



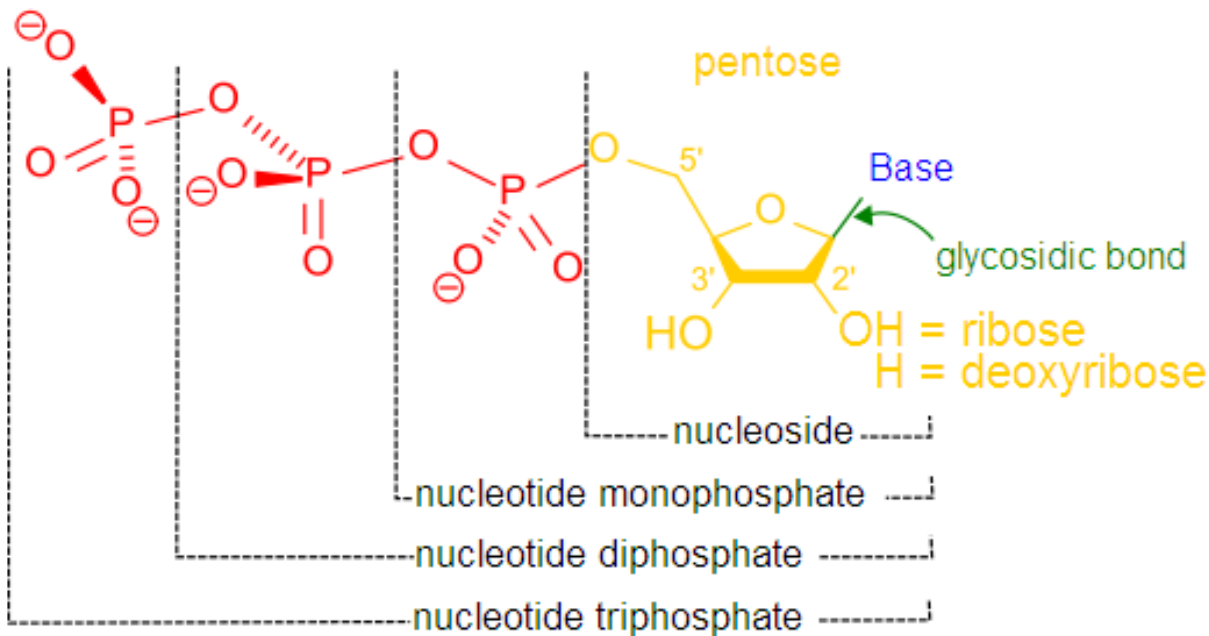
Biological Building Blocks IV

Dr. James Hebda

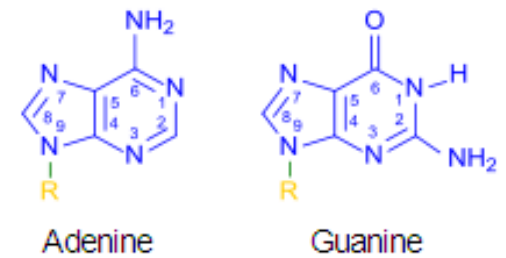
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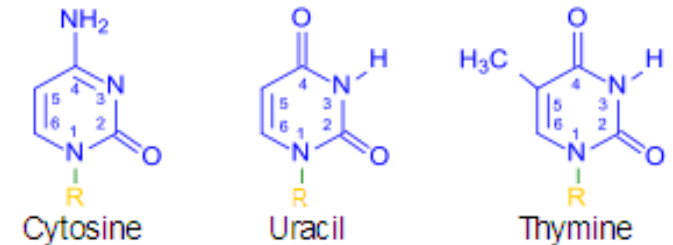
Fundamental Pieces of a Nucleotide



Purines



Pyrimidines



Organic Chemical Groups

Functional group	Class of compounds	Structural formula	Example	Ball-and-stick model
Hydroxyl -OH	Alcohols	R-OH	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ Ethanol	
Carbonyl -CHO	Aldehydes	R-C(=O)H	$\begin{array}{c} \text{H} \quad \text{O} \\ \quad // \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$ Acetaldehyde	
Carbonyl >C=O	Ketones	R-C(=O)-R	$\begin{array}{c} \text{H} \quad \text{O} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$ Acetone	
Carboxyl -COOH	Carboxylic acids	R-C(=O)OH	$\begin{array}{c} \text{H} \quad \text{O} \\ \quad // \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ \\ \text{H} \end{array}$ Acetic acid	
Amino -NH2	Amines	R-NH2	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{N}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$ Methylamine	

What
fundamental
Groups Are there
in a NUCLEIC
ACID?

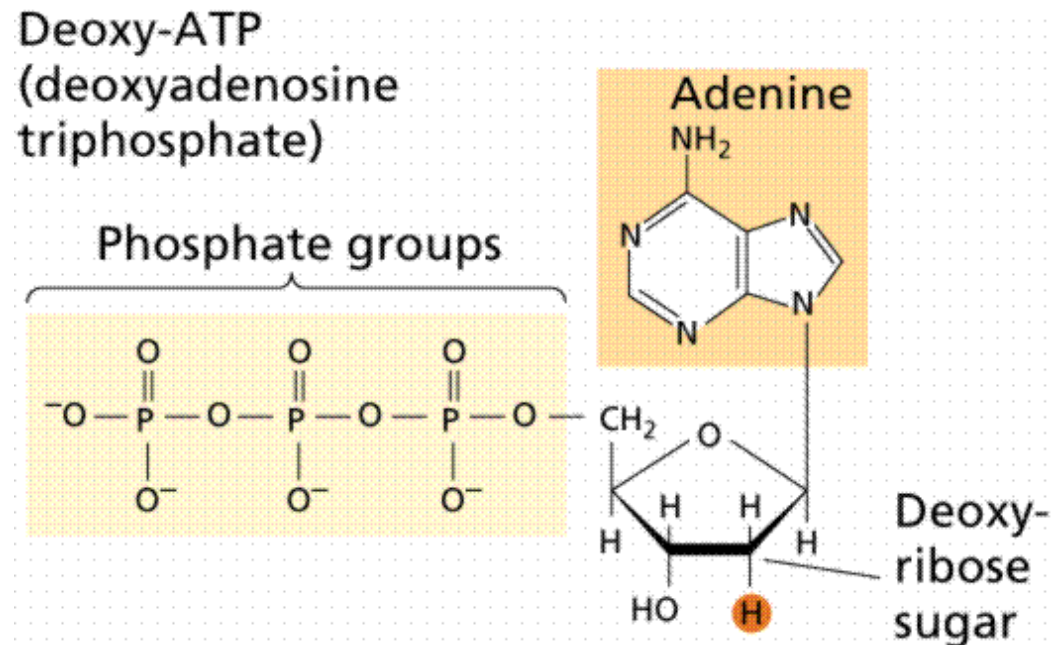
Building Block of DNA: Nucleotide

DNA:
deoxyribonucleic acid

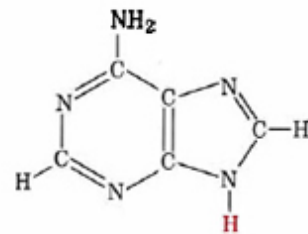
Where is the deoxy?

Where is the nucleic base?

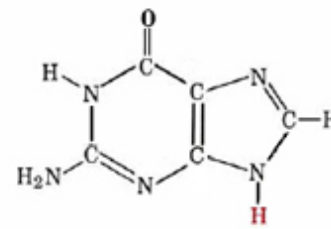
Where is the acid?



The purine and pyrimidine bases

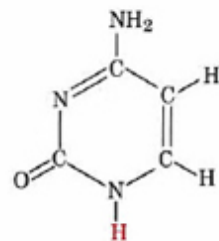


Adenine (A)
(DNA and RNA)

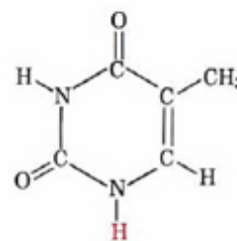


Guanine (G)
(DNA and RNA)

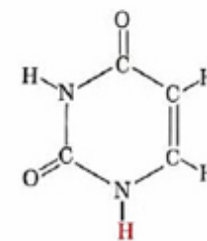
Purines



Cytosine (C)
(DNA and RNA)



Thymine (T)
(DNA only)



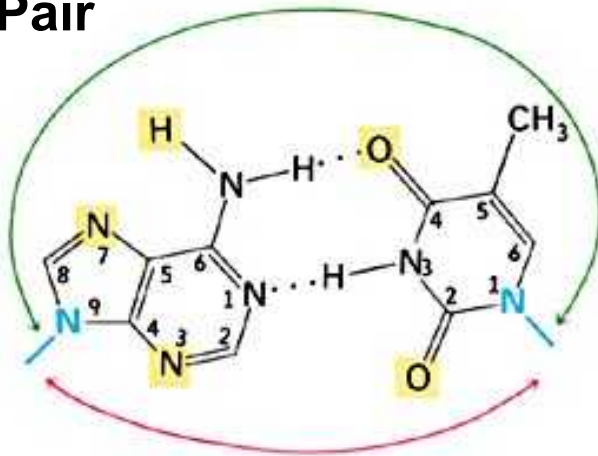
Uracil (U)
(RNA only)

Pyrimidines

How do base pairs interact with one another?

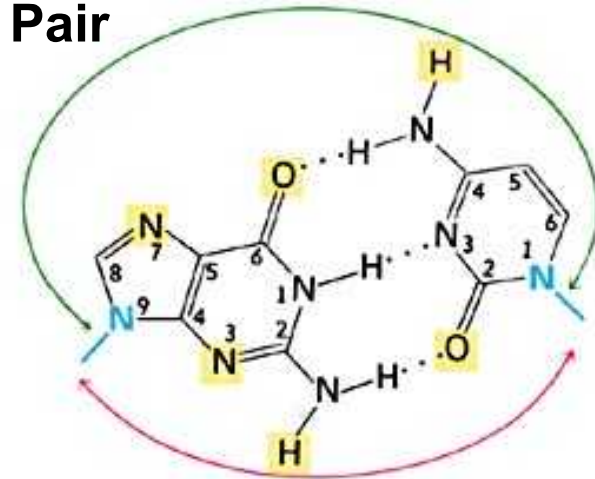
Weak Hydrogen Bonds: (___ kJ/mole)

AT Watson-Crick Base Pair



AT has two H bonds

GC Watson-Crick Base Pair



GC has three H bonds



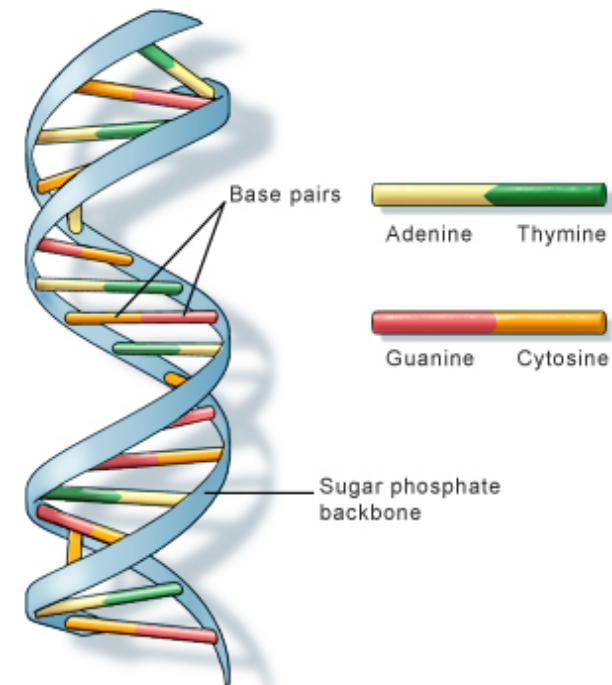
What is a hydrogen bond?

- Weak bond \sim nearly 1/100 the strength of a real covalent bond.
- Forms between three atoms X-H---Y, where X and Y are atoms that are more electronegative than H (usually or).
 - X is bound covalently to H, and pulls the electrons in the bond towards itself.
 - This makes the H slightly positive.
 - Y then interacts with the slightly positive H to form a weak association



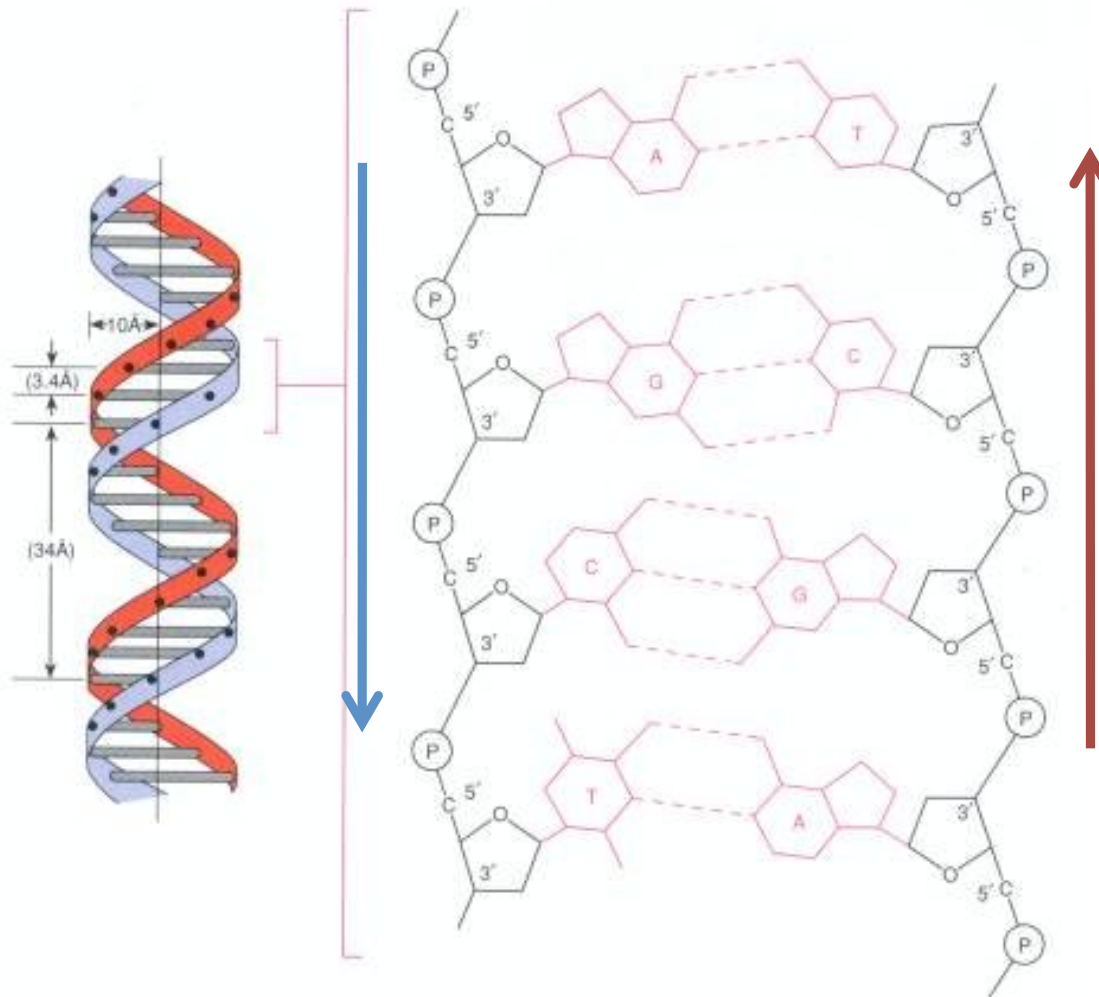
Double stranded DNA helix (ds DNA)

- The strands are made up of _____ sugars that run in anti parallel fashion
- The nucleic bases point towards the center
 - A on one strand H-bonds with T on the other
 - G on one strand H-bonds with C on the other
- The _____ groups are on the outside



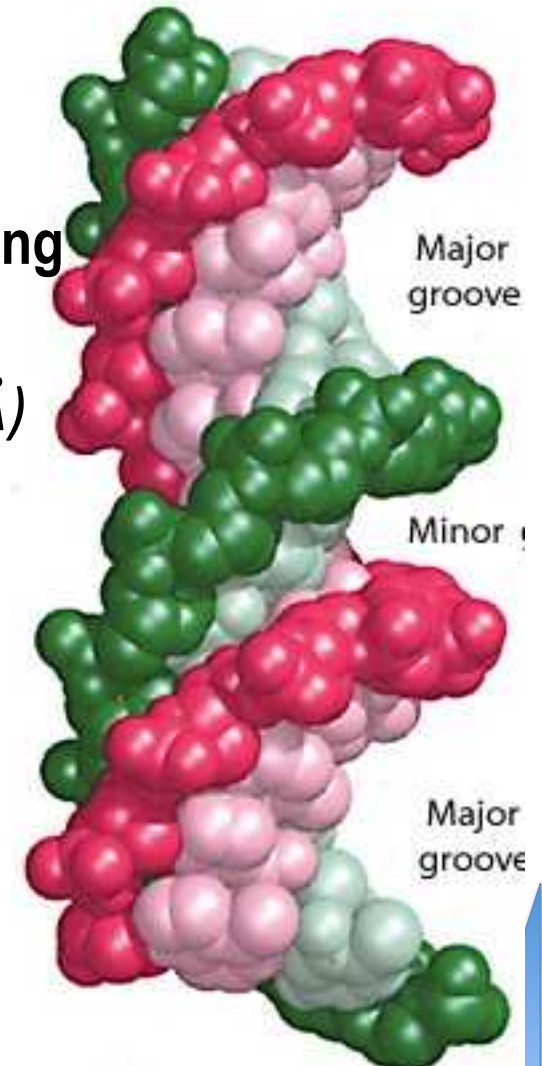
U.S. National Library of Medicine

How do you put together a DNA duplex?



What Does a Protein “see” in DS DNA?

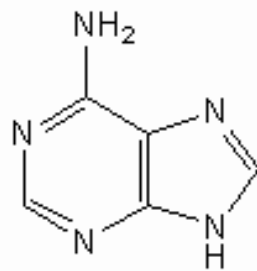
- “Reading” the major and minor groove
 - Grooves are lined by sequence specific H-bonding groups
 - _____ Groove deep (8.5 Å) & wide (11.5 Å)
 - _____ Groove (7.5 Å) & narrow (4.5 Å)



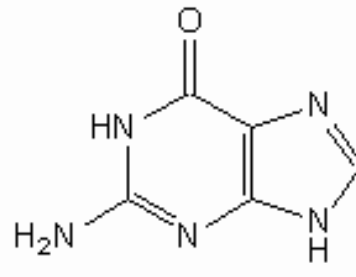
What nucleic acid bases do you find in RNA?

Adenine Guanine Cytosine Uracil

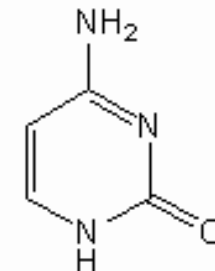
Nucleoside bases found in RNA:



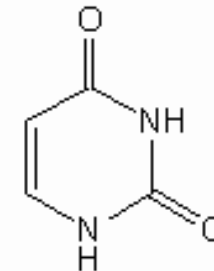
adenine (A)



guanine (G)

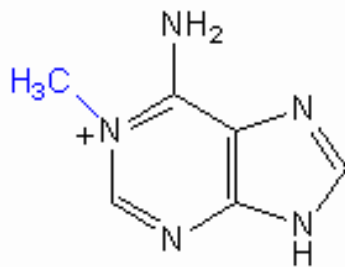


cytosine (C)

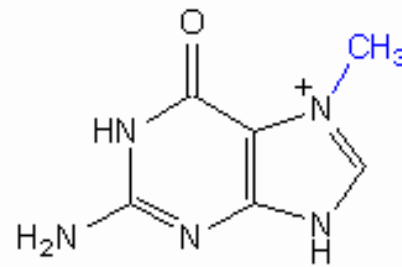


uracil (U)

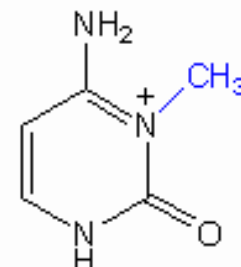
Examples of modified bases found in tRNA:



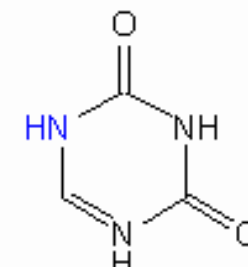
1-methyladenine (m¹A)



7-methylguanine (m⁷G)



3-methylcytosine (m³C)



pseudouracil (Ψ)