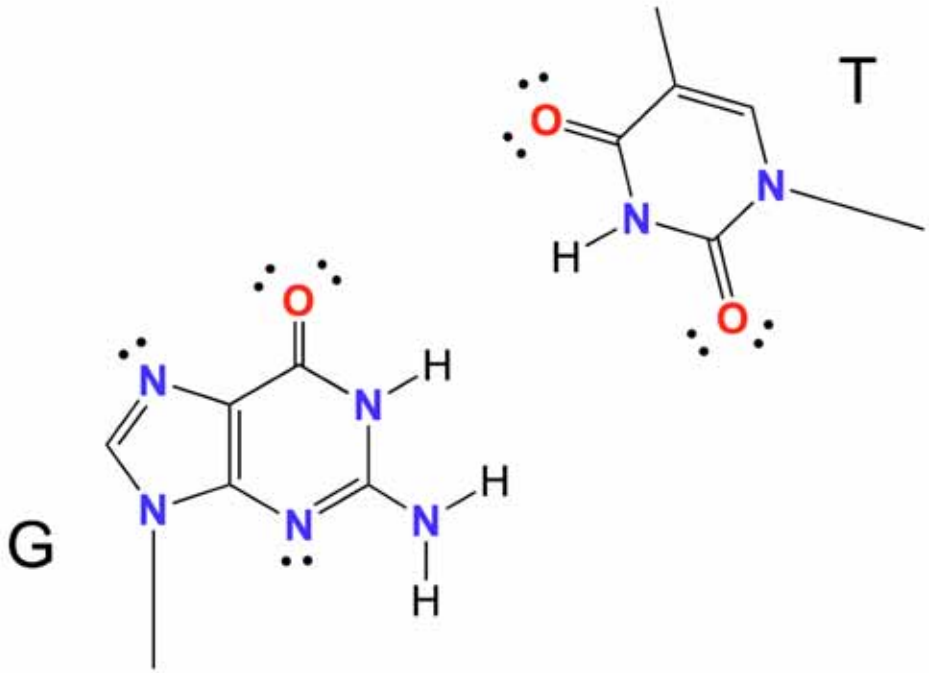
(Donors matched to Acceptors)

T



A

Good base pairing
WC-Hoogsteen facing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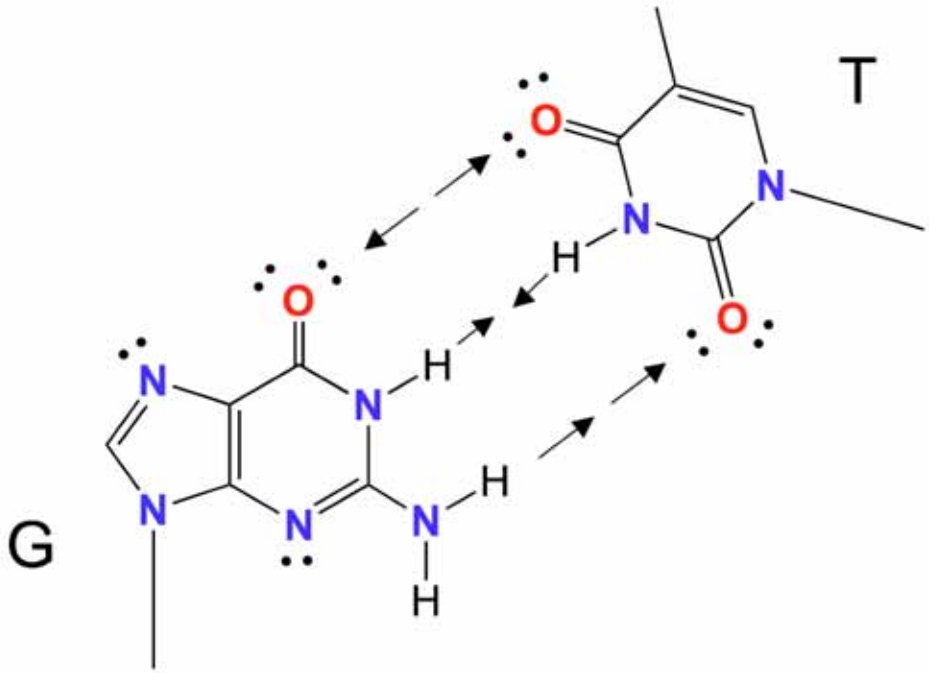
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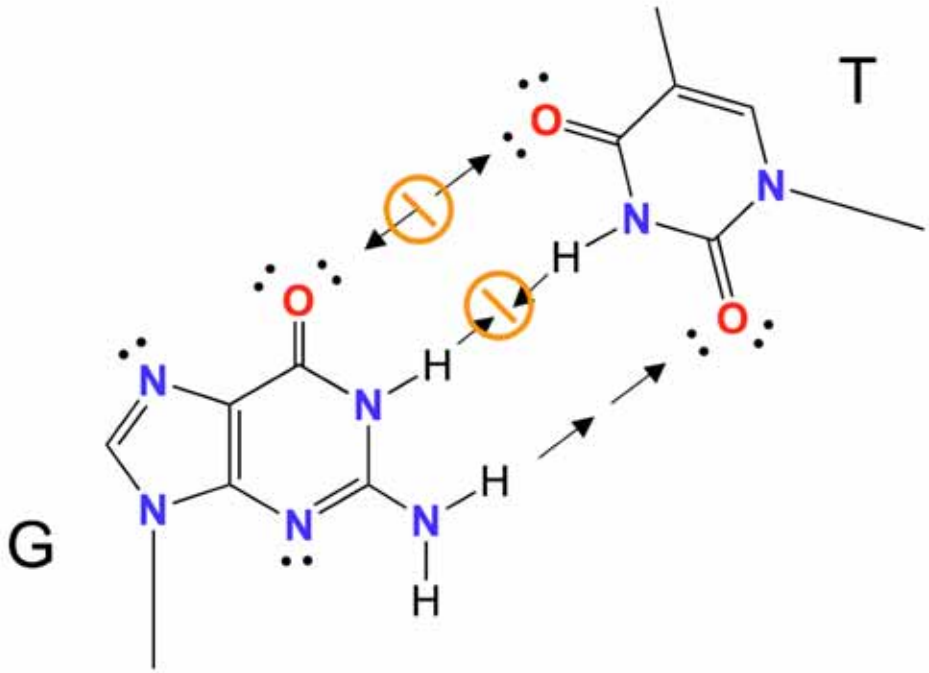
T
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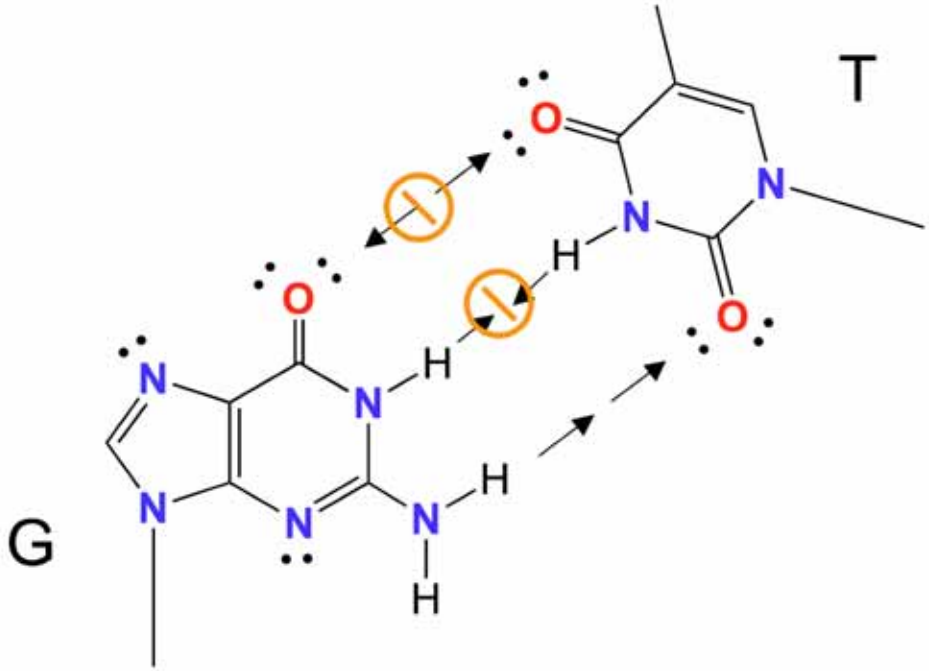
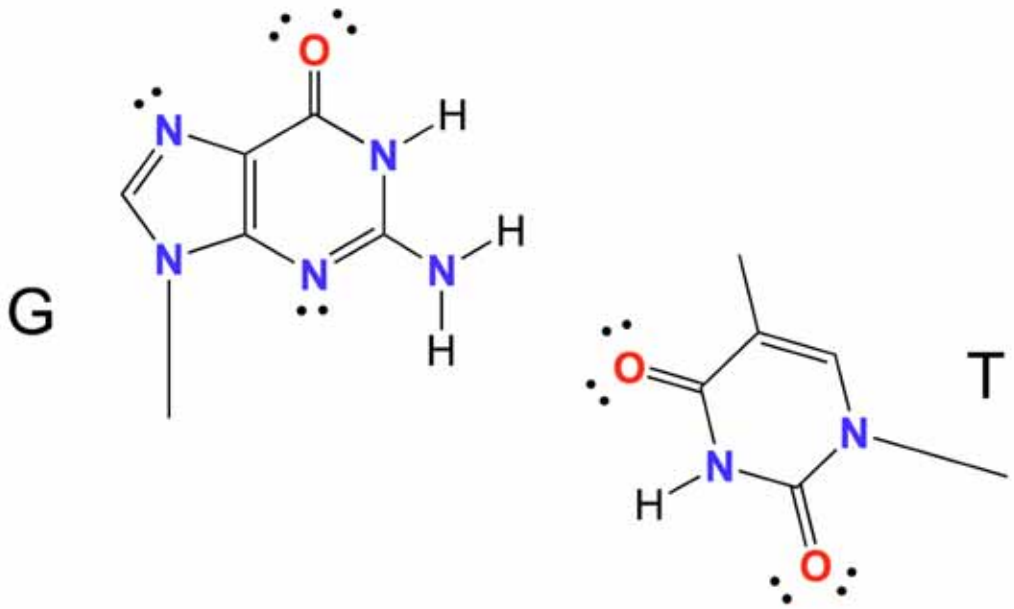
Bad Base Pairing

(Donors ***not*** matched to Acceptors)

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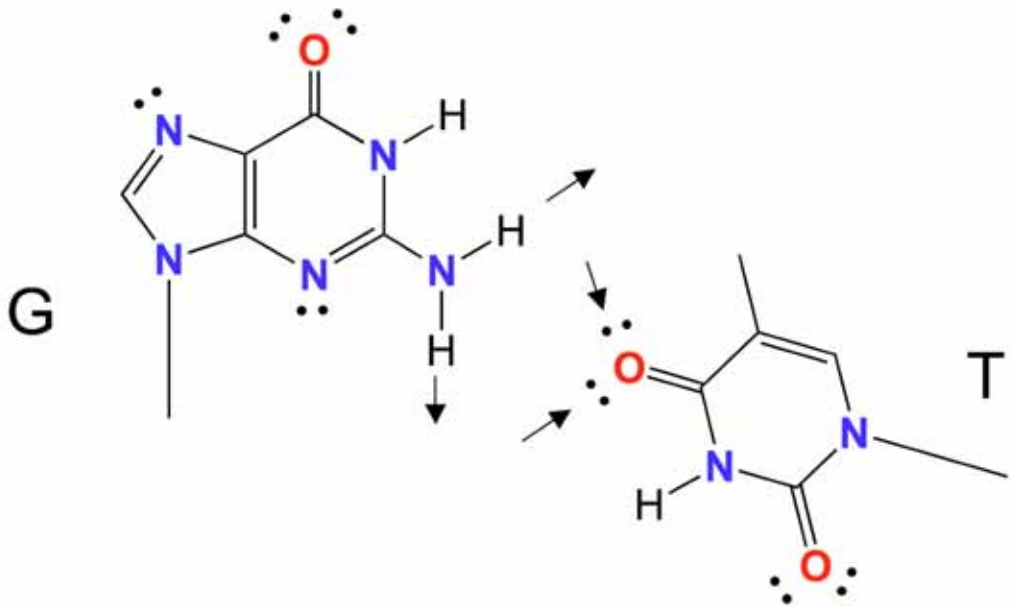
G
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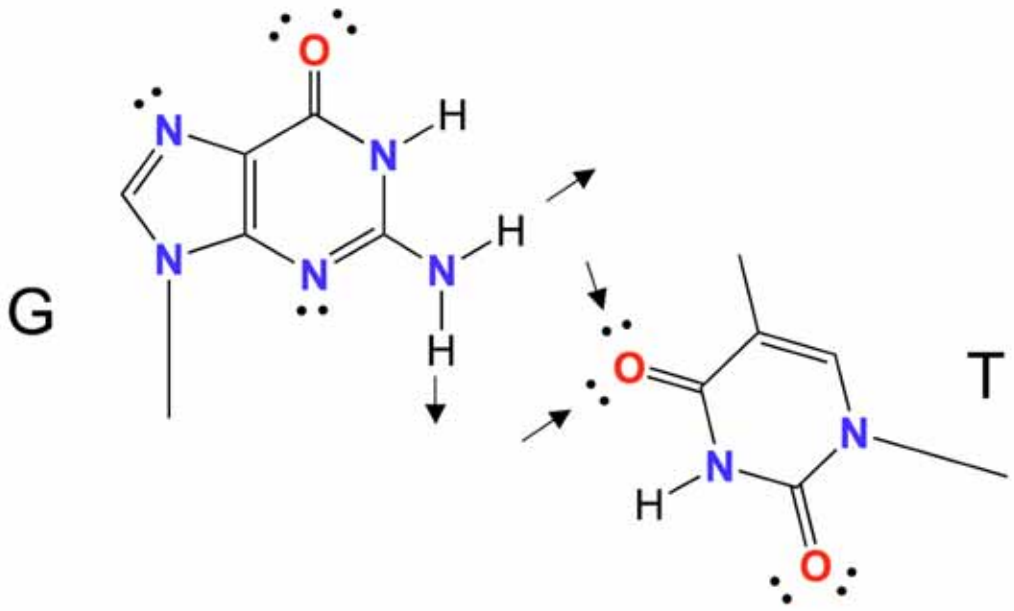
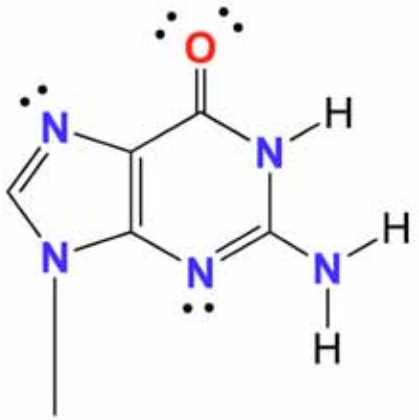
Bad Base Pairing

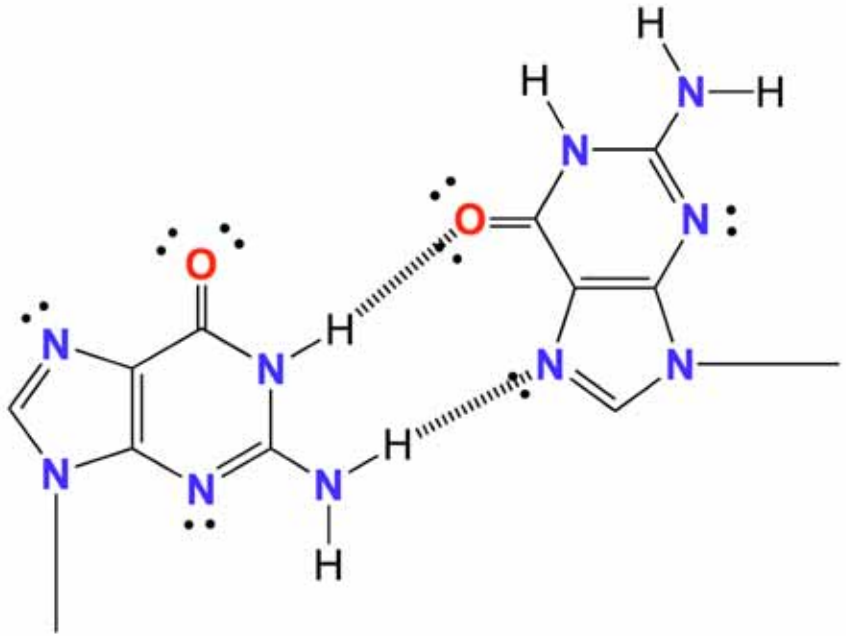
(Donors to Acceptors with ***terrible angles***)



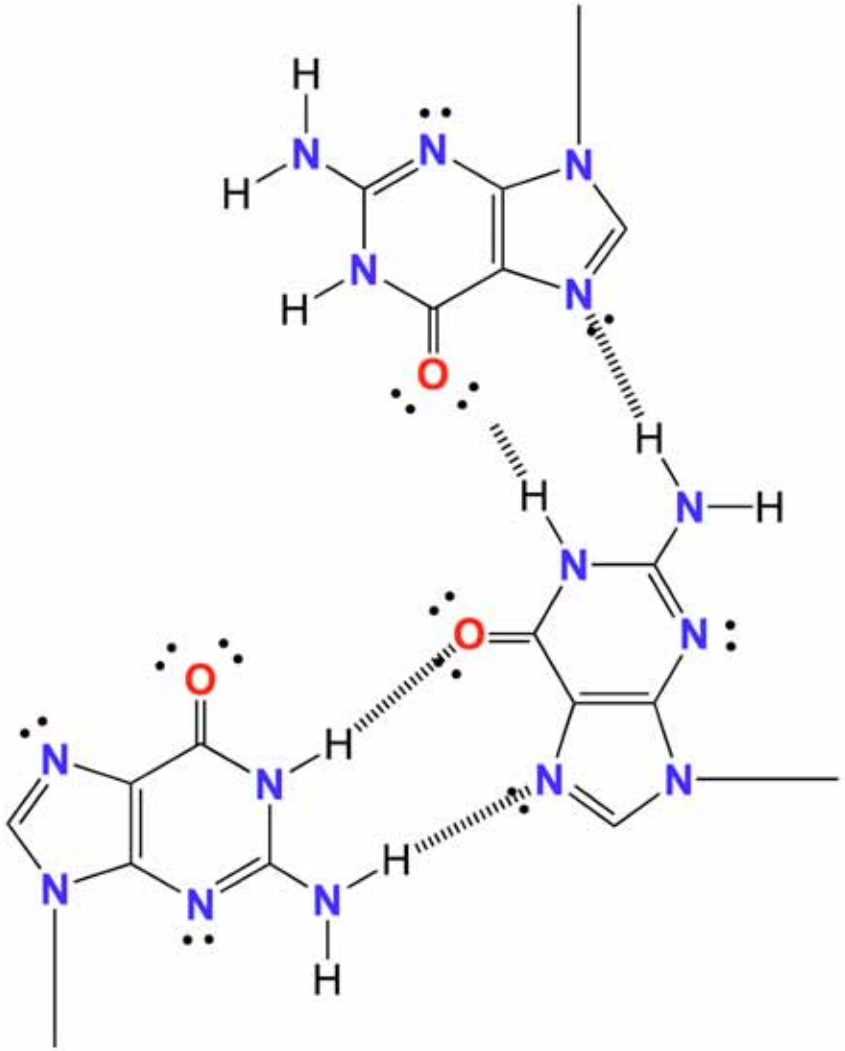
Wild (but good) Base Pairing



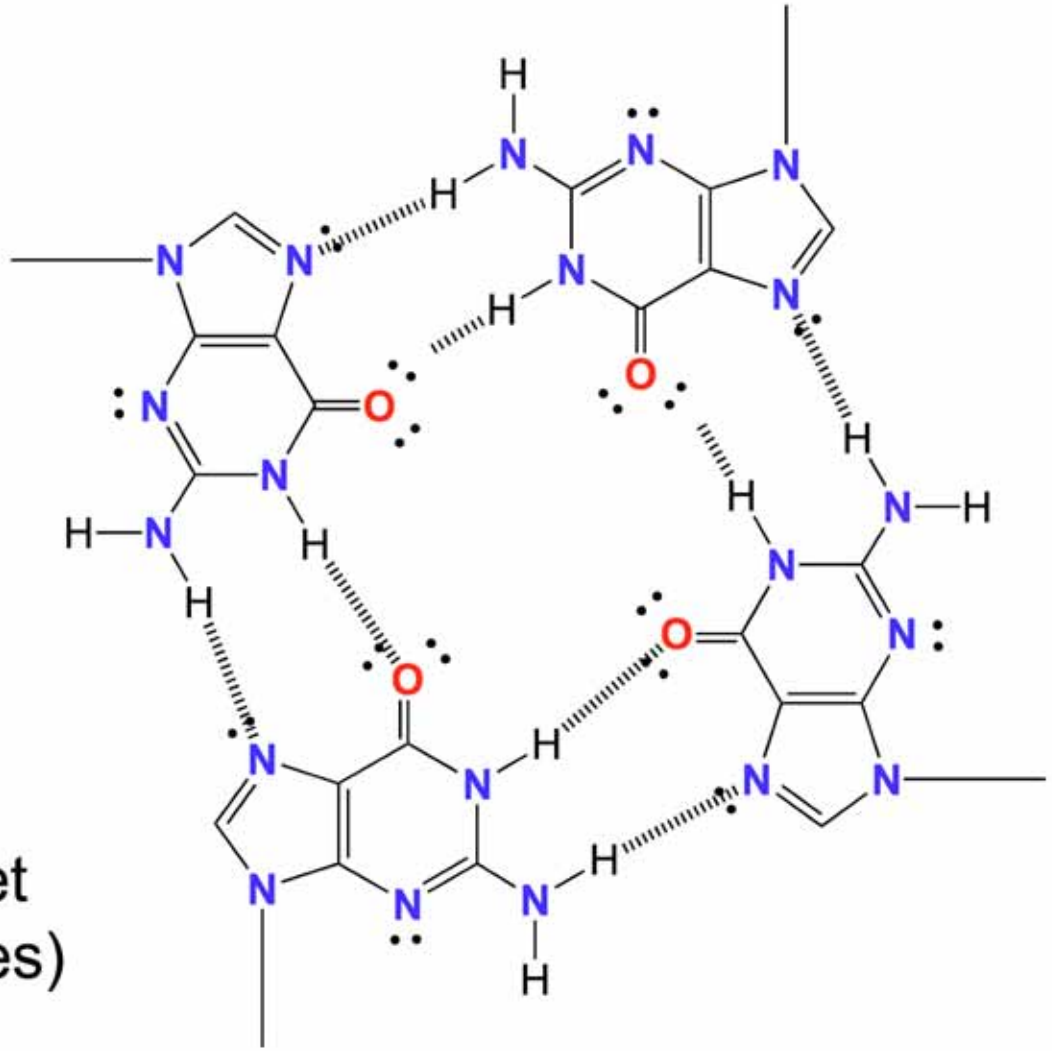
Wild (but good) Base Pairing



Wild (but good) Base Pairing

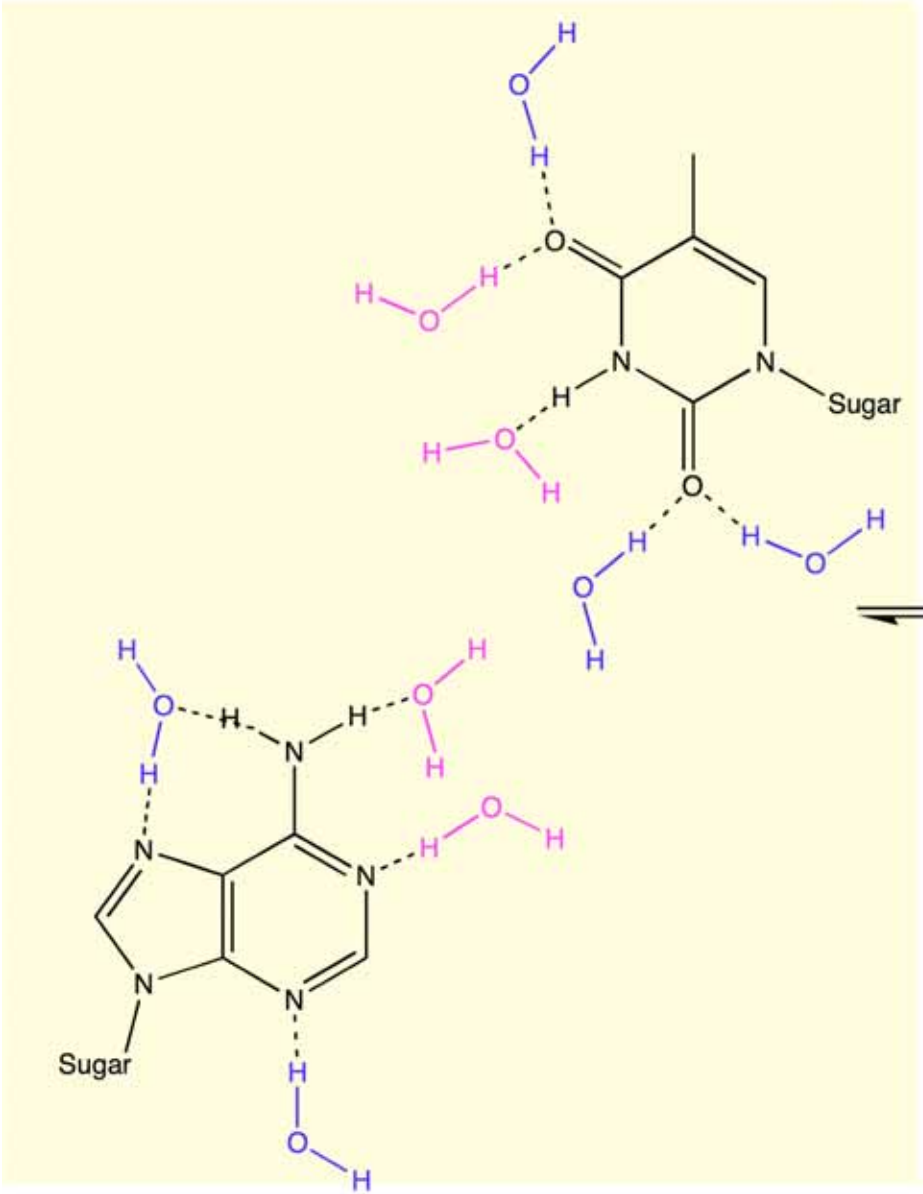


Wild (but good) Base Pairing



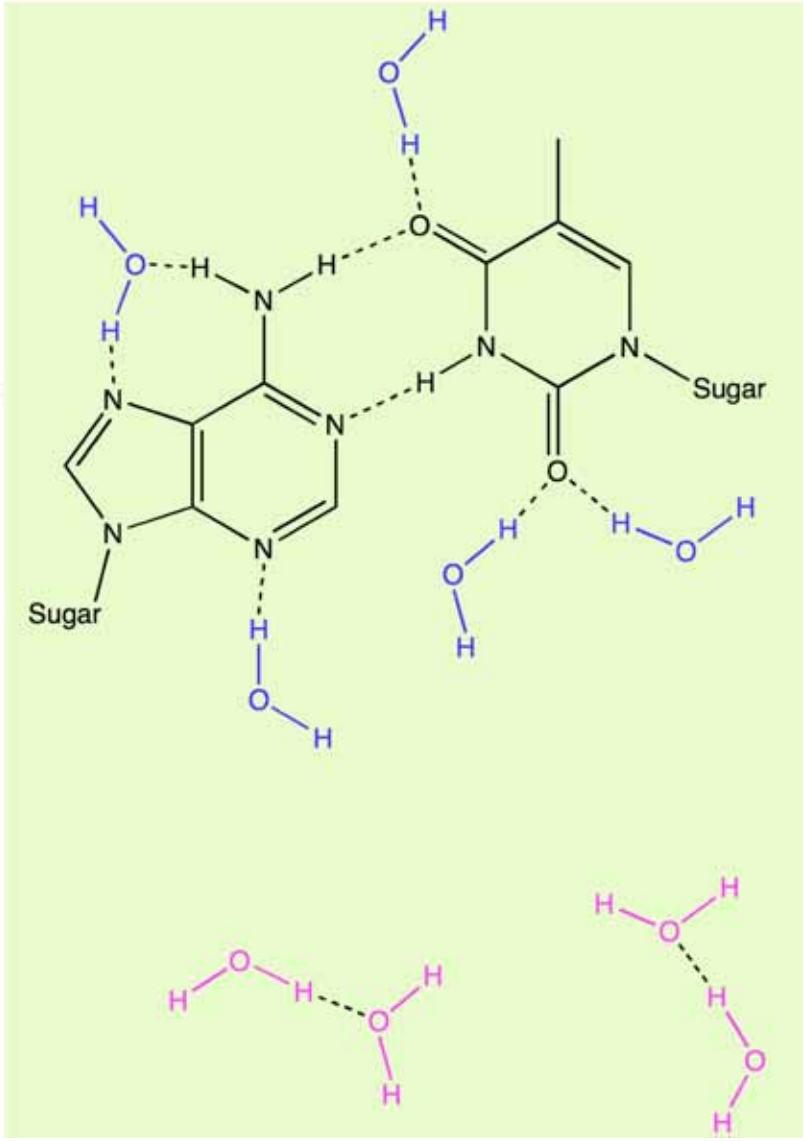
G-quartet
(Telomeres)

AT Base Pair

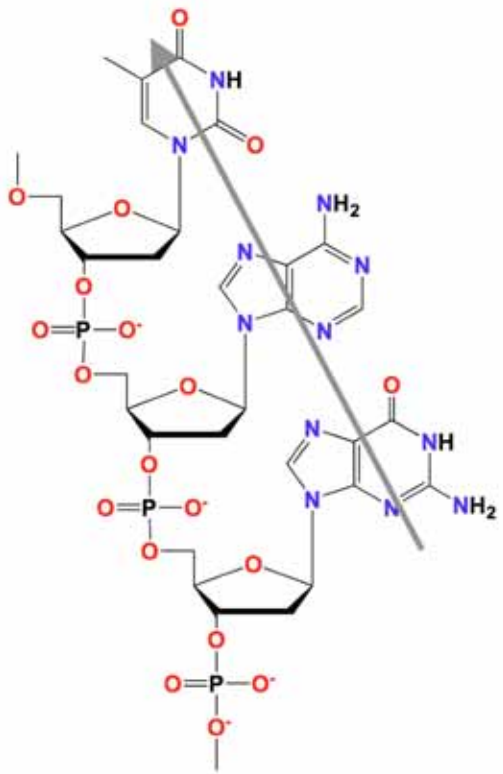


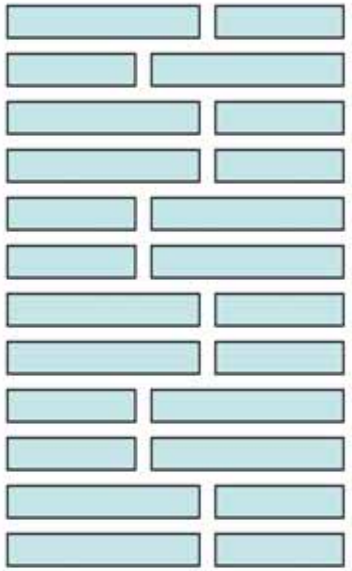
Ten H-Bonds

Ten H-Bonds



Burial of hydrophobic surface drives helix formation (hydrophobic core / stacking interactions)





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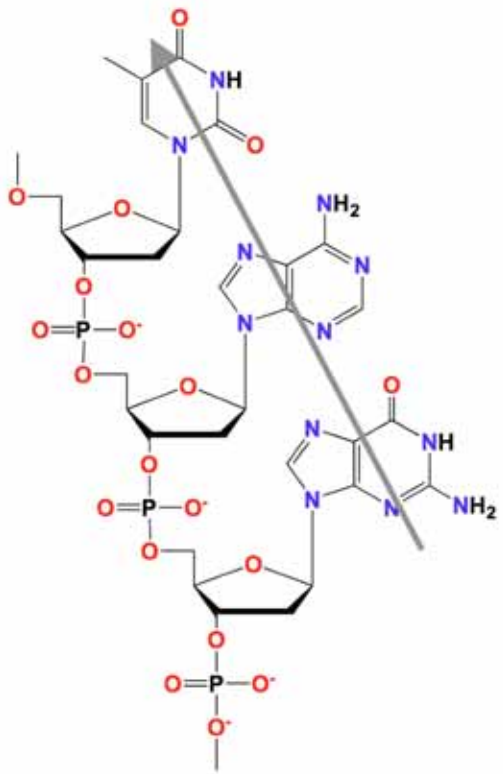
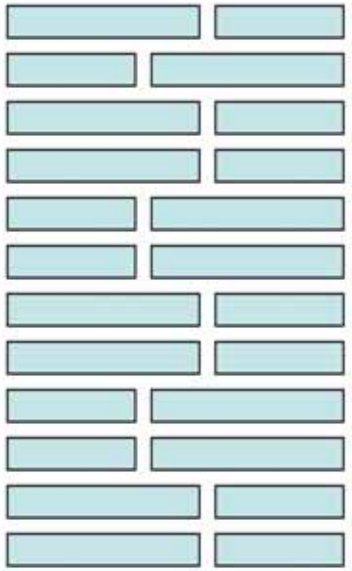
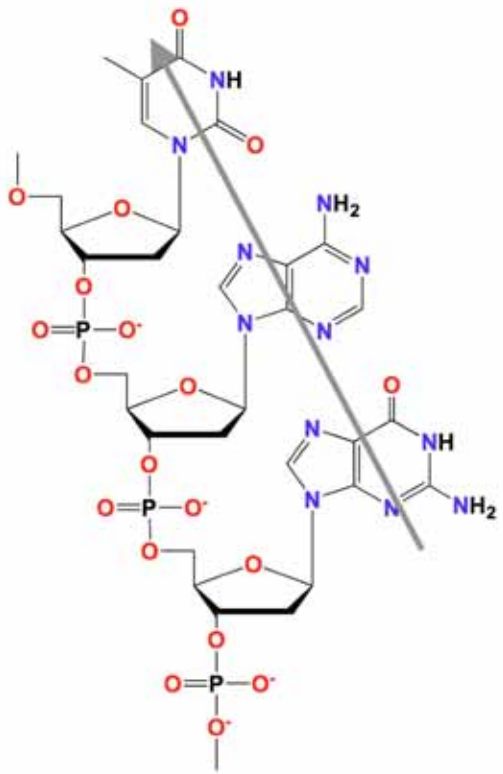
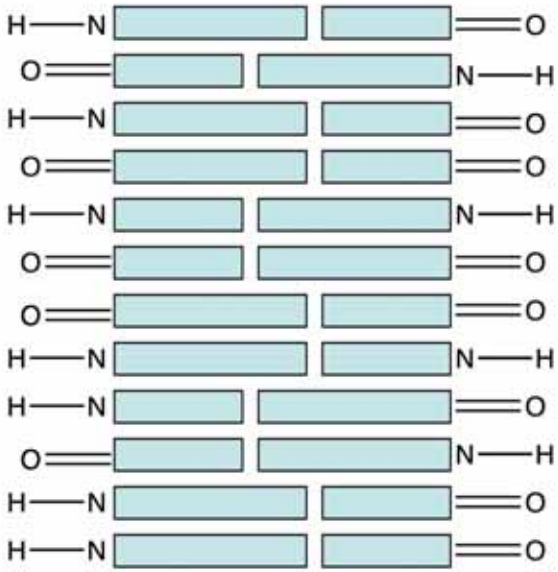




Flat faces are nonpolar

Burial of hydrophobic surface drives helix formation (hydrophobic core / stacking interactions)

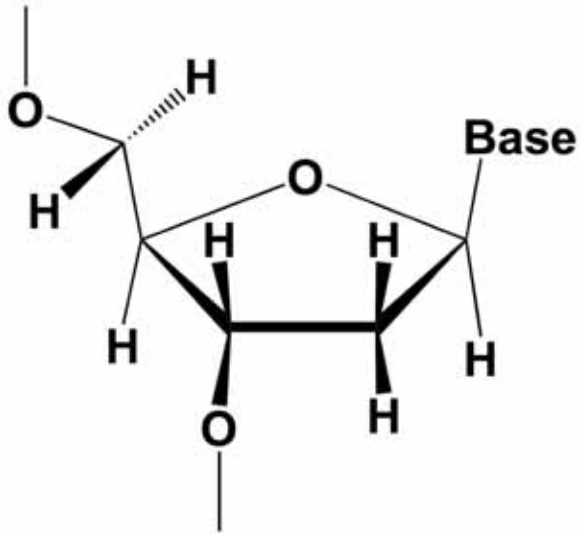


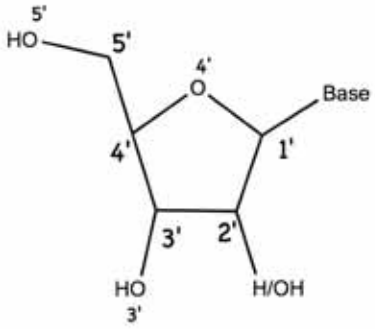


Flat faces are nonpolar
Edges are very polar (can H-bond)

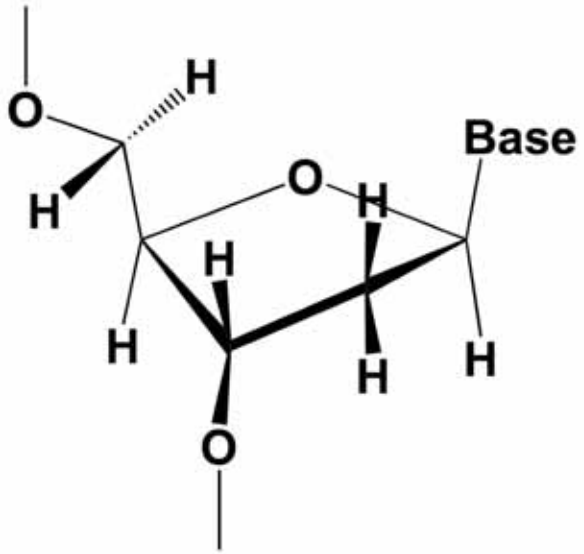
Other chemical constraints

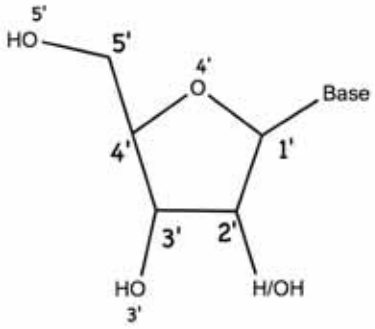
Furanose Sugar Ring



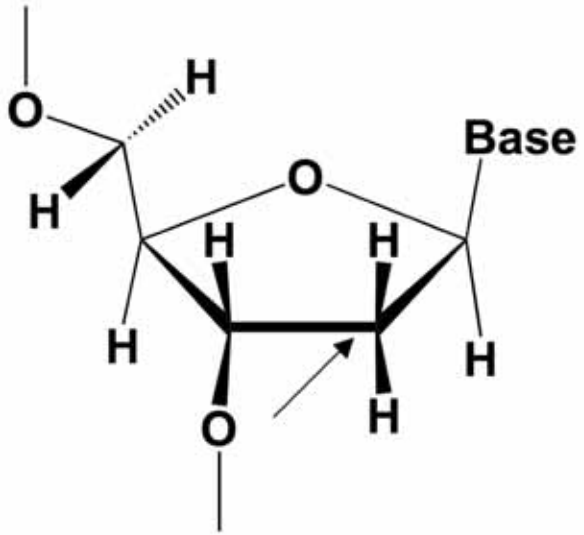


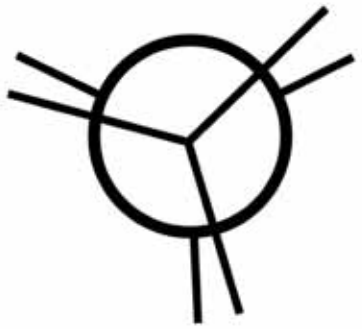
Furanose Sugar Ring

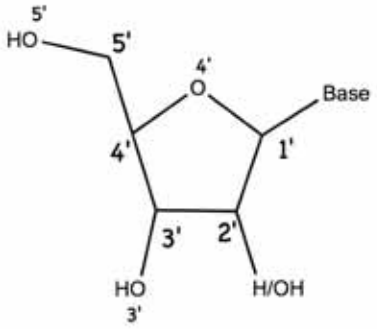




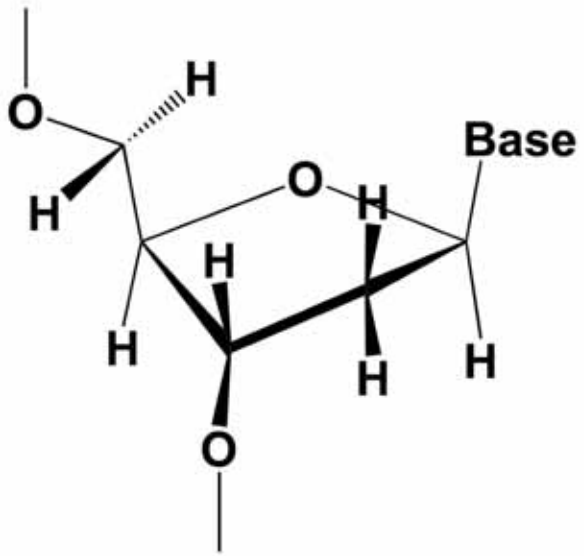
Furanose Sugar Ring

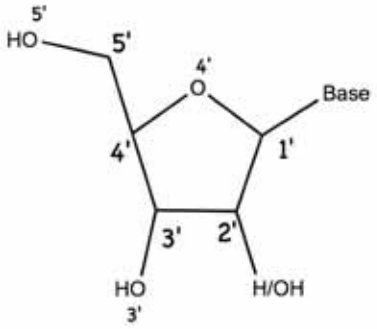




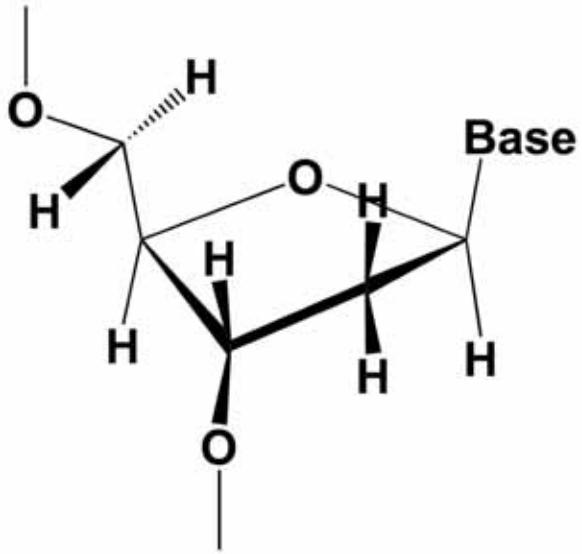


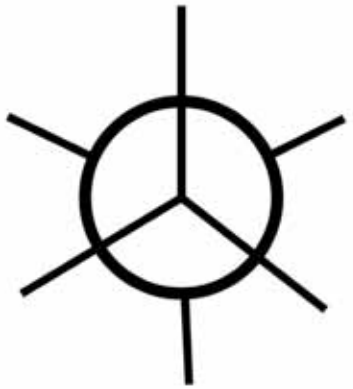
Furanose Sugar Ring

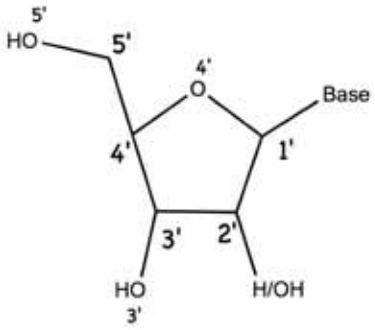


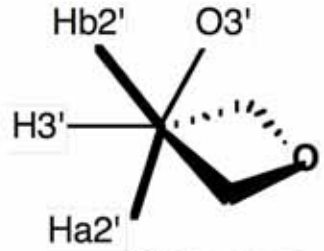


Furanose Sugar Ring

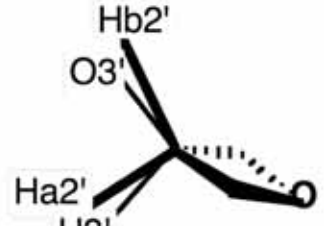






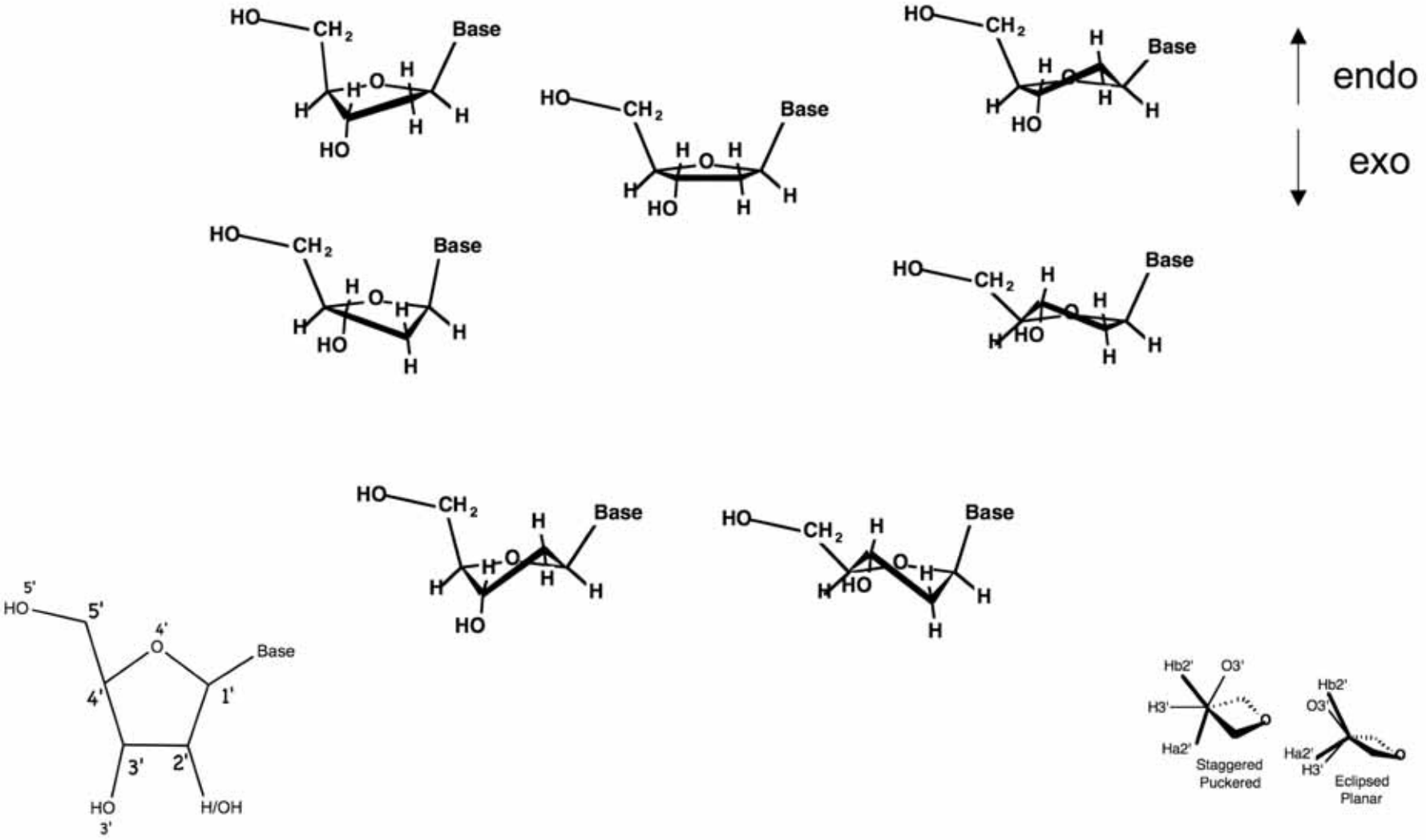


Staggered
Puckered



Eclipsed
Planar

Furanose Sugar Ring



Hoogsteen vindicated

Letters to Nature

Nature **430**, 377-380 (15 July 2004) | doi: 10.1038/nature02692

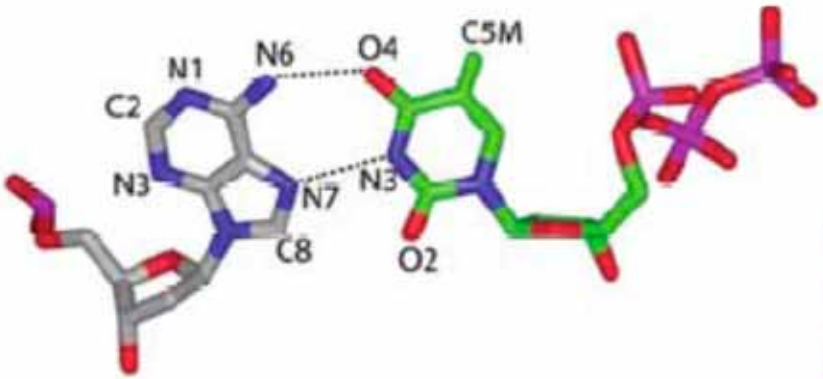
Replication by human DNA polymerase-ι occurs by Hoogsteen base-pairing

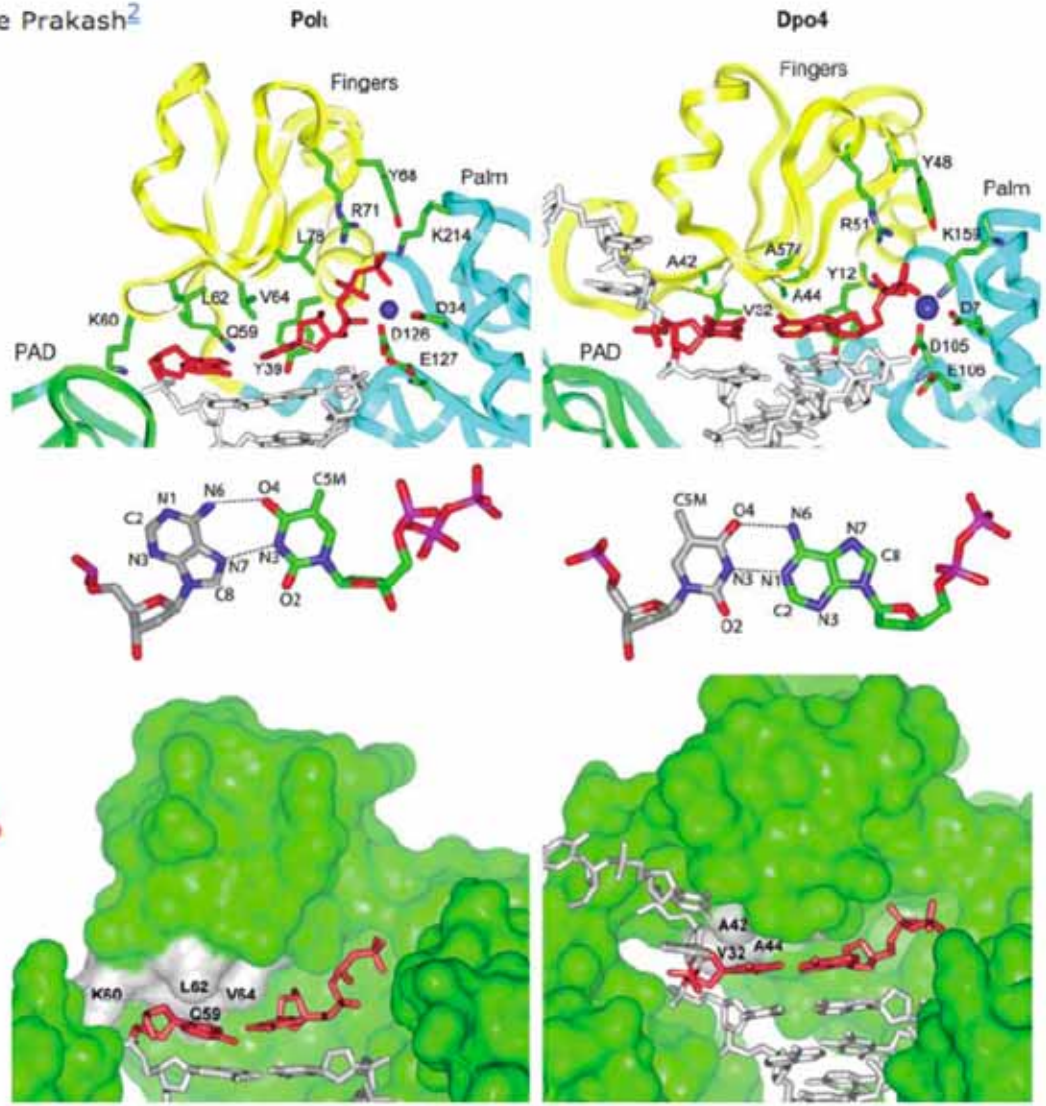
Deepak T. Nair[1], Robert E. Johnson[2], Satya Prakash[2], Louise Prakash[2] and Aneel K. Aggarwal[1]

A crystal structure from from July 2004 shows that an error correcting (and error-prone) DNA polymerase uses Hoogsteen-WC base pairing to recognize the incoming substrate dNTP.

This supports biochemical studies that had been suggesting such a pairing.

This polymerase is good at bypassing lesions in the DNA (eg, damaged Watson-Crick face of G).





Hoogsteen vindicated

But… perhaps not…

Letters to Nature

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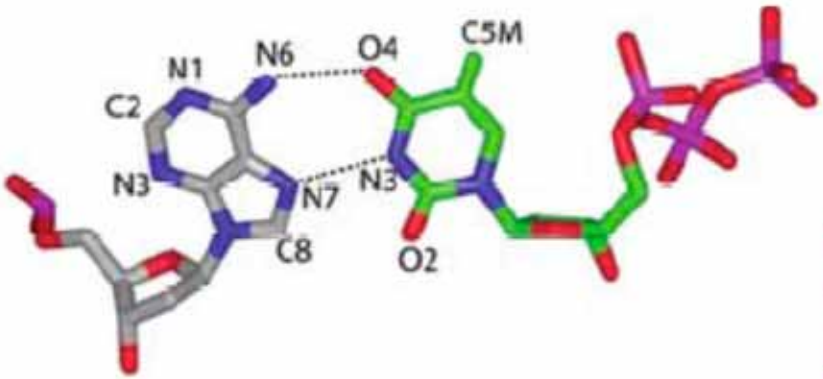
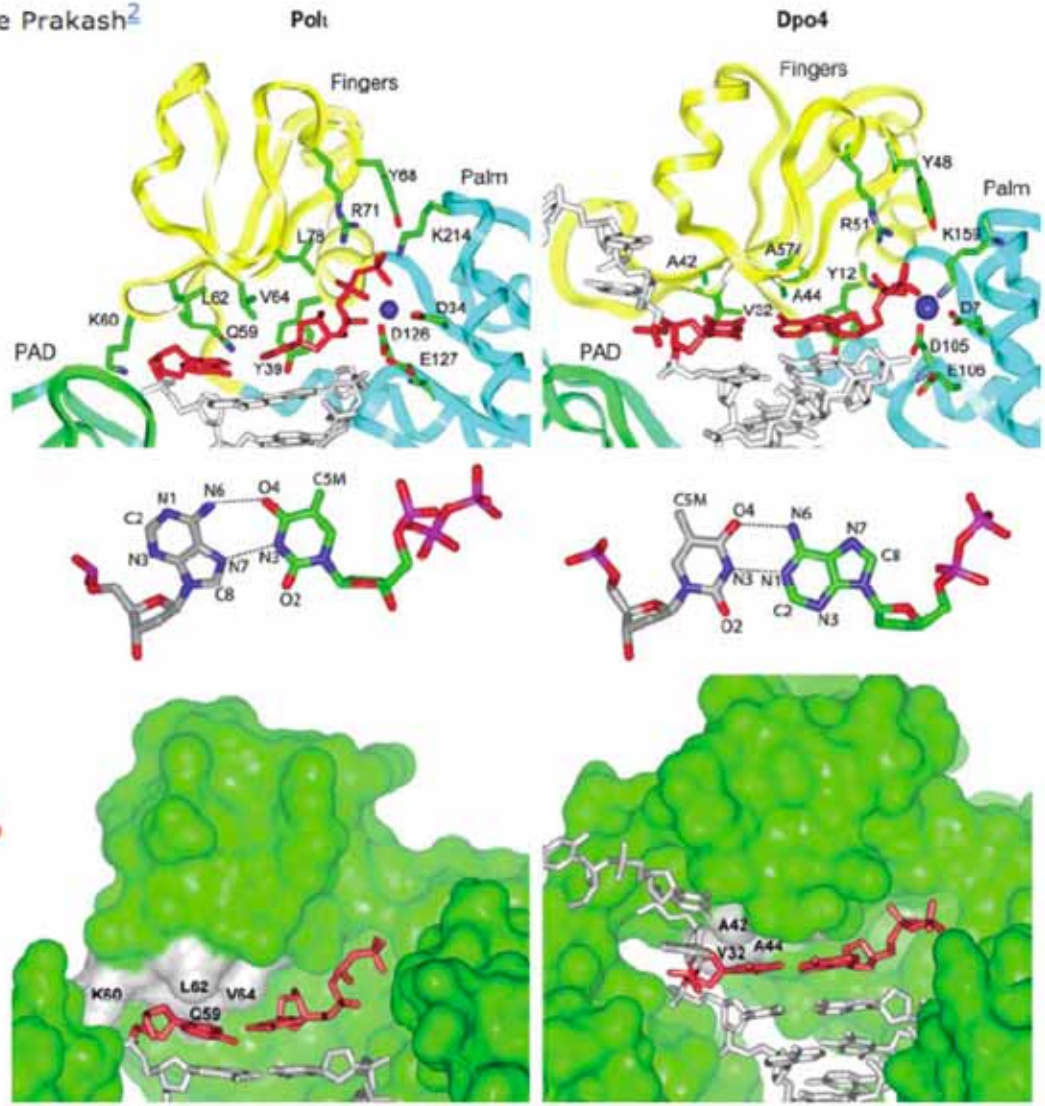
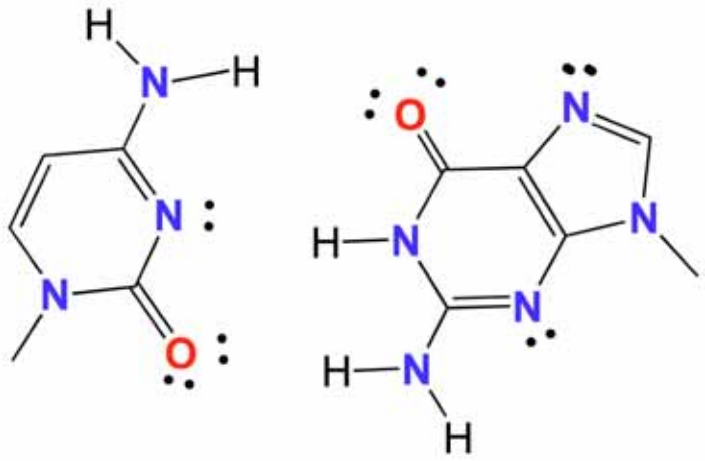




Why is Watson-Crick so good?

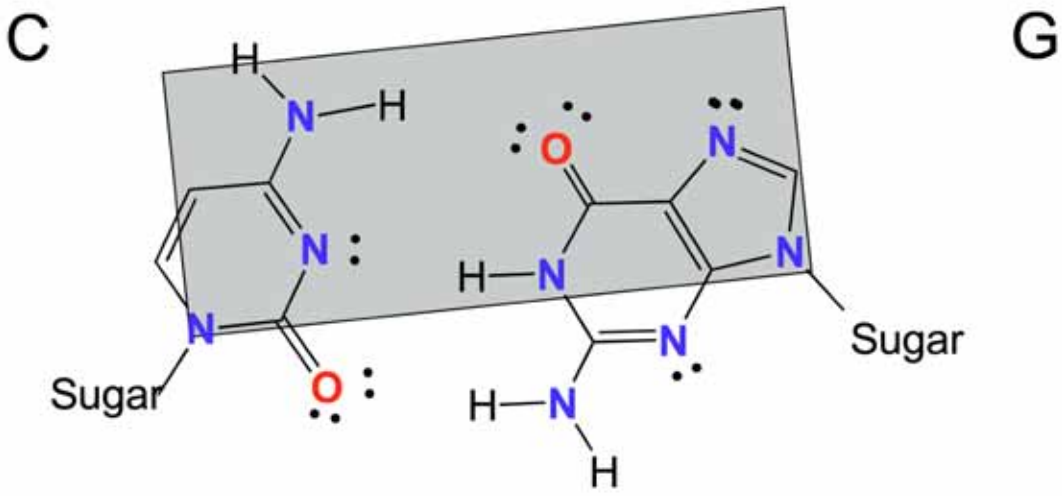
C



G

All four WC base pairs
are
isosteric

Why is Watson-Crick so good?



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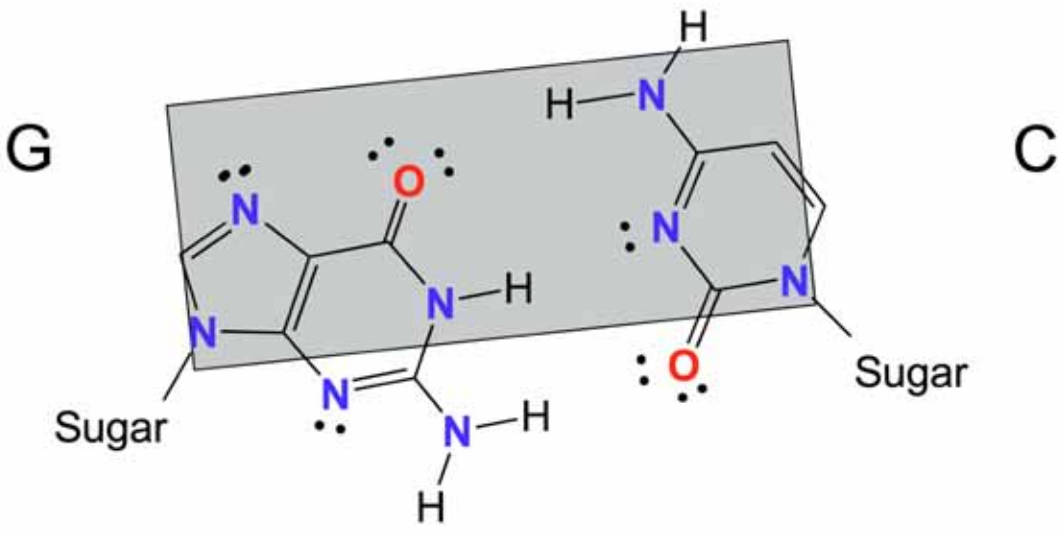

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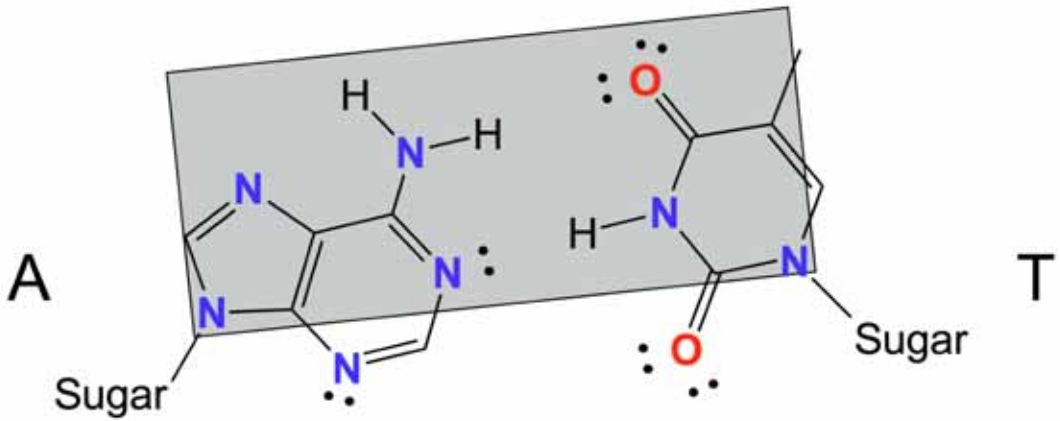

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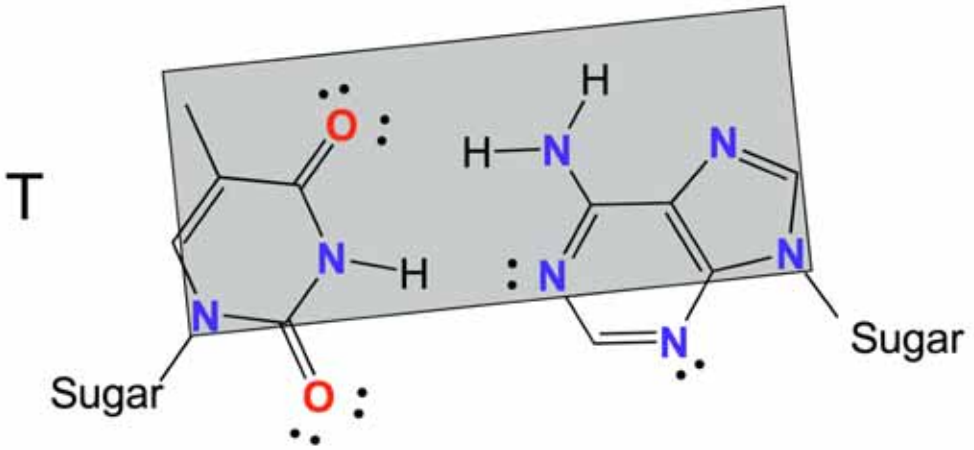

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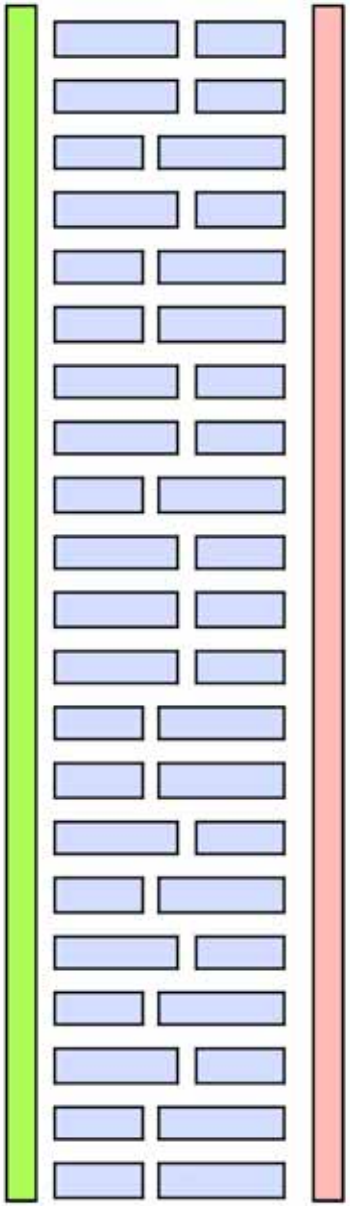
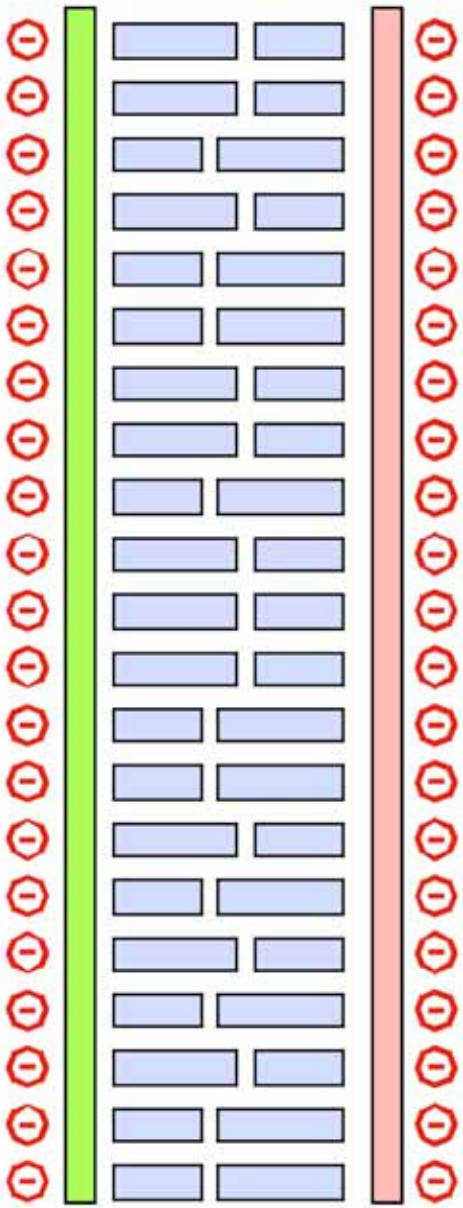


Why ***a helix***?



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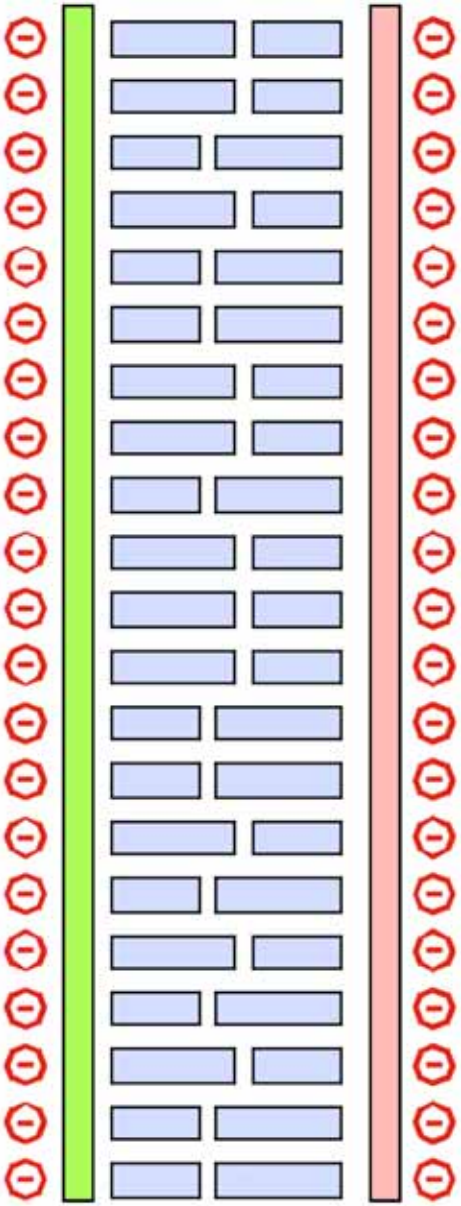
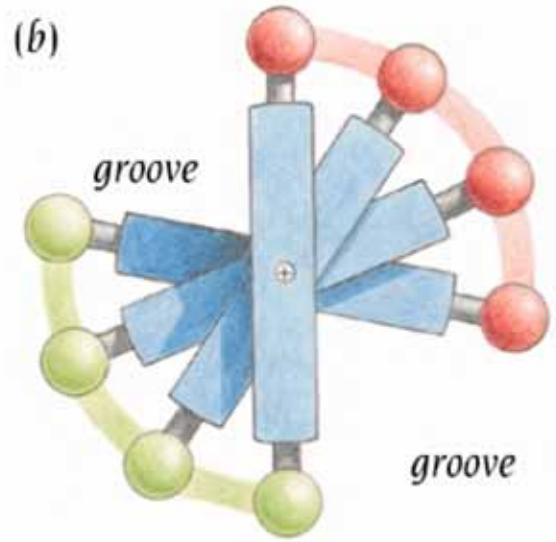
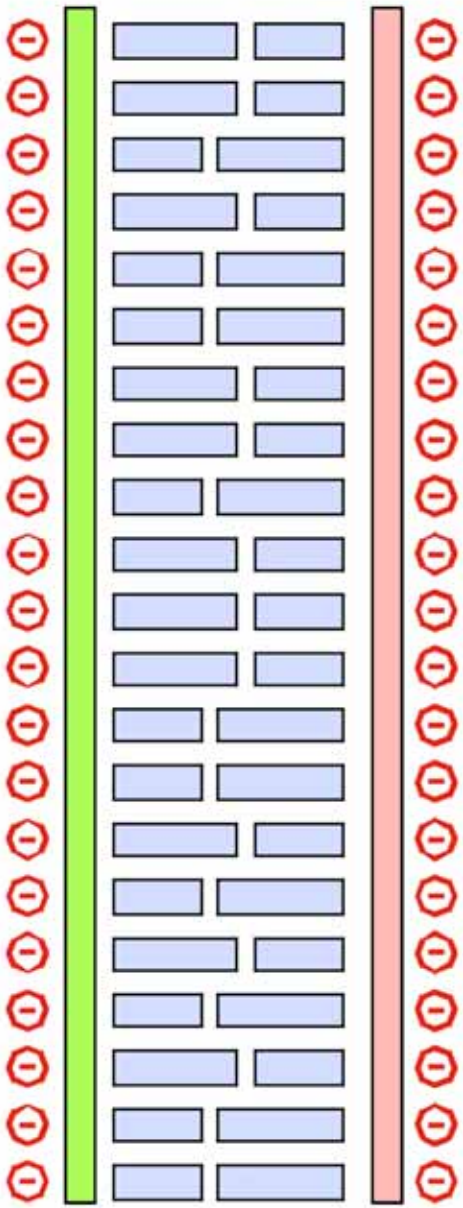


Why ***a helix***?





Why ***a helix***?