

생유기화학  
(*Bioorganic Chemistry*)

Nucleotides and Nucleic Acids-II  
(뉴클레오타이드, 핵산-2)

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Department of Chemical Engineering

Prof. Jungkyun Im

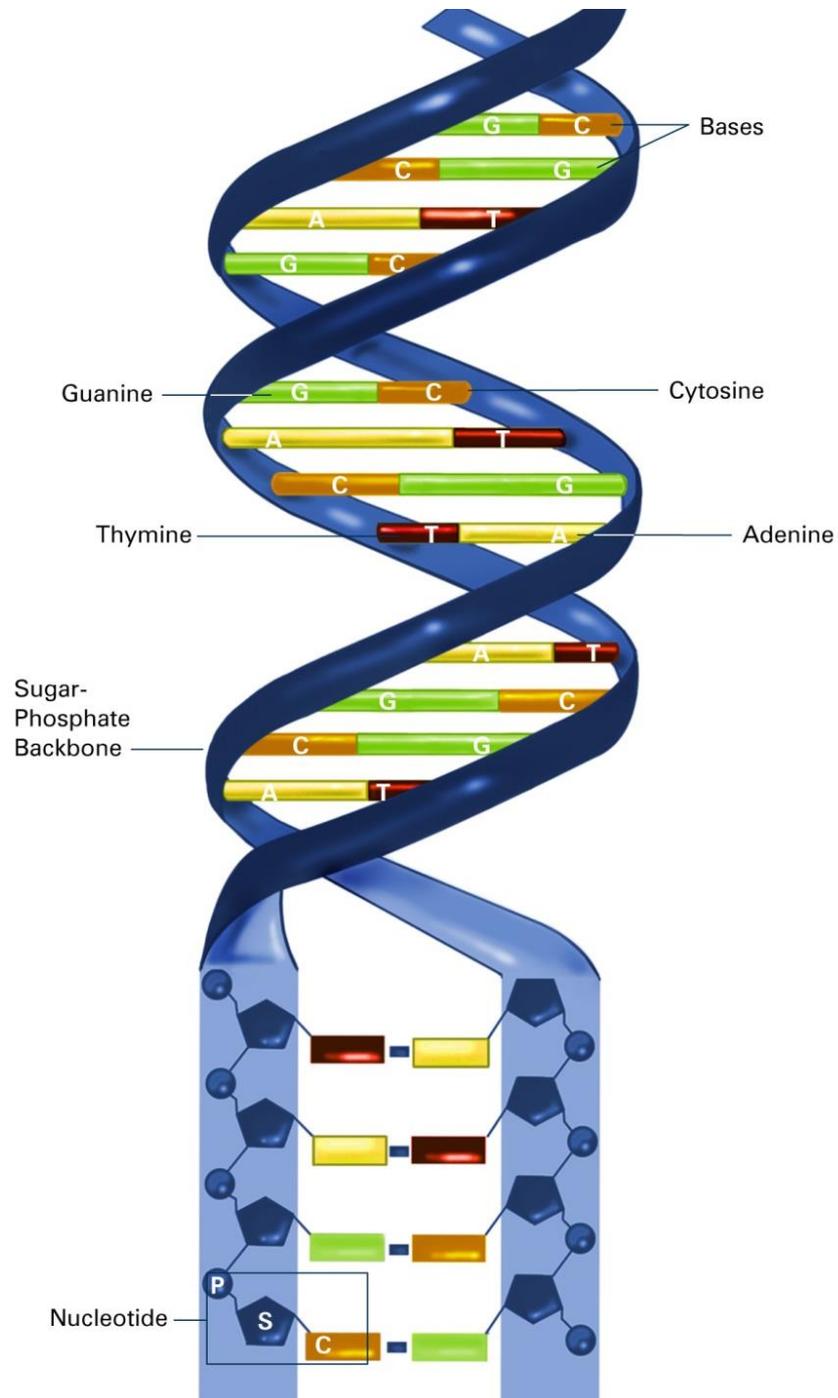
순천향대

나노화학공학과

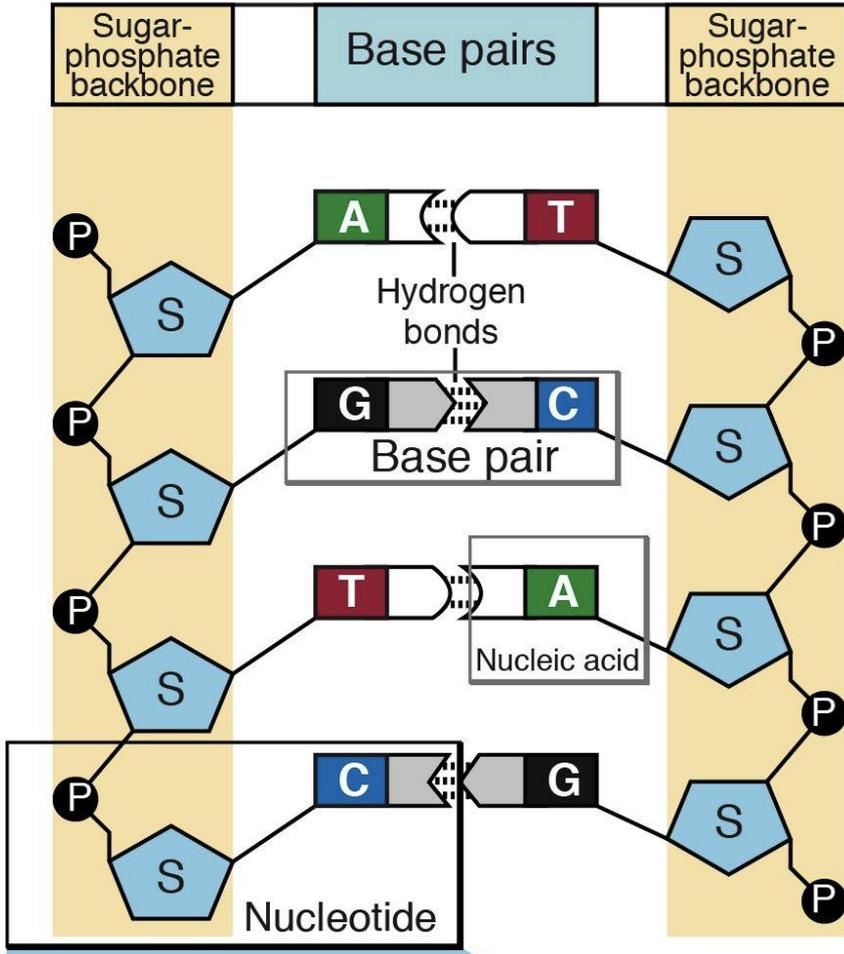
임정균 교수



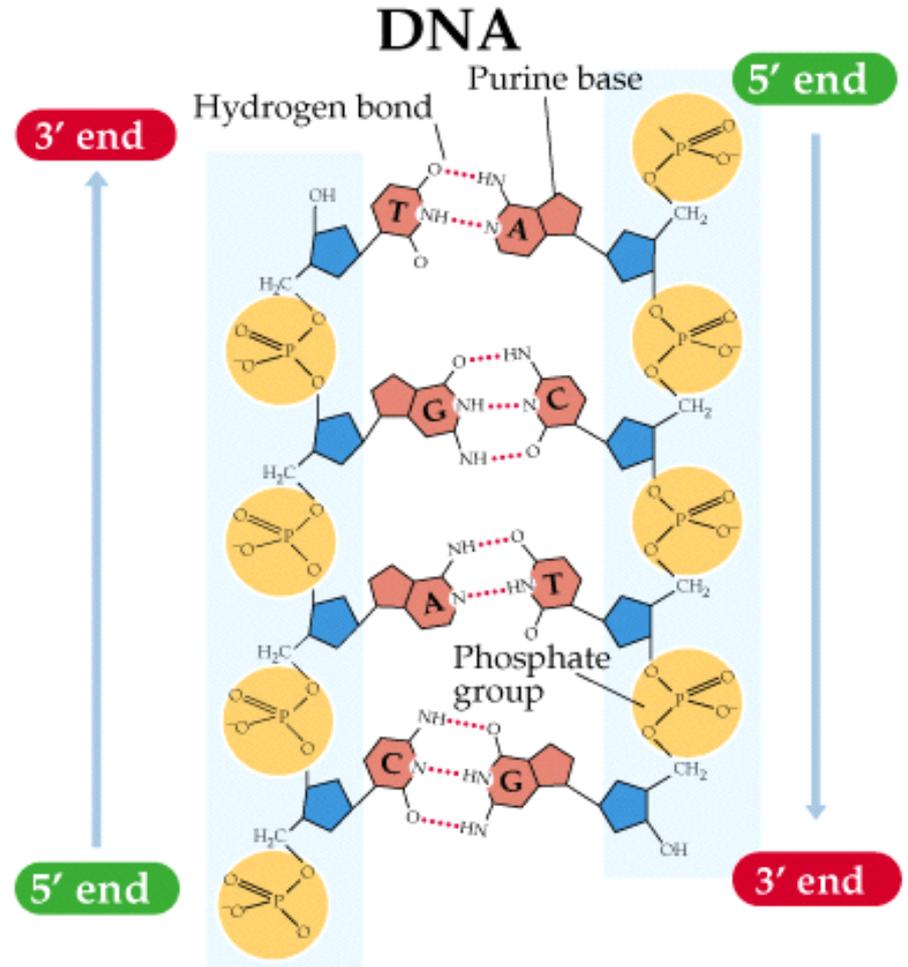
double-helical DNA



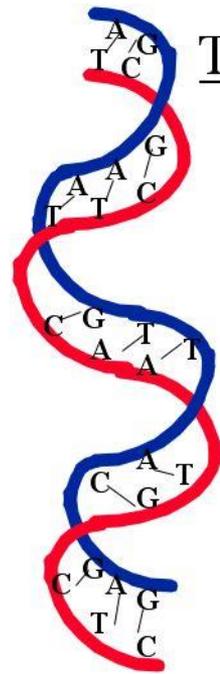
# Deoxyribonucleic Acid (DNA)



- A** Adenine
- T** Thymine
- C** Cytosine
- G** Guanine



antiparallel



## The double helix

**5' ACGGGTACATGAC 3'**



**3' TGCCCATGTACTG 5'**

antiparallel complimentary strand

These two single-stranded molecules will anneal as shown:

5' -ACCTGATAGG-3'

+



5' -ACCTGATAGG-3'  
3' -TGGACTATCC-5'

annealing or hybridization

3' -TGGACTATCC-5'

Can you understand why the two single-stranded DNA molecules shown below cannot anneal to one-another?

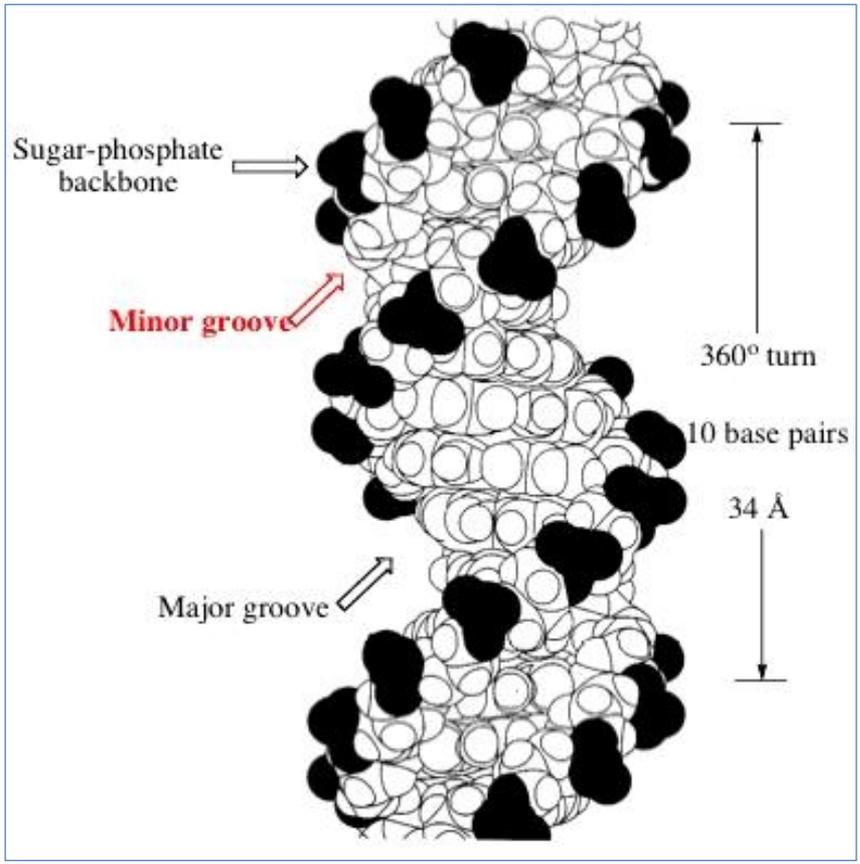
5' -TGACGTAGGTAC-3'

+

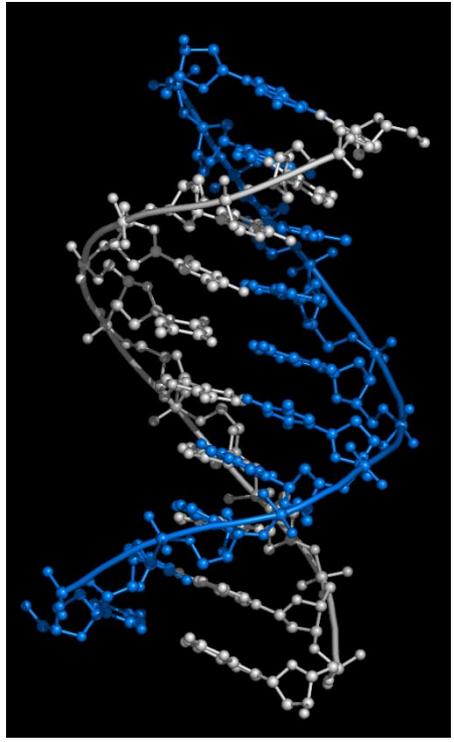


X

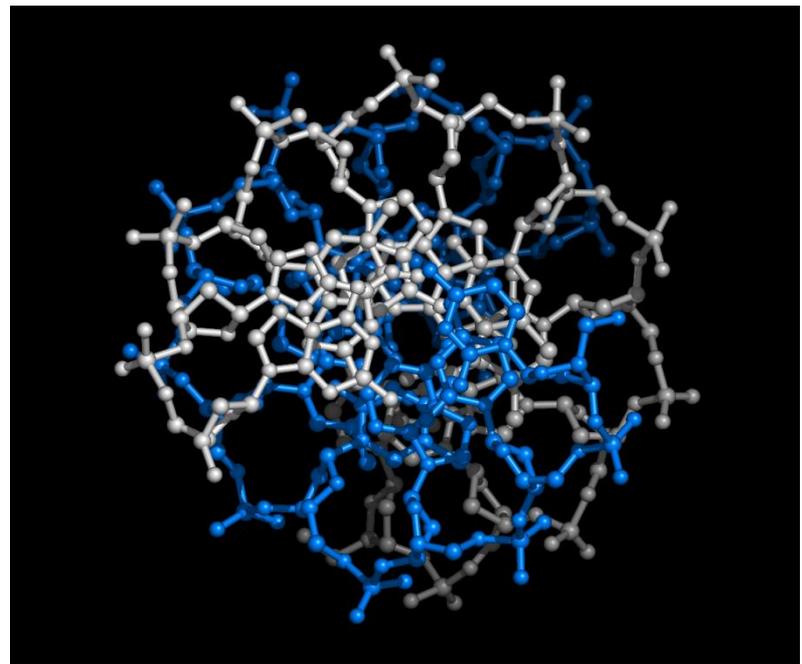
5' -ACTGCATCCATG-3'



side view

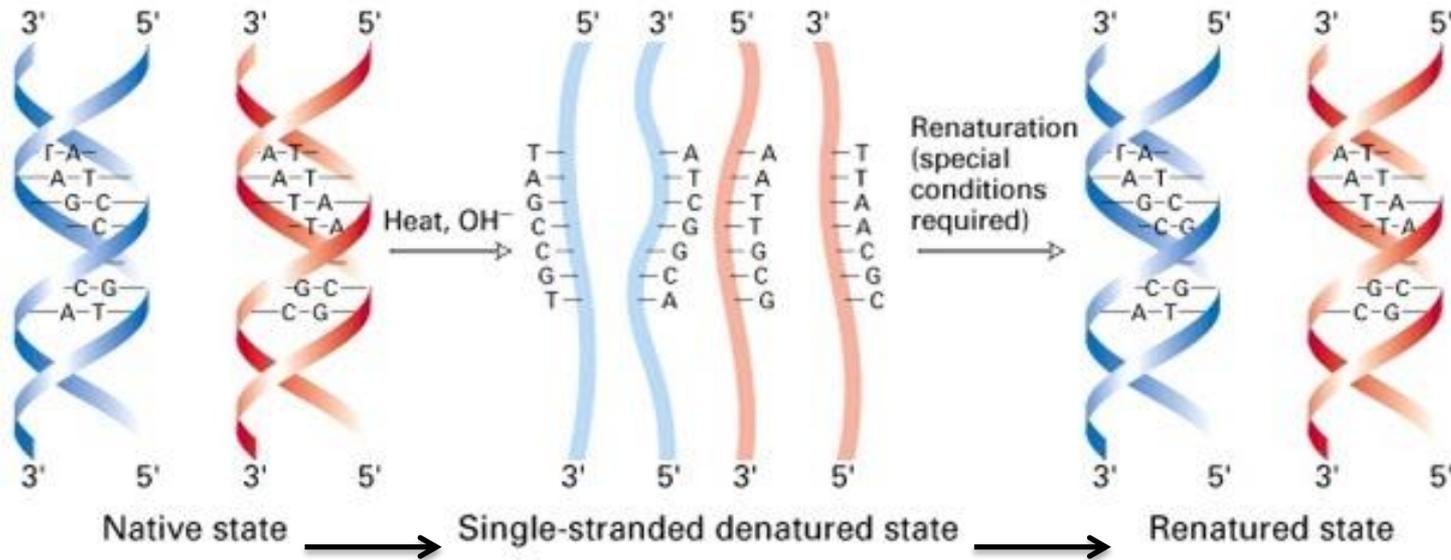


top view



경계 주위는 negative charge.  
So what?

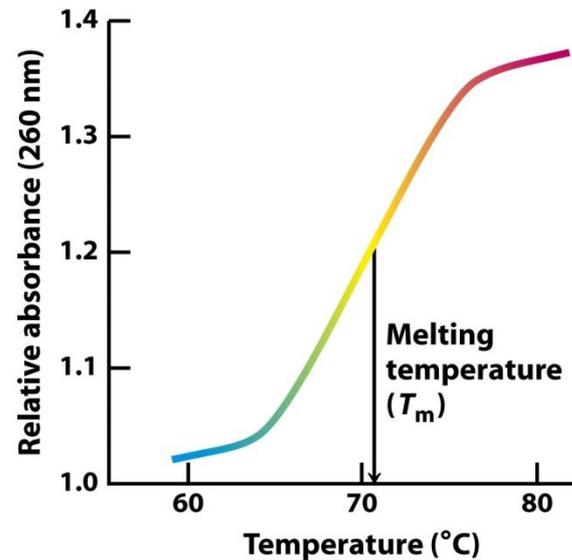
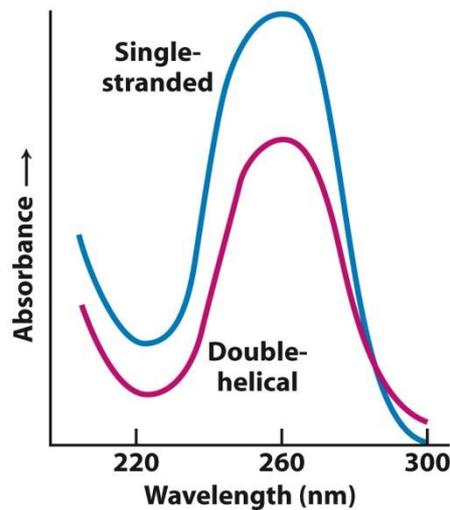
- **Denaturation:** The process of formation of single stranded DNA from double stranded helical DNA upon heating
- **Renaturation:** The process of formation of double stranded DNA (reannealing) from single stranded DNA upon cooling.



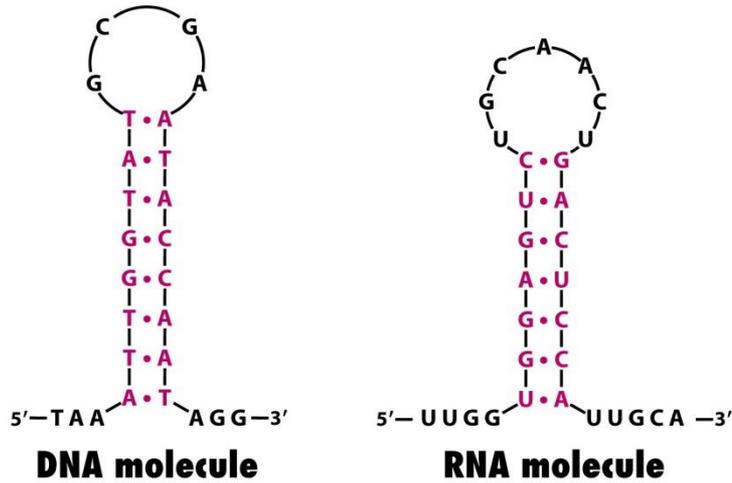
melting (breakage of HB)

hybridization, annealing

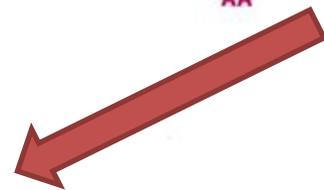
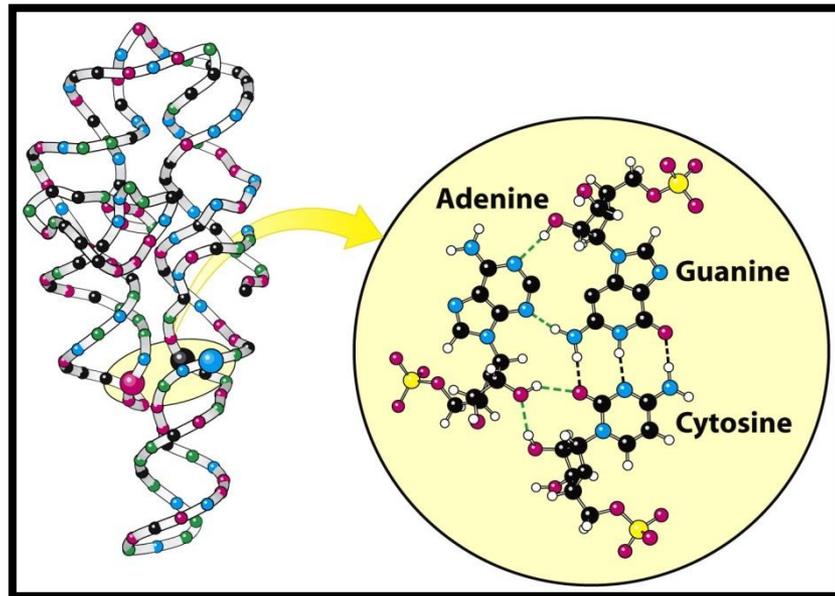
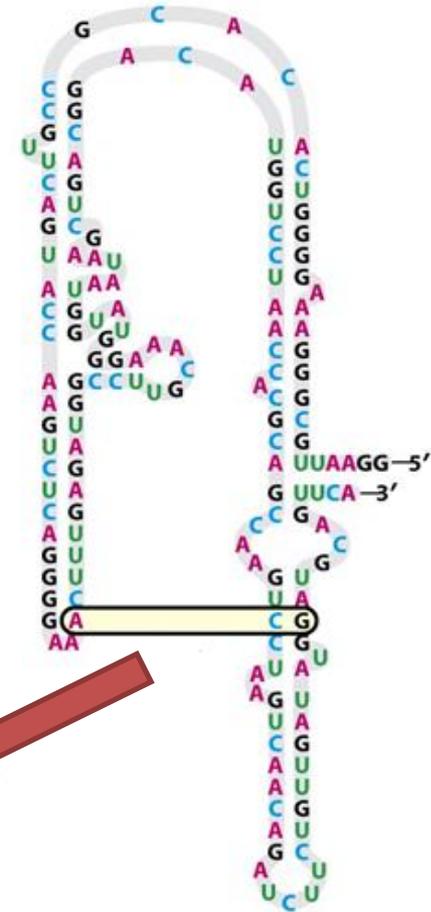
single-stranded DNA absorbs light more efficiently than double-helical DNA



single-stranded nucleic acid는 double helix구조를 갖기도 하지만 스스로 접어서 loop 형태를 띠기도 한다.



Complex structure of an RNA molecule



대부분은 Watson-Crick base pair를 이루나 구조의 일부분에서 mismatched base를 포함할 수 있다.

그러한 mismatch는 local structure를 불안정시킬 수 있으나, mismatch base를 통하여 중요한 기능을 할 수 있는 새로운 3차원적인 구조를 만들어낼 수 있다.

# Transcription & Translation



**Transcription(전사):** DNA를 원본으로 사용하여 RNA를 만드는 과정을 말한다.

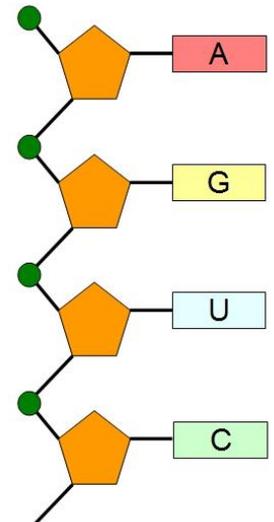
**Translation(번역):** 유전자 발현과정에서 mRNA(전령 RNA)의 염기배열에 따라 아미노산이 연결되어 단백질이 합성되는 과정이다.

**전령 RNA (messenger RNA {mRNA})**는 RNA 분자가 화학적으로 암호화된 단백질을 생산하는데 있어서 '설계도'와 같은 역할을 한다.

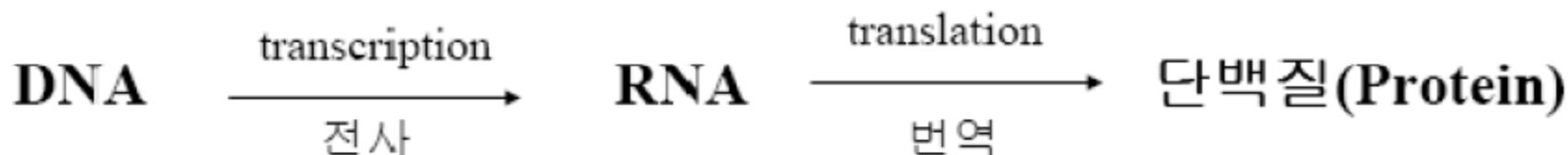
**운반 RNA (transfer RNA {tRNA})**는 translation과정에서 각각의 위치에 맞는 아미노산을 가져와 원래의 폴리펩티드 사슬에 결합시켜 주는 역할을 하는 RNA

**rRNA (Ribosomal RNA), snRNA (small nuclear RNA), siRNA** 등이 있다.

Structure of RNA:



# 유전정보의 흐름



## 단백질(Protein)

### 구조 단백질

콜라겐 (뼈와 피부에서 발견됨)  
케라틴 (머리카락과 손톱 등을 만듦)  
피브리 (혈액 응고를 도움)  
엘라스틴 (인대의 주성분)

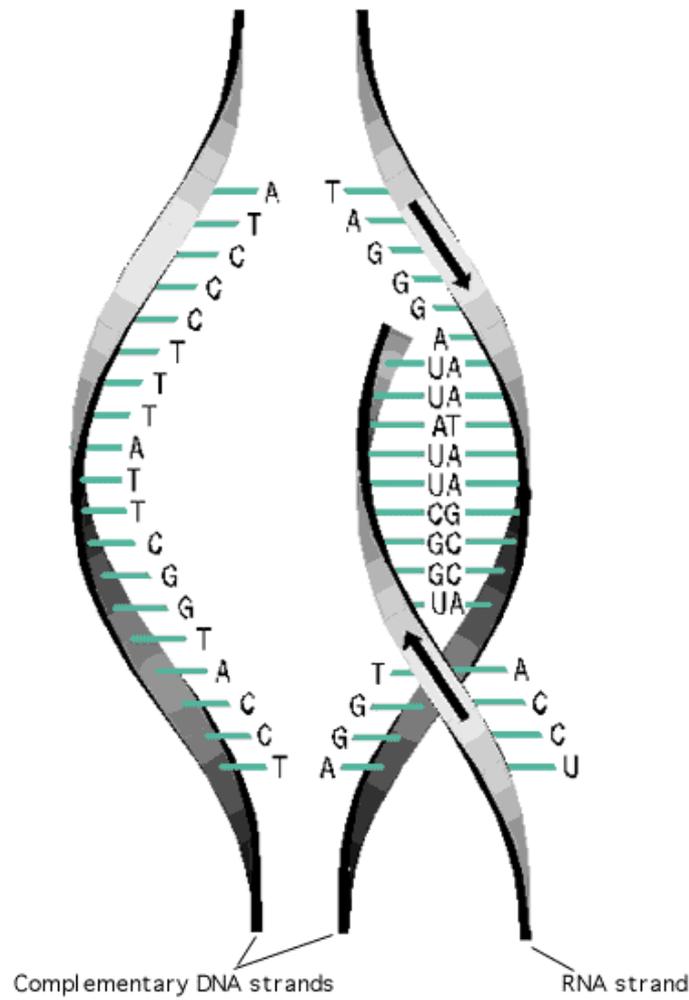
### 기능 단백질

호르몬 (신체의 기능을 조절함)  
항체 (면역 기능을 담당)  
효소 (신체 내의 화학반응을 촉진함)  
헤모글로빈 (혈액에서 산소를 운반함)

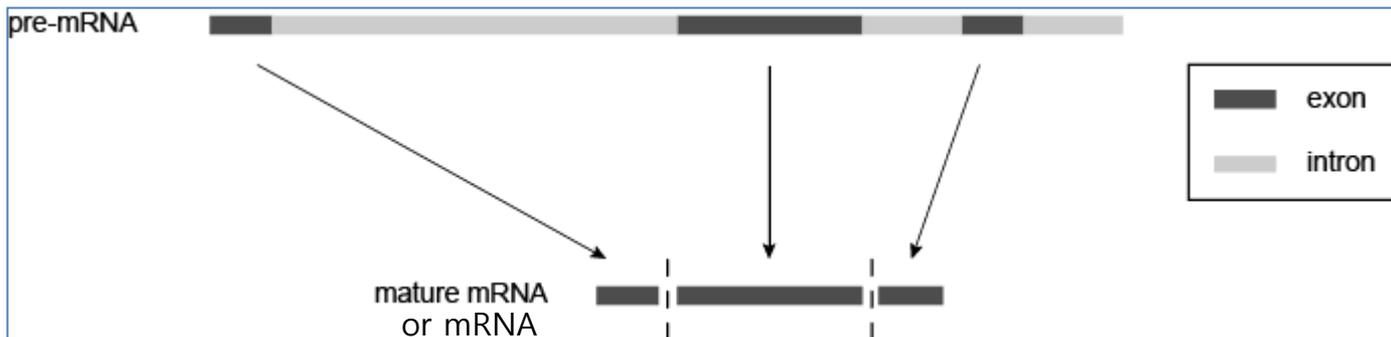
인체는 3만 종류이상의 단백질을 가지고 있음

잘못된 유전정보는 손상된 단백질을 만들고 따라서 질병을 초래할 수 있다!

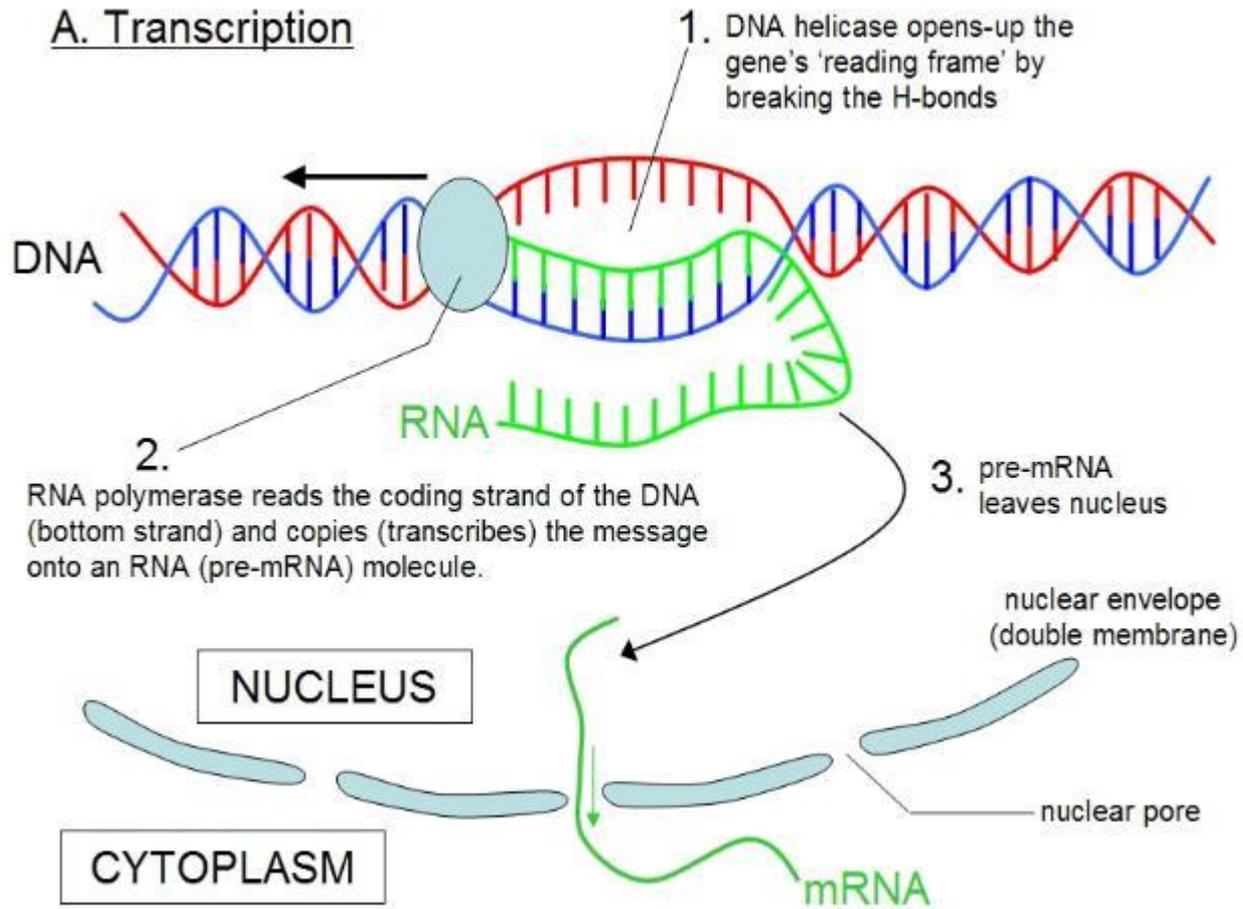
**(1)** transcription



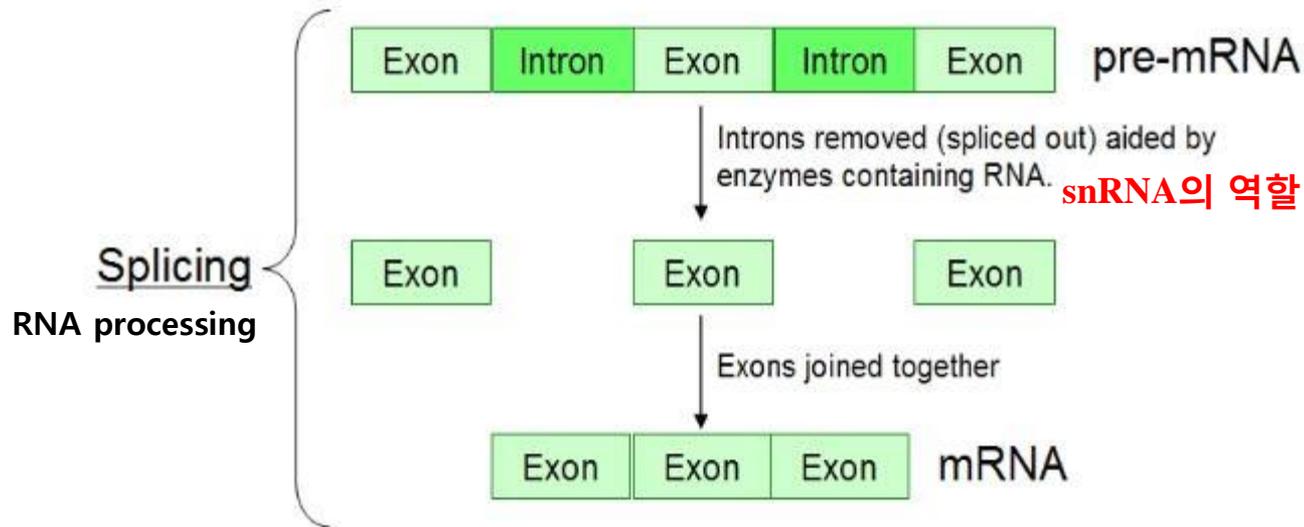
**(2)** splicing



## A. Transcription



## B. post-Transcriptional modification of pre-mRNA → mRNA



Splicing: in eukaryotes, non-coding DNA/RNA of unknown function (**introns**) are removed and the **exons** which code for the protein are joined together. Thought to occur either in the nucleus or the cytoplasm.

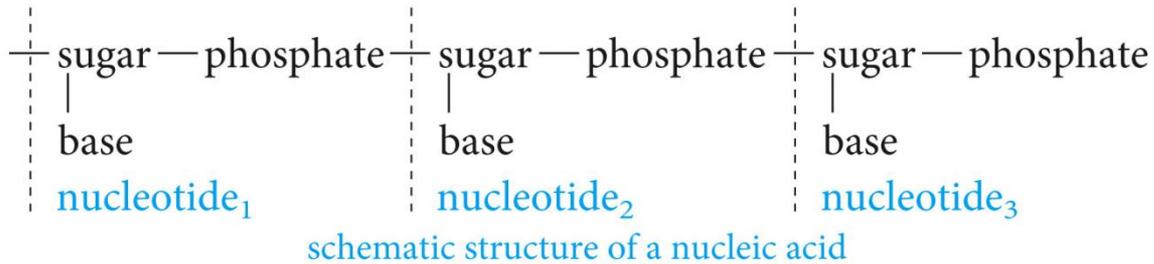
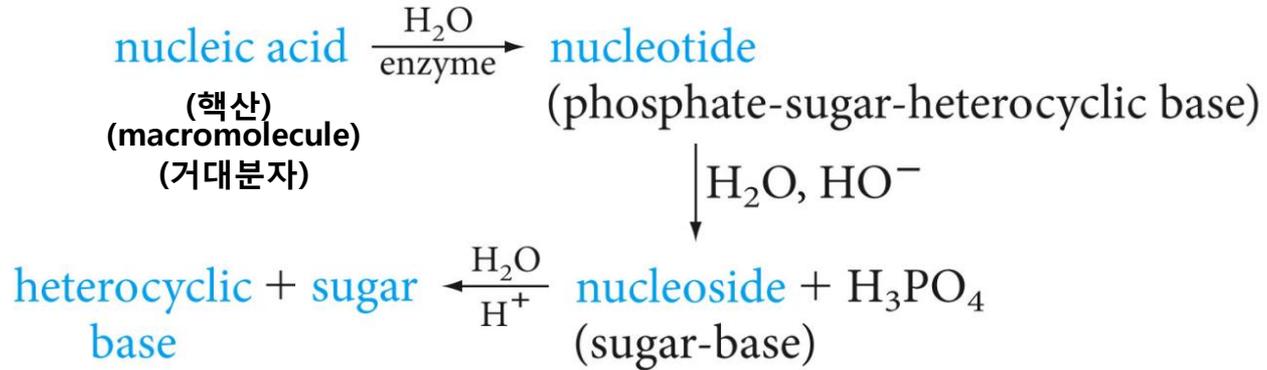
DNA를 구성하는 아미노산 서열들은 모두가 단백질과 같은 산물을 암호화하는 것은 아니다.

**Exon(엑손)**: DNA는 매우 복잡한 구성을 갖는데, DNA를 구성하는 아미노산 서열 중에 단백질과 같은 산물을 암호화하는 암호화 서열

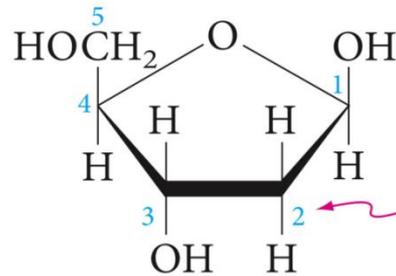
**Intron(인트론)**: DNA를 구성하는 아미노산 서열 중에 어떤 특정한 산물을 암호화하지 않는 비암호화 서열

\*사람과 같은 고등동물은 intron이 90%

# 1. The General Structure of Nucleic Acids

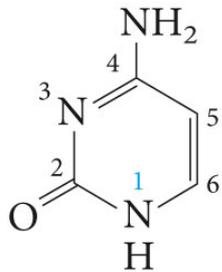


## 2. Components of Deoxyribonucleic Acid (DNA)

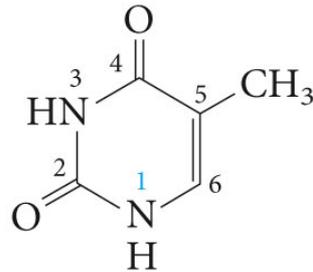


2-deoxy-D-ribose

the pyrimidines

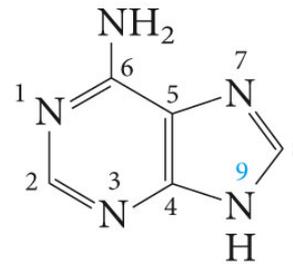


cytosine  
(C)

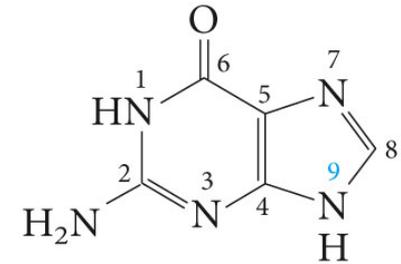


thymine  
(T)

the purines



adenine  
(A)



guanine  
(G)