

생유기화학
(*Bioorganic Chemistry*)

Nucleotides and Nucleic Acids-III
(뉴클레오타이드, 핵산-3)

Soonchunhyang University

Department of Chemical Engineering

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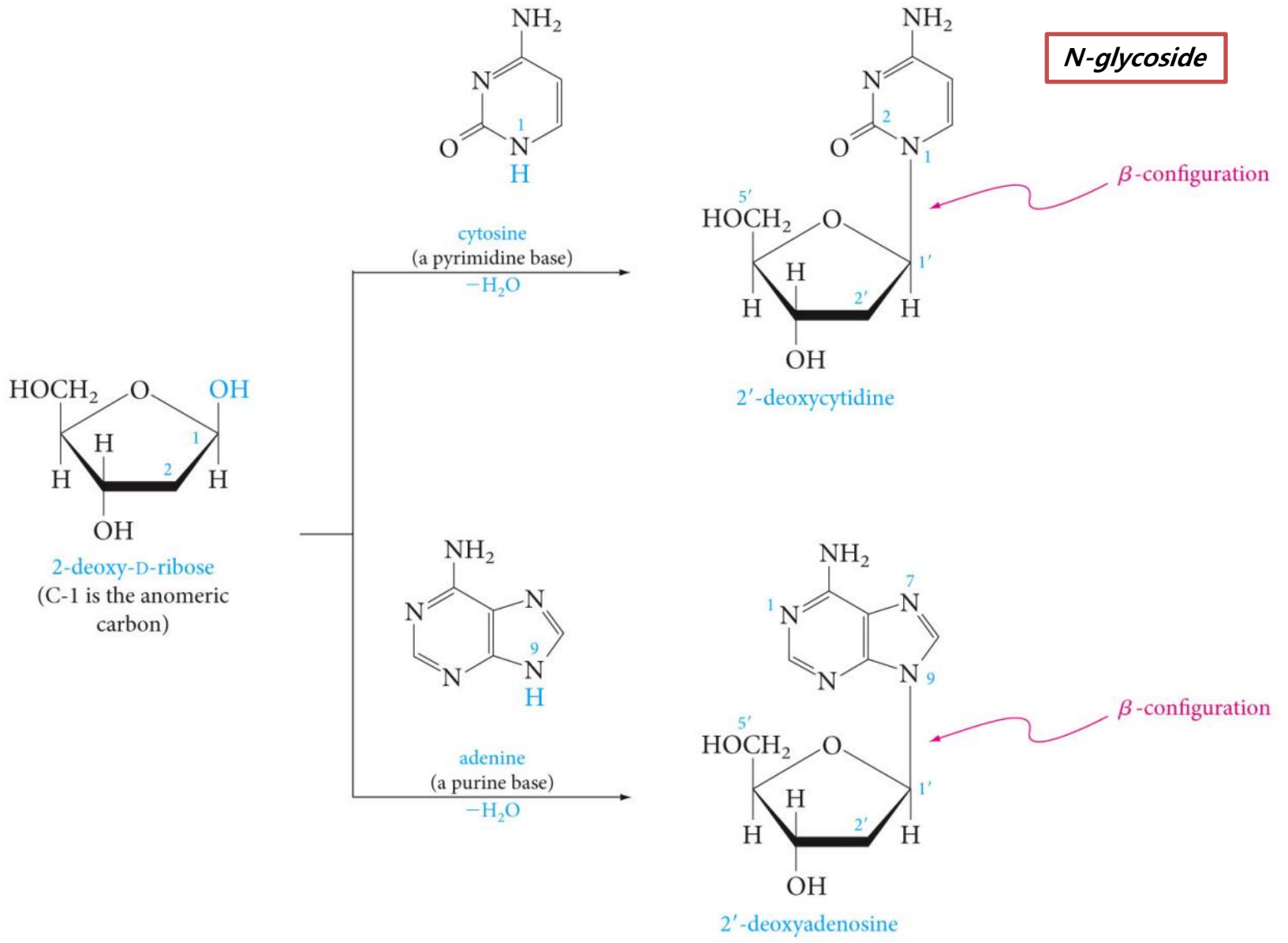
순천향대

나노화학공학과

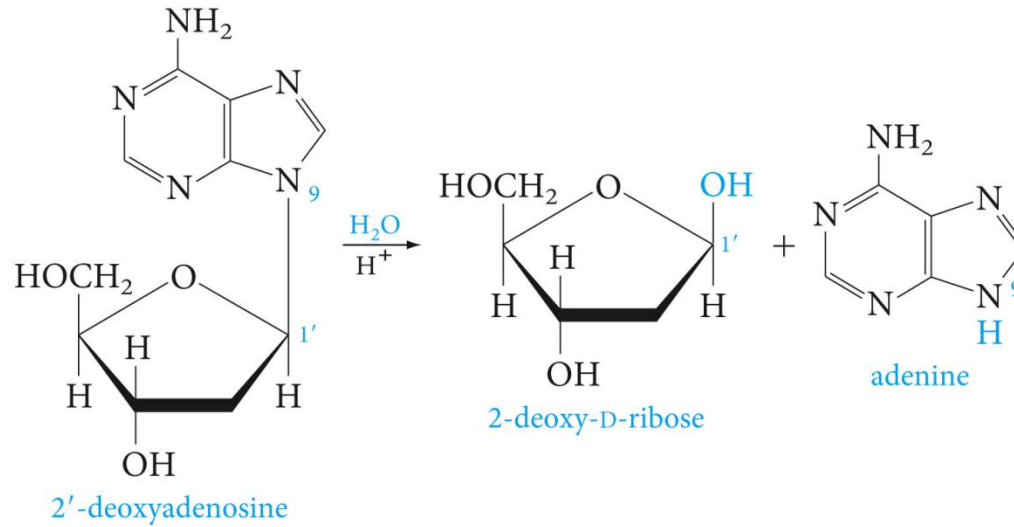
임정균 교수



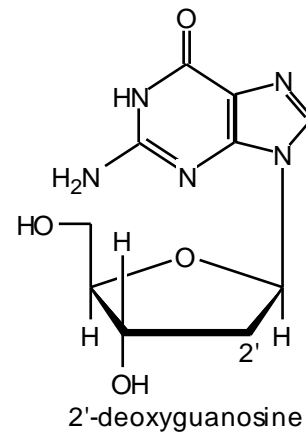
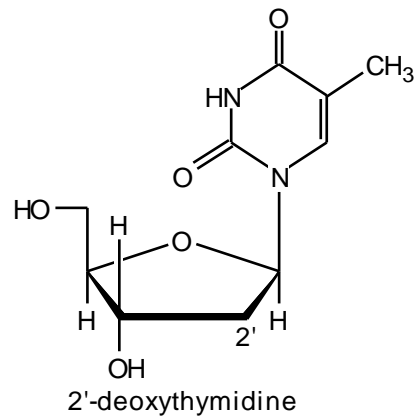
3. Nucleosides



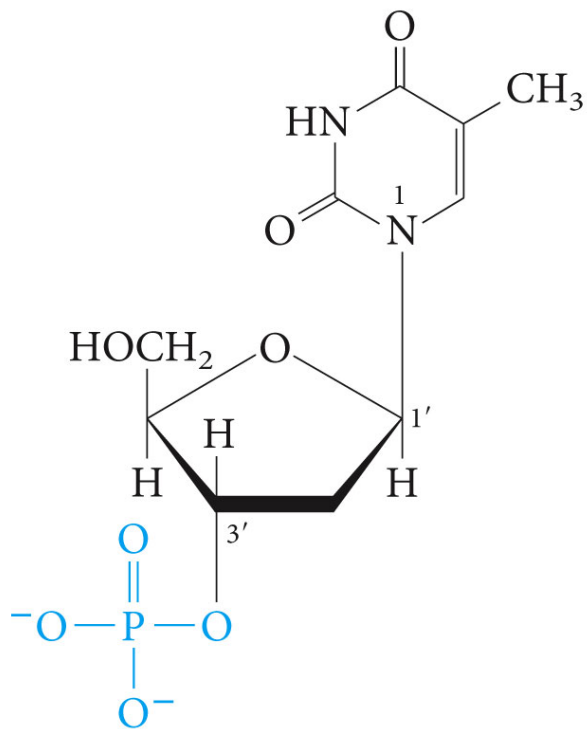
Hydrolyzed by aqueous acid (or by enzymes)



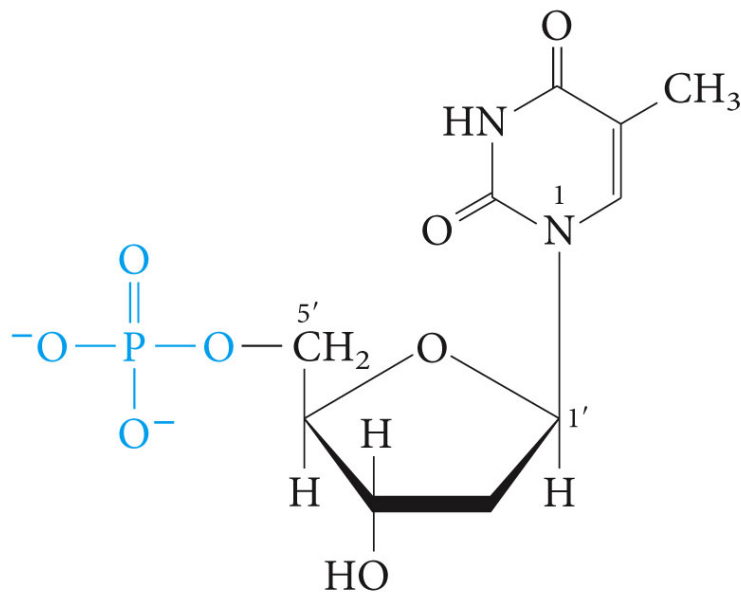
Problem 1. Draw the structures for the **2'-deoxythymidine** and **2'-deoxyguanosine**.



4. Nucleotides



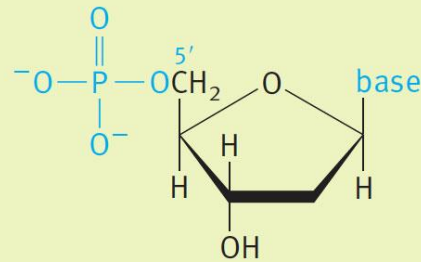
2'-deoxythymidine
3'-monophosphate



2'-deoxythymidine
5'-monophosphate

phosphate ester bond가 새로 생긴다.

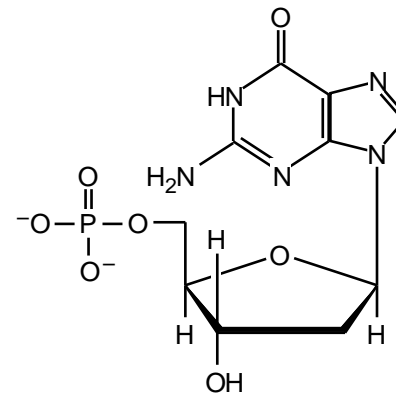
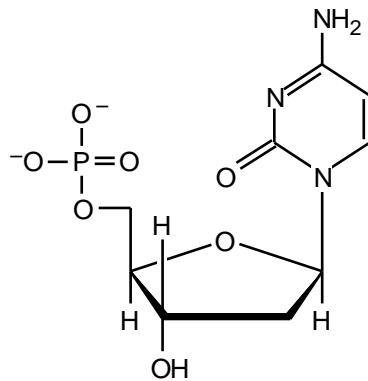
Table 18.1 ■ The Common 2-Deoxyribonucleotides

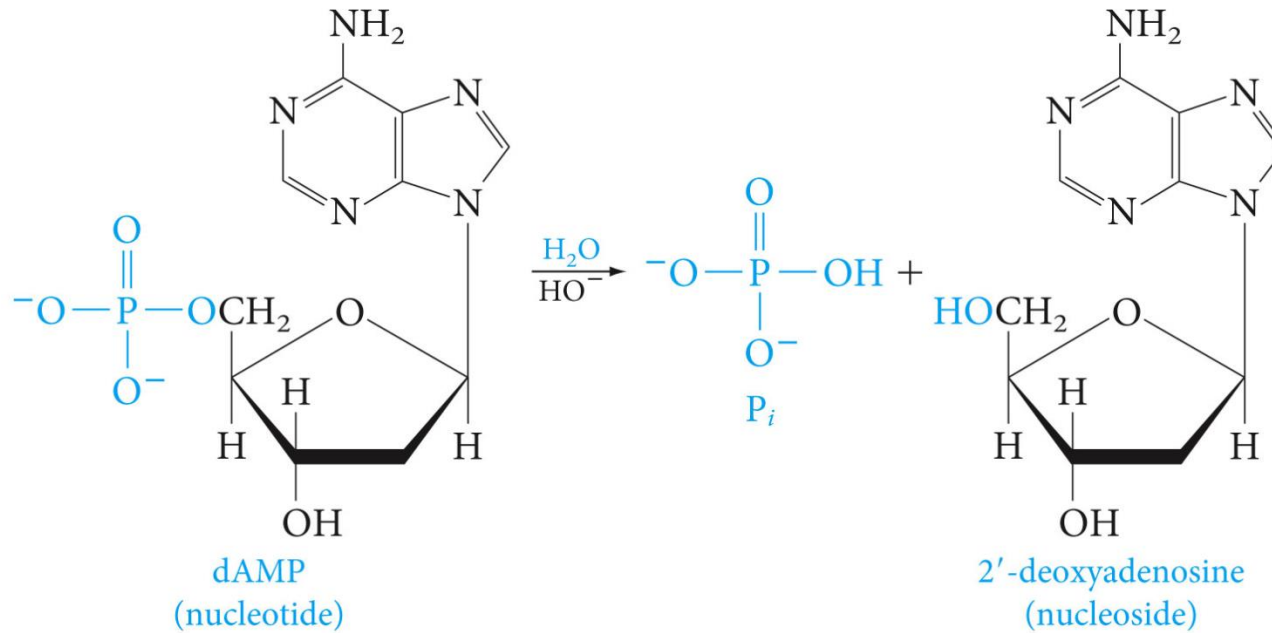


Base	Monophosphate name	Abbreviation
cytosine (C)	2'-deoxycytidine 5'-monophosphate	dCMP
thymine (T)	2'-deoxythymidine 5'-monophosphate	dTMP
adenine (A)	2'-deoxyadenosine 5'-monophosphate	dAMP
guanine (G)	2'-deoxyguanosine 5'-monophosphate	dGMP

Problem 3. Write the structure for

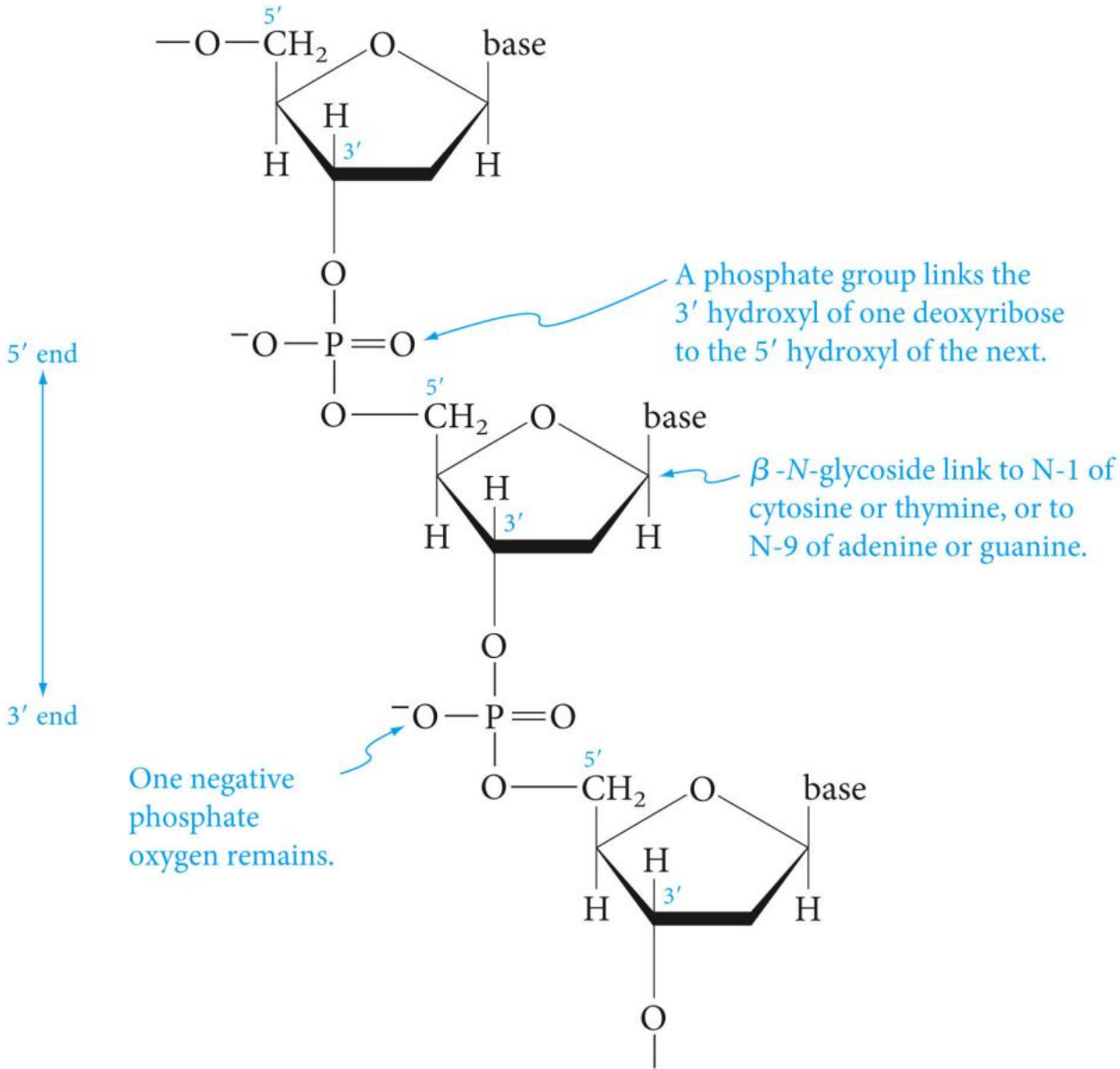
a. dCMP b. dGMP

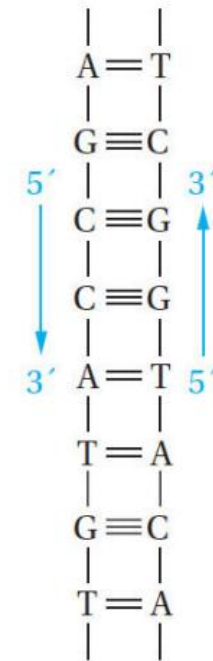
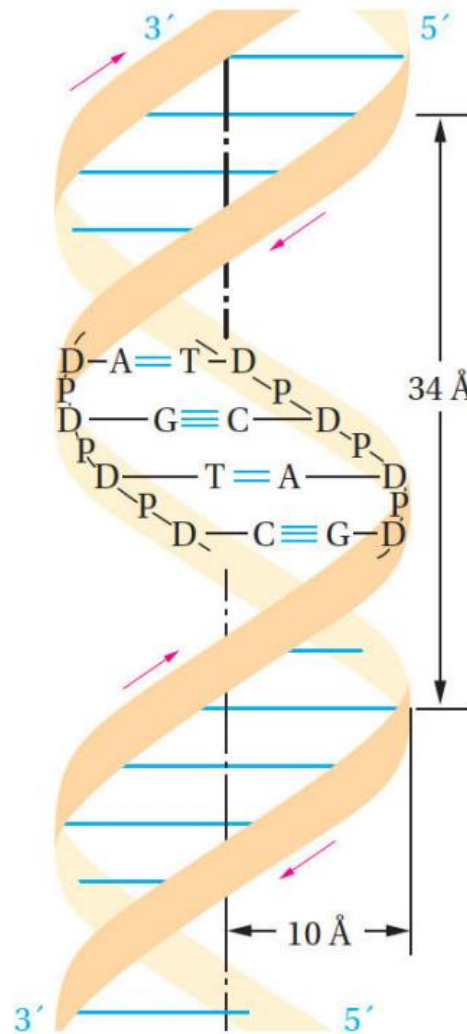
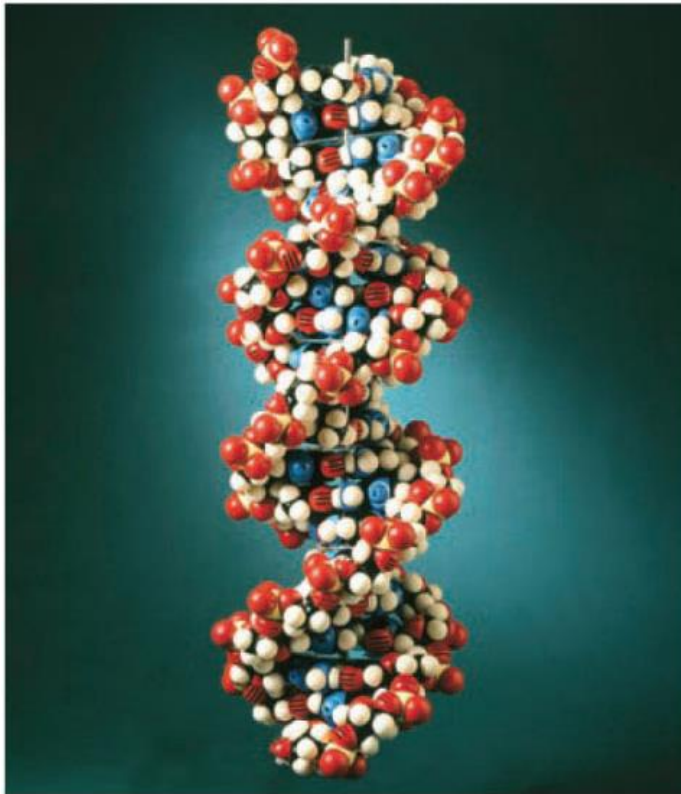




- 생리적인 조건 (pH 7)에서 phosphate은 -2 전하를 띤다. dianion이다.
- P_i는 inorganic phosphate의 약자로서 monophosphate을 가리킨다.
- Nucleotide는 염기 수용액 또는 효소에 의해서 쉽게 가수분해된다.

5. The Primary Structure of DNA

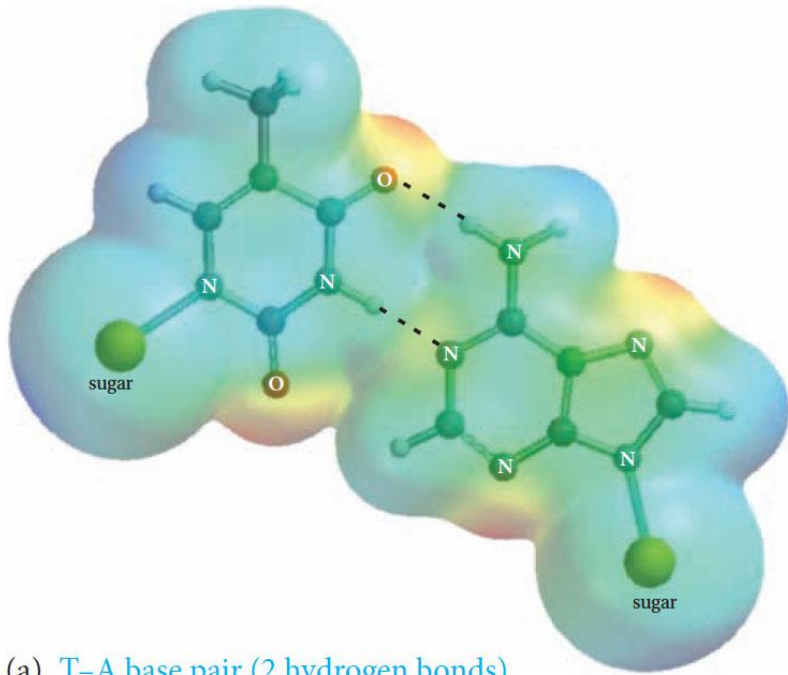




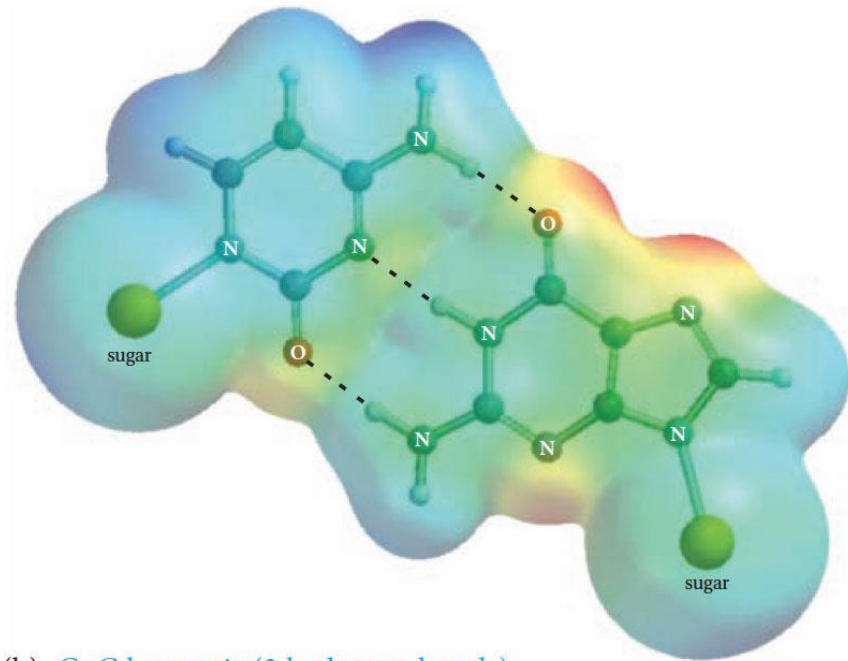
A = T pairs have two hydrogen bonds

G ≡ C pairs have three hydrogen bonds

D = deoxyribose
 P = phosphate
 A = adenine
 T = thymine
 G = guanine
 C = cytosine

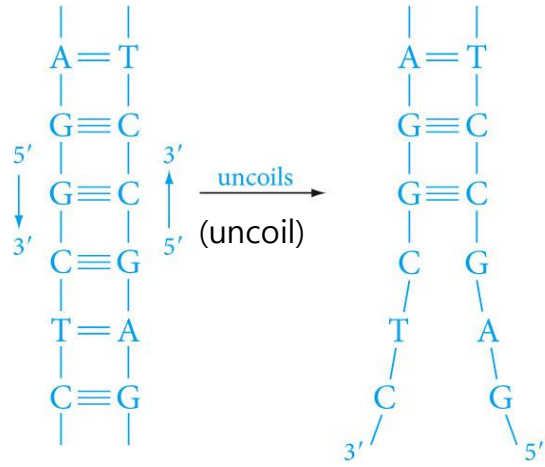


(a) T-A base pair (2 hydrogen bonds)

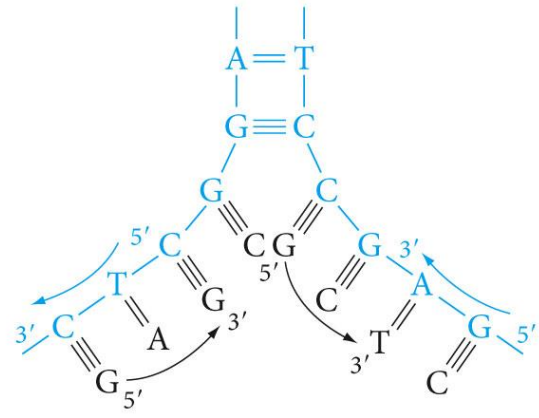


(b) C-G base pair (3 hydrogen bonds)

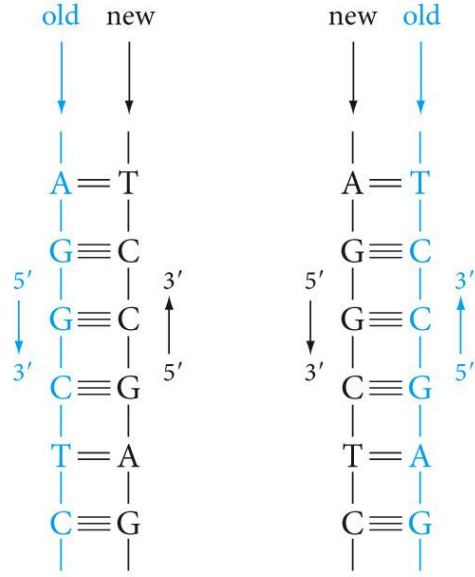
9. DNA replication



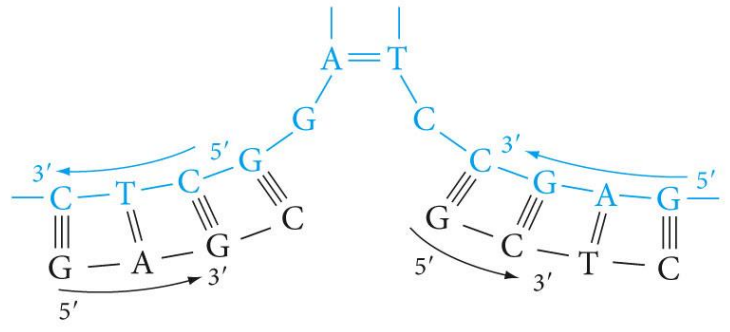
Nucleotides in the cell are bonded to the separating strands.



A polymerizing enzyme (DNA-polymerase) links the nucleotides in the new strands.

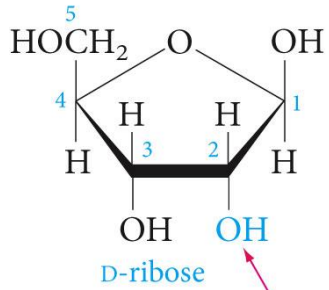


The process continues until each strand is replicated.

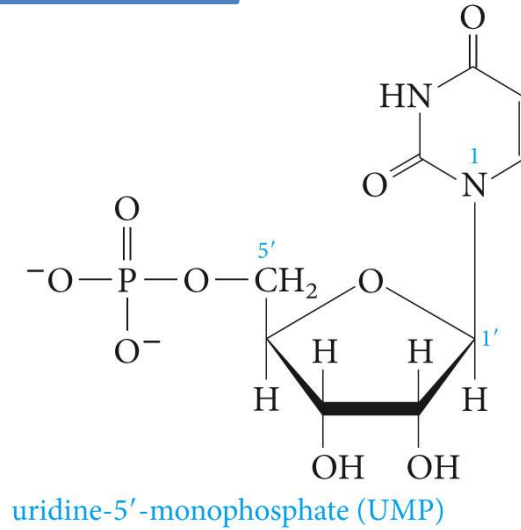
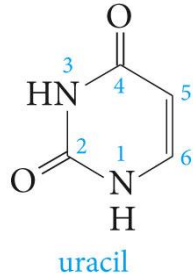


two new double helices

10. Ribonucleic Acids; RNA

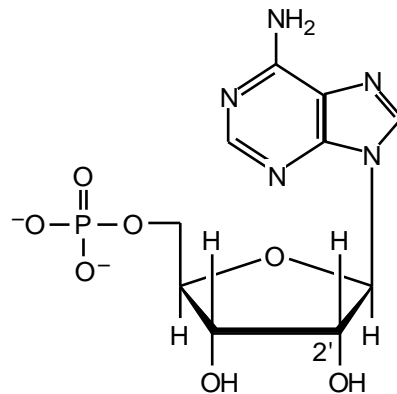


hydroxyl
at C-2



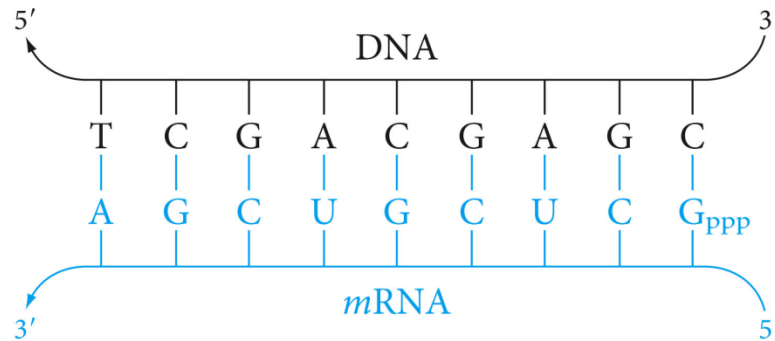
Thymidine 대신 uracil이 쓰인다.

Problem 6. Draw the structure of adenosine-5'-monophosphate (AMP)



11. The Genetic Code and Protein Biosynthesis

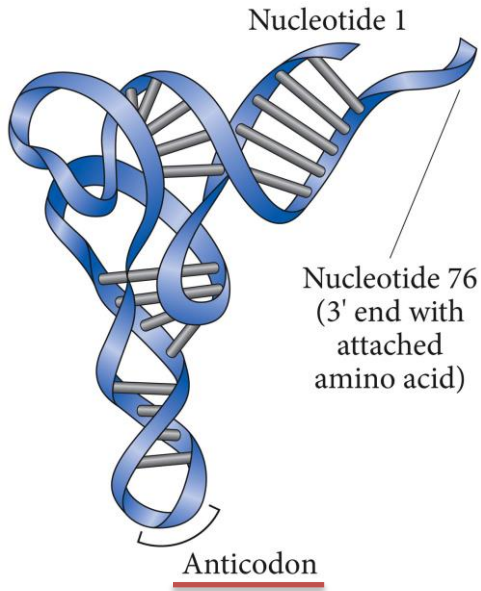
Transcription(전사)



Translation

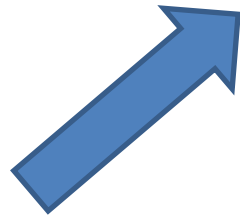
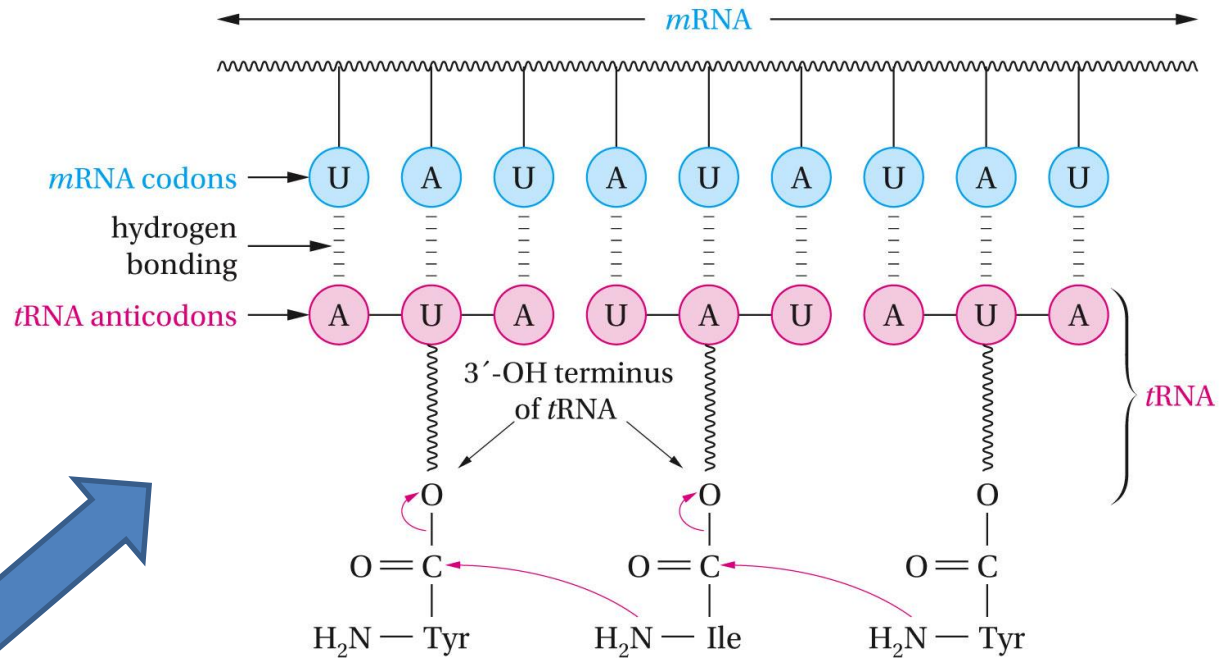
Table 18.2 The Genetic Code; Translation of the Codons into Amino Acids

First base (5' end)	Middle base	Third base (3' end)			
		<i>U</i>	<i>C</i>	<i>A</i>	<i>G</i>
U	U	Phe	Phe	Leu	Leu
	C	Ser	Ser	Ser	Ser
	A	Tyr	Tyr	Stop	Stop
	G	Cys	Cys	Stop	Trp
C	U	Leu	Leu	Leu	Leu
	C	Pro	Pro	Pro	Pro
	A	His	His	Gln	Gln
	G	Arg	Arg	Arg	Arg
A	U	Ile	Ile	Ile	<u>Met (start)</u> (double duty)
	C	Thr	Thr	Thr	Thr
	A	Asn	Asn	Lys	Lys
	G	Ser	Ser	Arg	Arg
G	U	Val	Val	Val	Val
	C	Ala	Ala	Ala	Ala
	A	Asp	Asp	Glu	Glu
	G	Gly	Gly	Gly	Gly



Transfer RNA (tRNA)

There is at least one tRNA for each of the 20 amino acids.



**Ribosomal RNA (rRNA),
리보솜의 구성성분**

RNA도 protein처럼 enzyme의 역할을 할 수 있다.

RNA + enzyme → ribozyme

Problem 7.

A polynucleotide made from the dinucleotide UA turned out to be (Tyr-Ile)_n.

UAU AUA UAU ...



UAU is the codon for Tyr, and AUA is a codon for Ile.

Problem 18.

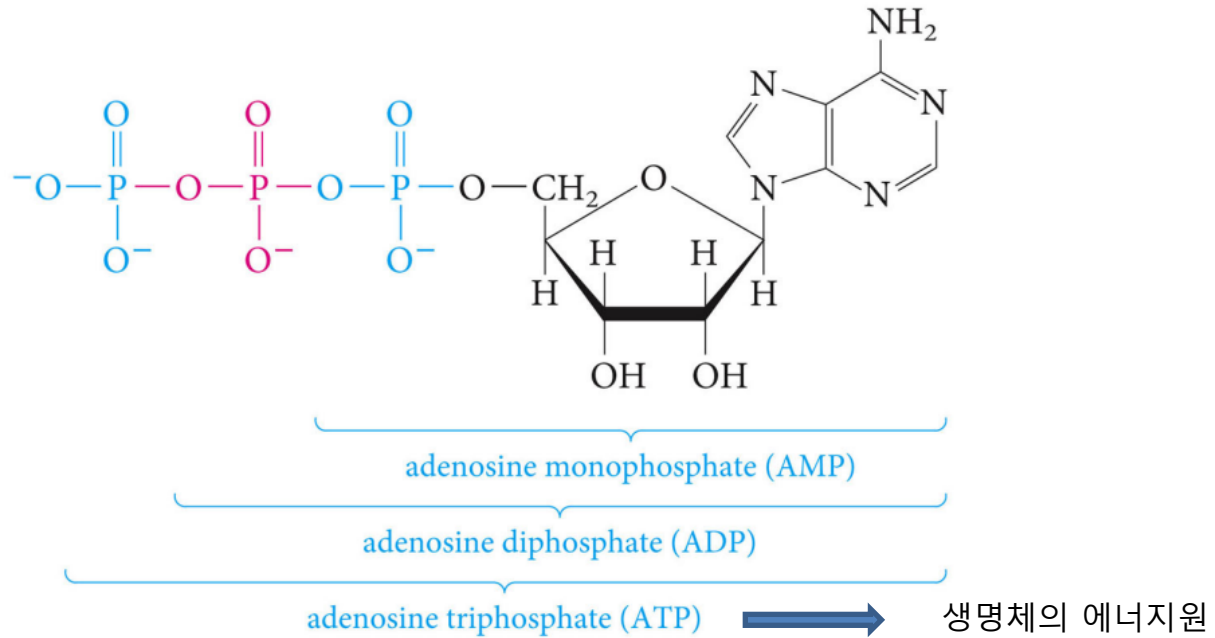
Mutations (caused by radiation, cancer-producing agents, or other means) may replace one base with another or may add or delete a base.

What would happen to the protein produced if the sequence UUU were mutated to UCU?
If UCU were mutated to UCC?

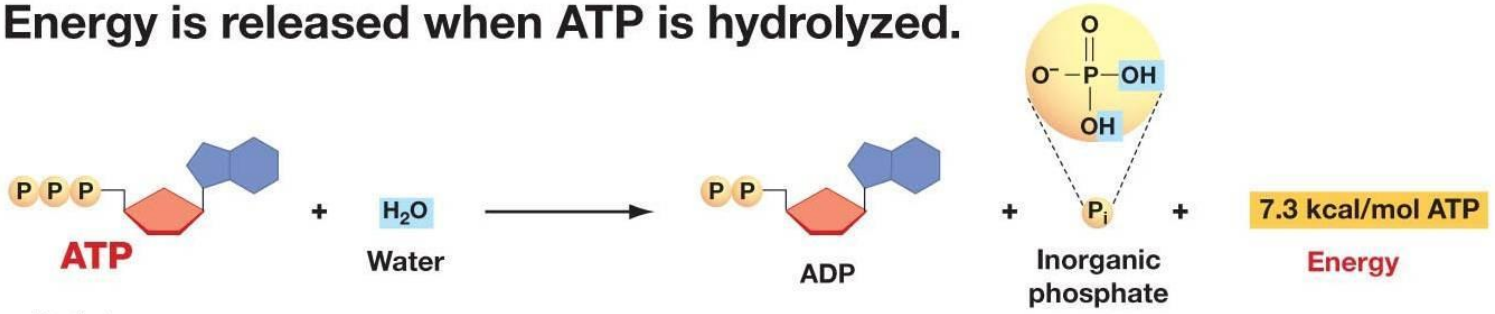
UUU sequence were to be mutated to UCU (the codon for serine), the protein produced would have a Ser residue in place of the Phe.

Since UCU and UCC both code for Ser, a UCU → UCC mutation would not lead to a change in the protein sequence.

12. Other Biologically Important Nucleotides



(b) Energy is released when ATP is hydrolyzed.



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