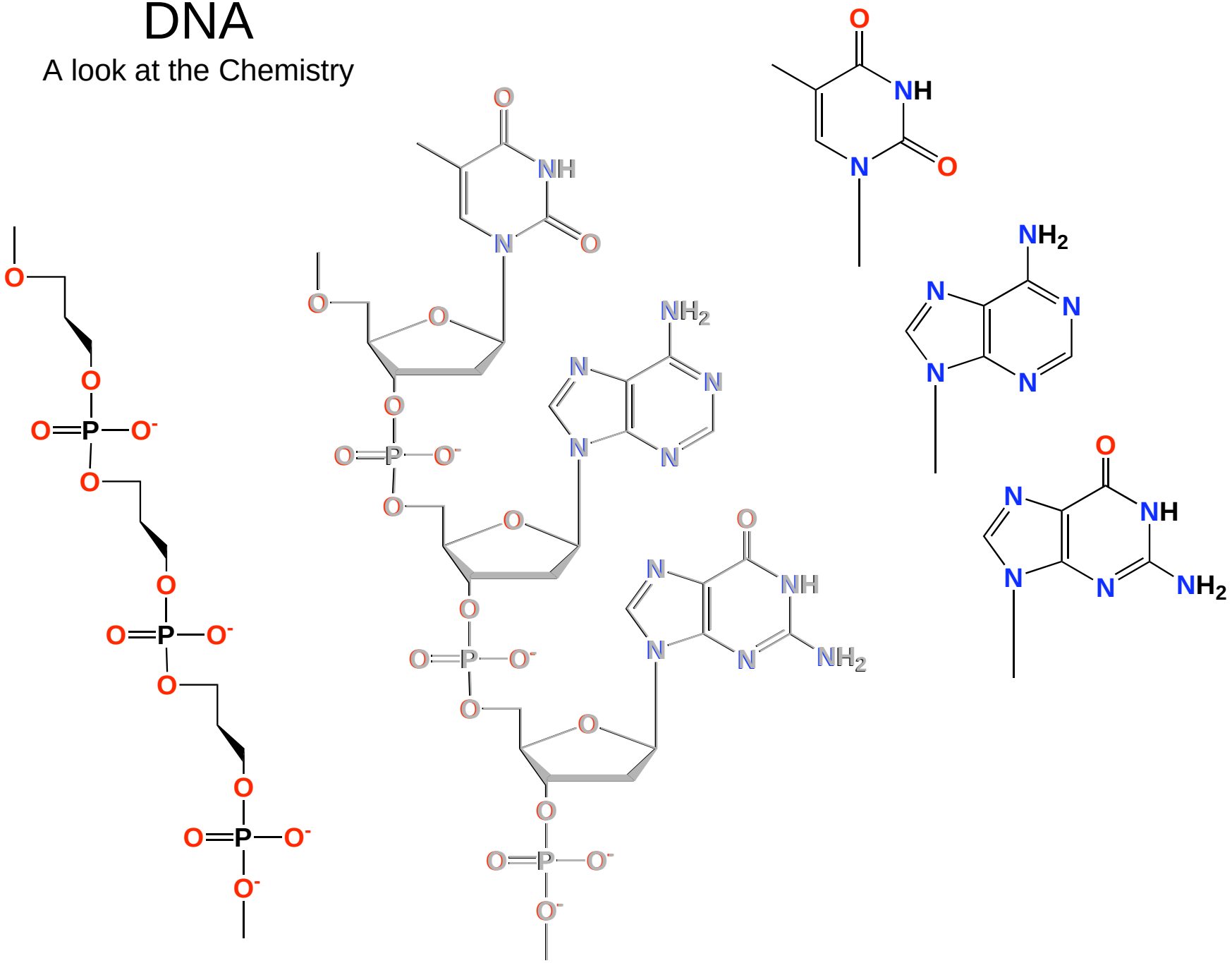
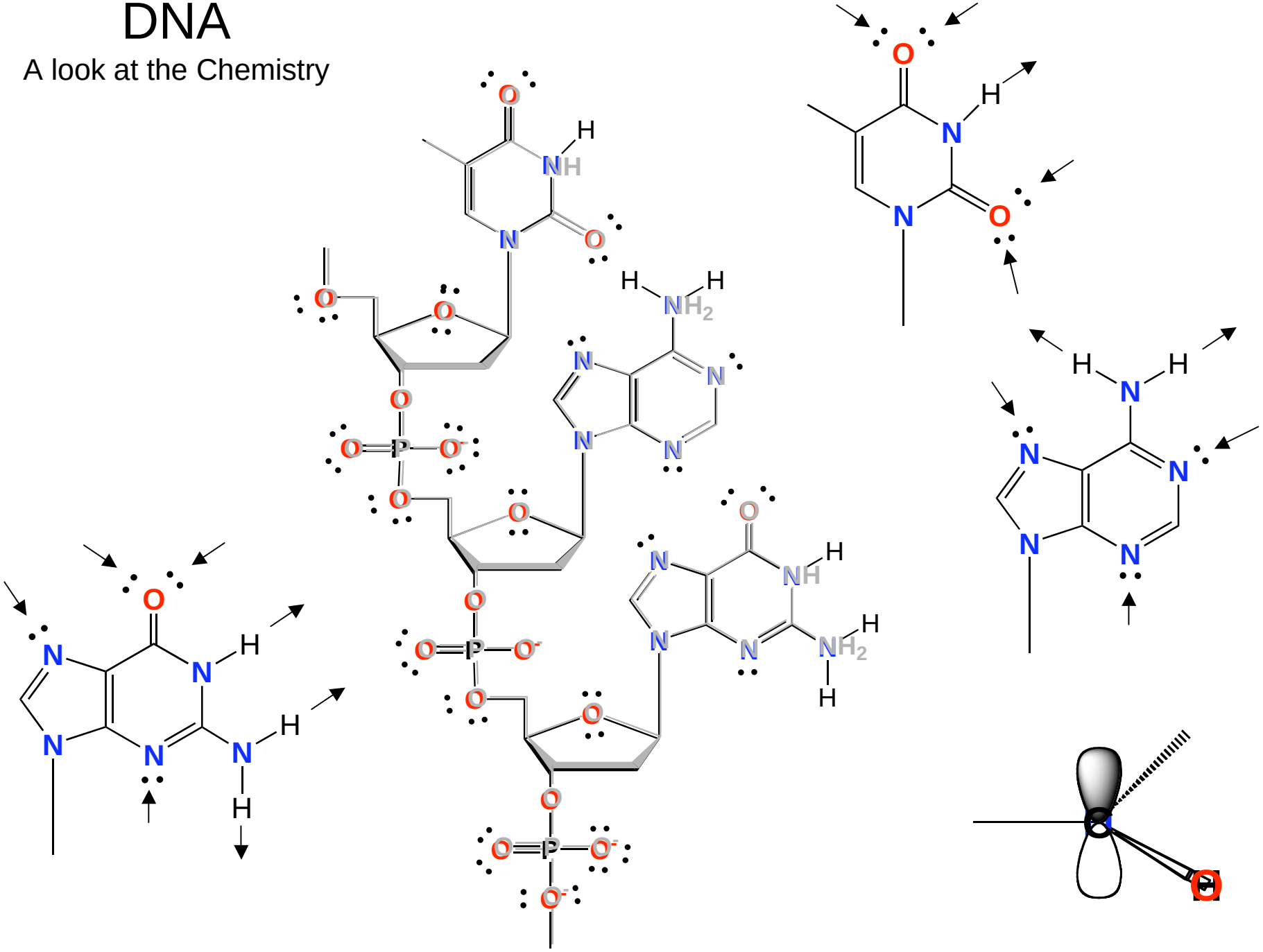
DNA

A look at the Chemistry

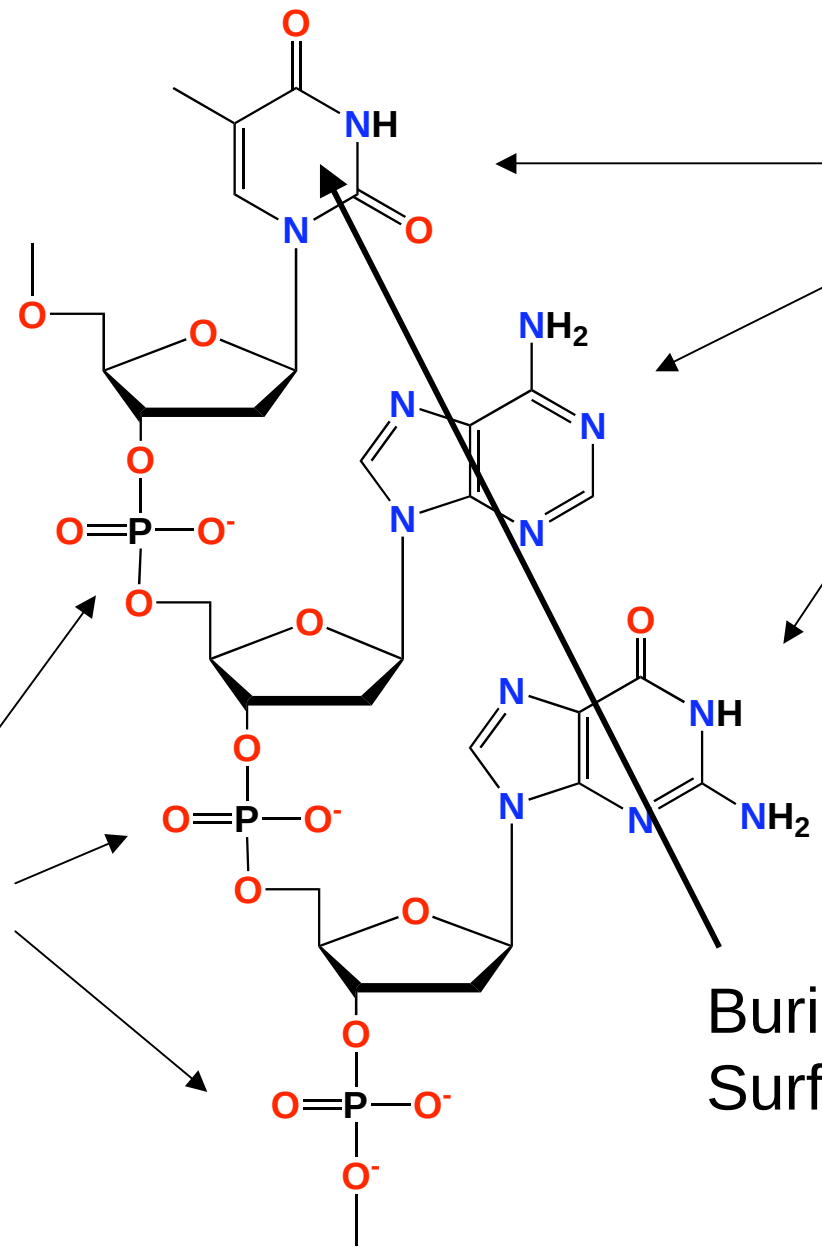


DNA

A look at the Chemistry



What forces are important?



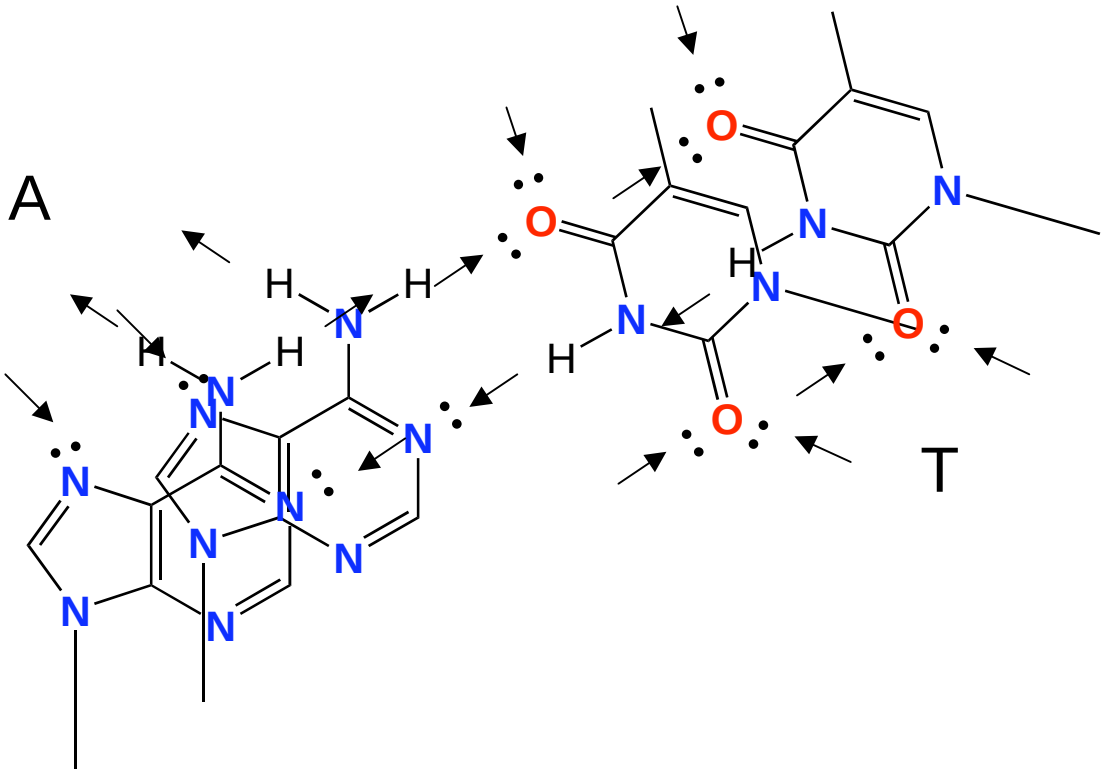
Hydrogen Bonding

Electrostatics

Burial of Hydrophobic Surface & Stacking

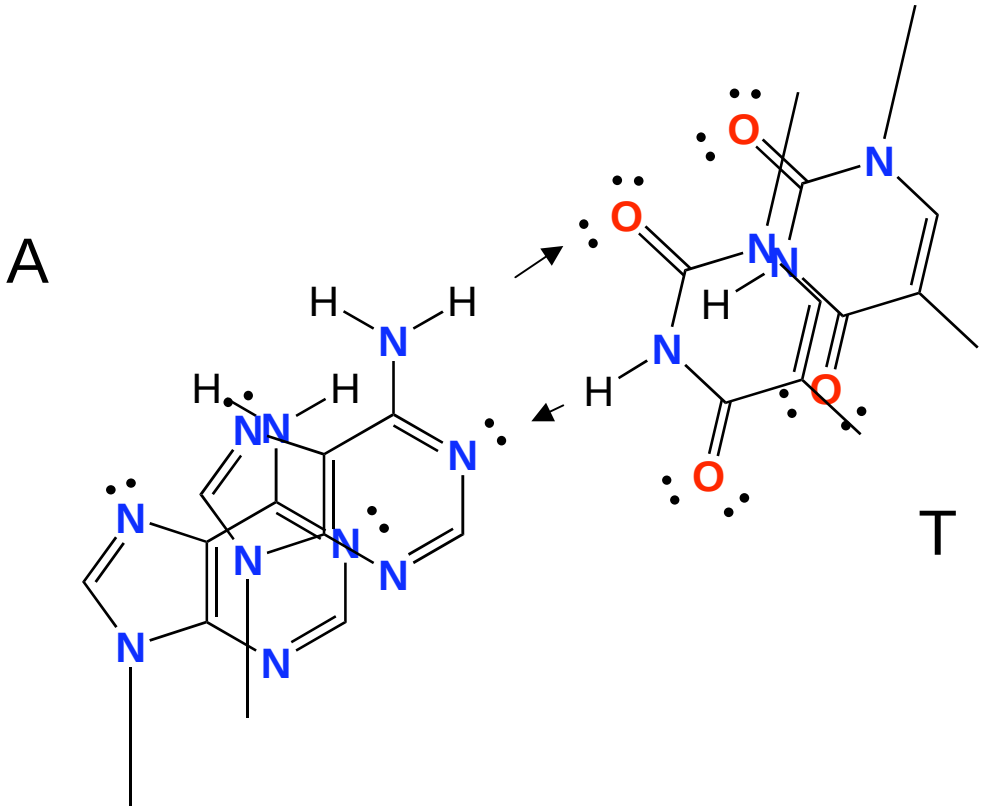
Base Pairing

(Donors matched to Acceptors)



Base Pairing

(Donors matched to Acceptors)



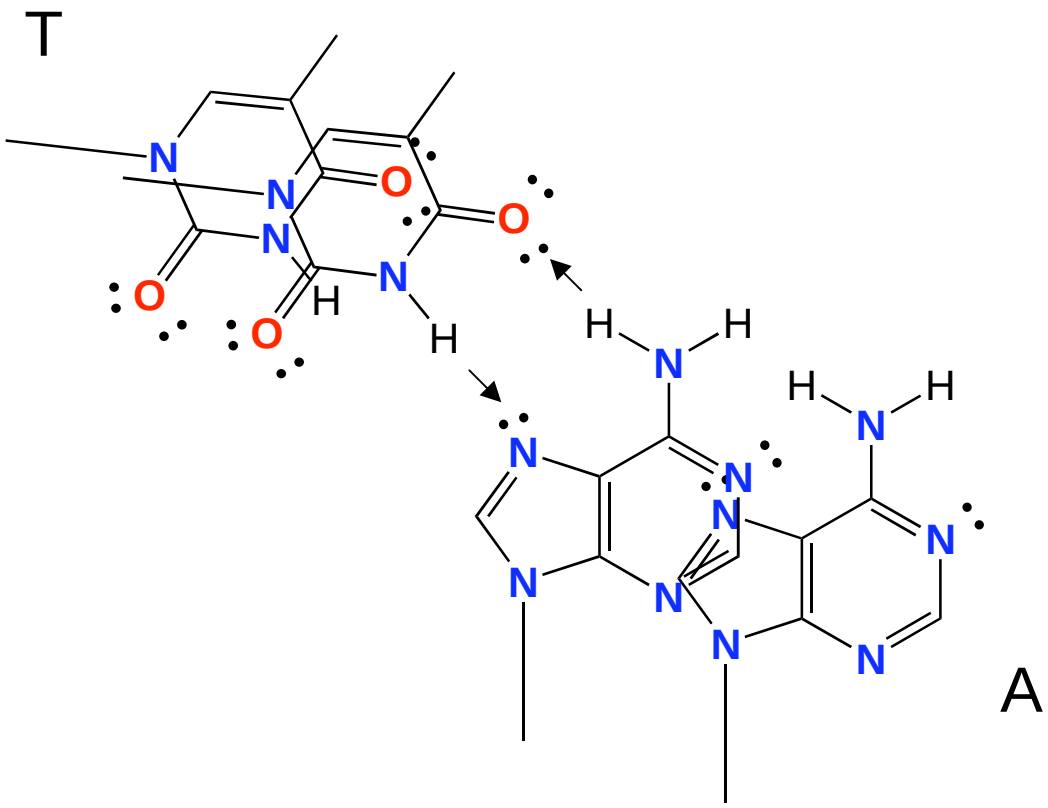
Good base pairing

Watson-Crick facing

but *Anti-Watson-Crick* orientation

Base Pairing

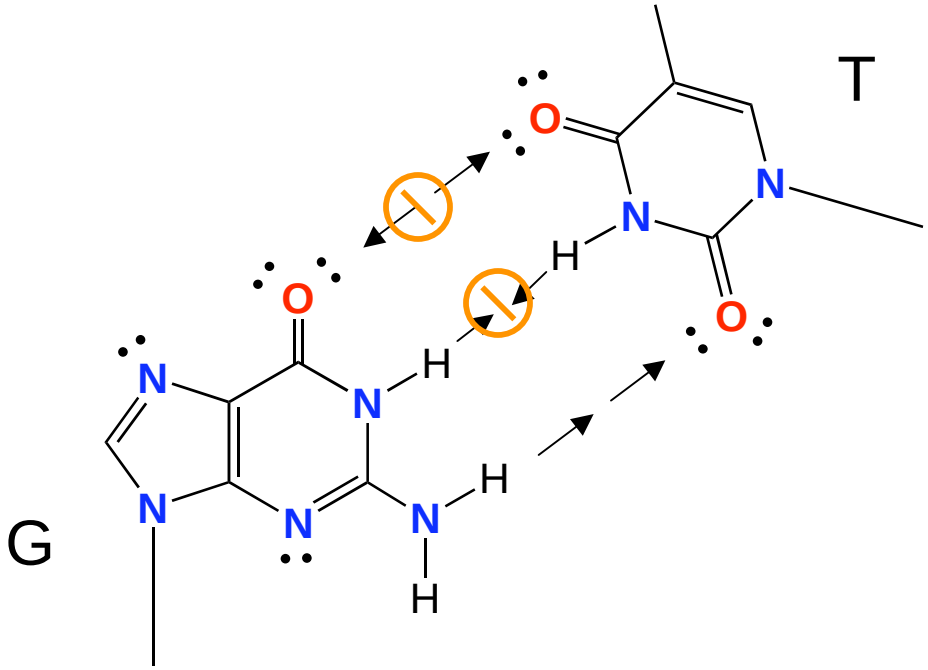
(Donors matched to Acceptors)



Good base pairing
WC-Hoogsteen facing

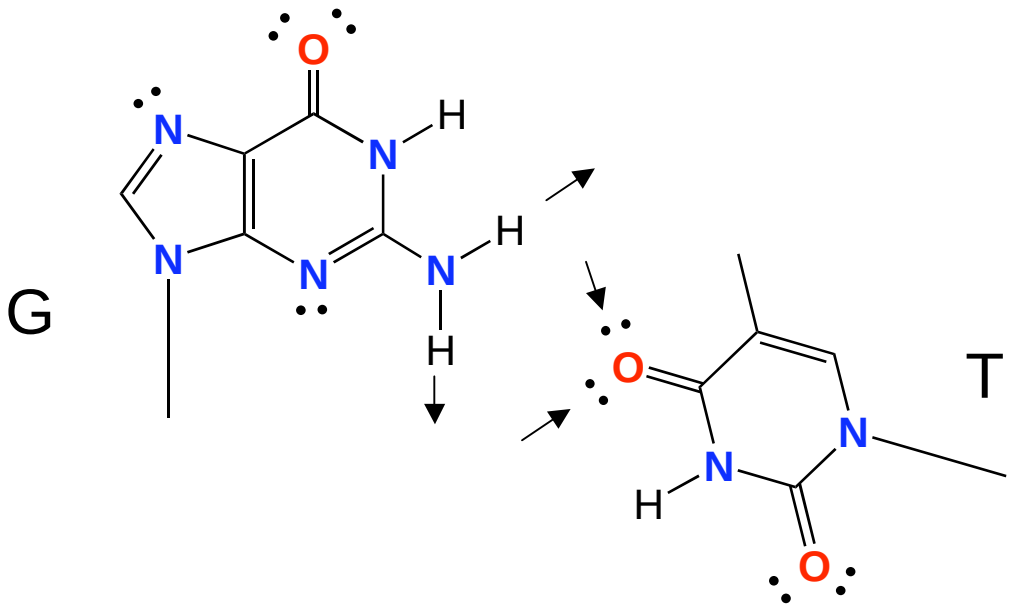
Bad Base Pairing

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

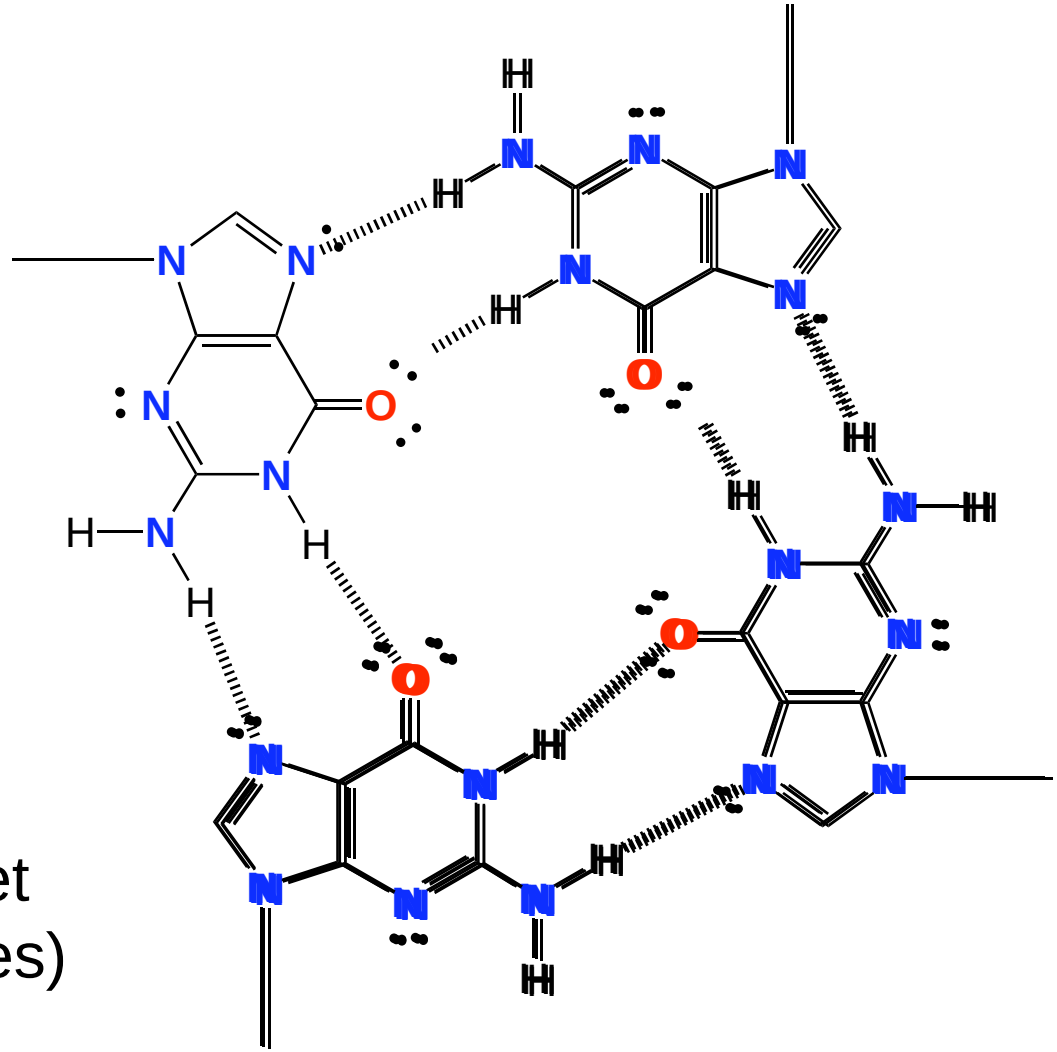


Bad Base Pairing

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

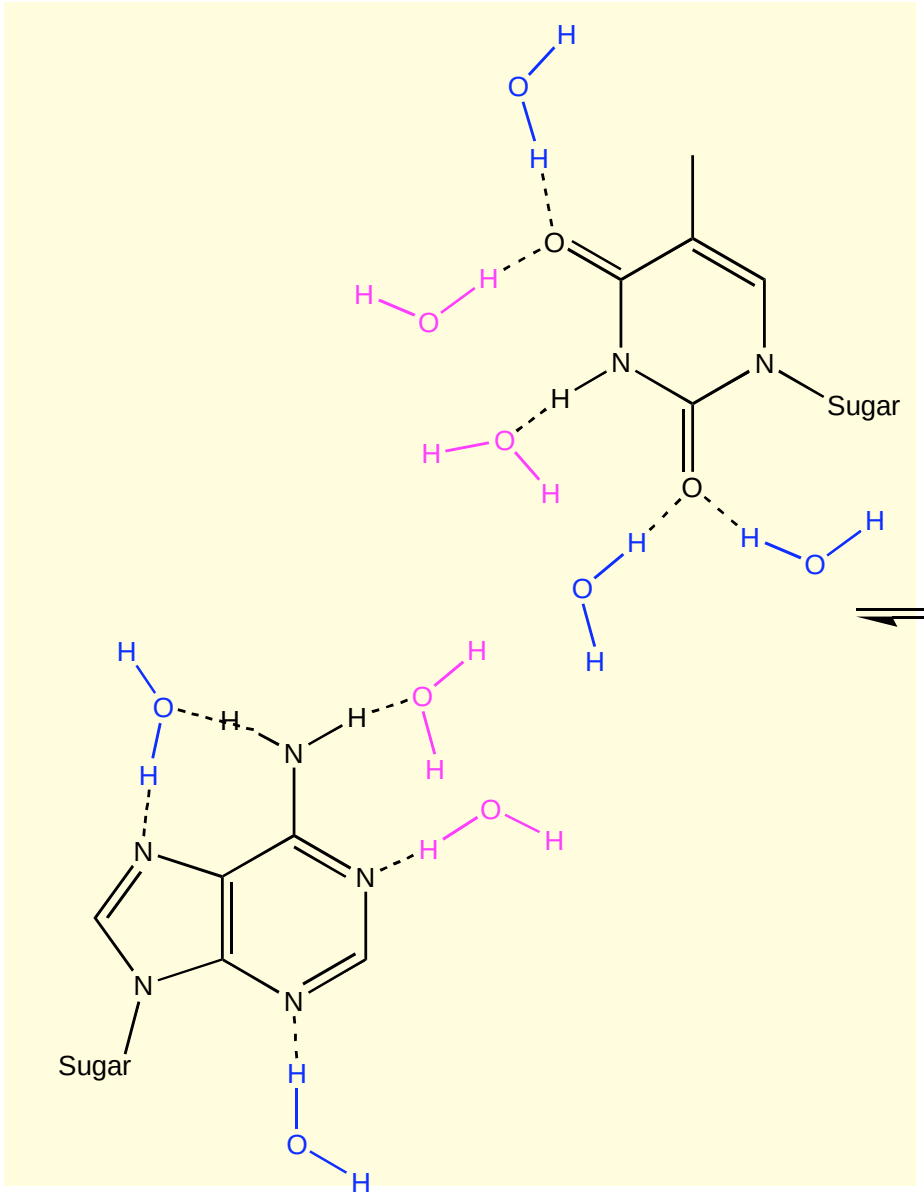


Wild (but good) Base Pairing

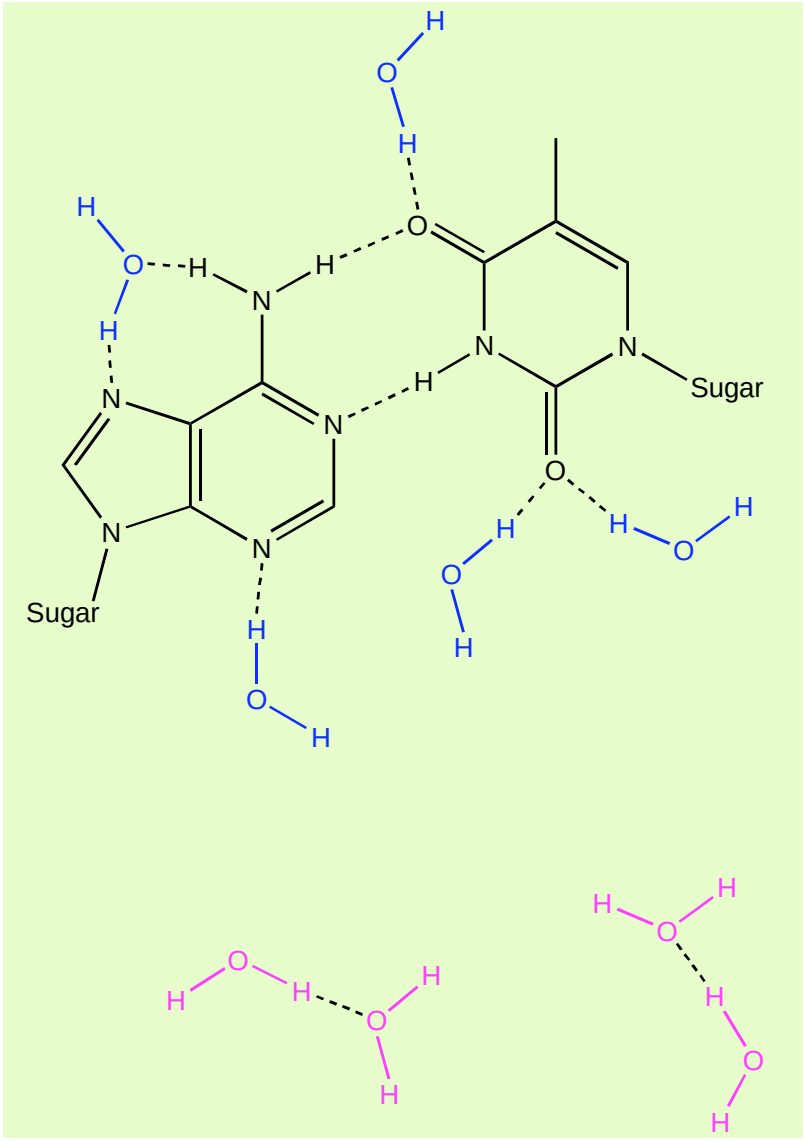


G-quartet
(Telomeres)

AT Base Pair

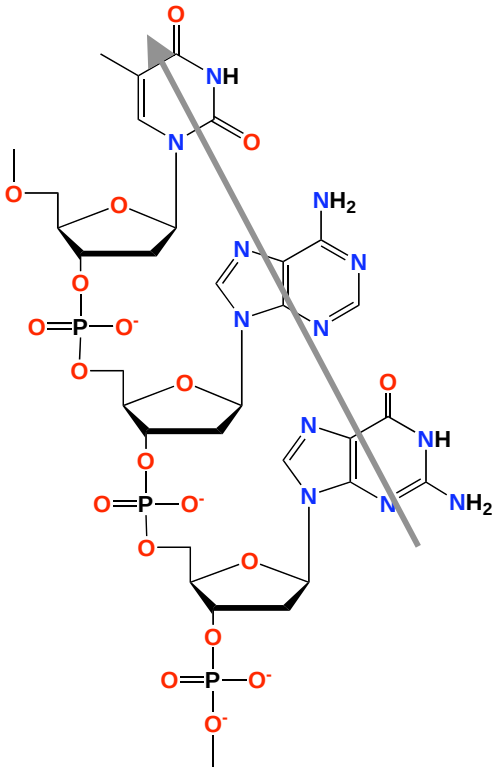


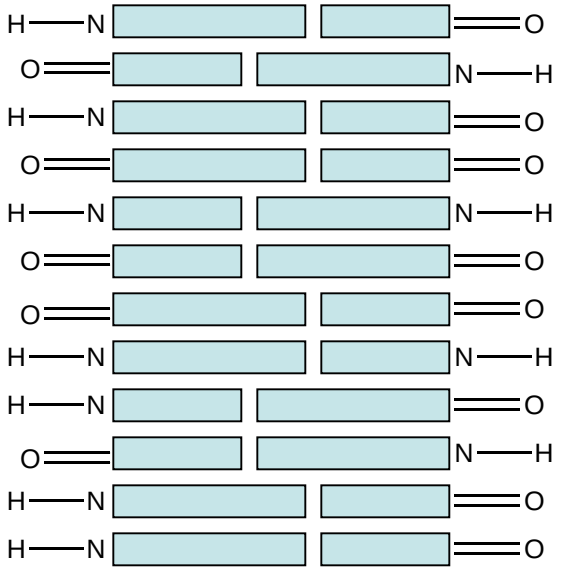
Ten H-Bonds



Ten H-Bonds

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

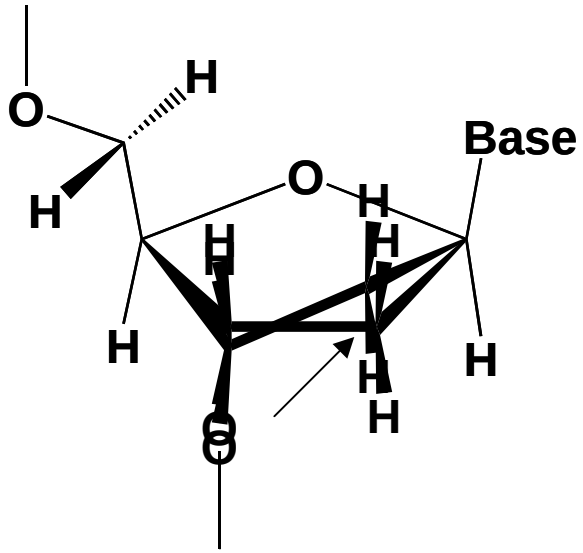


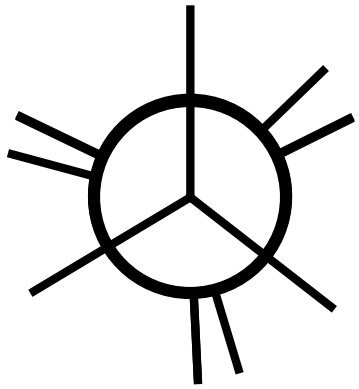


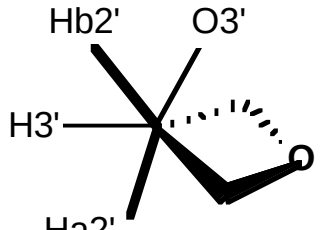
Flat faces are nonpolar
Edges are very polar (can H-bond)

Other chemical constraints

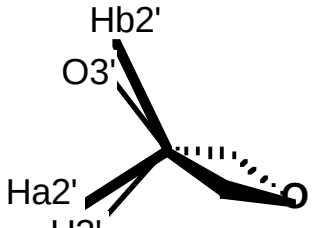
Furanose Sugar Ring





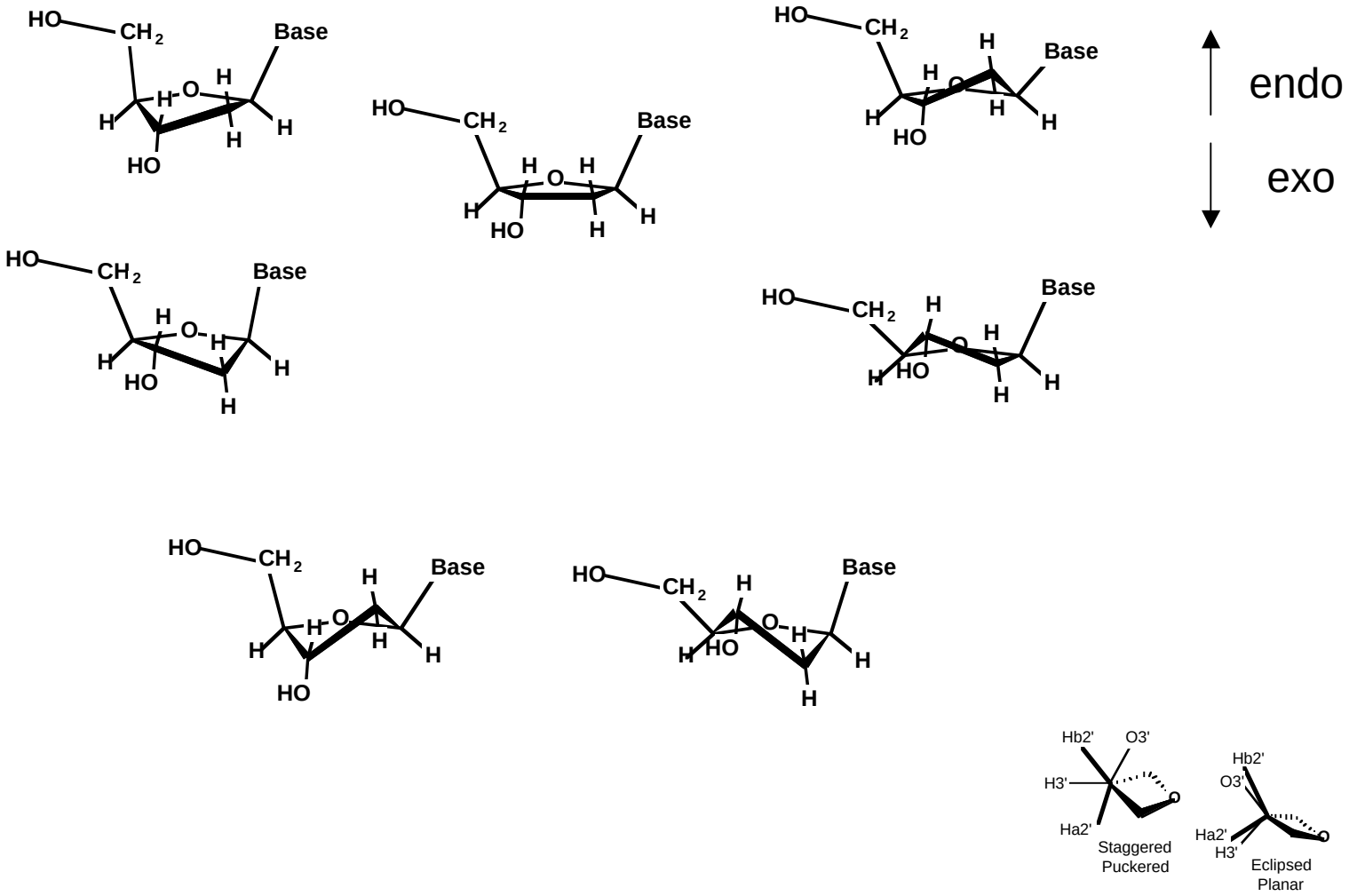


Staggered
Puckered



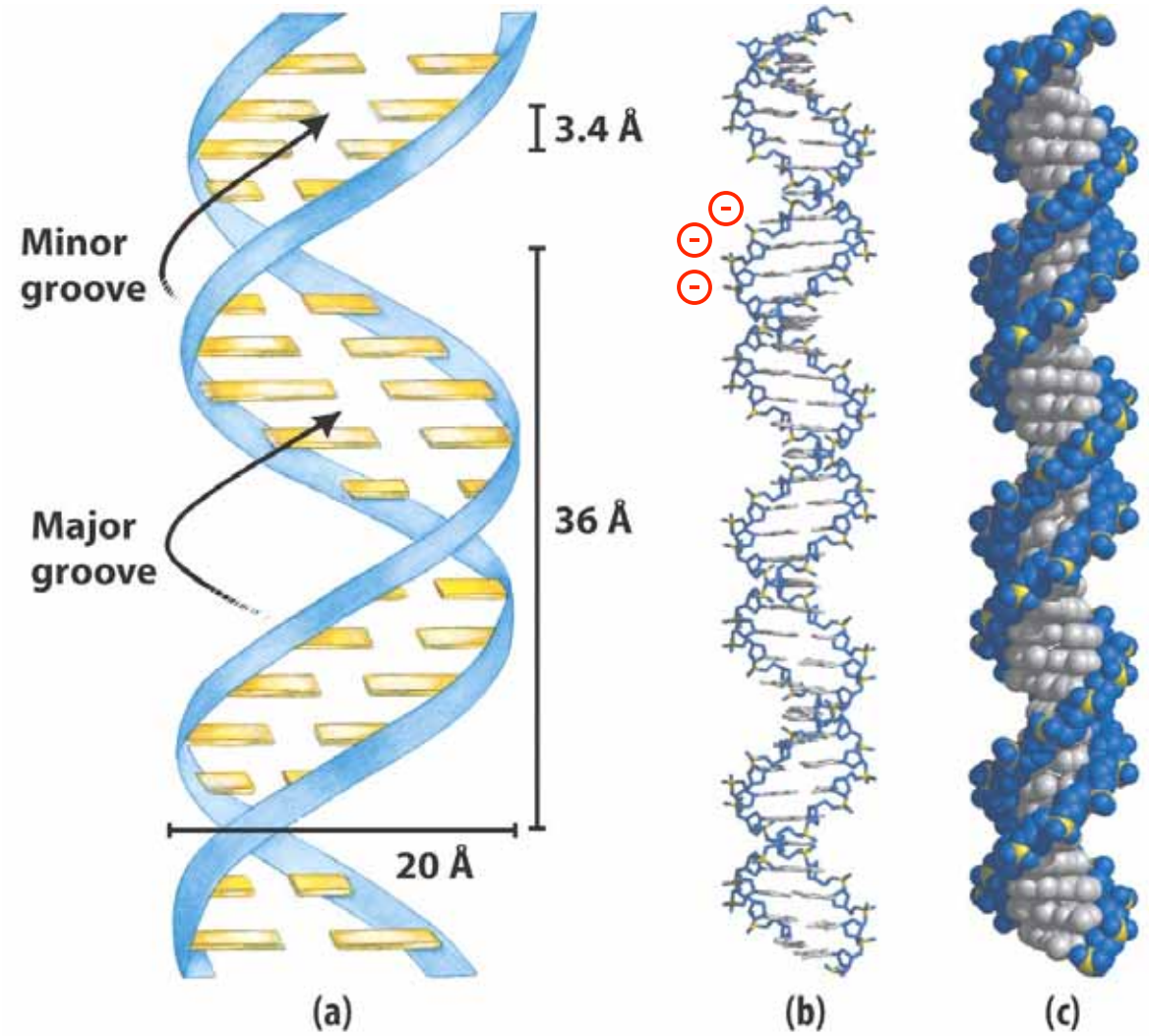
Eclipsed
Planar

Furanose Sugar Ring



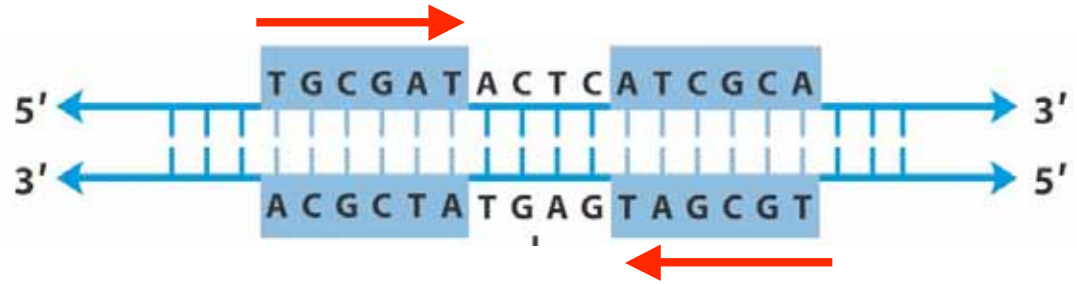
Duplex - An Ideal Structure

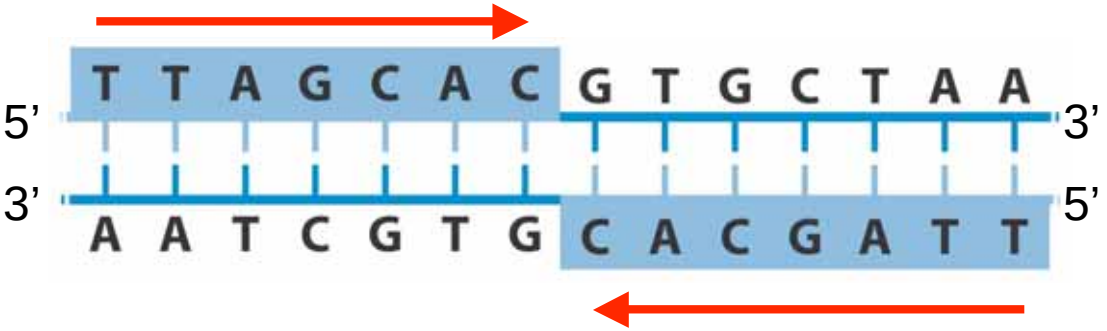
- Charges outside
- H-bonders pointing outside
- Aromatic faces buried
- Result:
  - Helix
  - Twisted
  - Major/Minor Grooves



Palindromes

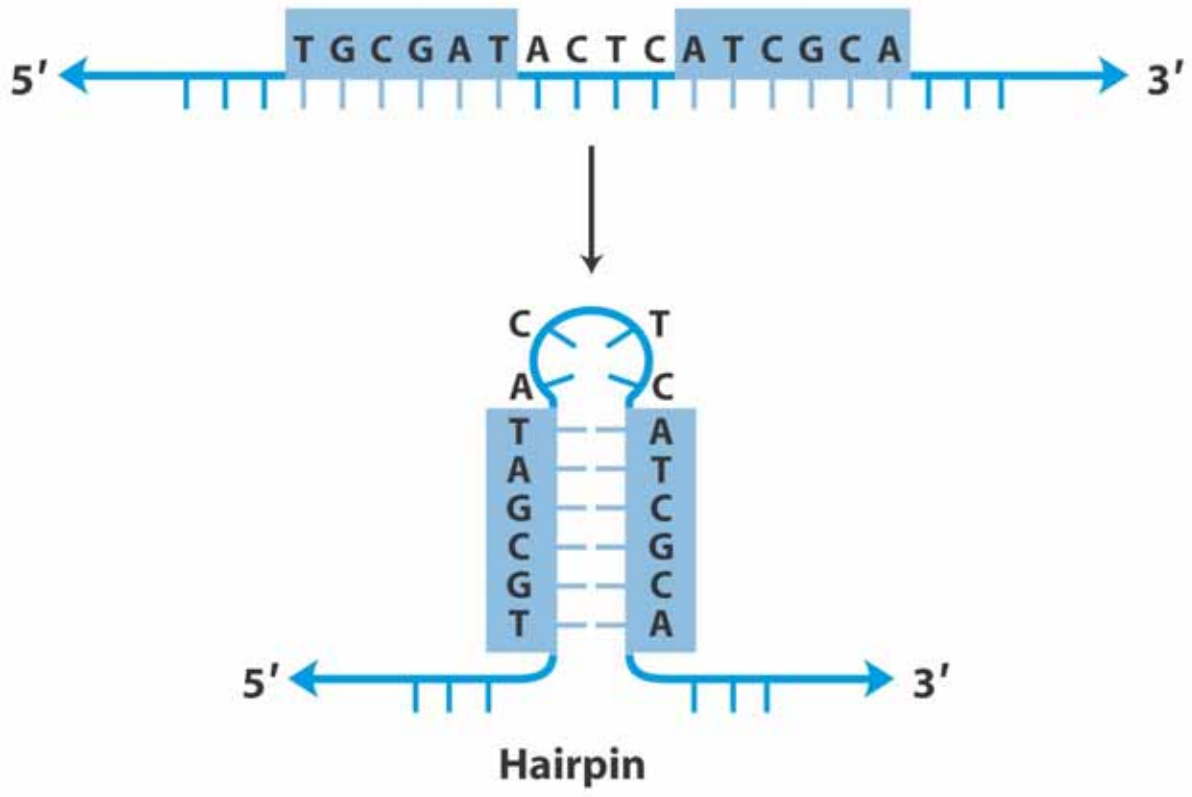
- Sequences reads the same 5’ to 3’ on either strand
- Yeah, so what?





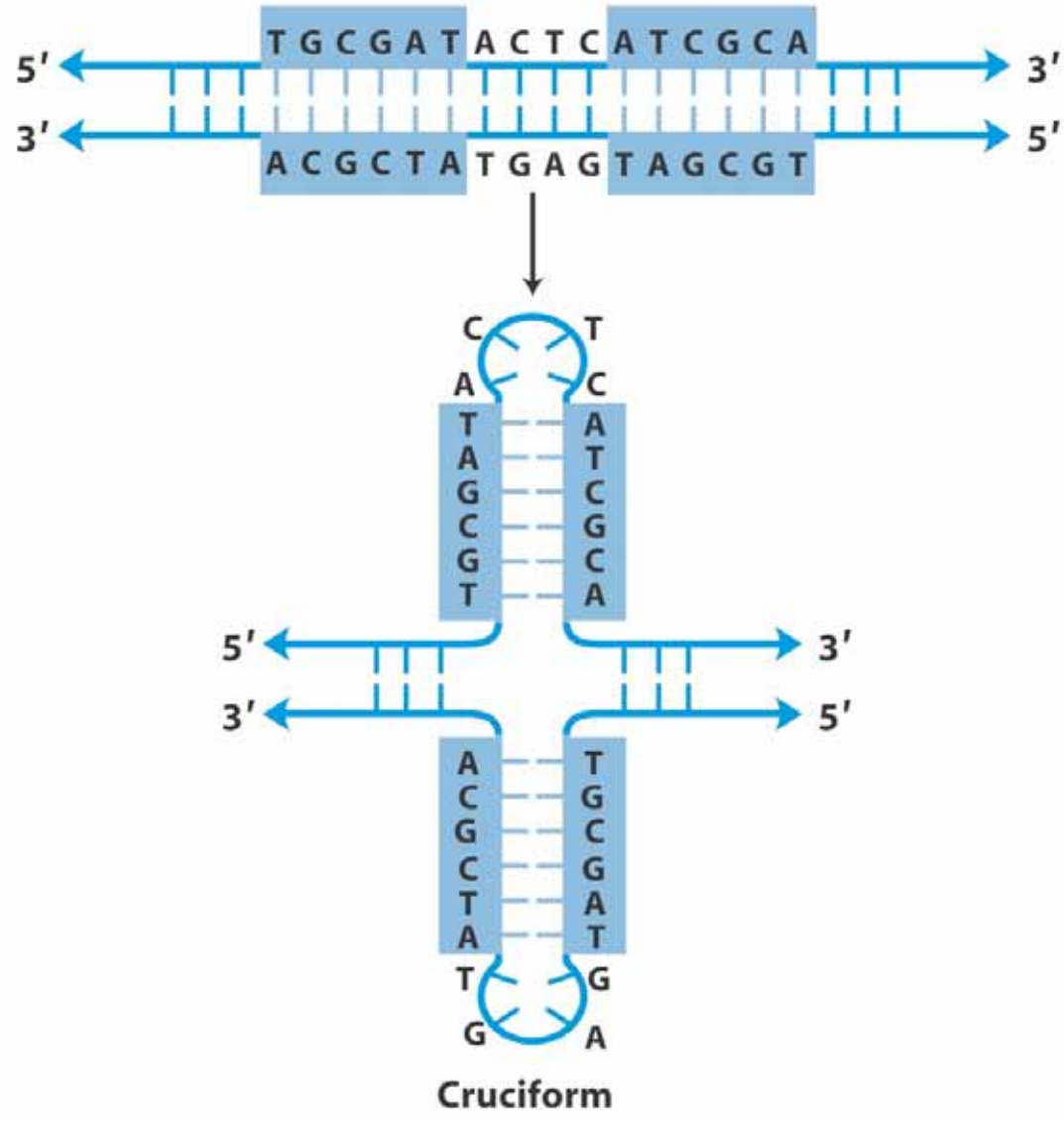
Palindromes

- Palindromic DNA/RNA can adopt alternate structures
  - Stem/hairpins
    - RNA structure



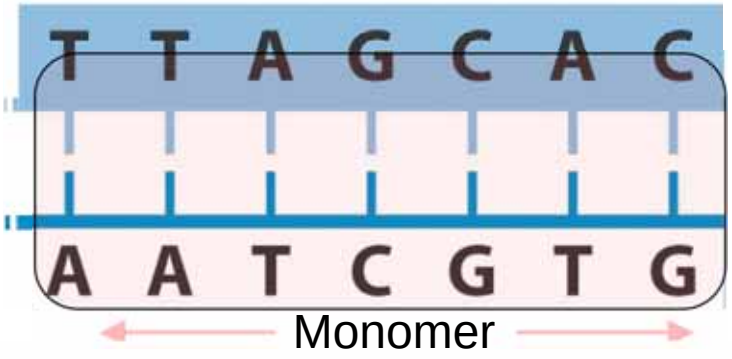
Palindromes

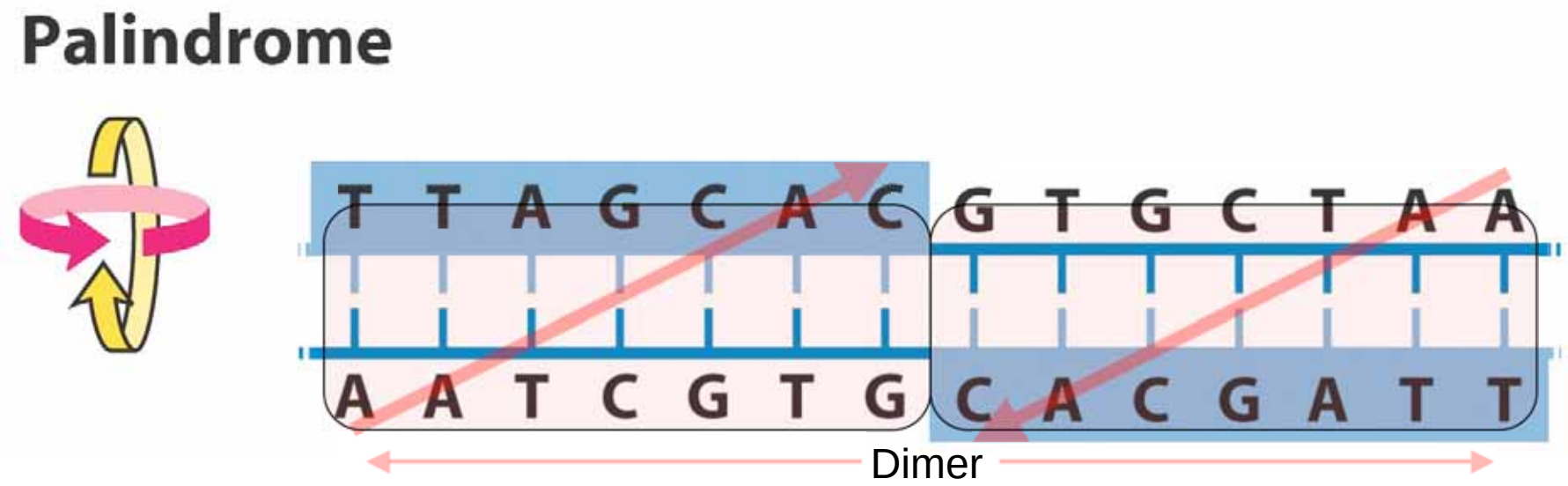
- Palindromic DNA/RNA can adopt alternate structures
  - Holliday junctions
    - Recombination



Palindromes

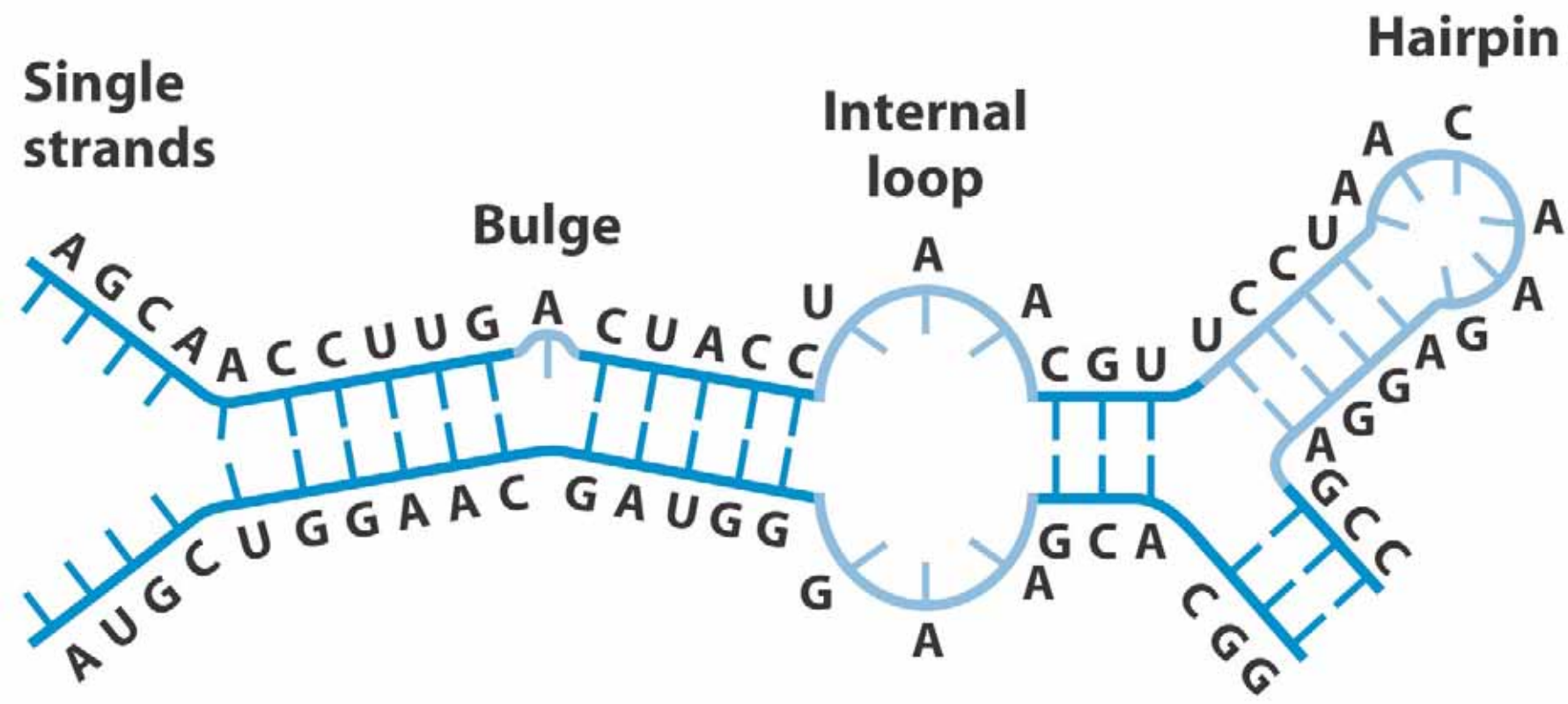
- Homodimeric proteins can recognize twice the monomor binding site, easily…





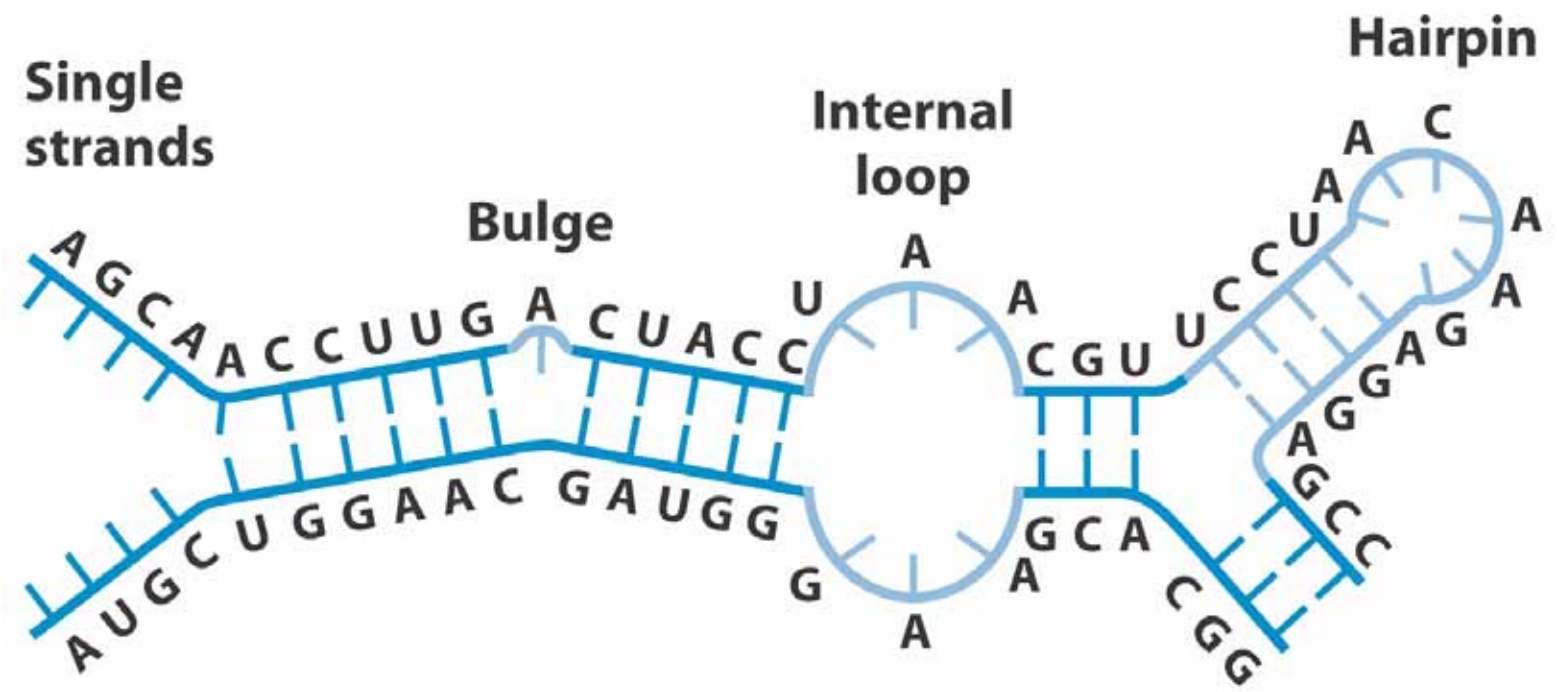
RNA Secondary Structure

- Common structural features



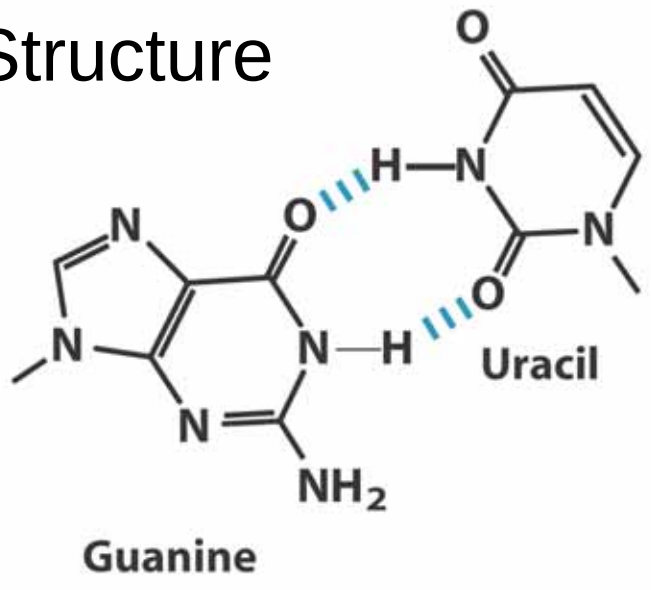
RNA Secondary Structure

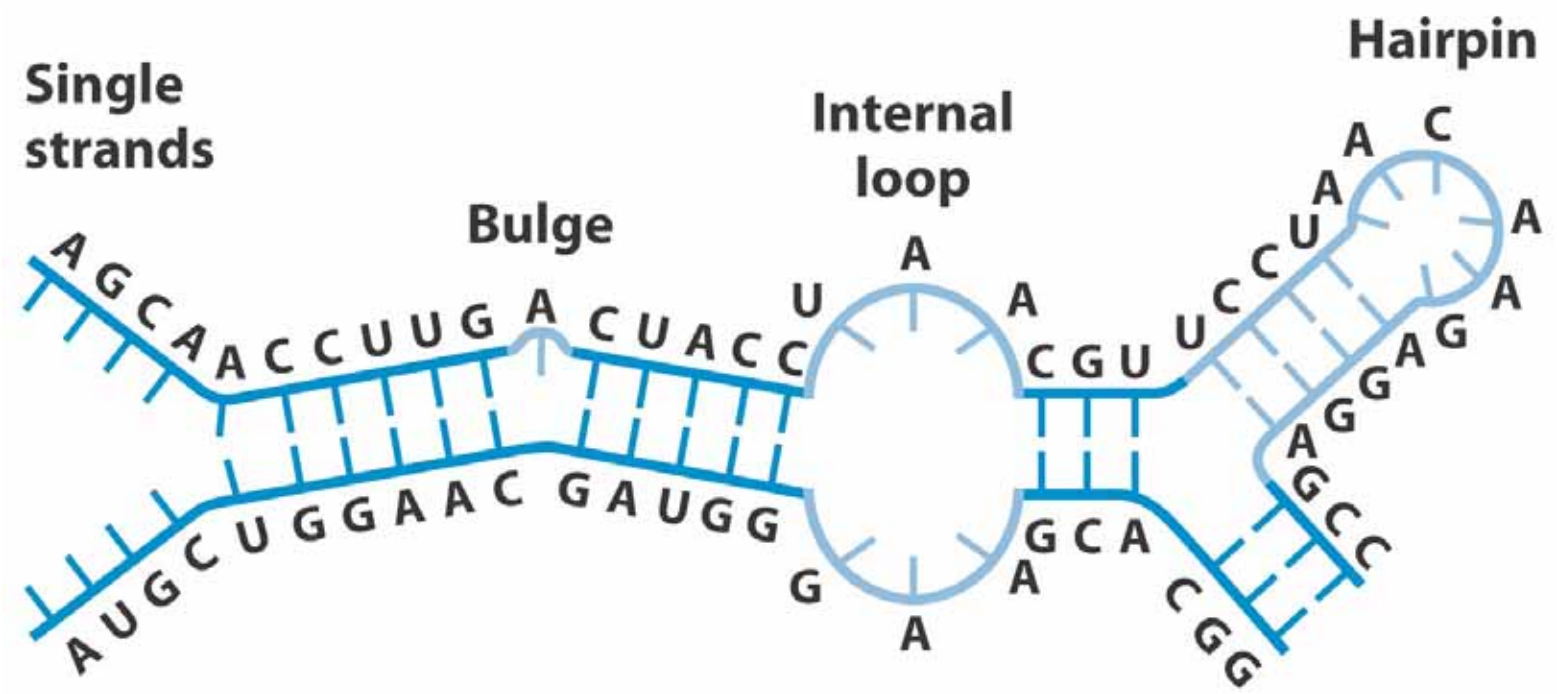
- Base stacking and pairing is maintained.



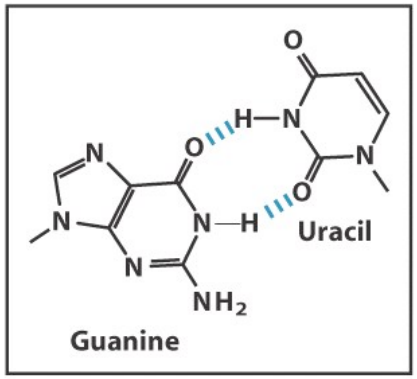
RNA Secondary Structure

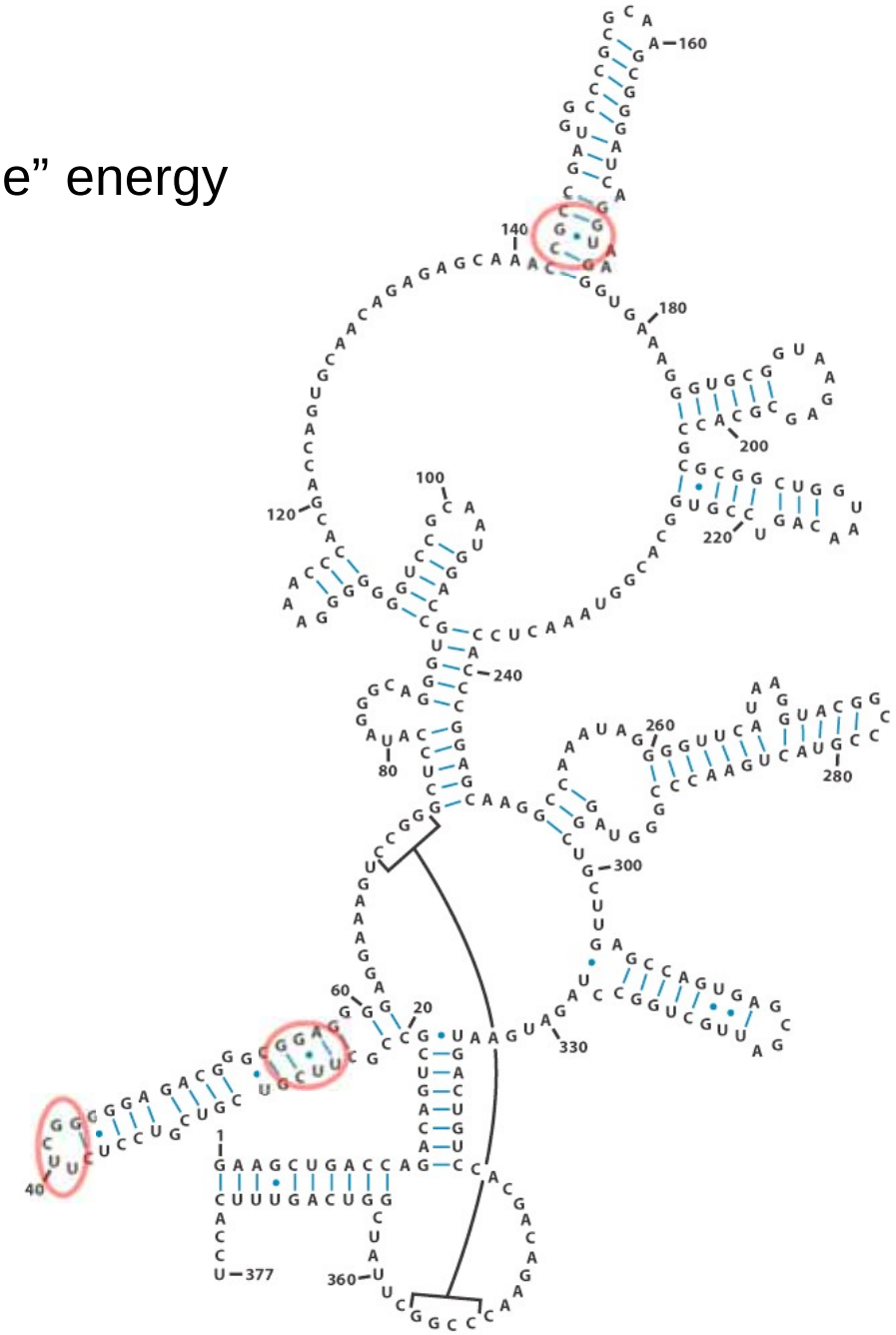
- GU Pairs are “reasonable” energy



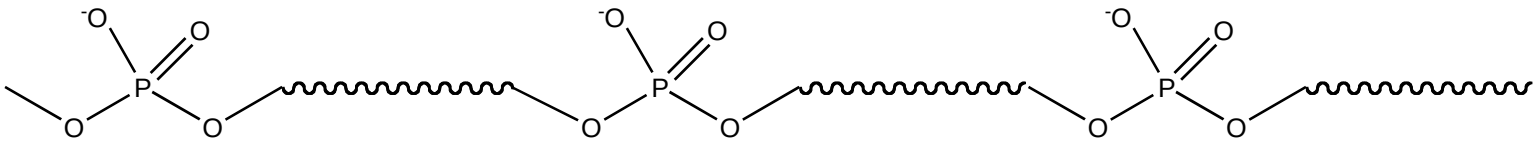


- GU Pairs are “reasonable” energy

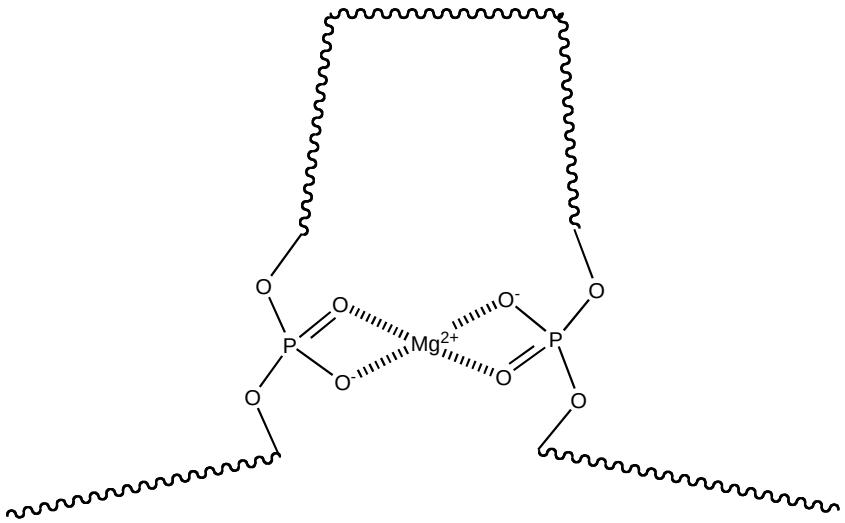




Tertiary Structure - Polyanionic RNA

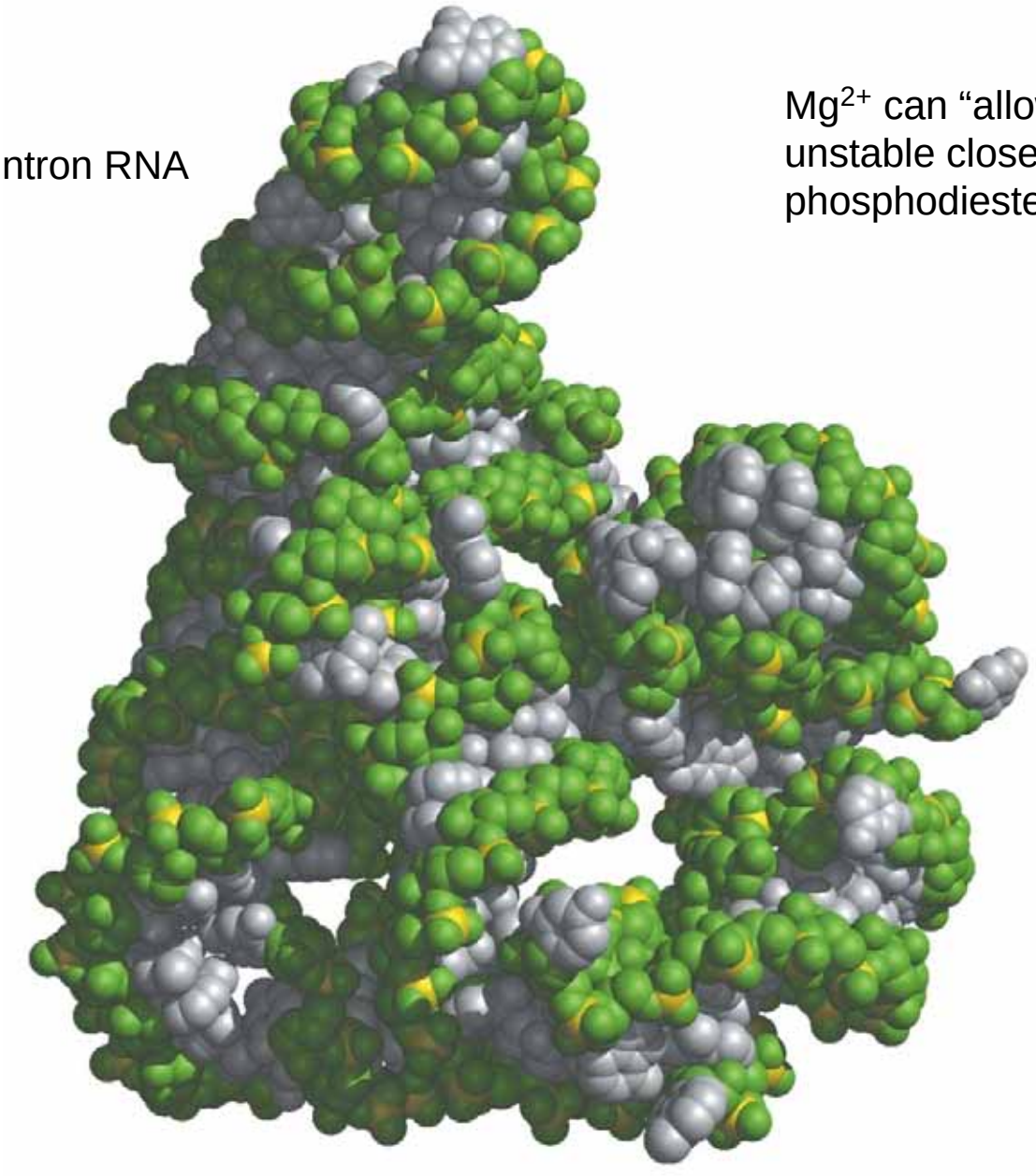


- Very water soluble
  - Charges need to be “outside”
- This limits size of folded structures
  - *Except* that Mg^{2+} can neutralize charge and allow larger folded structures



Tertiary Structure

Intron RNA



Mg^{2+} can “allow” otherwise unstable close approach of phosphodiester backbones

Tertiary Structure

tRNA