

생유기화학
(*Bioorganic Chemistry*)

Nucleotides and Nucleic Acids-I
(뉴클레오타이드, 핵산-1)

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순천향대

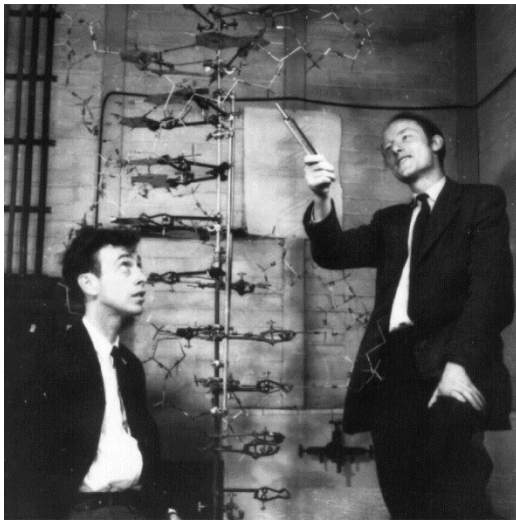
나노화학공학과

임정균 교수

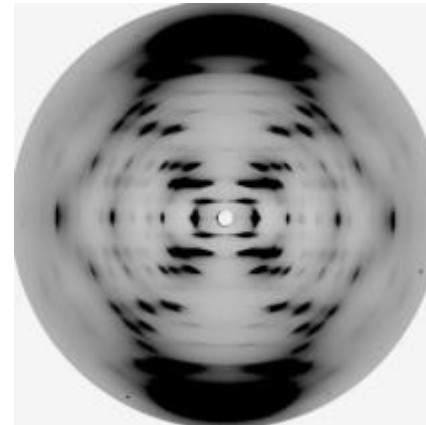


DNA (Deoxyribonucleic acid)

- 생물의 유전현상에 큰 역할을 하는 핵산의 일종으로 유전정보를 담는 화학물질
- 염기(아데닌, 구아닌, 시토신, 티민)와 디옥시리보오스 5탄당(탄소가 5개 있는 당) 및 인산으로 된 고분자 화합물로 염색체의 주성분이며 실질적인 유전물질이다.
- 1953년 왓슨(J. D. Watson)과 크릭(F. C. Crick)은 DNA가 2중나선형의 분자구조를 하고 있다는 것을 밝혀 노벨상을 수상하였다. (1953.4.25 <네이처>에 DNA구조를 밝힌 논문 발표함)
- 참고: Nucleic acid (핵산) : DNA, RNA 모두 포함

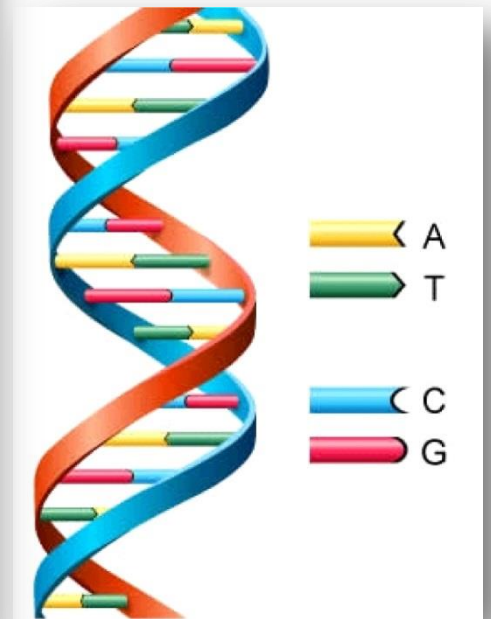
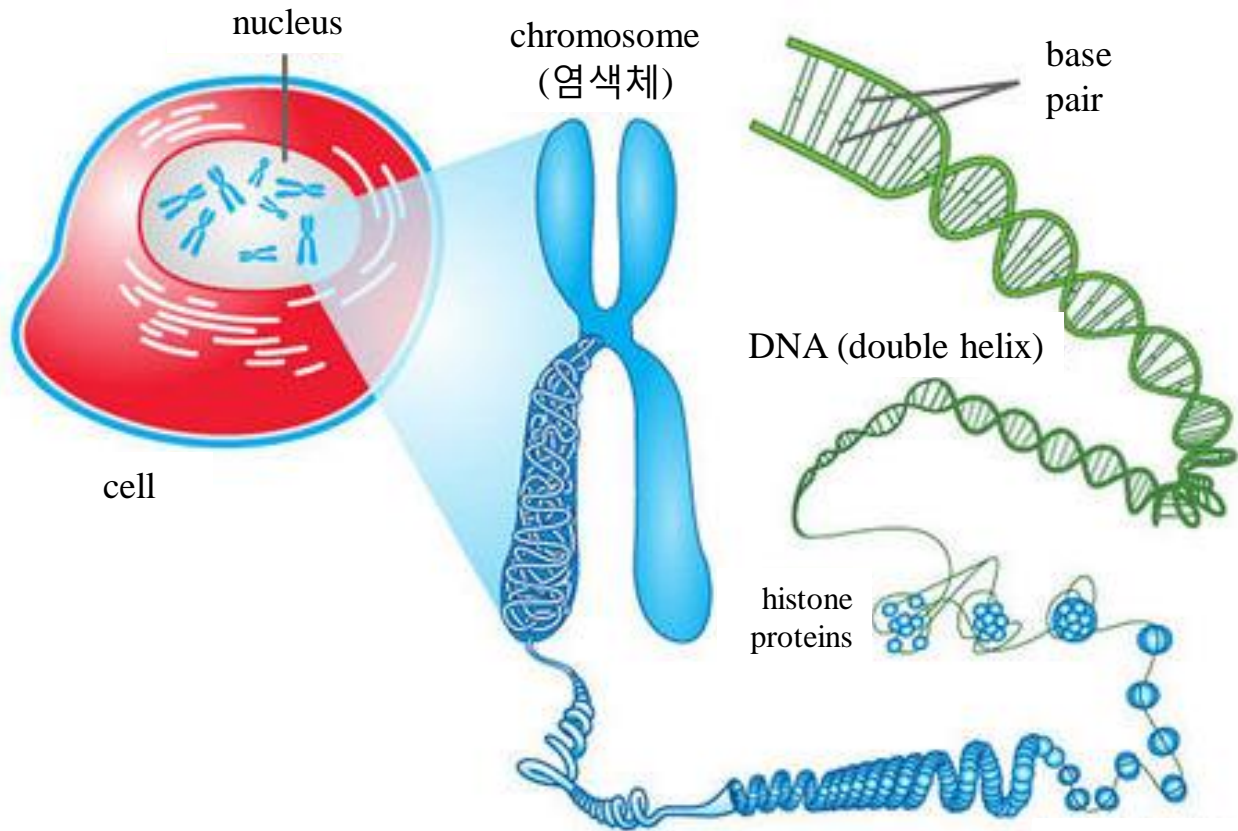


Watson and Crick



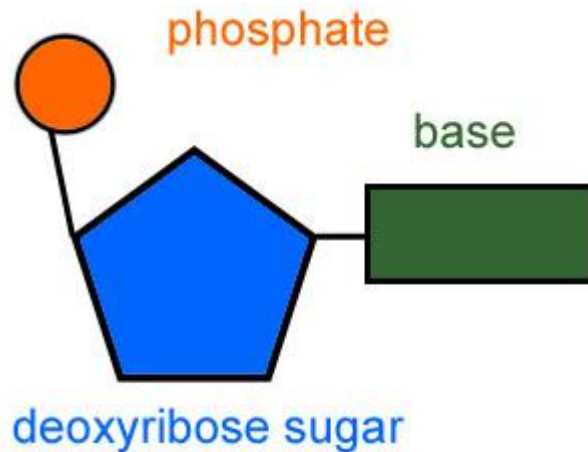
X-ray diffraction photo
(DNA의 이중 나선 구조를 풀어냄)

Cell, chromosomes and DNA

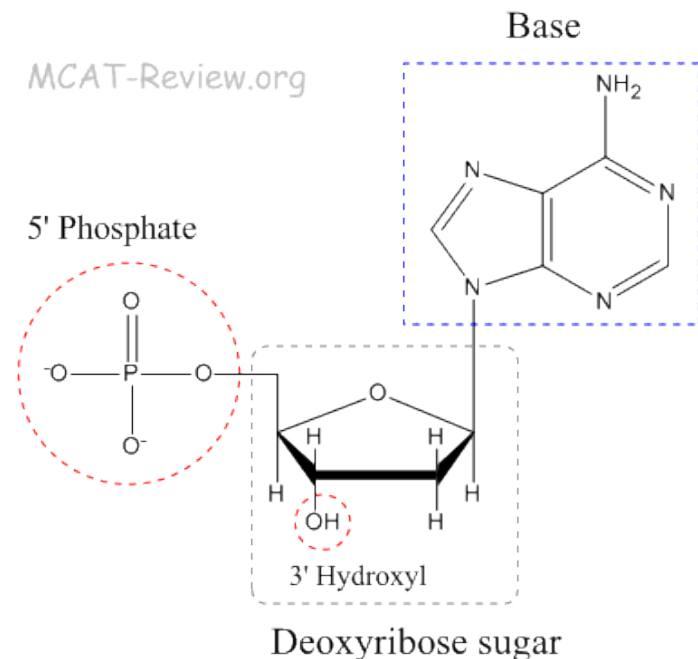


DNA Structure and Function

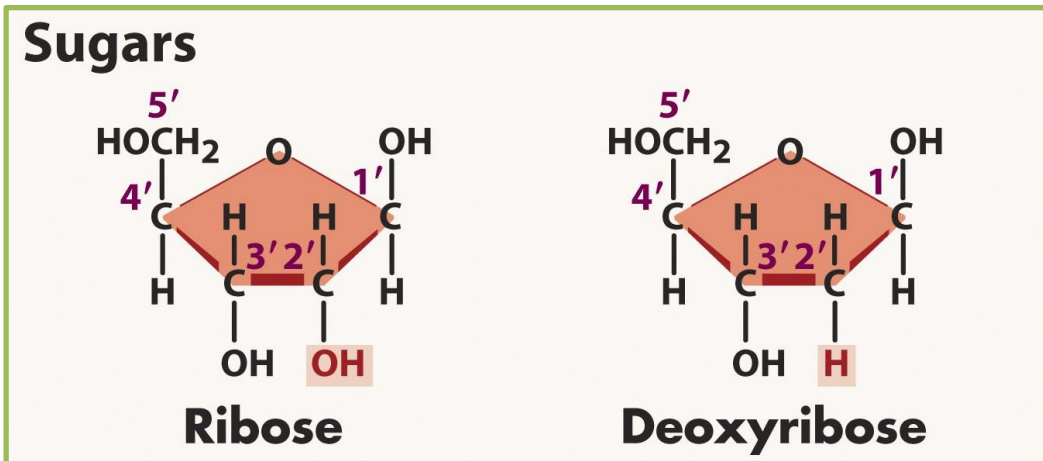
- ◆ Watson-Crick model of DNA; double helix
 1. The "double" in the double helix means that DNA is found in a double-stranded form - 2 single-stranded chains of DNA stuck to each other via **hydrogen bonding** of the base pairs.
 2. The 2 single-strands are anti-parallel to each other. Going from 5' to 3' of one strand means going from 3' to 5' of the other strand.
 3. The "helix" in the double helix means that the entire thing is wound up in a spiral.
- ◆ DNA composition: purine and pyrimidine bases, sugars, phosphate
- ◆ The phosphate group gives DNA its acidity.



Nucleotide = base + sugar + phosphate



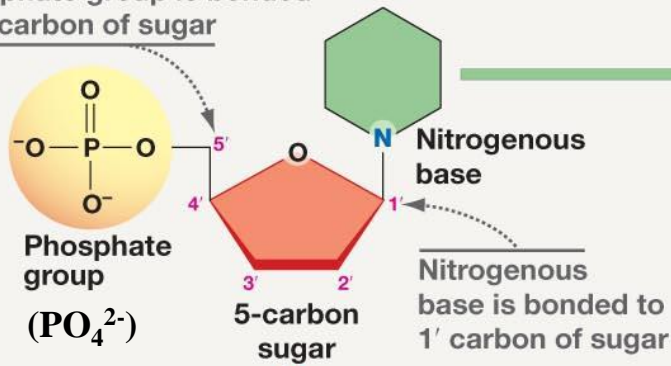
sugar = carbohydrate = polysaccharide = 탄수화물



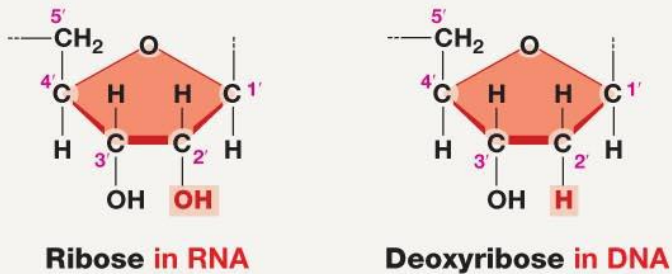
5탄당

(a) Nucleotide

Phosphate group is bonded to 5' carbon of sugar

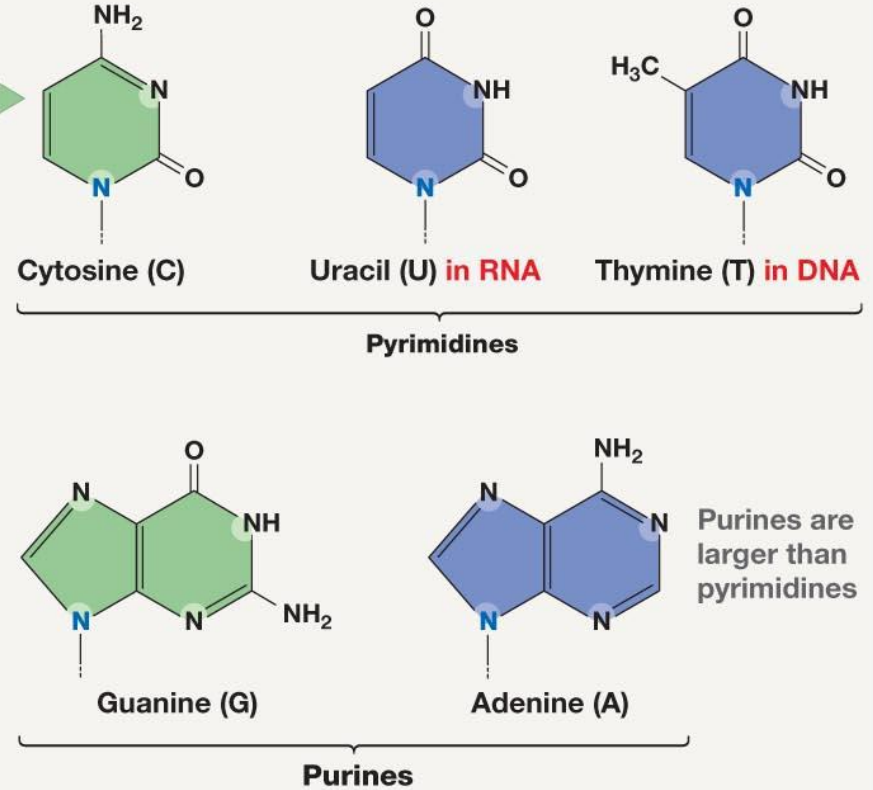


(b) Sugars

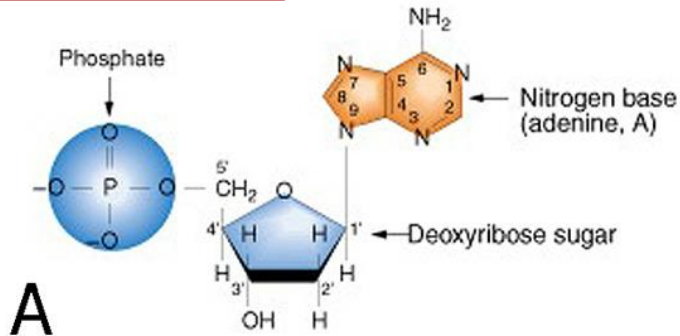


(nucleobase, base)

(c) Nitrogenous bases

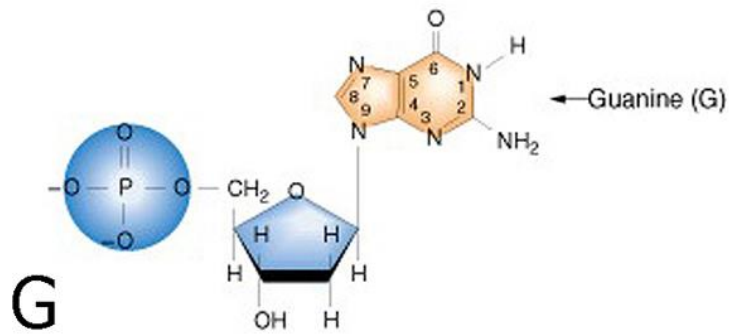


Purine nucleotides



A

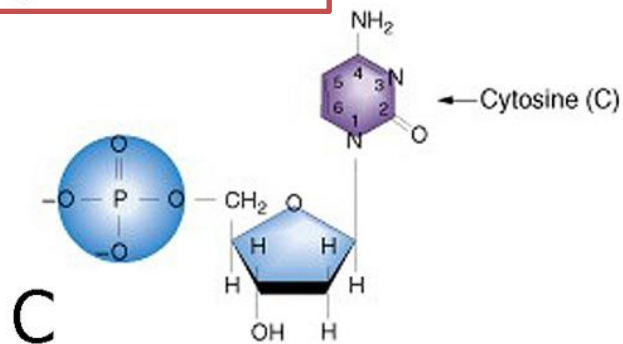
Deoxy**adenosine** 5'-phosphate (dAMP)



G

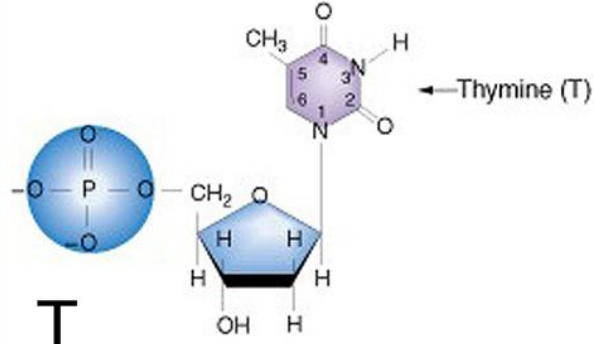
Deoxy**guanosine** 5'-phosphate (dGMP)

Pyrimidine nucleotides



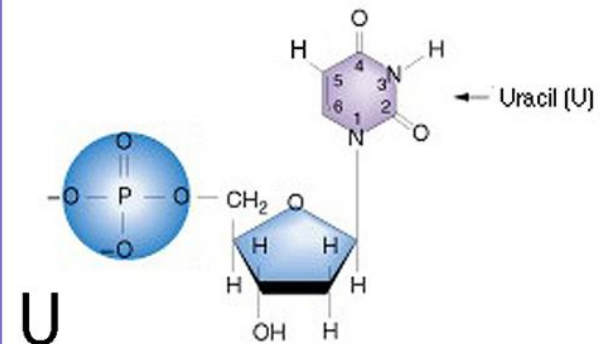
C

Deoxy**cytidine** 5'-phosphate (dCMP)



T

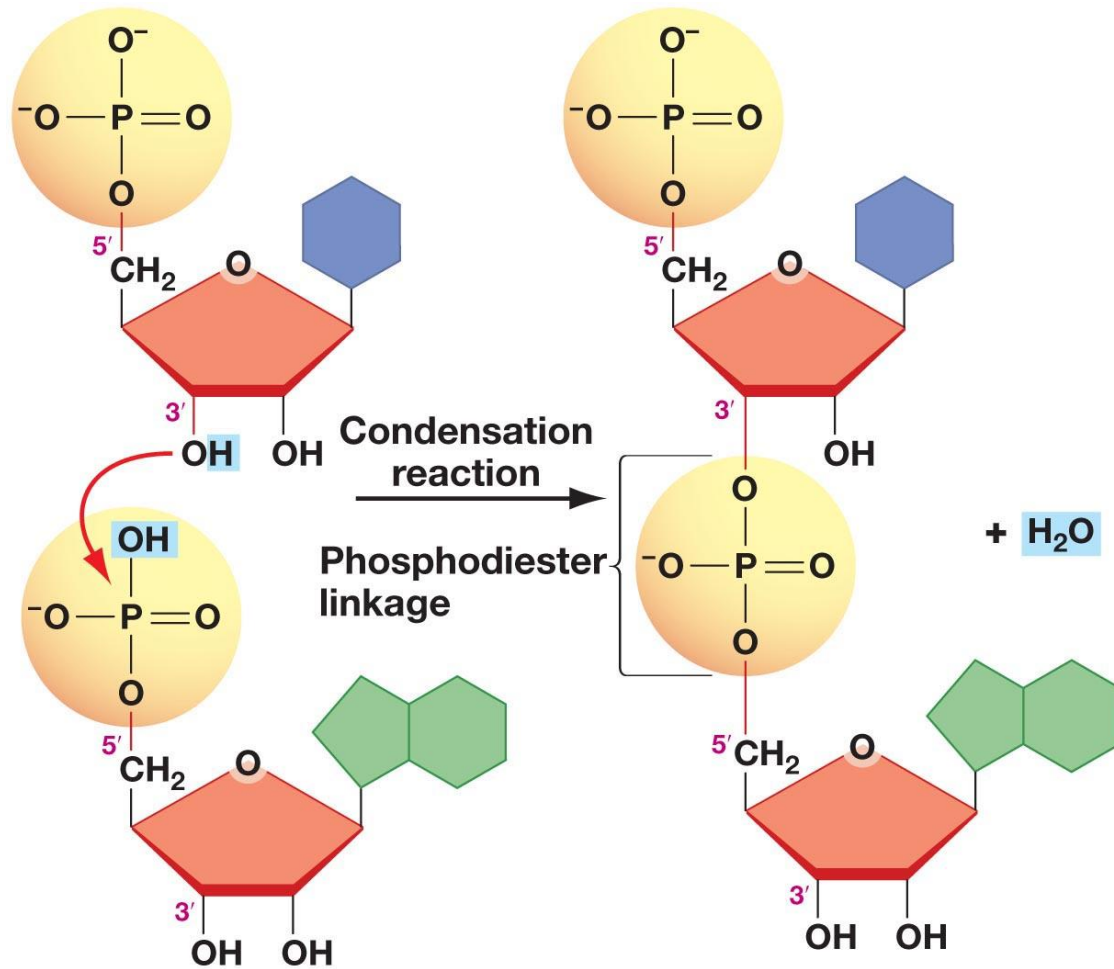
Deoxy**thymidine** 5'-phosphate (dTMP)
(DNA only)



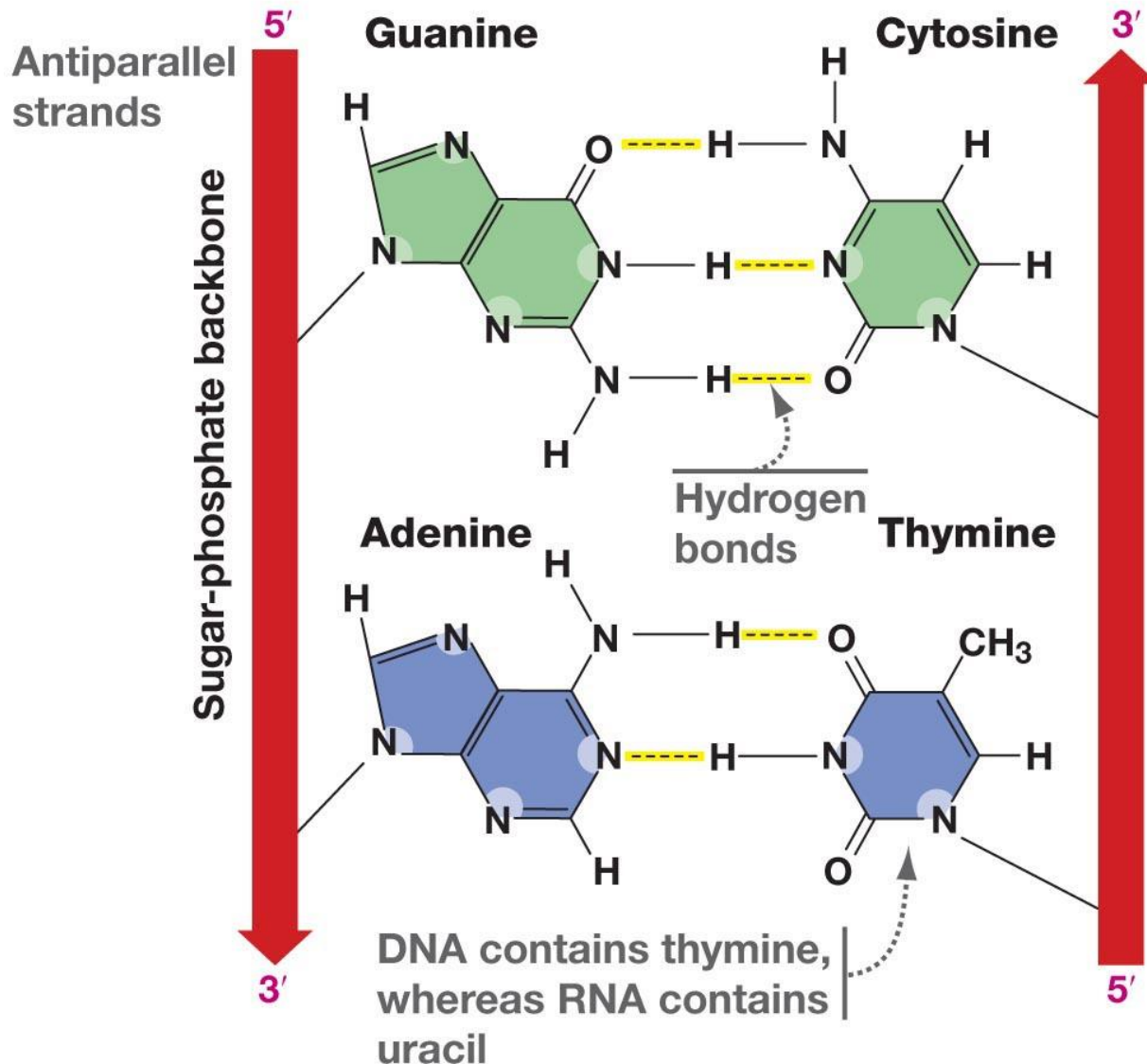
U

Deoxy**uridine** 5'-phosphate (dUMP)
(RNA only)

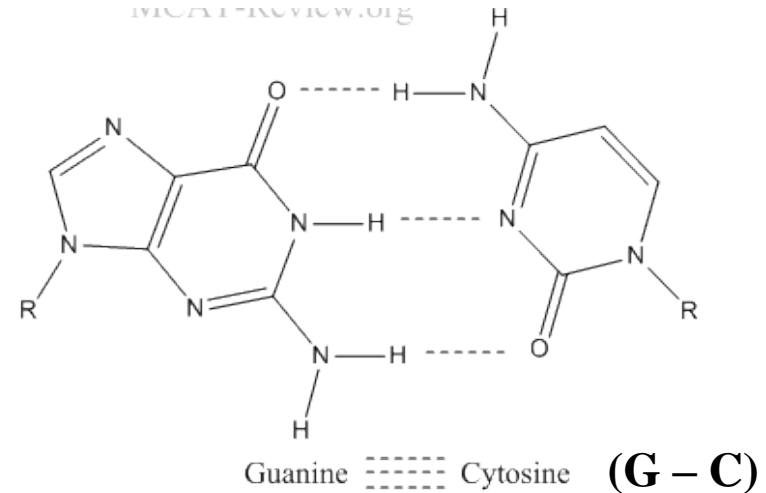
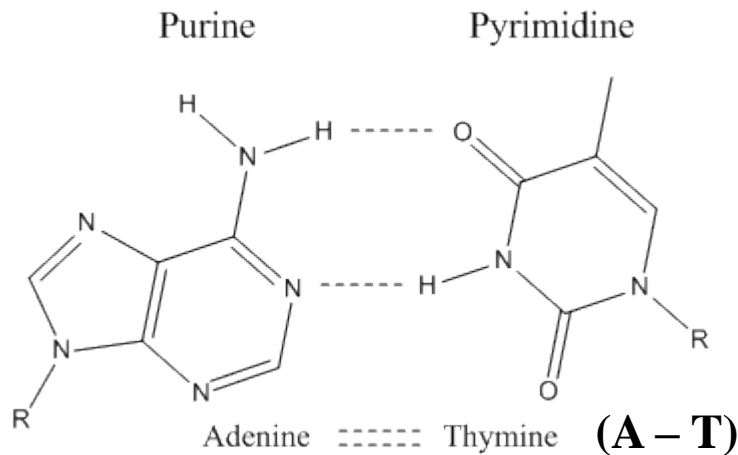
Nucleotide간의 결합



(b) Hydrogen bonds form between G-C pairs and A-T pairs.



Base pair(염기쌍)간의 hydrogen bonding



- A forms 2 hydrogen bonds with T.
- G forms 3 hydrogen bonds with C.
- GC bonds are stronger. DNA with high GC content will be harder to break apart.
- Complementary strands of DNA hydrogen bond with each other.
- 5'-ATGC-3' will be complementary to 5'-GCAT-3' or 3'-TACG-5', but NOT 5'-TACG-3'.
make sure you get the 5's and 3's right.
- Hydrogen bonding : intermolecular attractions caused by hydrogen bonded to an electronegative element (F, O, N)
- 수소결합은 van der Waals attraction보다는 강하나 공유결합, 이온결합보다는 약하다.

(a) Only purine-pyrimidine pairs fit inside the double helix.

