Chem 431A-L07-F'07
5 Oct; Friday
admin: Quiz2 ave=50%

Reminding you to do online quizzes.
How to go there:
www. whfreeman.com/lehninger/

register. Enter my email address:
gsantil@calstatela. edu

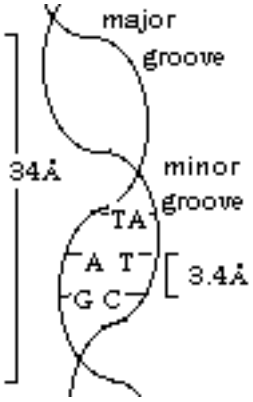
For chapt 1 AND 2 Deadline is
Wednesday 10/10/2007
11:59 pm PDT

Last time: Chargaff's rules: (Chargaff & coworkers, late 1940's, Columbia U.made observ'ns on nature & structure of DNA:
1) The base composition of a species is constant: %A,G,C& T is same for members of a species. A/G=1, C/T=1
2) Different species have different base compositions.
3) In a given species, the base composition does not vary with the age of the organism, its nutritional state, or changes in the environment
4) The mole % of A = mole % of T ; mole % of G= mole % of C ;(Purine/pyrimidine= 1)

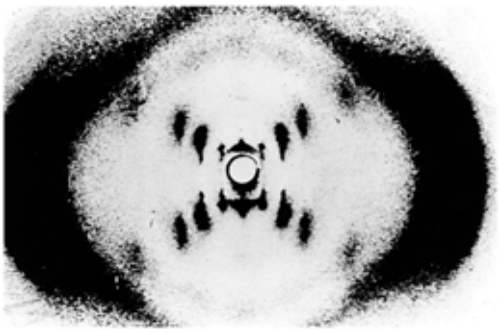
There were other structural clues as to its structure: Xray diffraction studies showed that DNA fibers have two periodicities alont their long axis. 3.4 Å and 34 Å.

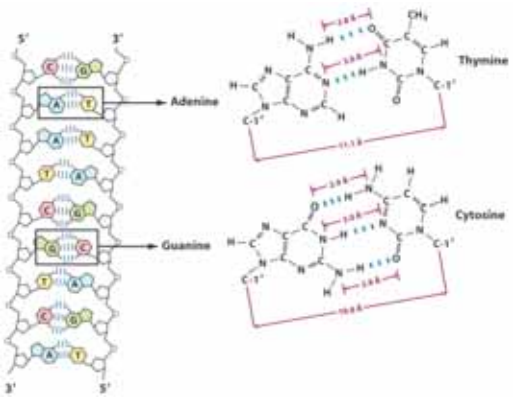
The X-ray diffraction data was collected by Rosalind Franklin, This was interpreted as being the diffraction coming from a helical molecule. Most of the elucidation of the structure of DNA came from model building studies. now known as <u>B-DNA</u> (ond of the various forms that DNA can take.

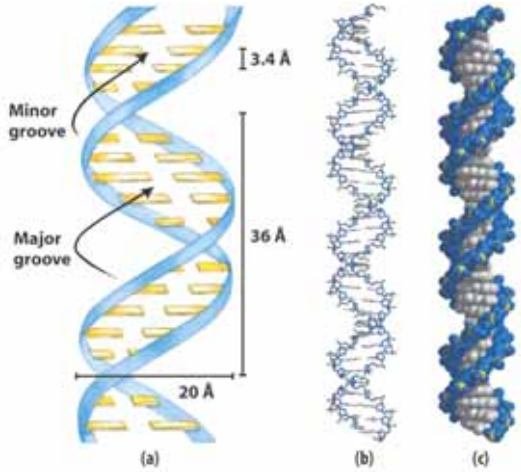
This is the 2° structure of DNA.

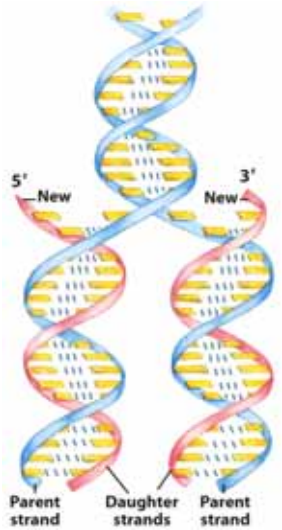


The features of the double stranded (duplex) DNA:
- helical with 2 DNA strands coiled around same axis to form a <u>right handed</u> double helix in which 2 chains are <u>antiparallel</u> (5',3' phosphodiester bridges running in opposite directions).
- strands held together by H bonds between bases (separated by 3.4Å) and by hydrophobic interxns which put polar phosphate groups and sugars on the outside interacting with aqueous environment.
- H-bonds specific between A & T and G & C. Thus molar equivalence of these groups as observed by Chargaff.
- <u>double helix</u> that has a pitch of 34Å,ie 10 bp per turn - *on average*..(actually varies as the sequence).



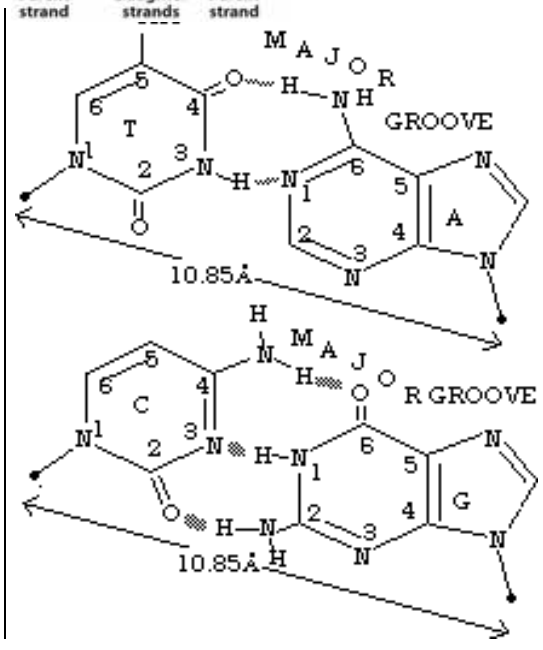






These paired base structures profoundly influenced the course of biology: immeidately suggested how genetic information is stored and even how it can be faithfully replicated.

Essential features:
a) 2 polynucleotide chains running in opposite directions around a common axis to form a right-handed double helix.
b) Bases are on the inside, phosphate and deoxyribose sugars outside (slightly tilted)
c) Pairing is by precisely directed H-bonds. A=T (2 bonds) , G∫ C (3 bonds)



Helix has 2 grooves which are not the same. It is not symmetric. Groove in which C(1')-helix axis-C(1') <180° is the *minor* groove. Other groove is *major* groove.

We note that GA pairs are too big to fit into the helix. TC pairs are too small to fit into the helix. How about the AC pair? It would not fit. If you want to practice it yourself, try it and see what you'll get.

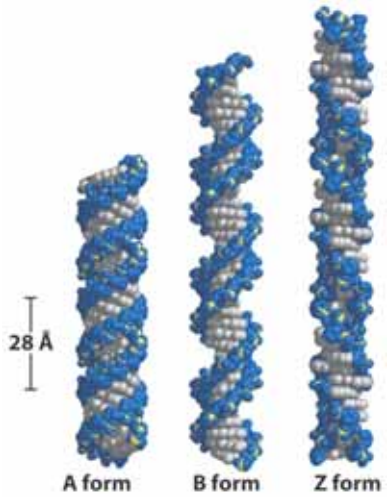
The helical twist per base pair ranges from 28-42°. There is also the presence of the "propeller twisting" (twisting in opposite directions about the base pair's axis. And also some base pair roll (tilting of the bp as a whole about its axis). It appears that this deviation is sequence-specific and may be very important in the ability of some DNA-binding proteins to bind in a sequence-specific manner.

Real DNA apparently deviates from B-DNA. It was found by Dickerson and Drew by X-ray crystallography of dodecamer, d(CGCGAATTCGCG). that indeed the dodecamer crystallizes in the B-DNA form with an average helical rise per residue of 3.4 Å and an average of 10.1 bp per residue. The average twist per base pair is 35.5°. The deviation from the ideal double helix makes DNA irregular *in a sequence specific manner*:

Another type of change occurs when the humidity of a DNA prep is lowered to 75% humidity. It shifts to A-DNA. Segments of DNA in vivo may assume the A conformation. Another more different form has been shown to be possible: Z-DNA (stabilized at high salt for the double helix of the self complementary segment: d(CGCGCG). The presence of Z-DNA has been shown in Ecoli. Its function is not known.

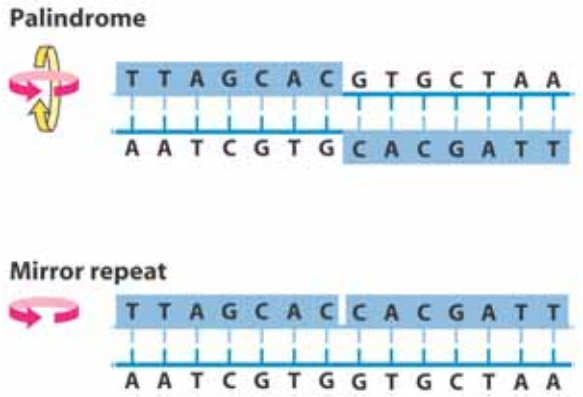
We summarize the various forms of DNA in the table below:

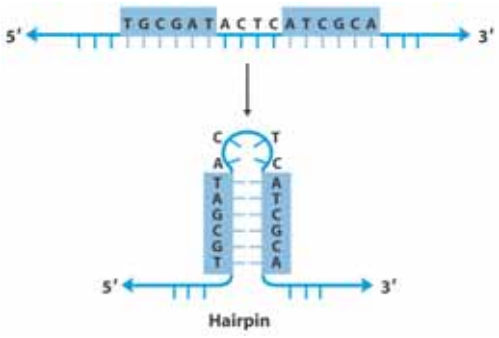
	A	B	Z
Helix sense	right-handed	right-handed	left-handed
residues/turn	11	10	12
rise per residue	2.55	3.4	3.7Å
conditions:	high humidity	low humidity	high salt conc

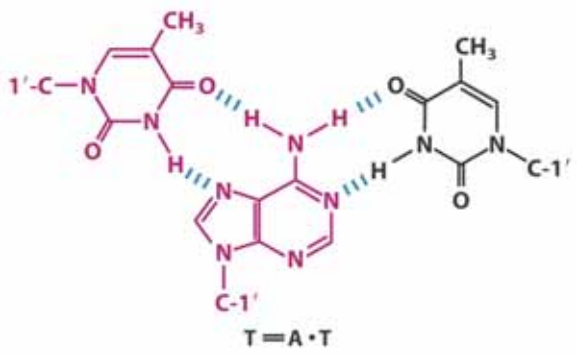


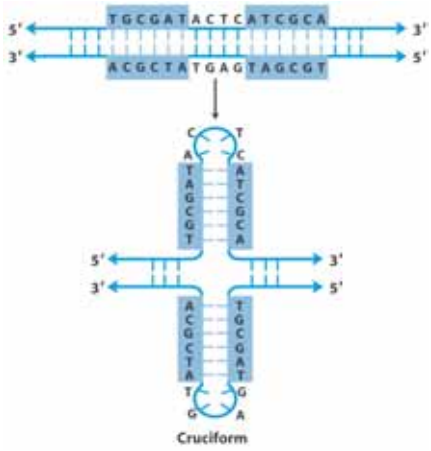
2 types of nucleic acids: RNA and DNA : show the overhead - polymeric difference is in the ribose group of the molecule their linkage is via phosphate group = phosphodiester linkage	RNA can't assume B-DNA conformation because of steric hindrance involving the -OH at 2' position. But it can take conformation of A-DNA (ie "A-RNA" or RNA-11). rRNA and tRNA contain complementary sequences that form double helical stems. Hybrid double helices, which consist of one strand each of RNA and DNA, also have an A-DNA-like conformation.

Palindromes and the 3 –dimentional
Structure of RNA and DNA









Can have triplex or even 4-plex
DNA (Hoogsteen pairing)

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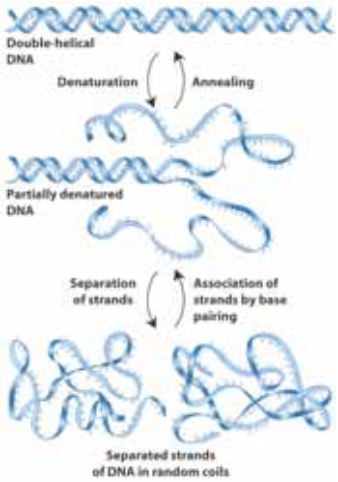
What happens to double stranded (ds) DNA in vitro when it is subjected to disruptive environmental factors like heightened temperatures:
native DNA (double helix)—> random coil



This process can be reversed ("renaturation") as long as there is about 12 residues or more still connected in the double helix. Cooling must be slow. to allow the strands to "anneal" and form the duplex. The melting temperature

is defined below. It is affected by the %GC content due to the greater H-bonding of GC vs AT base pairs.