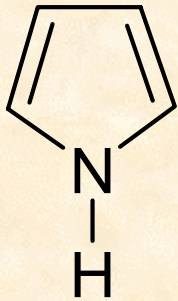
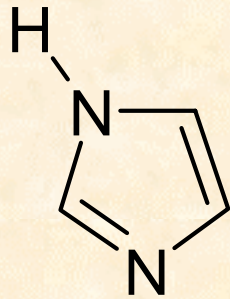


Chemie der Nukleinsäuren

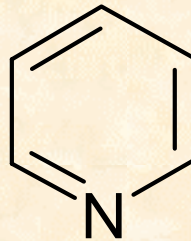
1. Eigenschaften von N-Heterocyclen



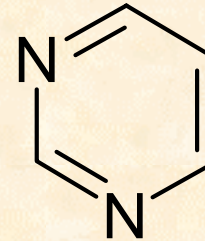
Pyrrol
(Azol)



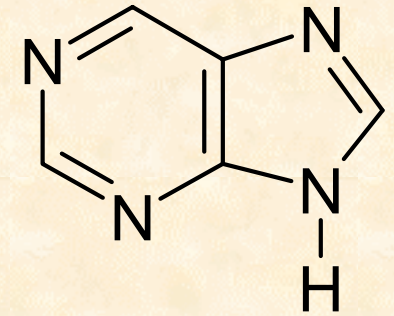
Imidazol
(1,3-Diazol)



Pyridin
(Azin)



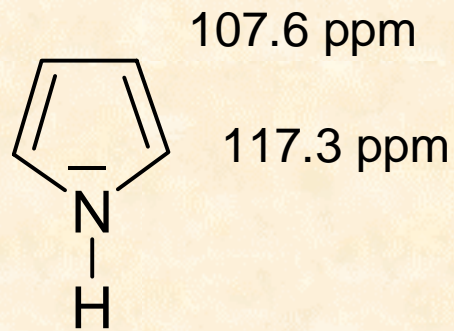
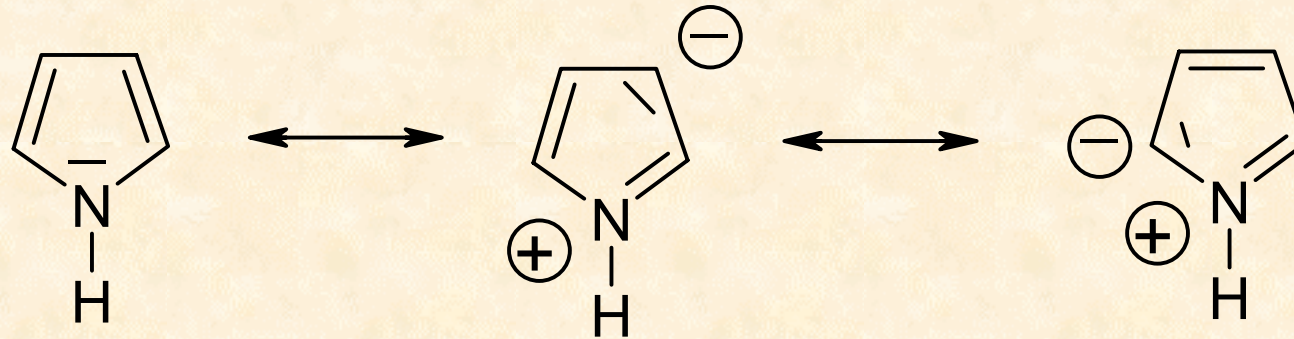
Pyrimidin
(1,3-Diazin)



Purin

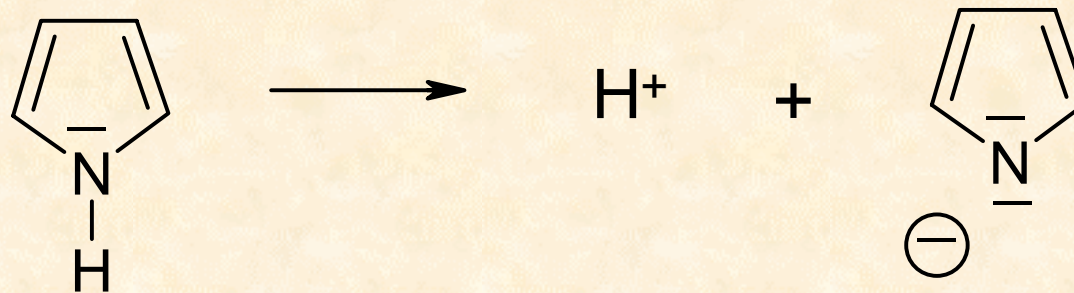
Pyrrol

Pyrrol: Aromat (6 π -Elektronen)

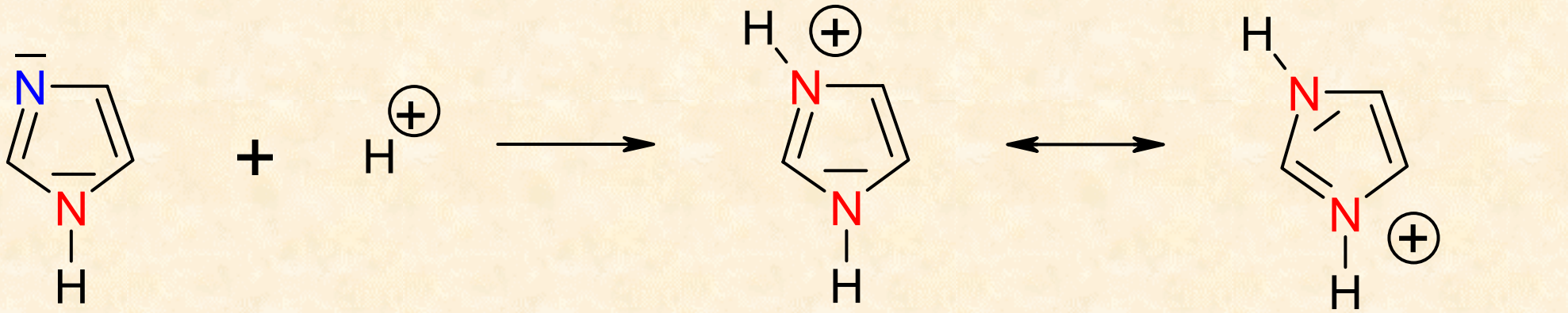


Mesomere Formeln:
Elektronenreicher Aromat

N: kein Basencharakter

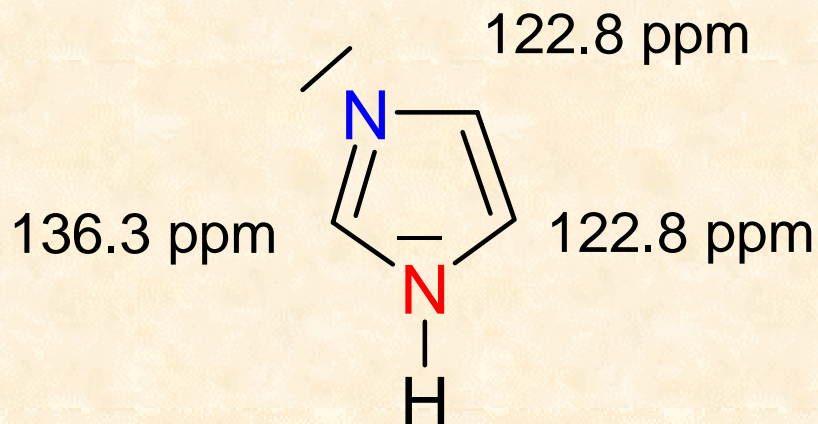


Imidazol

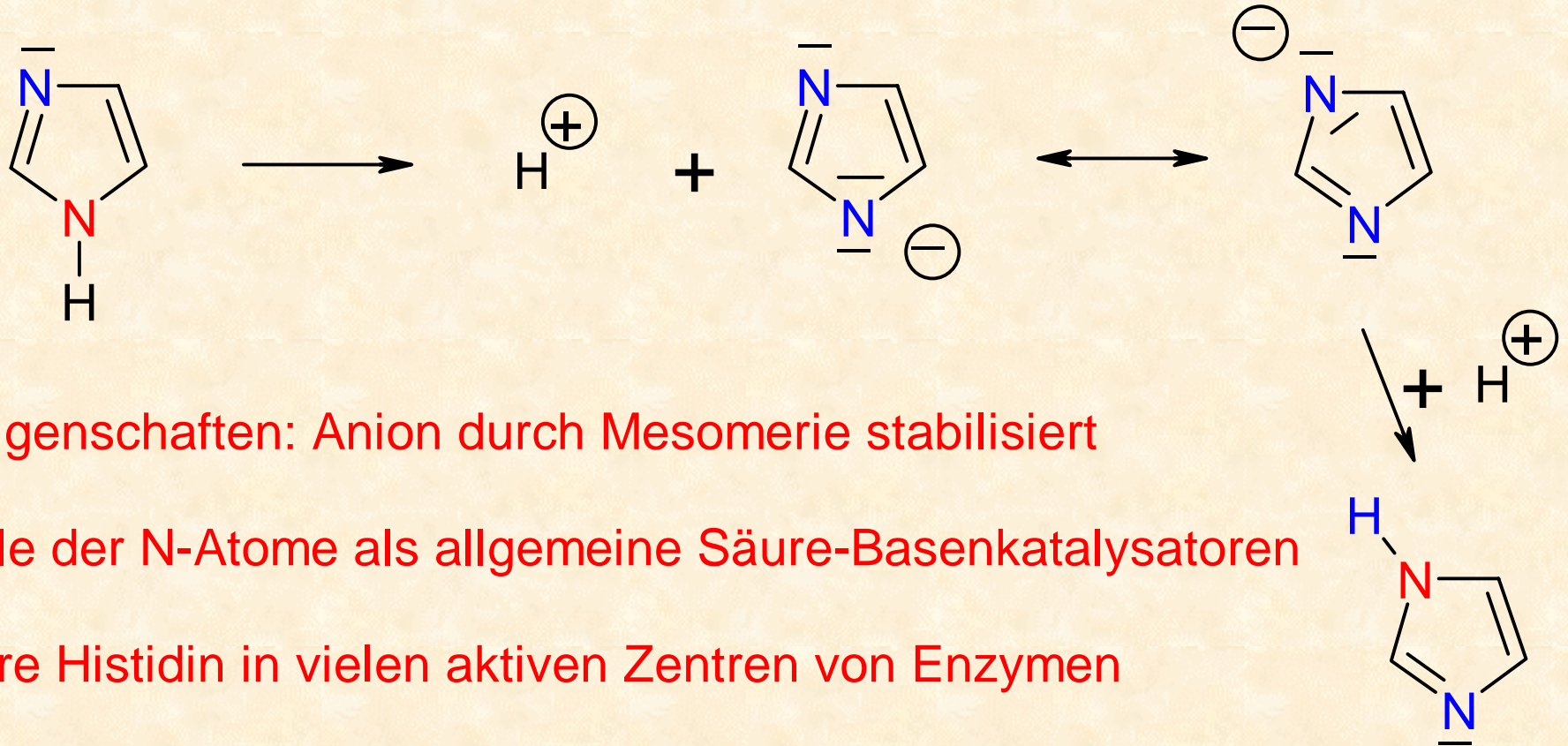


1. Basen-Eigenschaften: Kation durch Mesomerie stabilisiert

pK_B 7.0



Imidazol



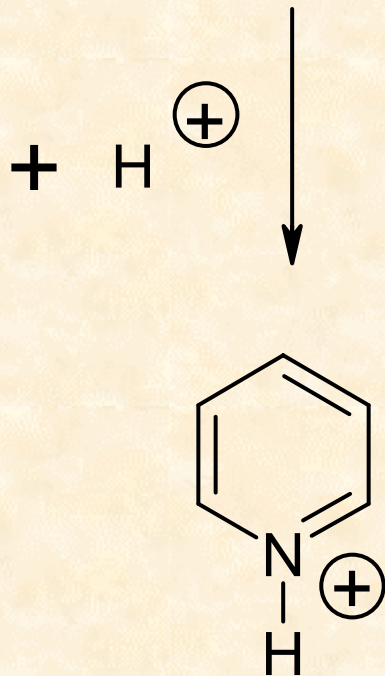
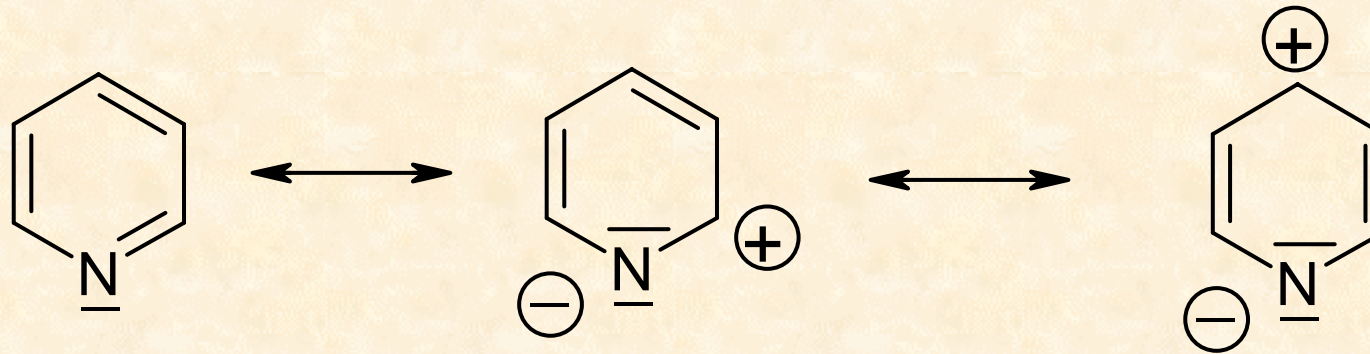
2. Säureeigenschaften: Anion durch Mesomerie stabilisiert

Duale Rolle der N-Atome als allgemeine Säure-Basenkatalysatoren

Aminosäure Histidin in vielen aktiven Zentren von Enzymen

Pyridin

Pyridin: 6 π -Elektronen

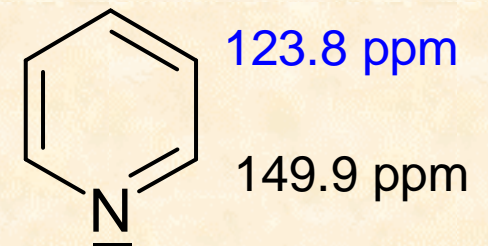


Mesomere Formeln:
Elektronenarmer Aromat
(höchste El. Dichte: *m*-Position)

N: schwacher Basencharakter

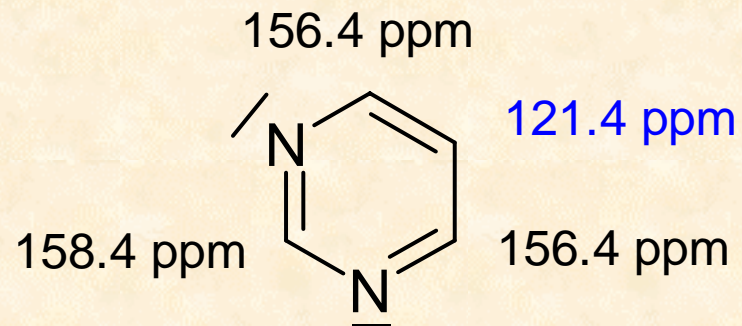
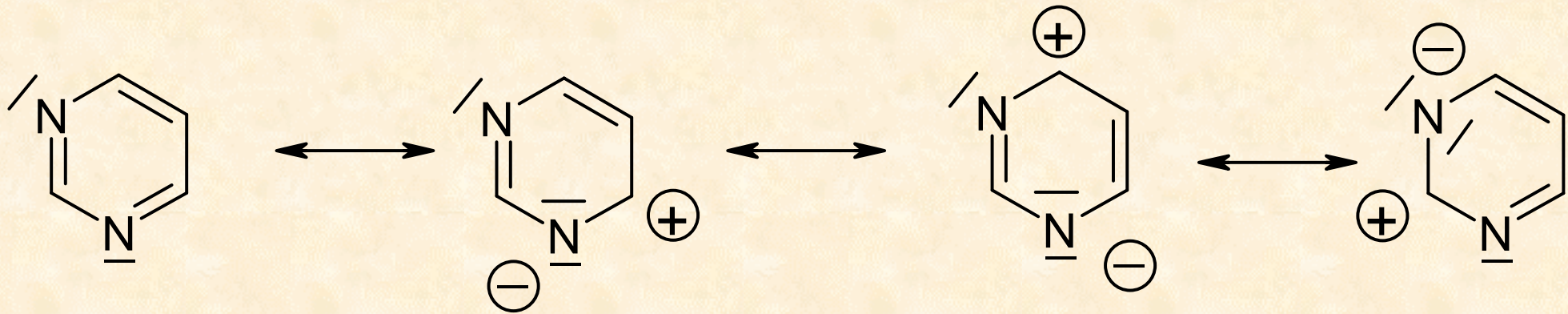
pK_B : 8.7

136.0 ppm



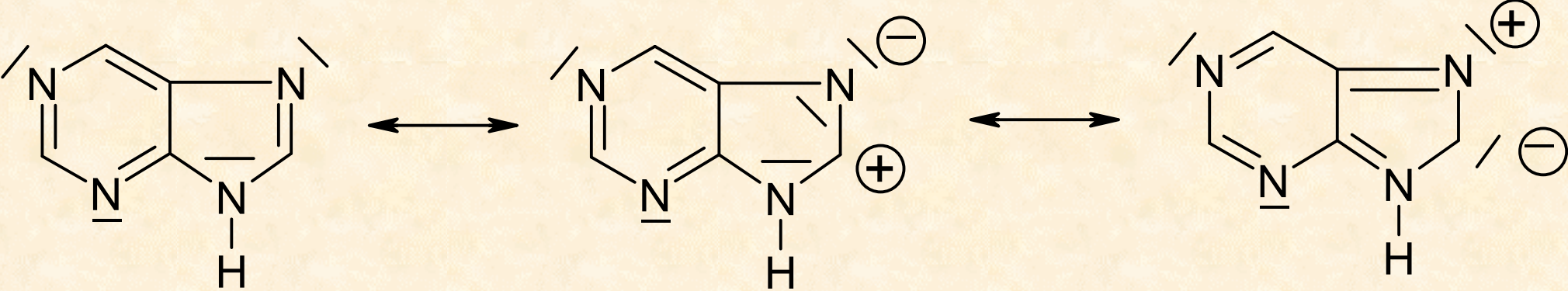
Pyrimidin

Pyrimidin: 6 π -Elektronen

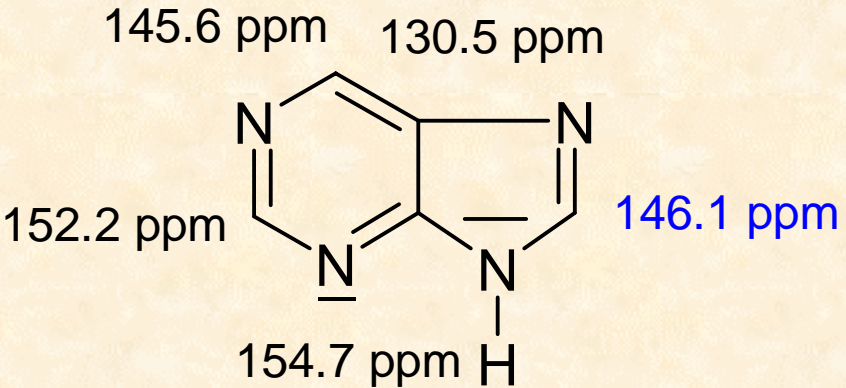
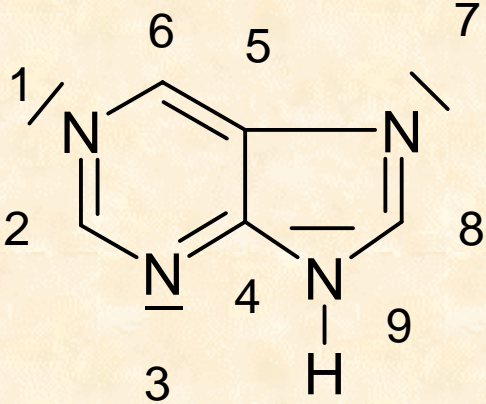


Aromat. Charakter herabgesetzt
5-Stellung relativ elektronenreich

Purin

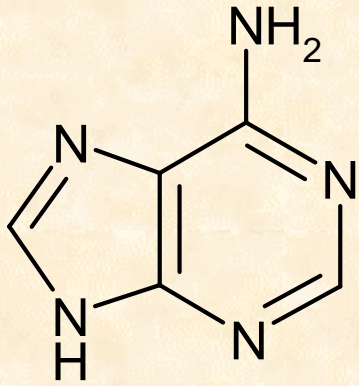


Aromat. Charakter herabgesetzt
8-Stellung relativ elektronenreich

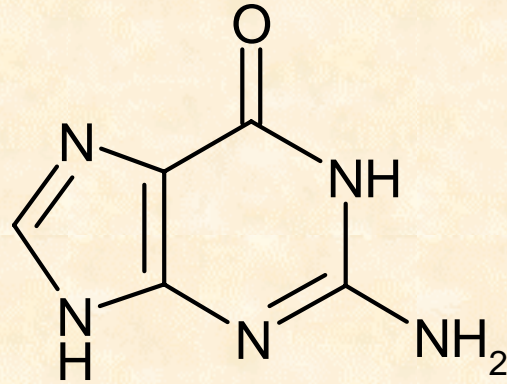


Die N-Basen von DNA und RNA

Purin-Basen

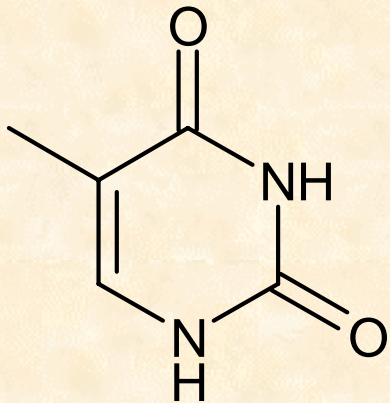


Adenin

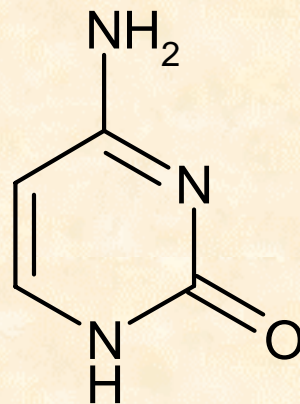


Guanin

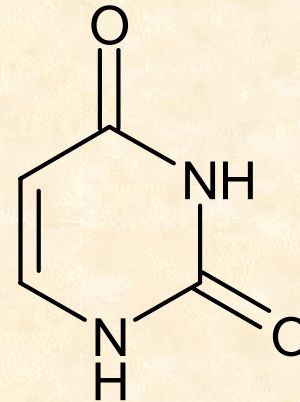
Pyrimidin-Basen



Thymin

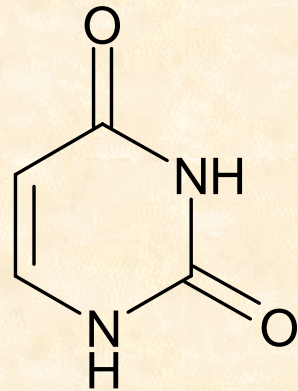


Cytosin

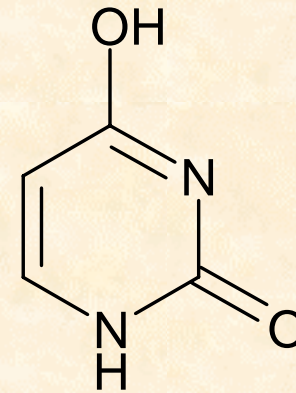
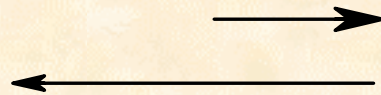


Uracil

Lactam-Lactim Tautomerie

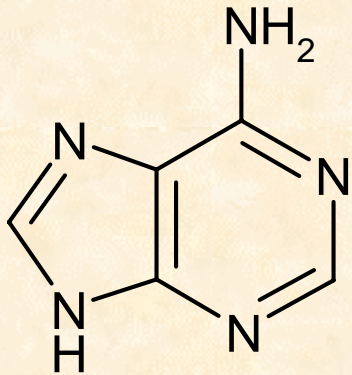


Uracil: Lactamform

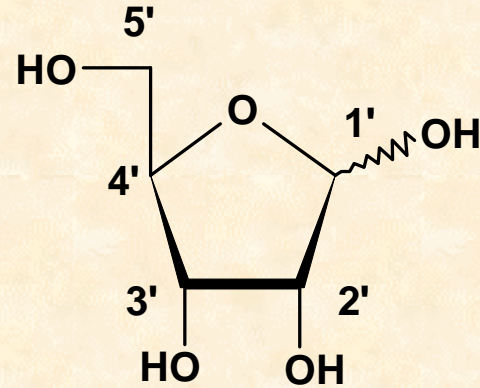


Lactimform

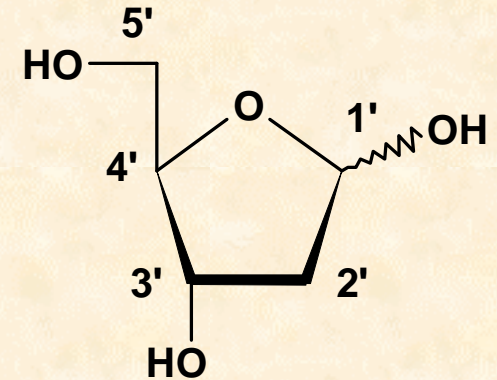
Nucleoside: N-Glycoside der N-Basen



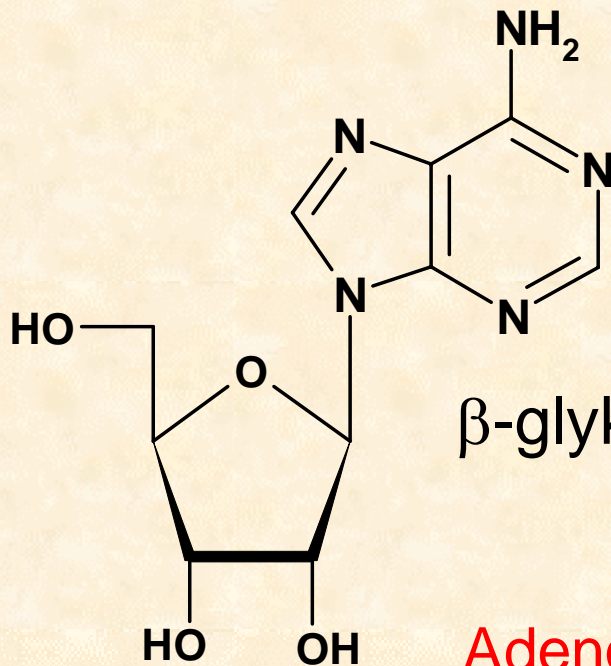
Adenin



Ribose
(Furanose)



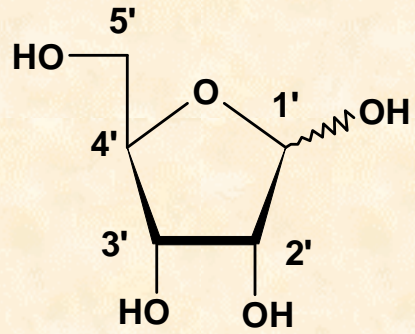
2'-Desoxyribose
(Furanose)



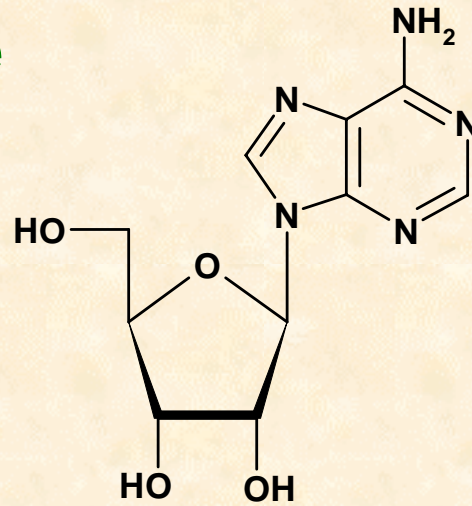
β -glykosidische Bindung (β -Ribofuranosid)

Adenosin

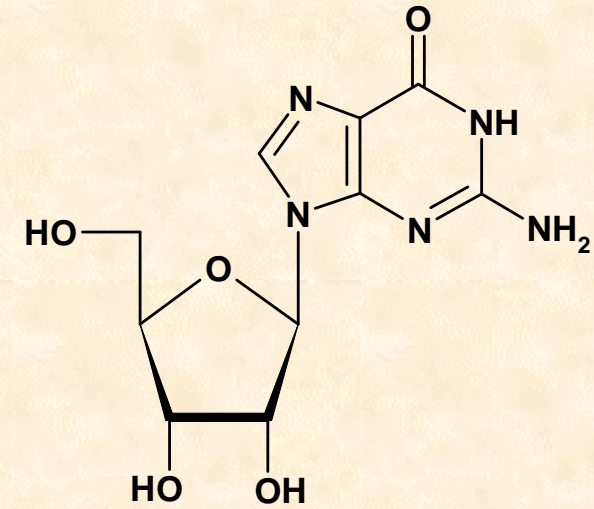
Purin-Nucleoside



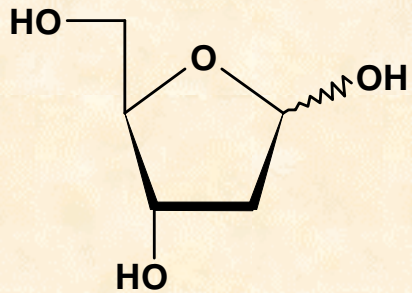
**Ribose
(Furanose)**



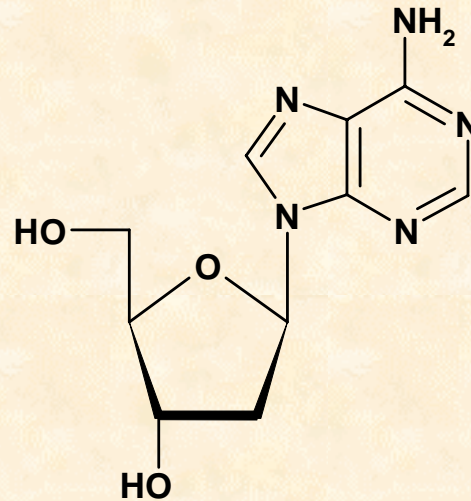
Adenosin



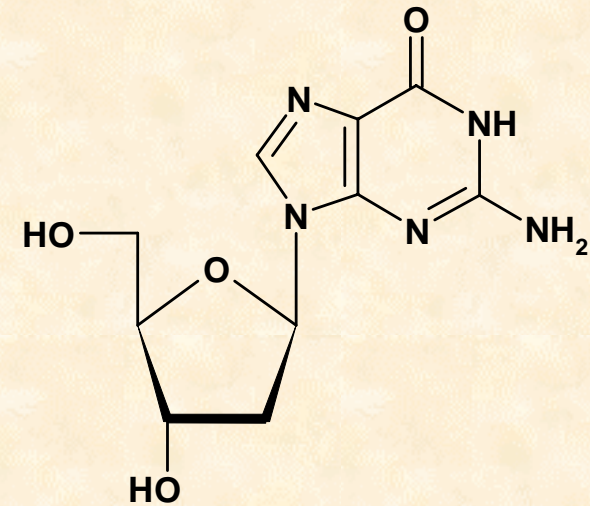
Guanosin



**2'-Desoxyribose
(Furanose)**

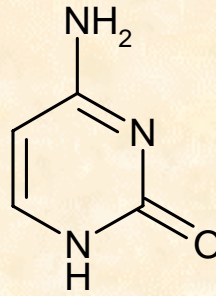


**2'-desoxy-Adenosin
dA**

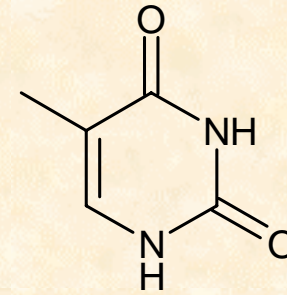


**2'-desoxy-Guanosin
dG**

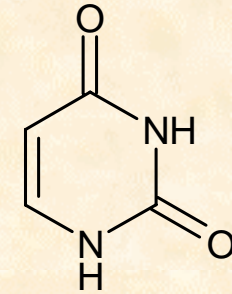
Pyrimidin-Nucleoside



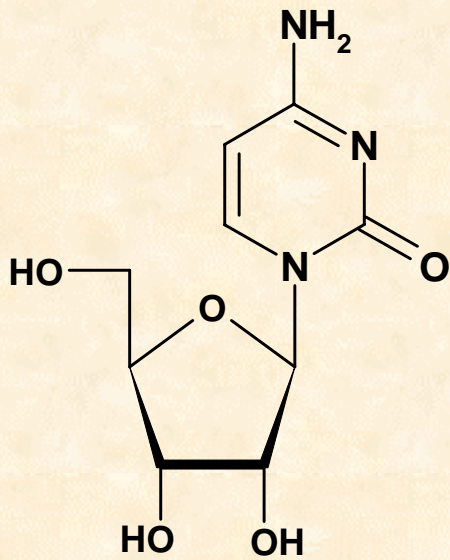
Cytosin



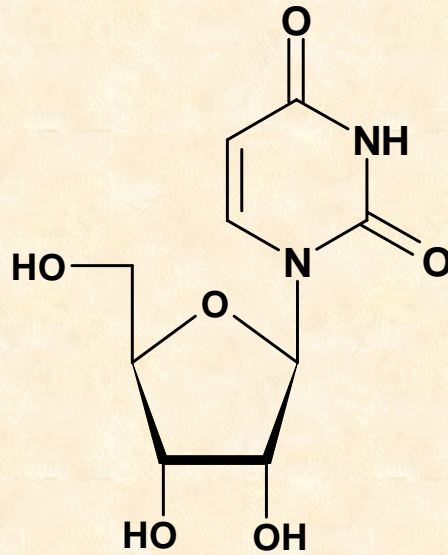
Thymin



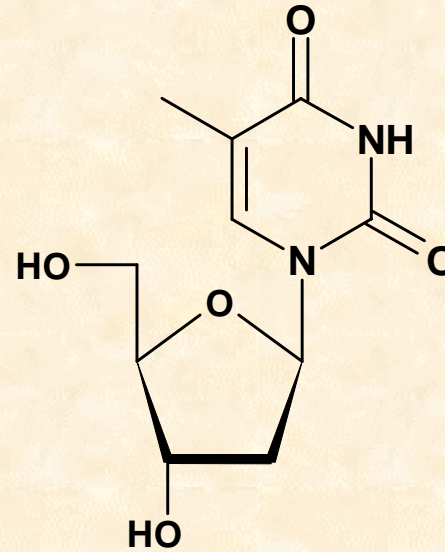
Uracil



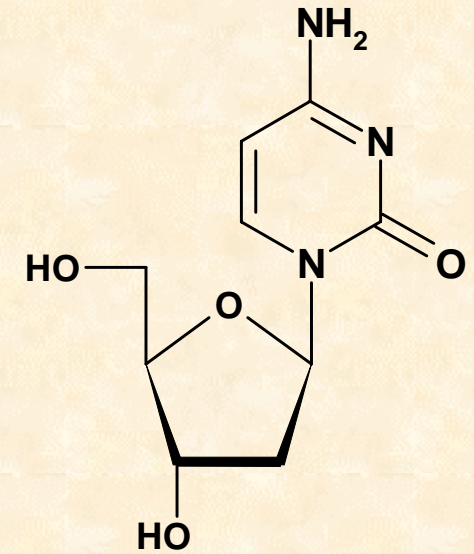
Cytidin
C



Uridin
U

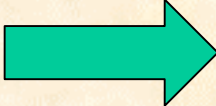
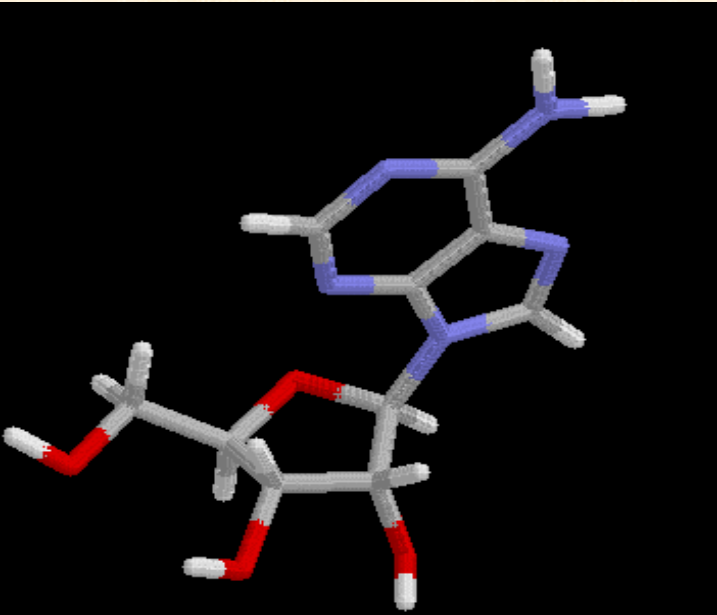
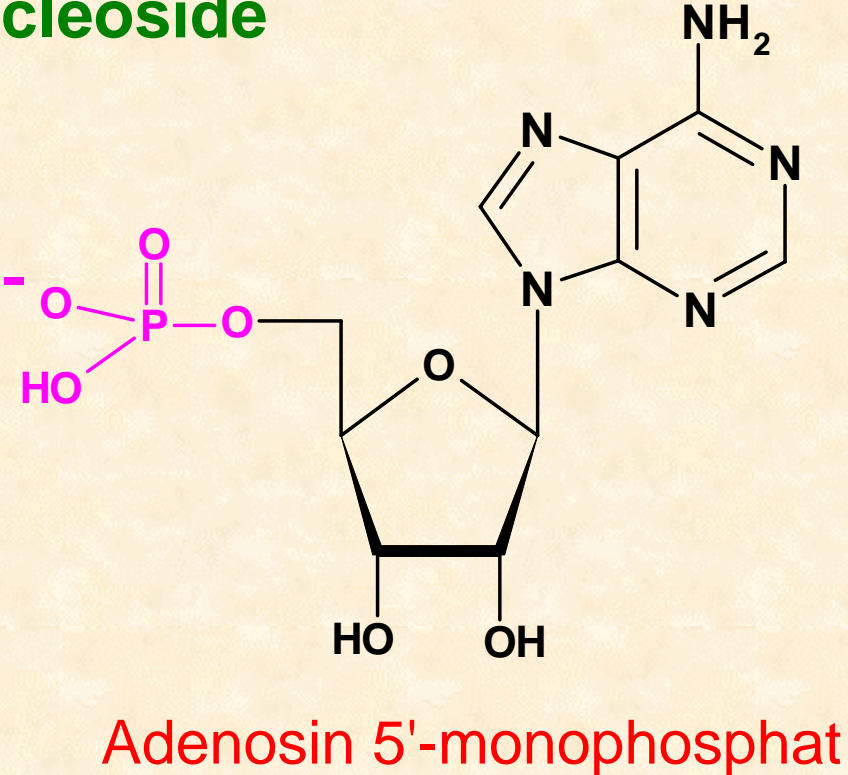
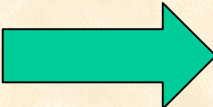
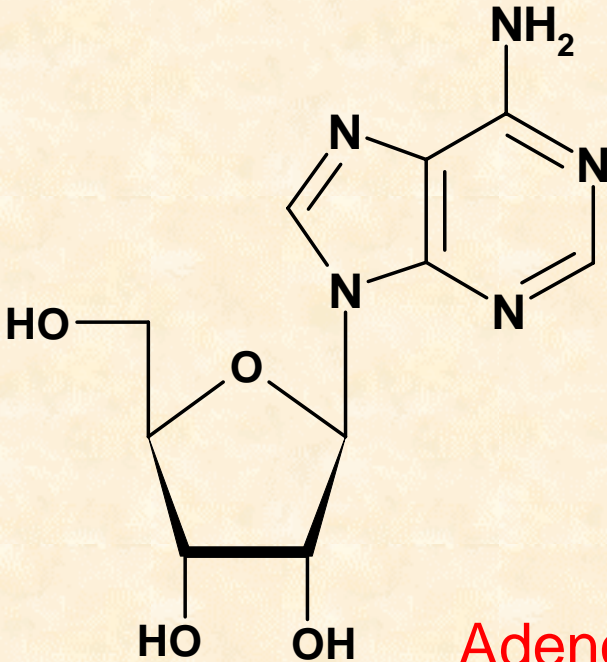


Thymin
2'-Desoxyribosylthymin
dT

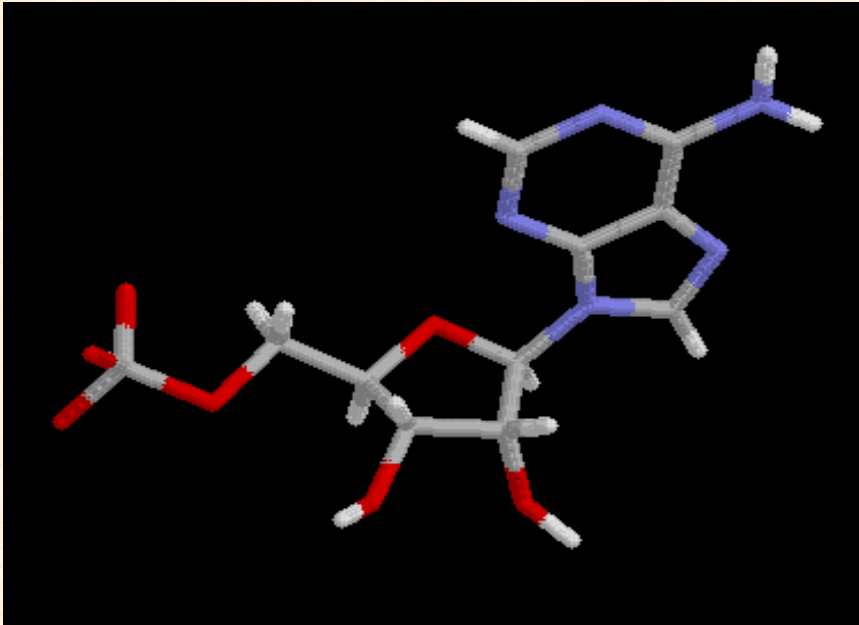


2'-desoxy-Cytidin
dC

Nucleotide: Phosphorsäureester der Nucleoside



Phosphorsäure ester



2. Allgemeine Eigenschaften

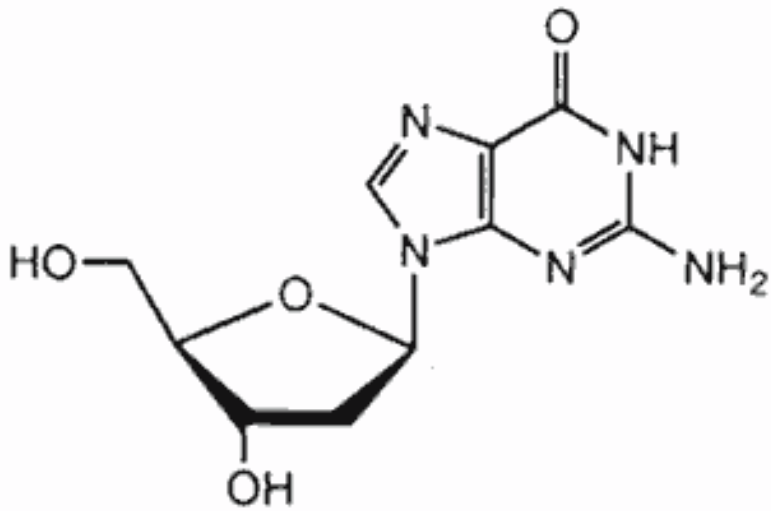
Löslichkeit von Pyrimidinen und Purinen in Wasser (1 g Verbindung auf x g H₂O)

Heterocyclus	x g H ₂ O	funktionelle Gruppen
Pyrimidin	1	-
Uracil	280	2 OH
Thymin	250	2 OH, 1 Me
Purin.Pikrat	2	-
Adenin.Pikrat	1086	1 NH ₂
Guanin.Pikrat	26000	1 OH, NH ₂
2,8-Dihydroxyadenin	500000	1 OH, NH ₂
Harnsäure	39480	3 OH
Nukleoside, Nukleotide	gut in heißem, schlecht in kaltem Wasser	

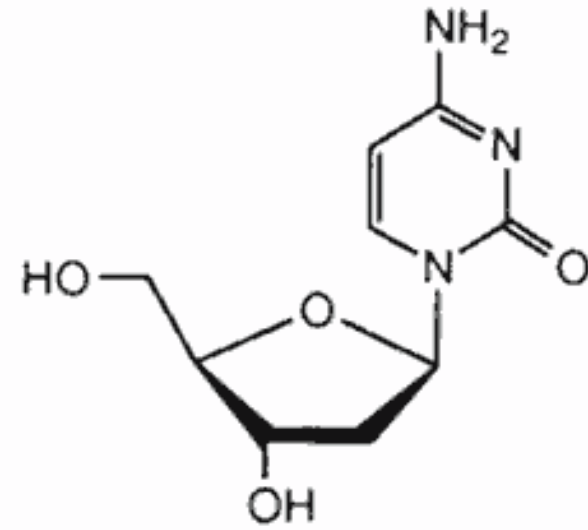
Allgemeine Eigenschaften

Dissoziationsgleichgewichte in Nukleotiden

Funktionelle Gruppe	Dissoziationsgleichgewicht	pK
1. Phosphat-OH	$\text{RO-PO}_3\text{H}_2 \Leftrightarrow \text{RO-PO}_3\text{H}^- + \text{H}^+$	0.7-1.6
-NH ₂ von Adenin	$\text{R-NH}_3^+ \Leftrightarrow \text{R-NH}_2 + \text{H}^+$	3.5-4.5
2. Phosphat-OH	$\text{RO-PO}_3\text{H}^- \Leftrightarrow \text{RO-PO}_3^{2-} + \text{H}^+$	5.8-6.6
Heterocycl. Protonen (U, T, G)	$-\text{NH-CO-} \Leftrightarrow -\text{N=C(O}^-\text{)-} + \text{H}^+$	9.5
-OH von Ribose	$\text{R-OH} \Leftrightarrow \text{RO}^- + \text{H}^+$	12.5

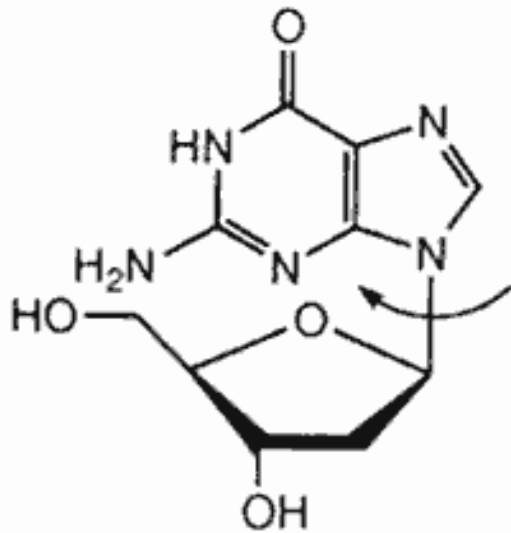


anti deoxyguanosine

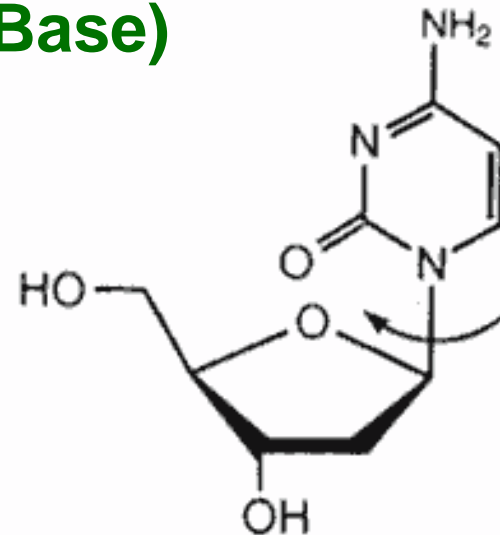


anti deoxycytidine

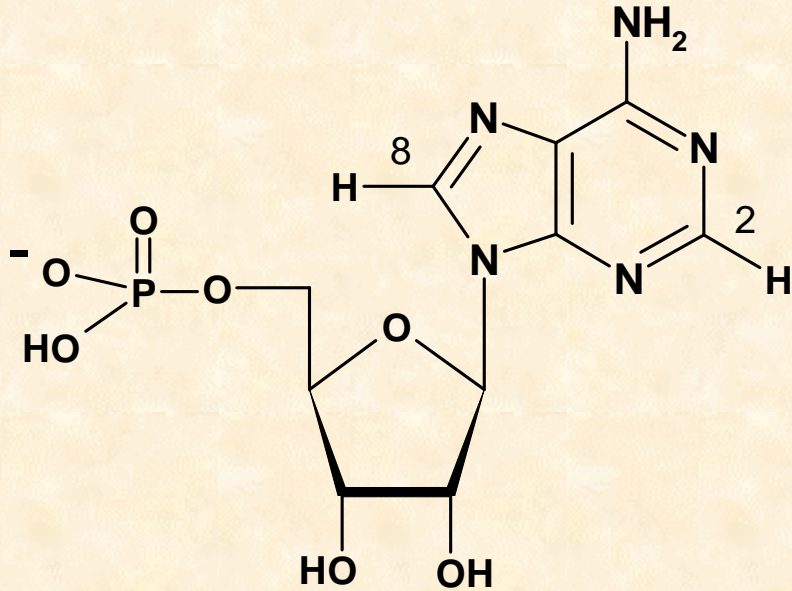
**Allgemeine Eigenschaften
Konformationen der Nukleoside
(Orientierung der N-Base)**



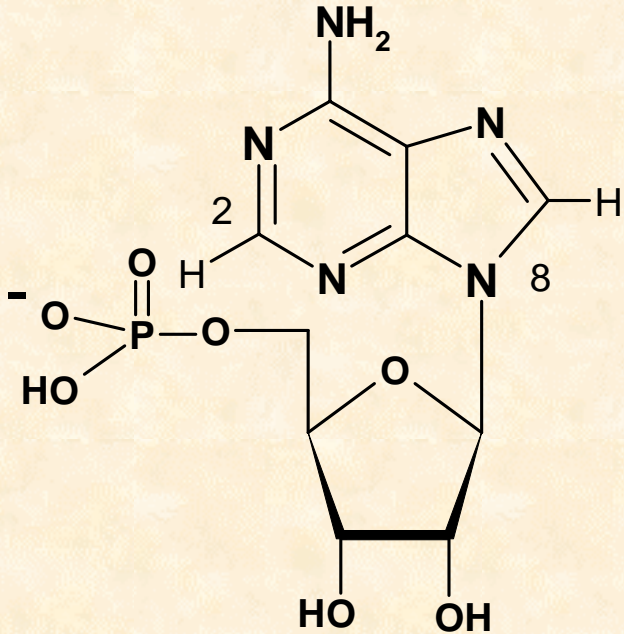
syn deoxyguanosine



Konformation der Nukleotide



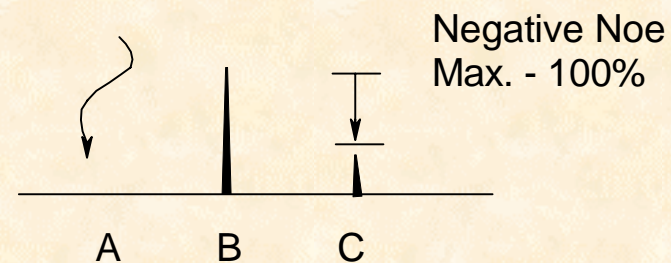
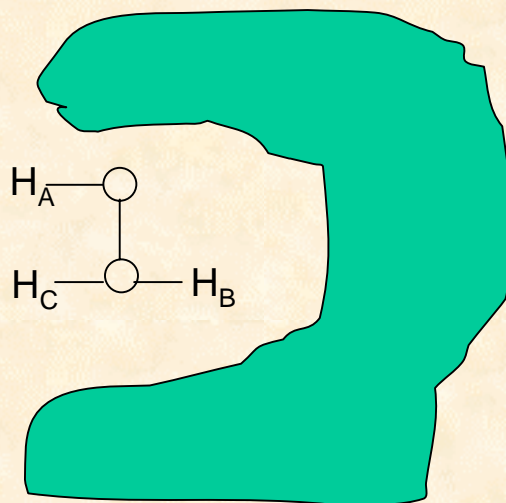
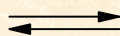
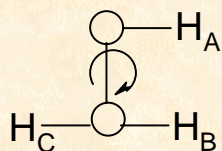
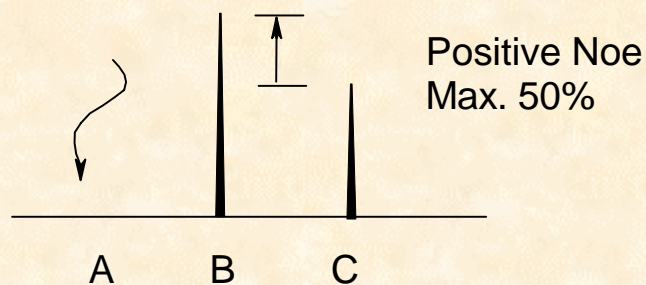
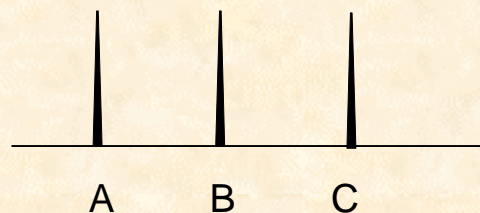
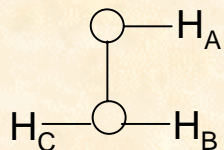
anti-Konformation



syn-Konformation

Relative Orientierung der N-Base zur Pentose

Transfer-Noe zur Bestimmung der Konformation gebundener Liganden



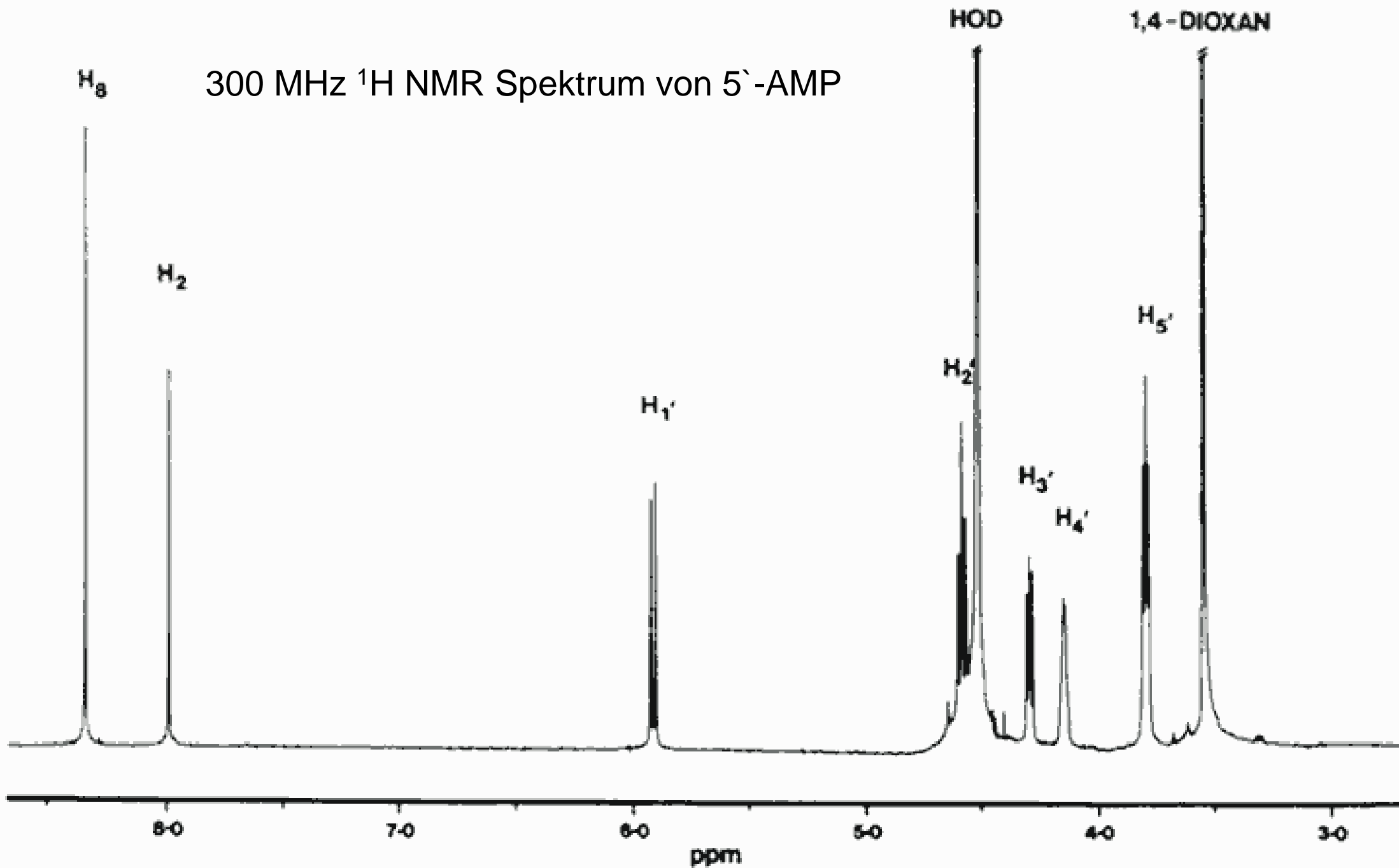
$$k_D \sim \mu\text{M}$$

Free ligand

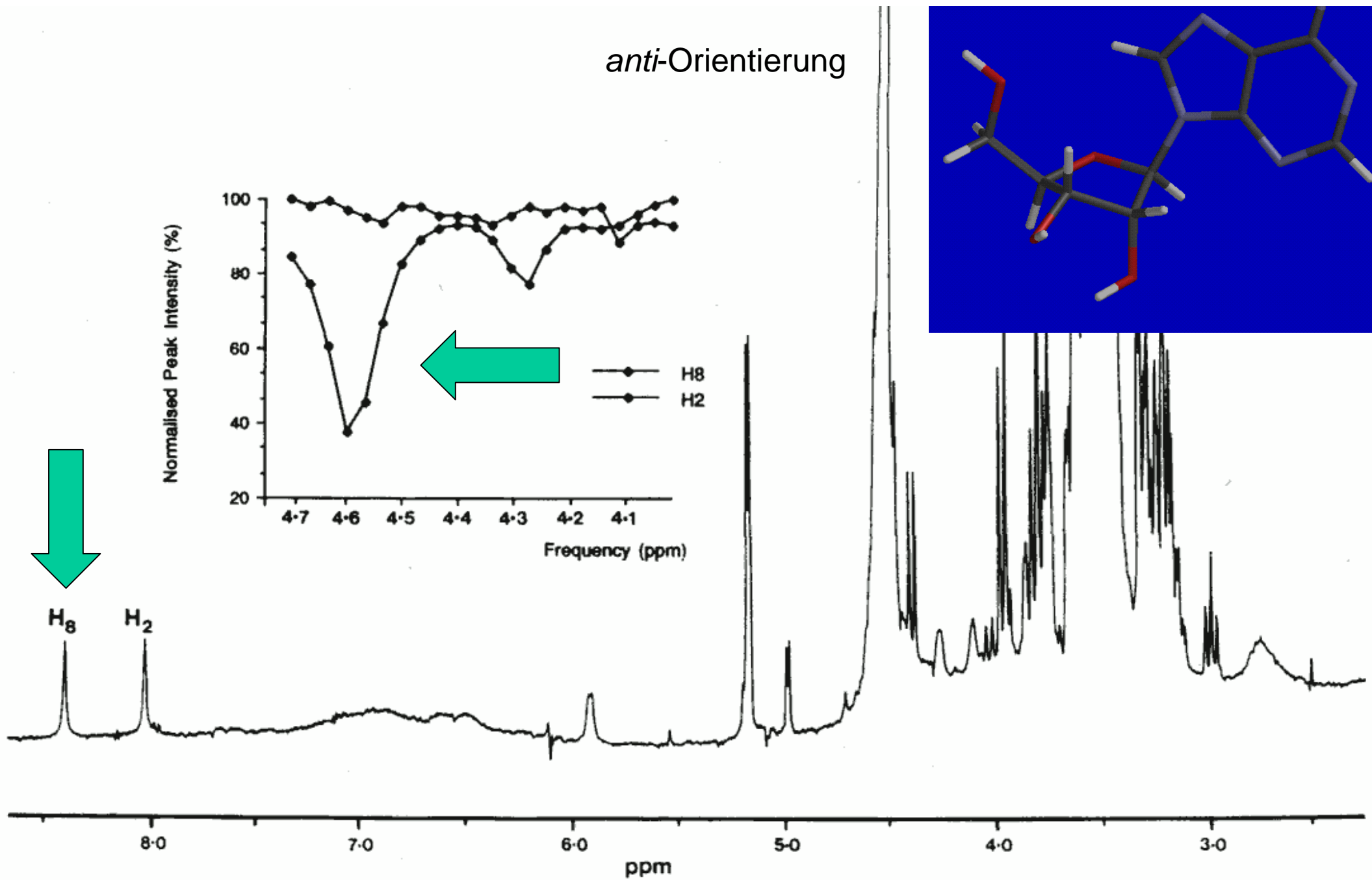
Bound ligand

Ligand : Protein > 10 : 1

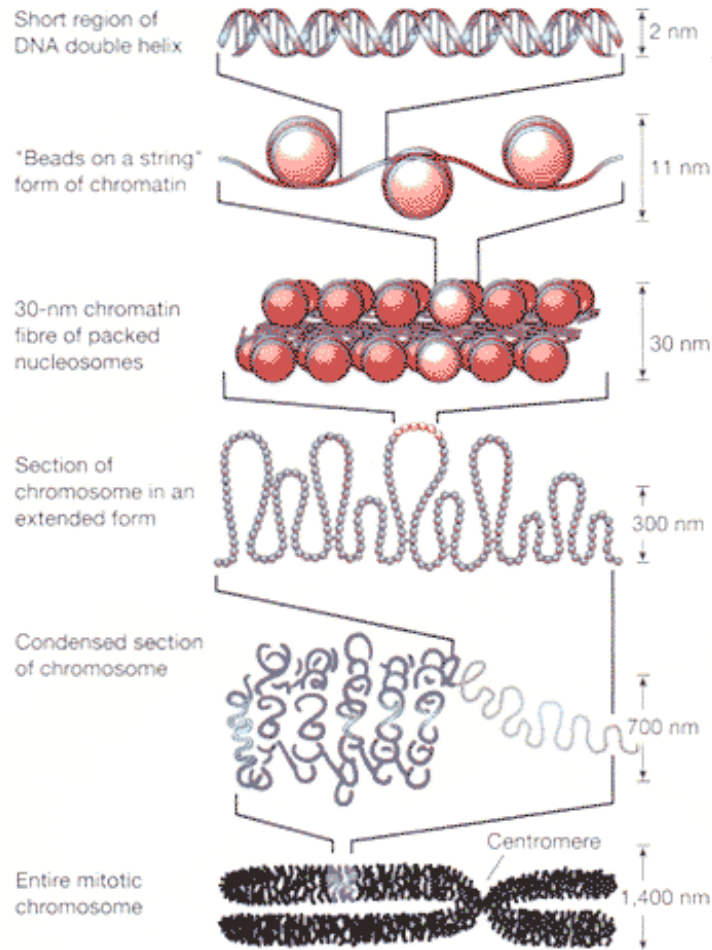
300 MHz ^1H NMR Spektrum von 5'-AMP



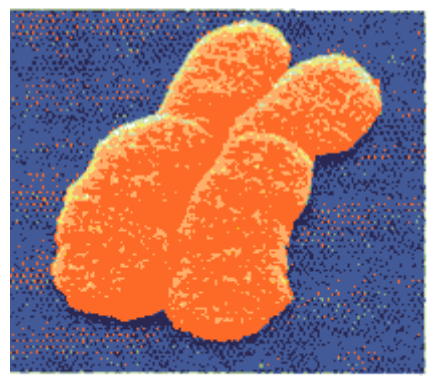
anti-Orientierung



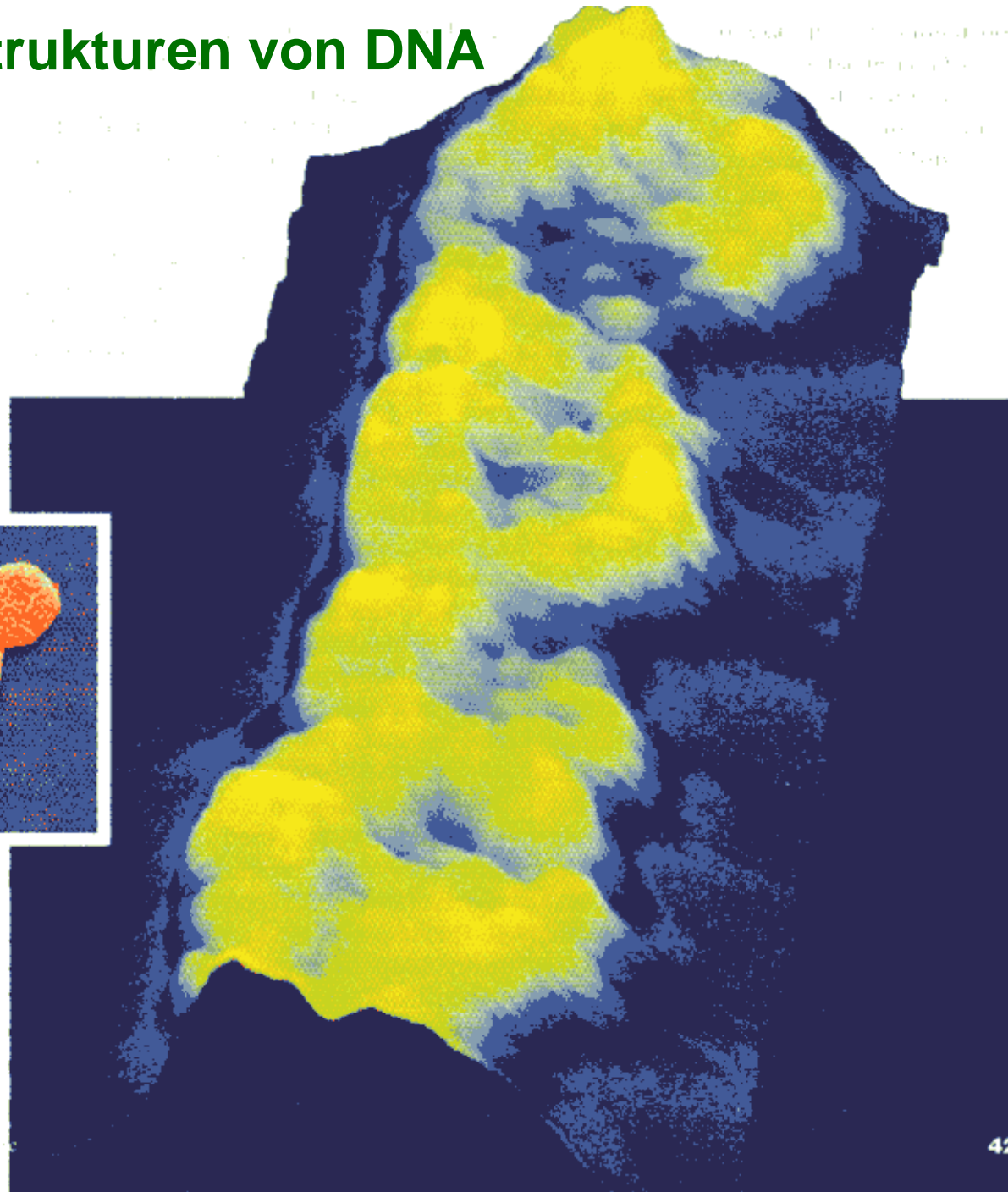
AMP (3.33 mM) als Ligand der Alkoholdehydrogenase (ADH, 0.1 mM);
TrNOe von H-2' und H-3' zu H-8



3. Raumstrukturen von DNA und RNA

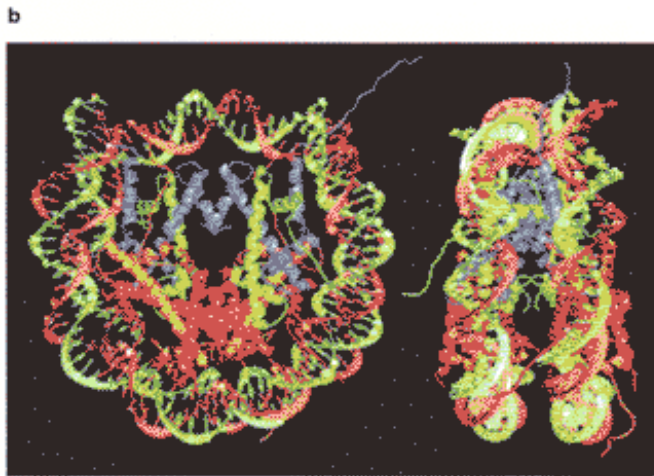


Chromosom



Doppelhelix

Nature, 412 (2003)



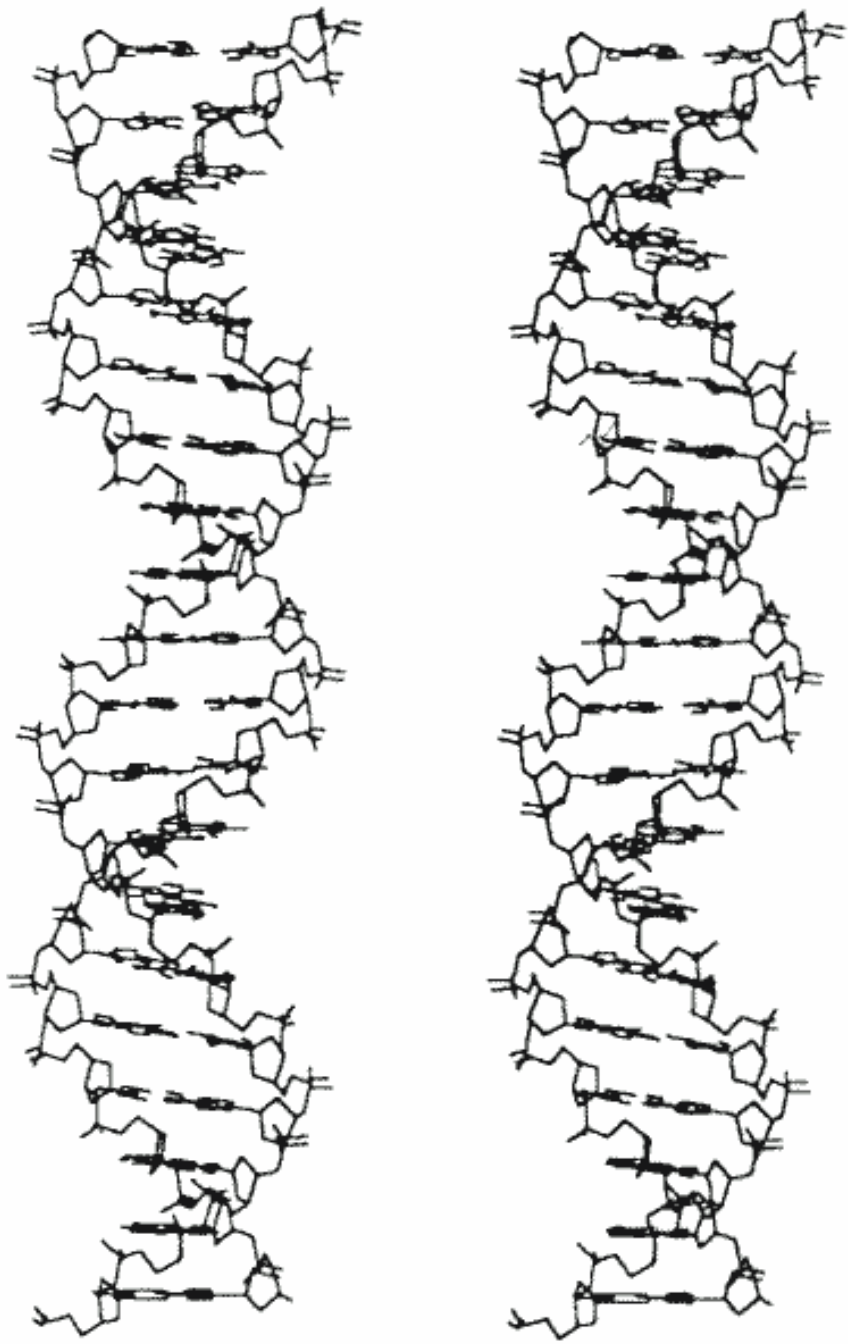
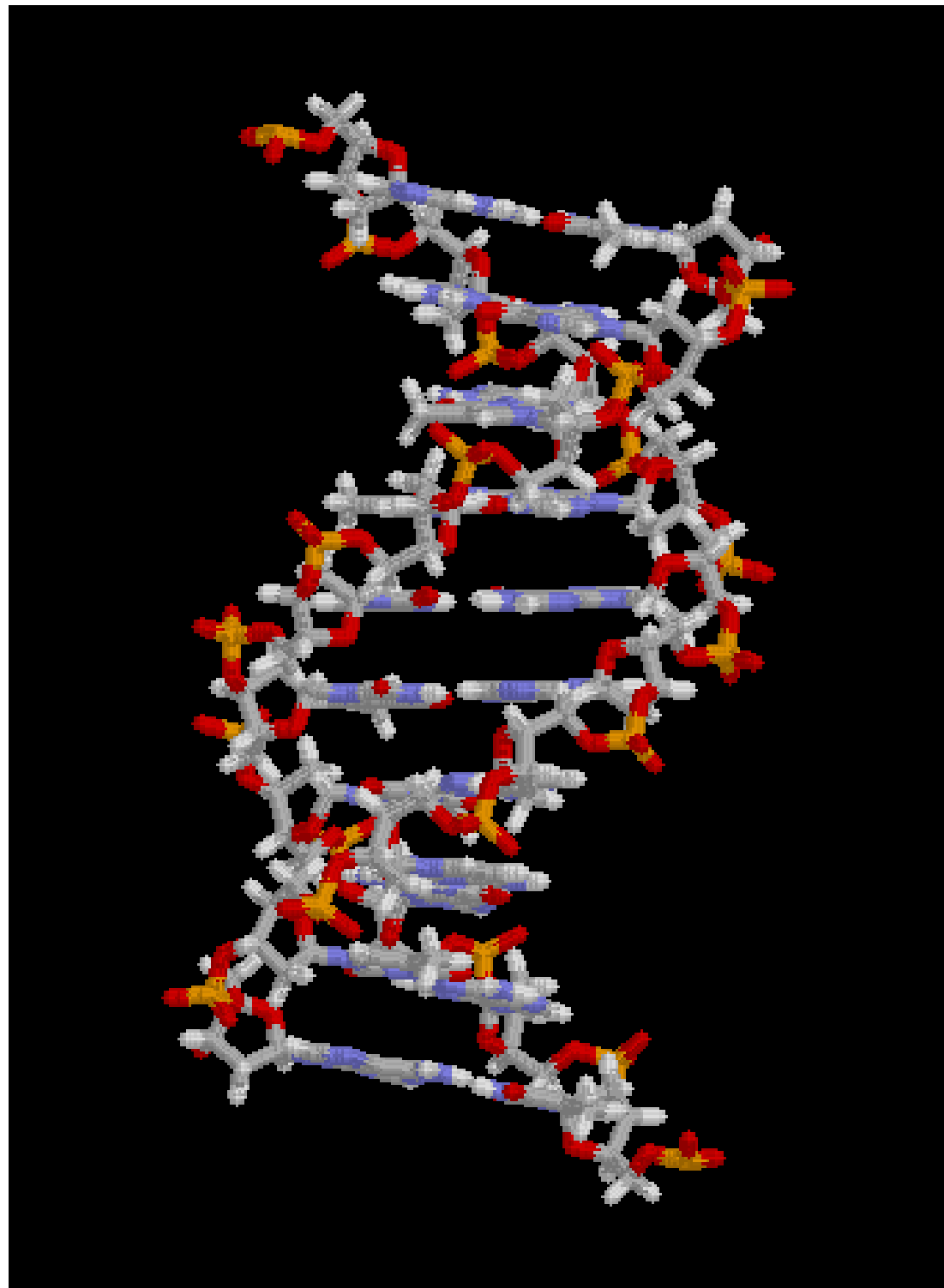
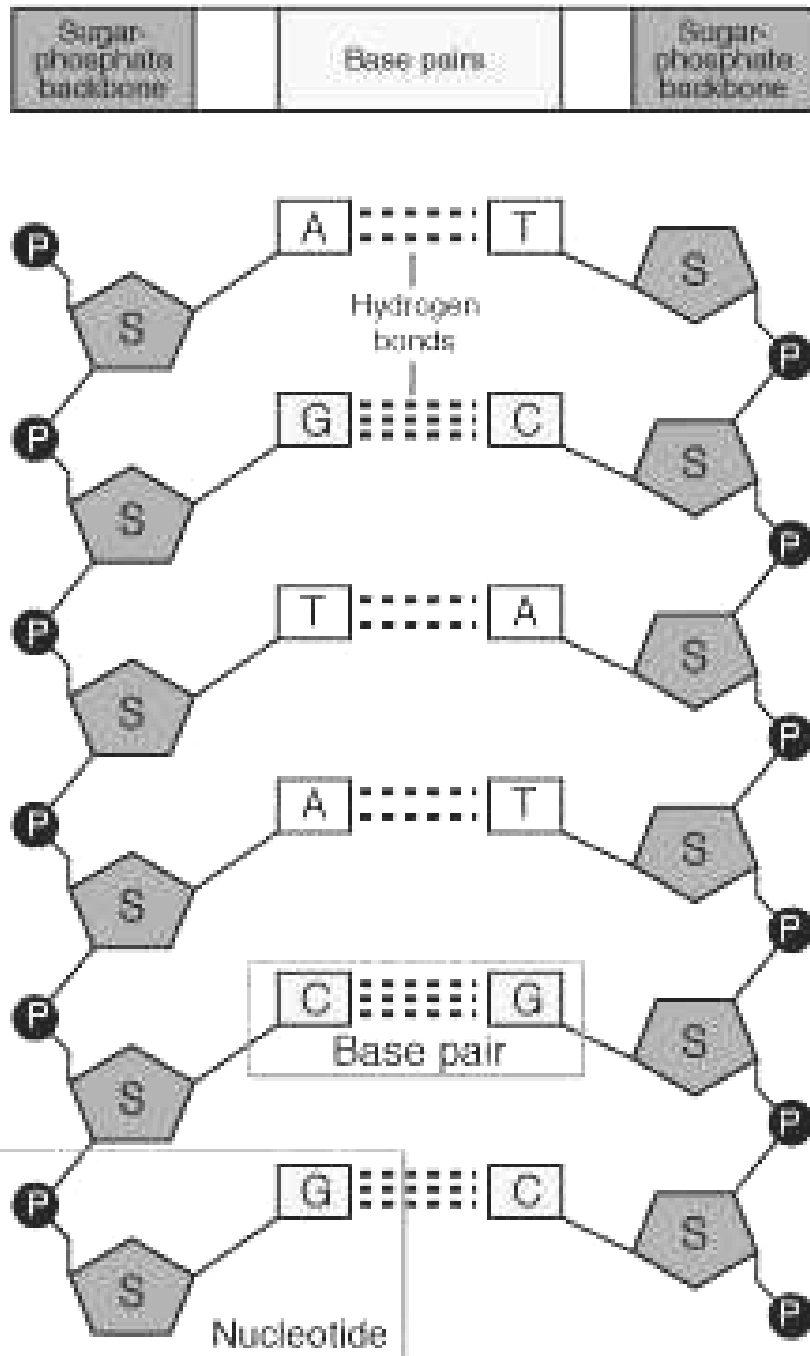


Figure 1-5. Stereoview of B-form DNA.

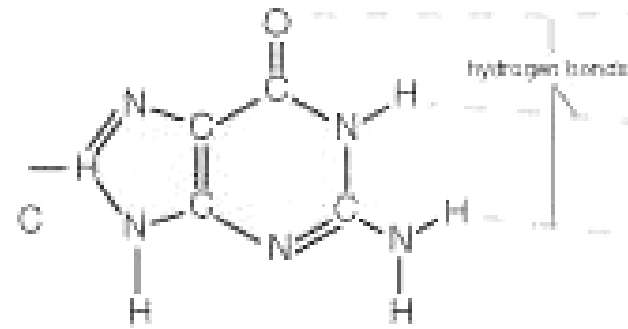


Deoxyribonucleic Acid (DNA)

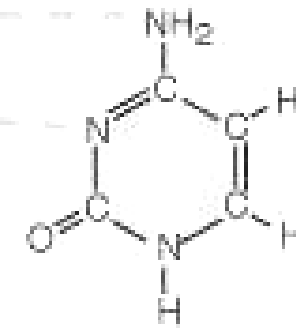


Nitrogenous Bases

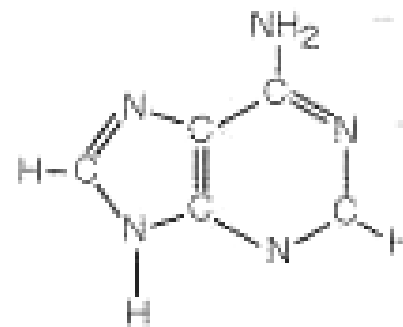
G Guanine



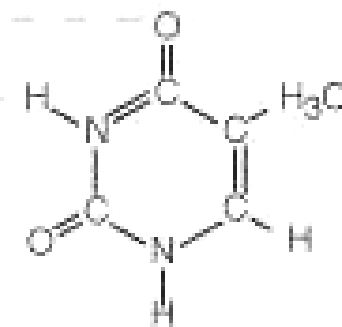
C Cytosine



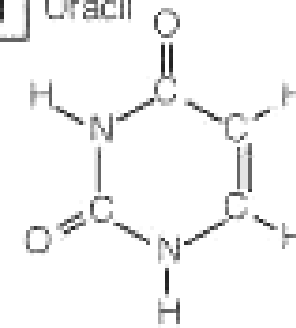
A Adenine



T Thymine



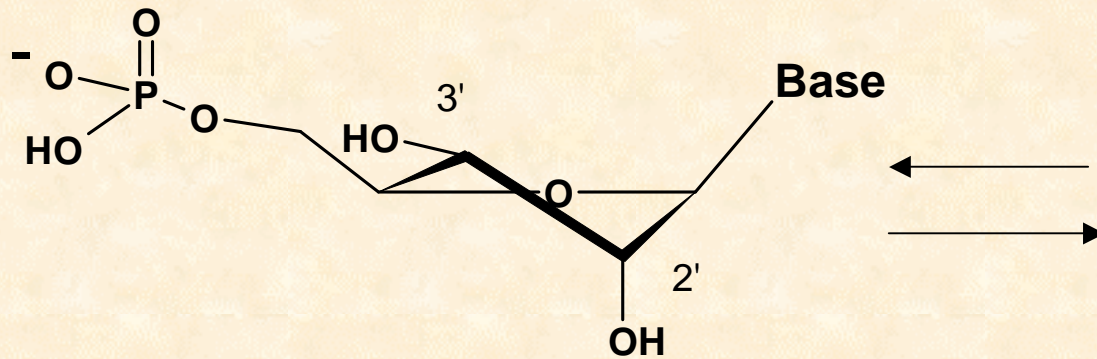
U Uracil



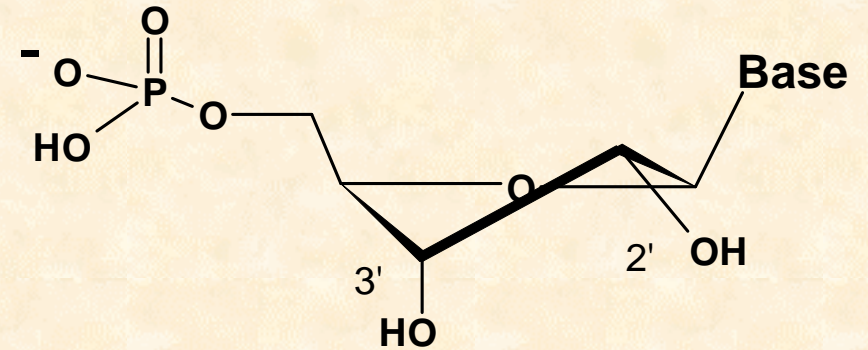
replaces Thymine in RNA

Konformation der Nukleotide

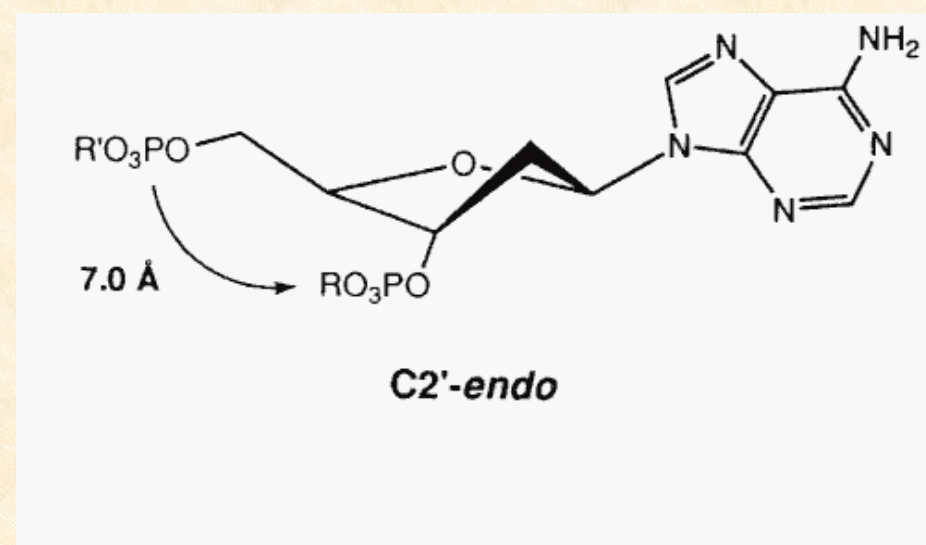
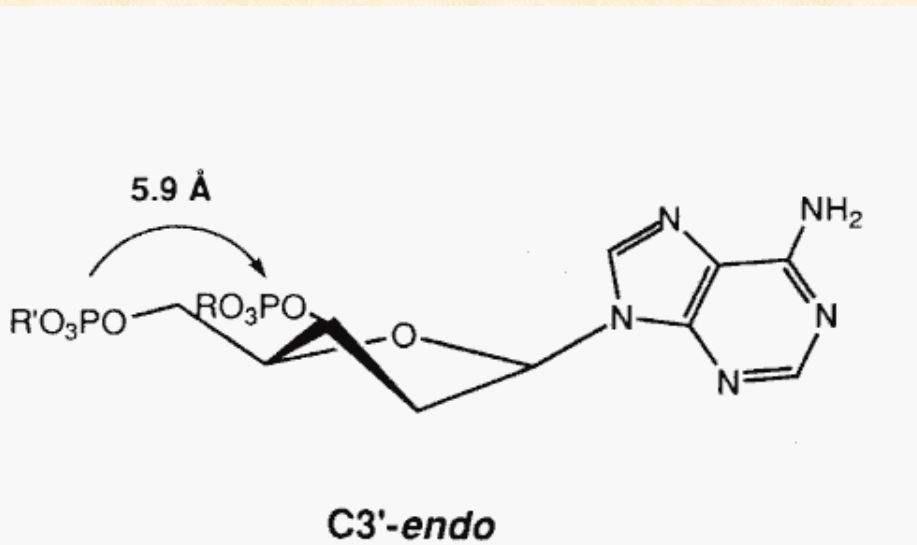
Konformationen des Furanoserings: „Ring puckering“, BEISPIEL:
exo-, endo- Twistkonformation



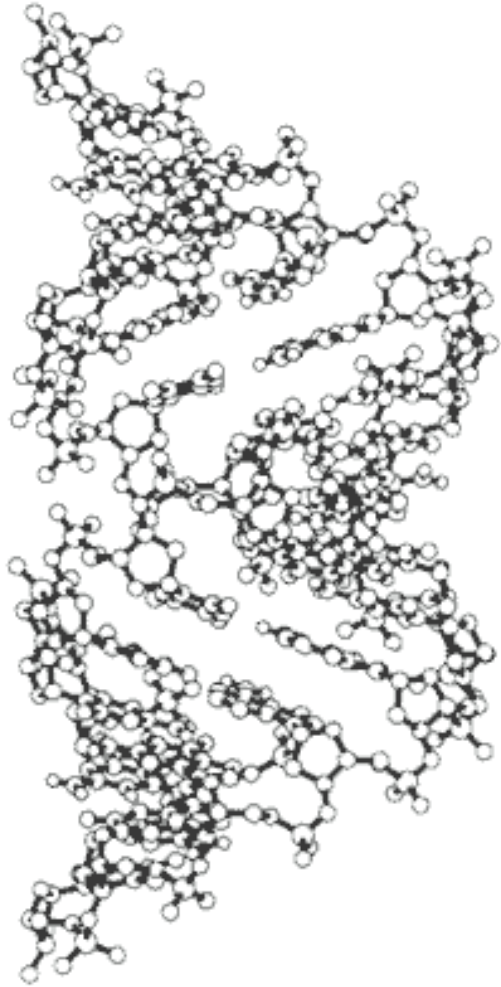
3T_2 3'-*endo*-Konformation



2T_3 3'-*exo*-Konformation

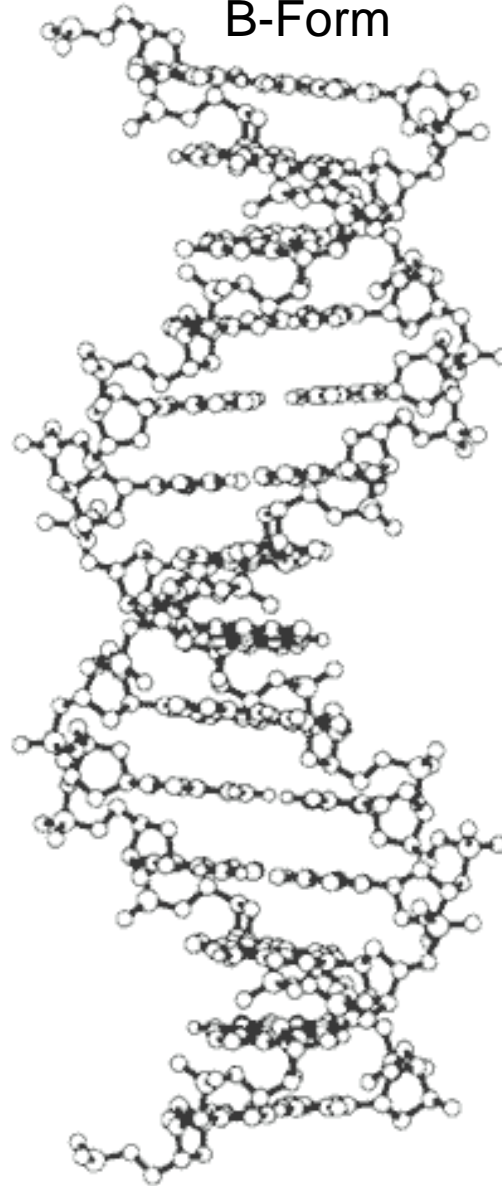


A-Form



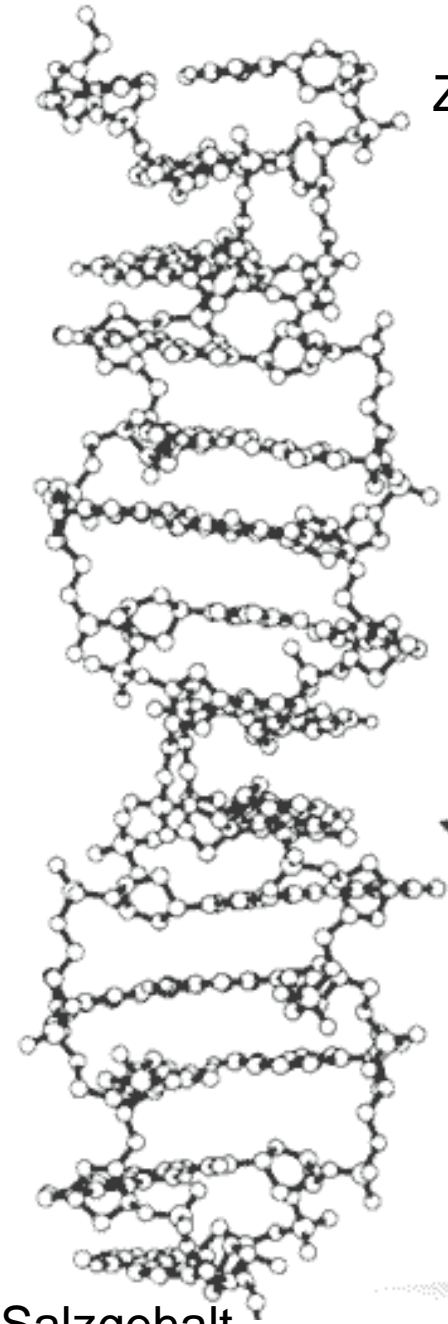
RNA, RNA-DNA
Geringer H₂O-Gehalt
„Tilt“ der N-Basen
C3'-endo

B-Form



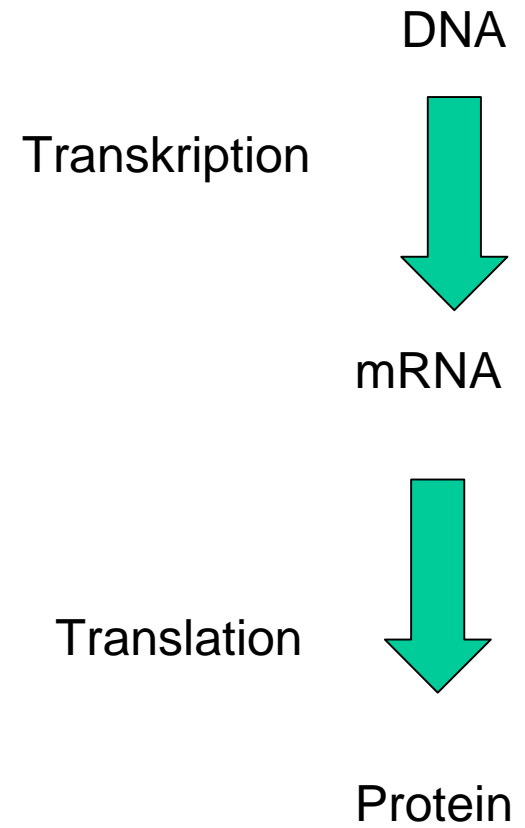
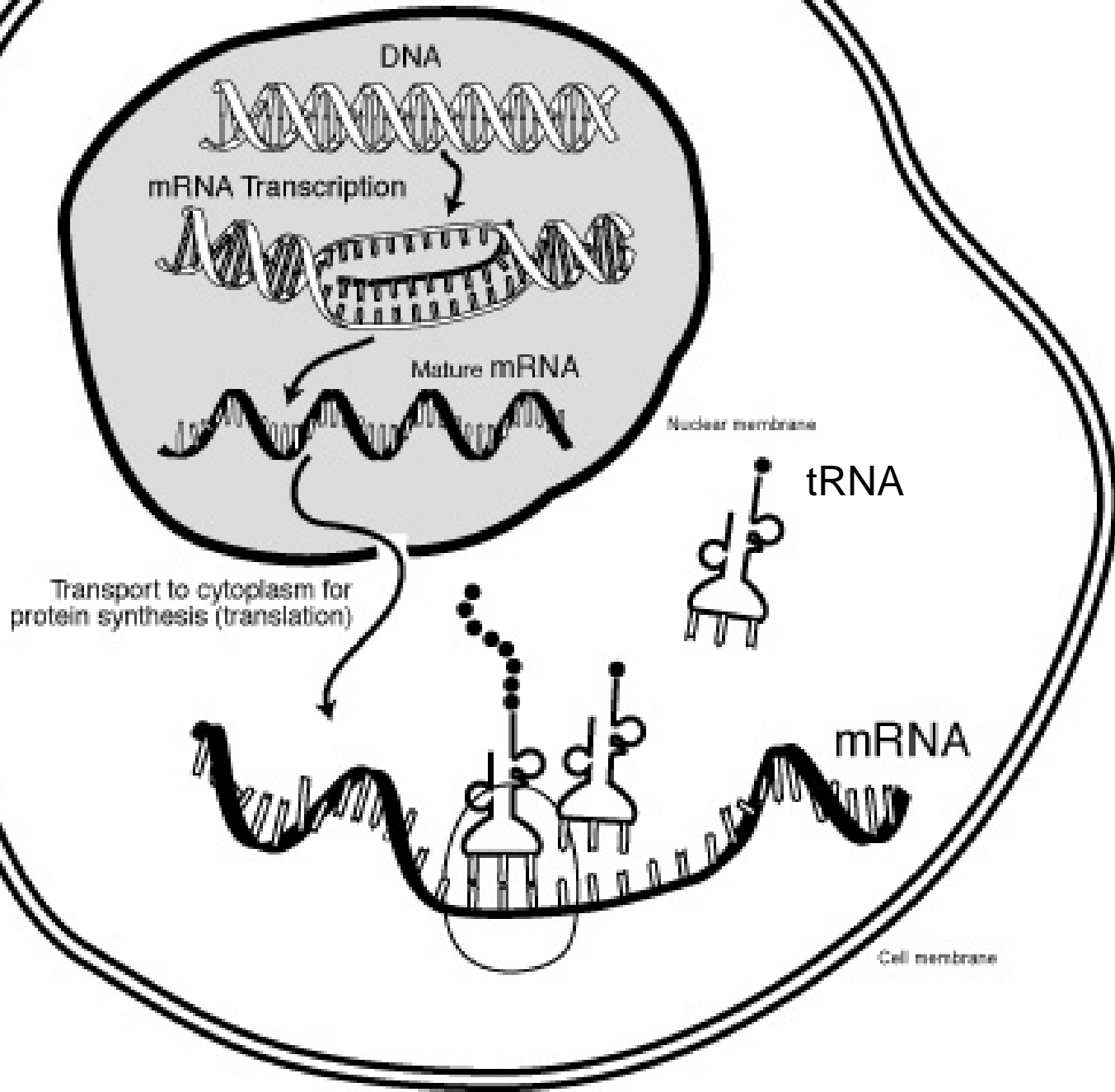
DNA
Hoher H₂O-Gehalt
C2'-endo

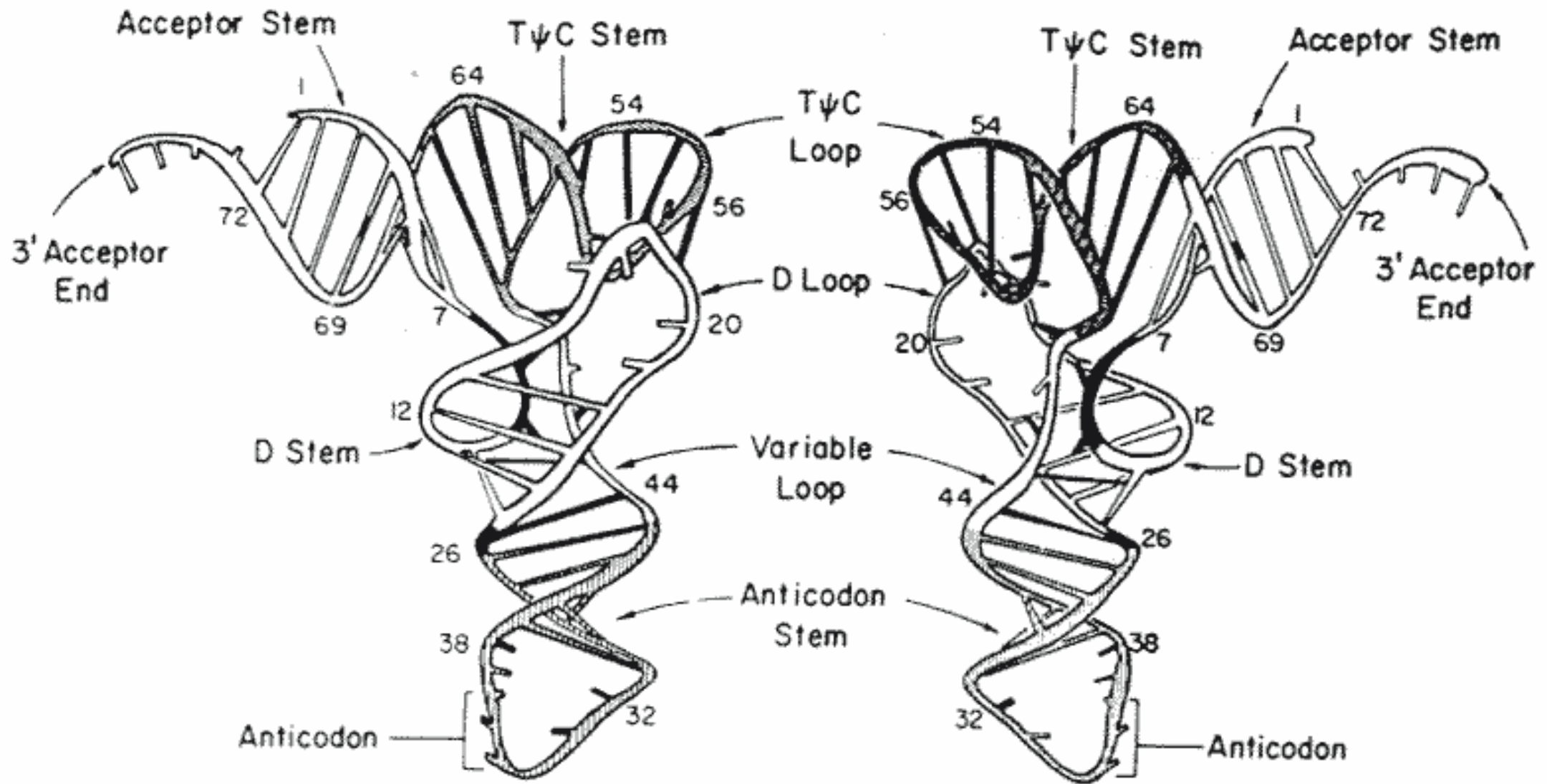
Z-Form



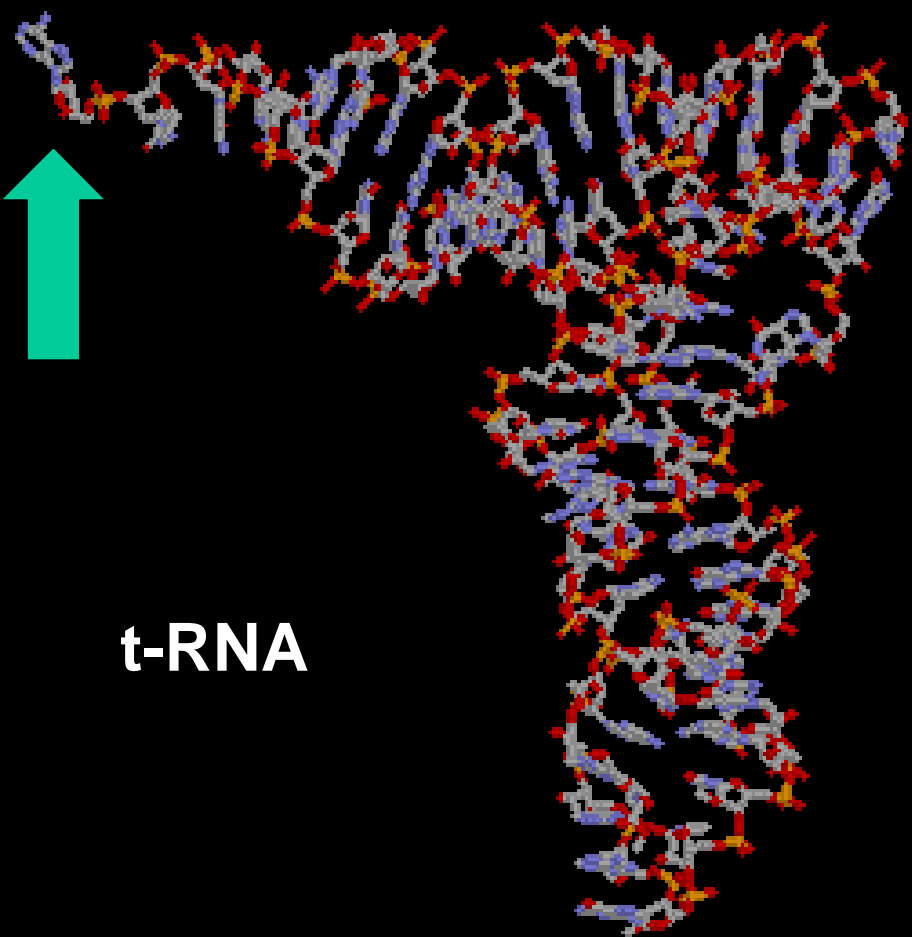
DNA
Hoher Salzgehalt
Abwechselnd Purin-Pyrimidin
G: syn, C2'-endo; C: anti, C3'-endo

Umsetzung der genetischen Information





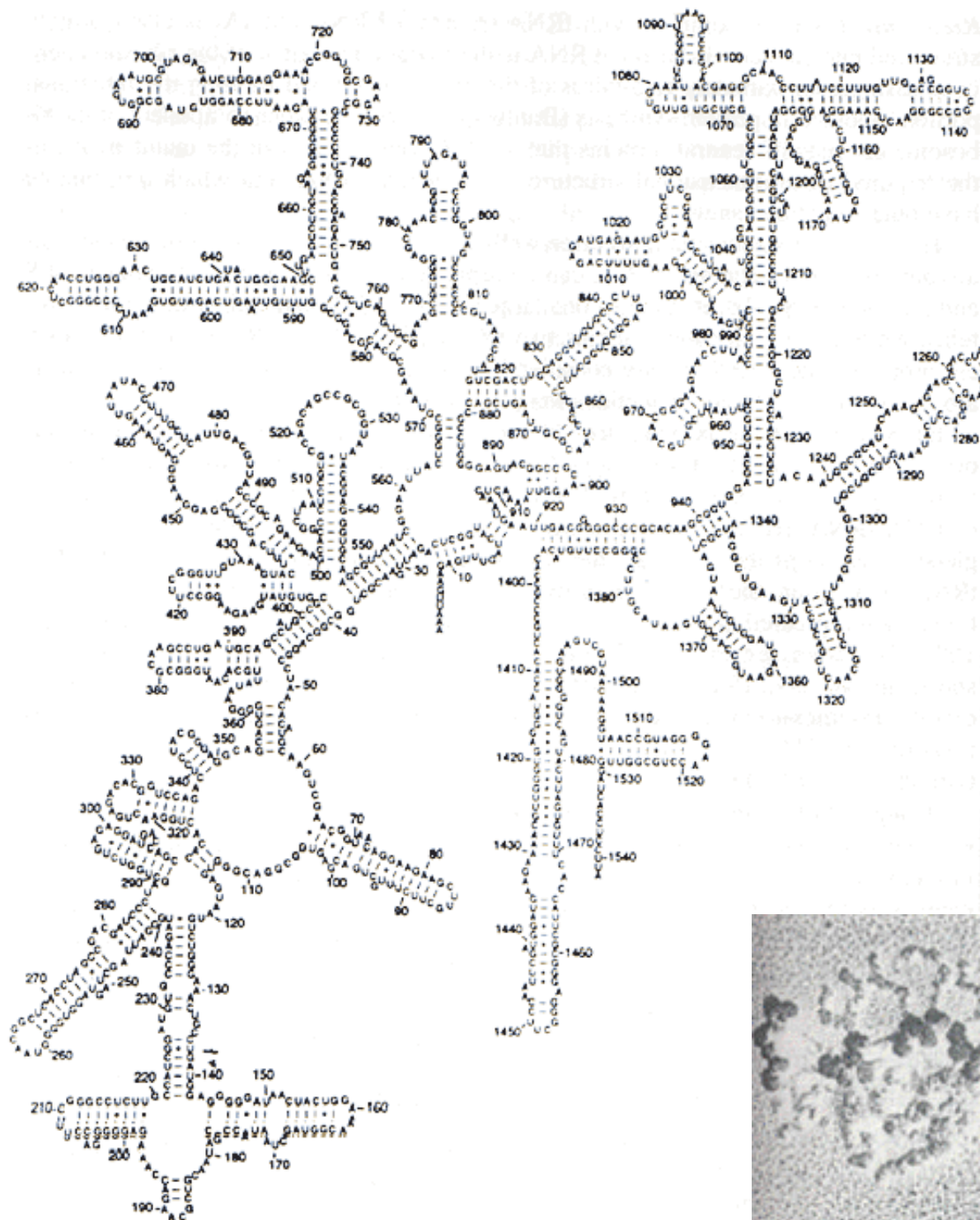
Transfer- RNA (t-RNA)



CCA-Terminus

Anticodon





16S rRNA *E. coli*

Ribosom

