

Introduction to Molecular Biology

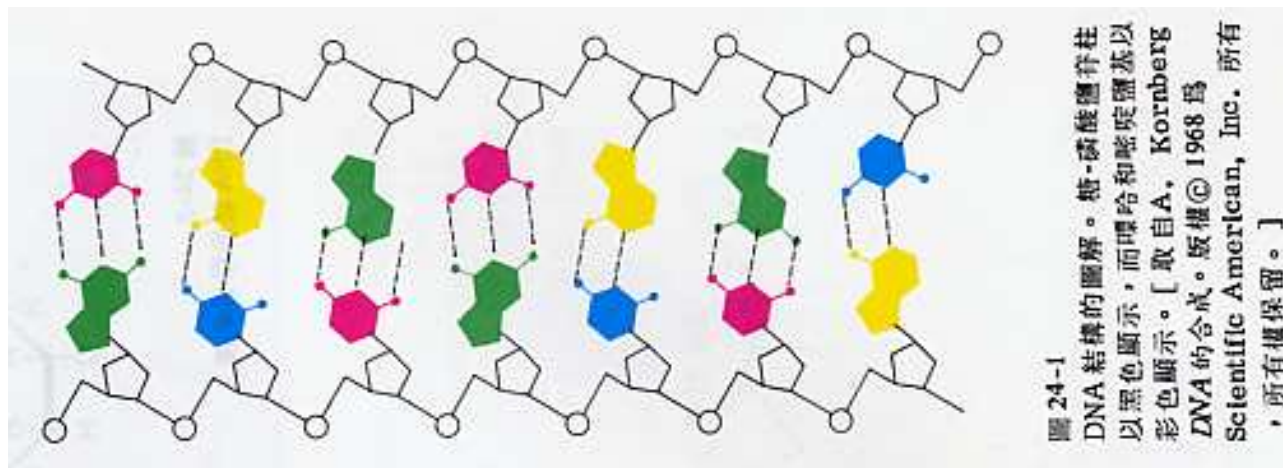
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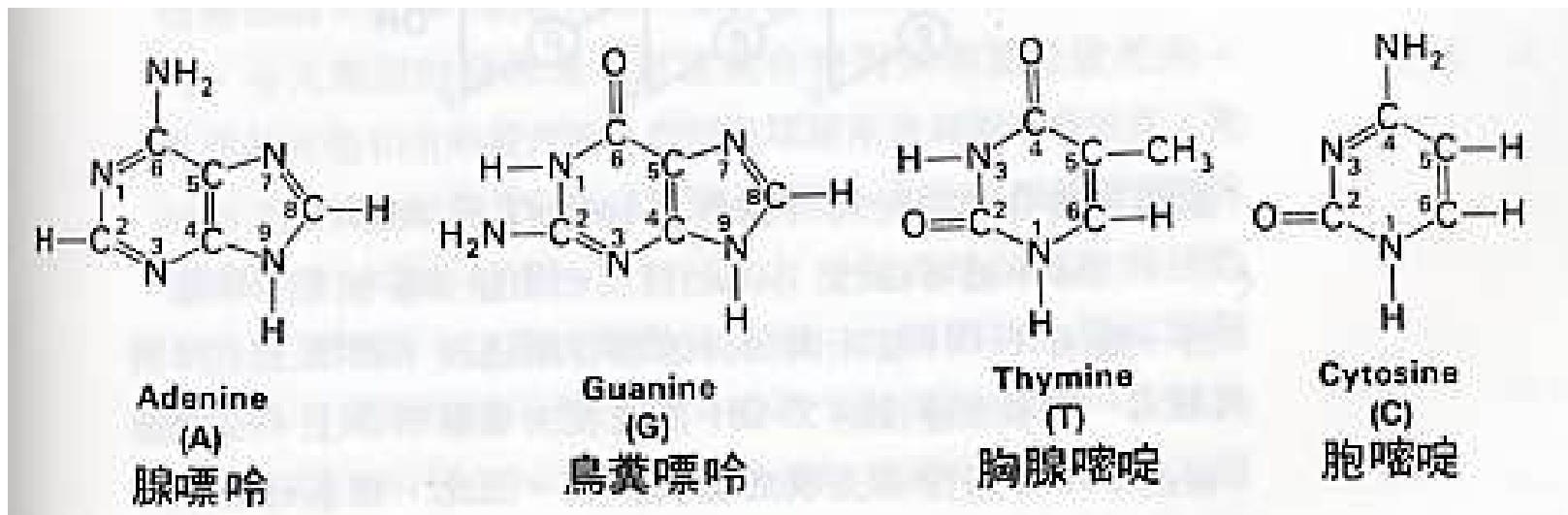
DNA—Structure and Nomenclature

1. The backbone of DNA is the phosphodiester (磷酸二酯).
2. The variable parts are the sequences of bases.



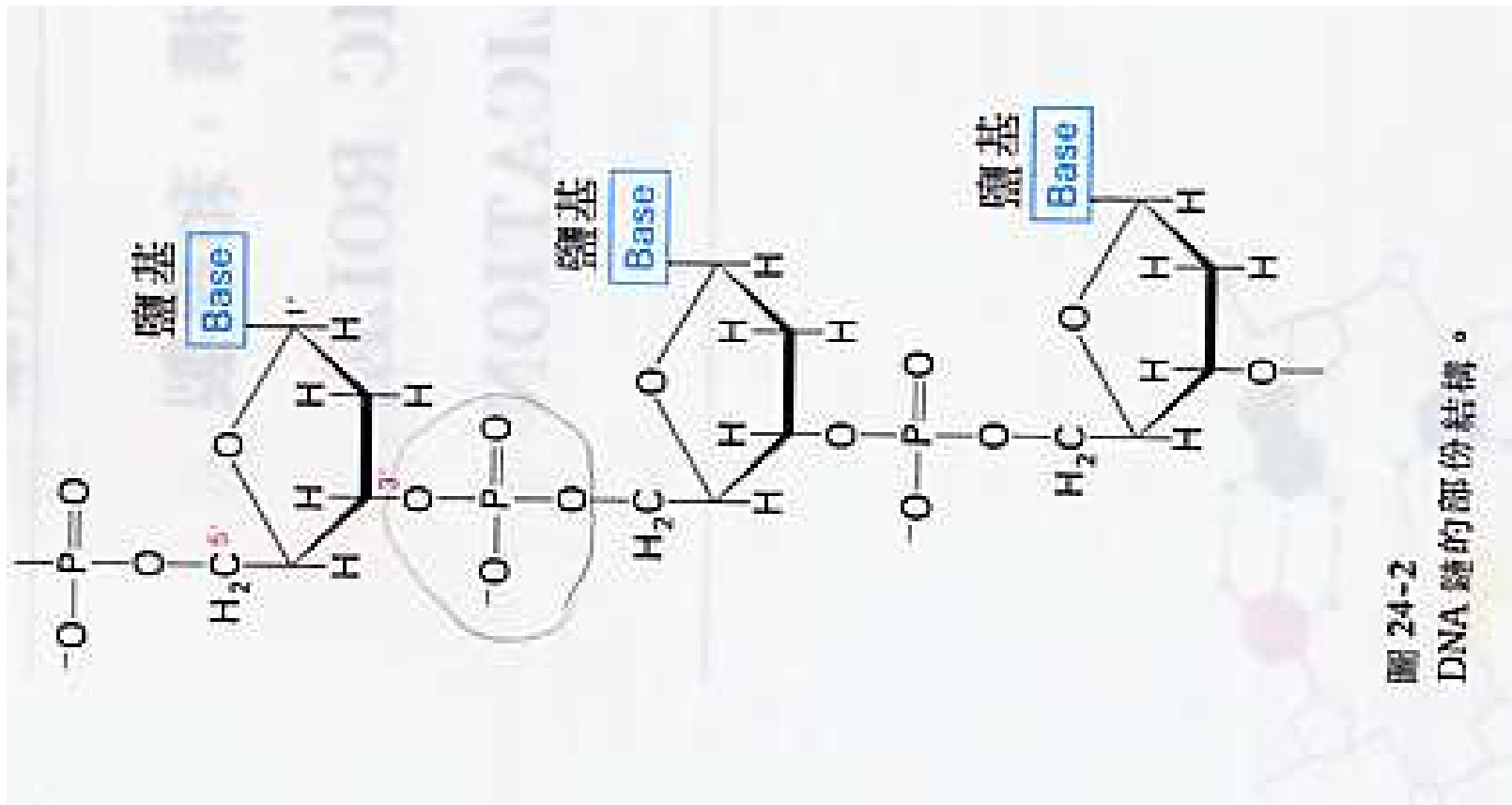
Bases of DNA

1. purine: adenine (A), guanine (G)
2. pyrimidine: thymine (T), cytosine (C)

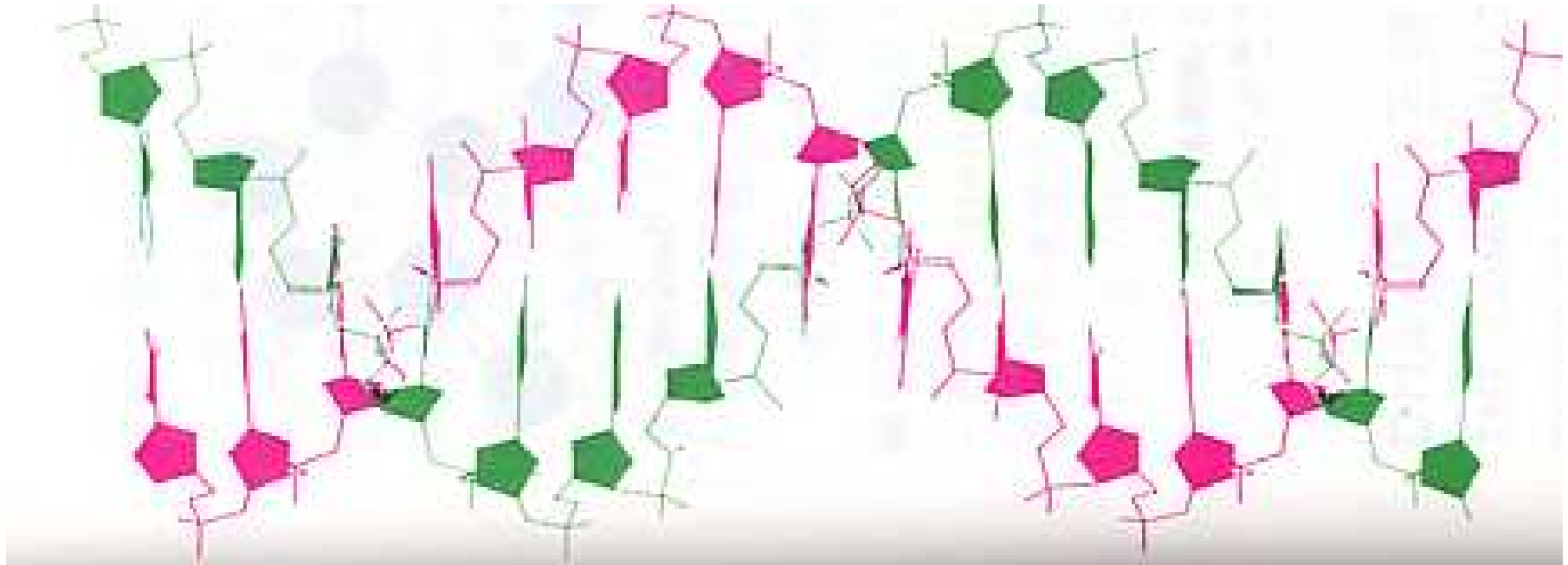


DNA Is Asymmetric

$5' \rightarrow 3', \therefore ACG \neq GCA.$



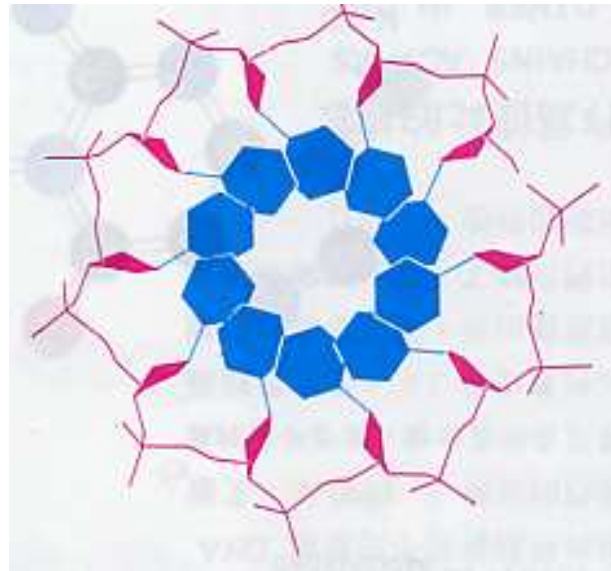
Doublix Helix Structure I



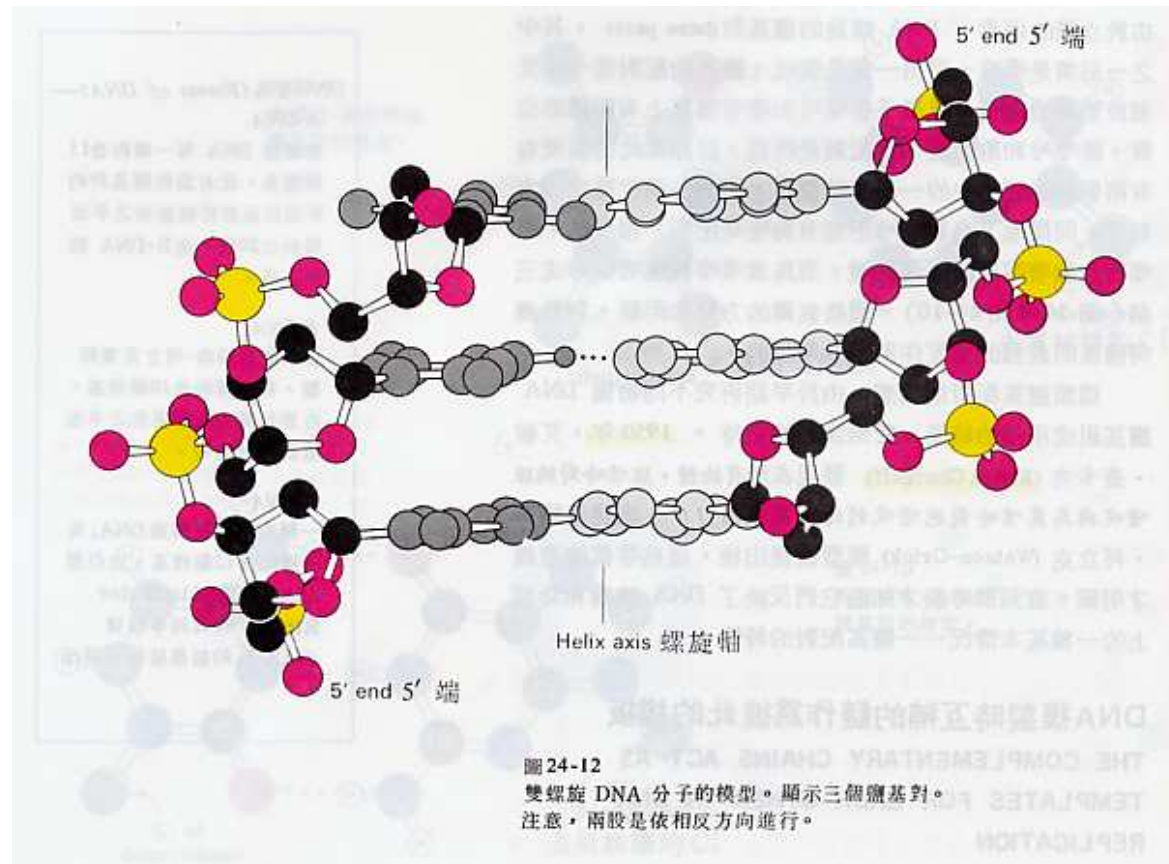
The diameter of the helix is 20\AA , bases distant 34\AA , spinning 36° .

Double Helix Structure II

Purines and pyrimidines are inside the helix.

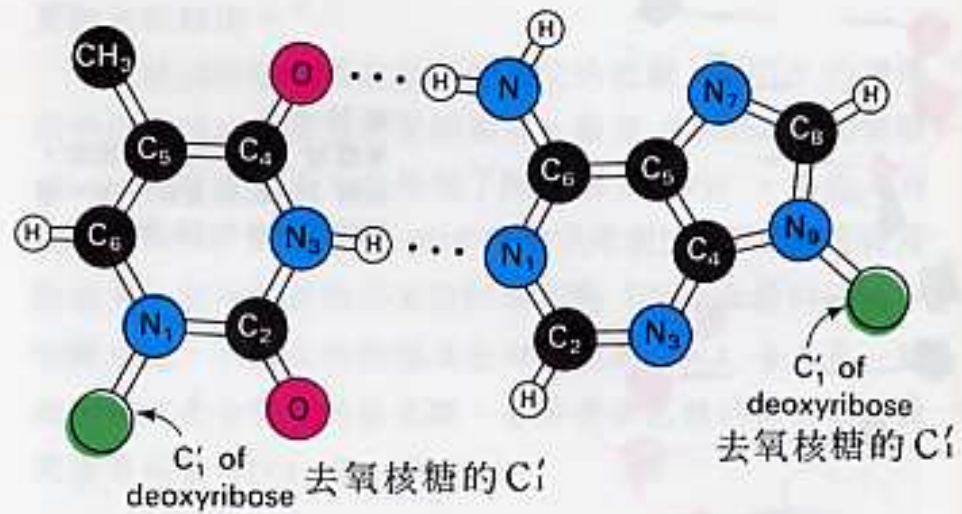


Doublix Helix Structure III

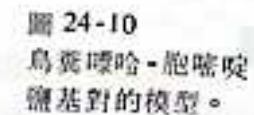


$$T = A$$

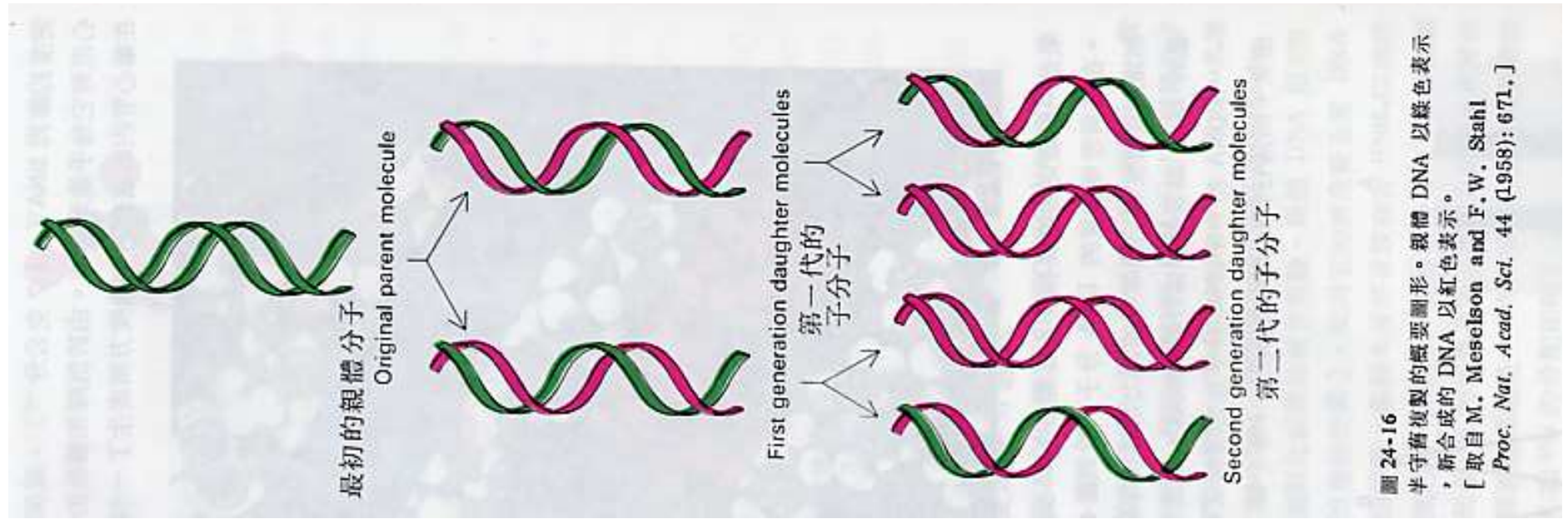
圖 24-9
腺嘌呤-胸腺嘧啶
鹽基對的模型。



Which explains Erwin Chargaff's observation.
(1950)

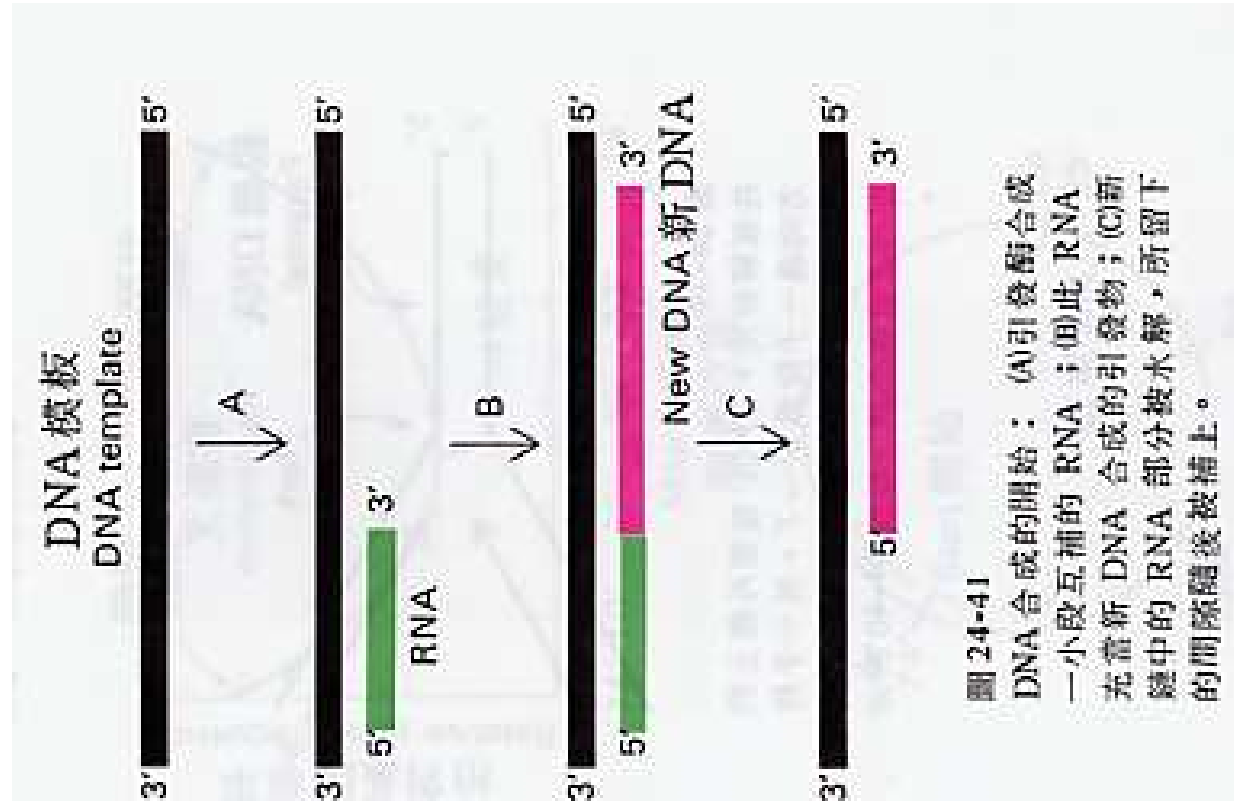


DNA—Replication





Primed by RNA.



Genes and Chromosomes

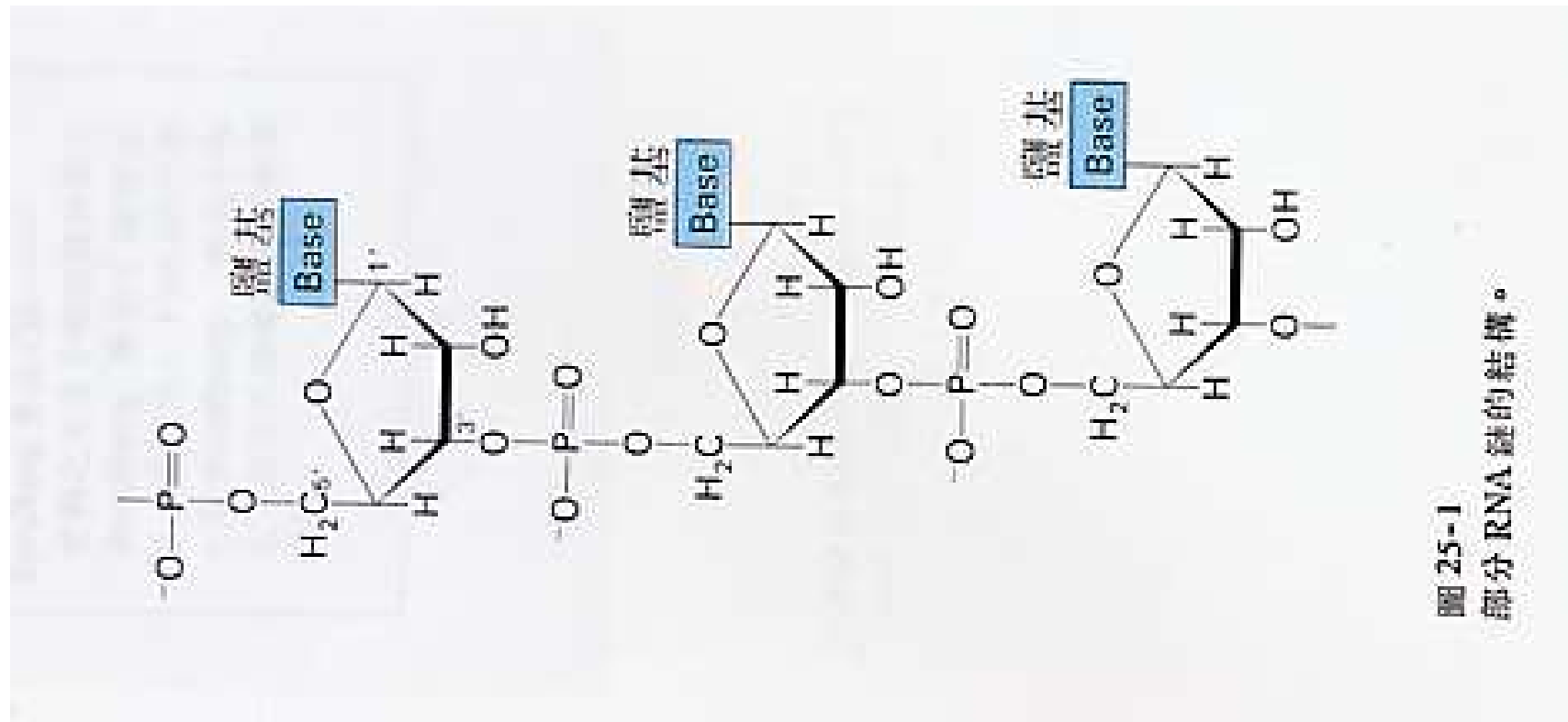
- Genome: the total genetic information stored in the chromosomes of an organism.
- Almost every cell of a Eukaryotic multi-cellular organism contains a complete set of of the genome.
- A gene is a region of DNA that controls a discrete hereditary characteristic, usually corresponding to a single mRNA carrying information for construction a protein.

表 24-1
DNA 分子的大小

生 物 <i>Organism</i>	鹽 基 對 (以仟, 或仟鹽 基) <i>Base pairs</i> (in thousands, or kb)	外圍長度 <i>Contour length</i> (μm)
病 毒 <i>Viruses</i>		
聚病毒或 SV 40 <i>Polyoma or SV40</i>	5.1	1.7
λ 噬菌體 <i>λ phage</i>	48.6	17
T2 噬菌體 <i>T2 phage</i>	166	56
牛 痘 <i>Vaccinia</i>	190	65
細 菌 <i>Bacteria</i>		
<i>Mycoplasma</i>	760	260
大腸桿菌 <i>E. coli</i>	4,000	1,360
真核生物 <i>Eucaryotes</i>		
酵母菌 <i>Yeast</i>	13,500	4,600
果蠅 <i>Drosophila</i>	165,000	56,000
人類 <i>Human</i>	2,900,000	990,000

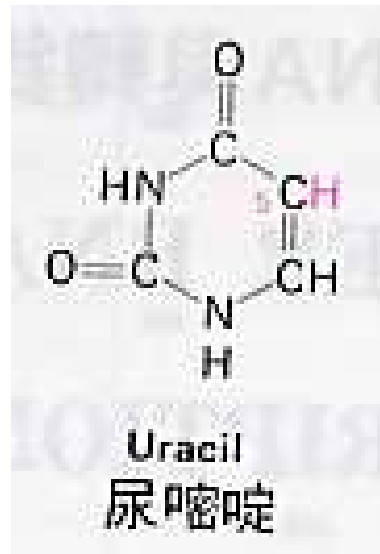
來源：取自 A. Kornberg *DNA 複製* (W.H. Freeman and Company, 1980), 第 20 頁。

RNA



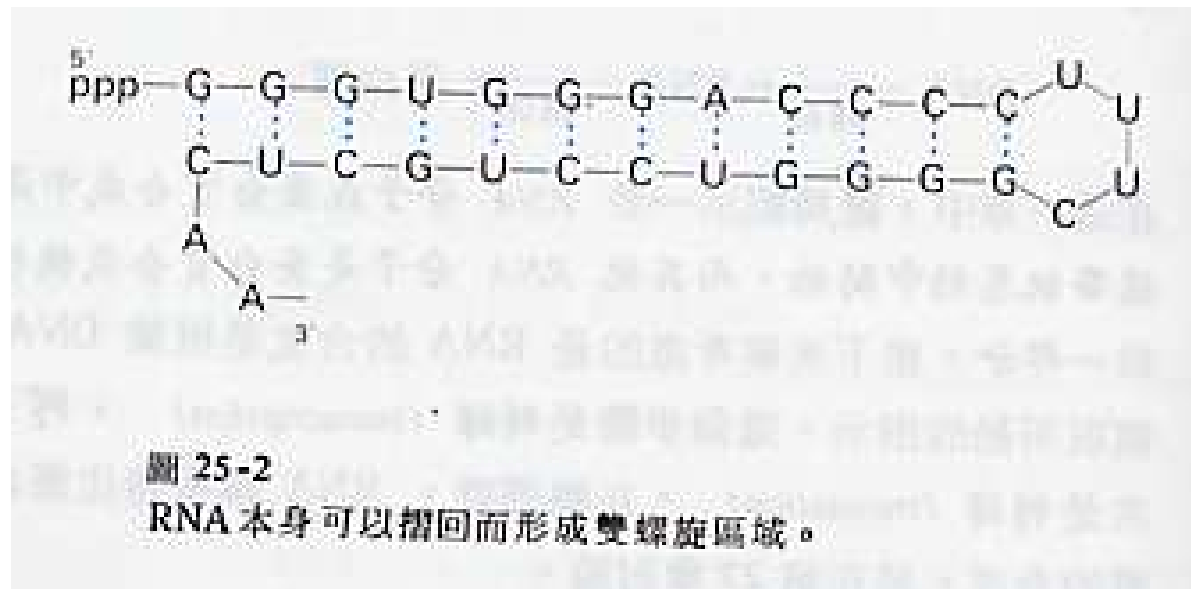
RNA

- A, G, C, U (Uracil)



RNA

- RNAs are usually single stranded.
- Cells contain three types of RNA: ribosomal (rRNA), transfer (tRNA), messenger (mRNA).



DNA \rightarrow mRNA \rightarrow Protein

Transcription: DNA \rightarrow mRNA

5'-GCGGCGACGCGCAGUUAUCCACAGCCGCCAGUUCGCGUGGCGGCAUUUU-3'

mRNA

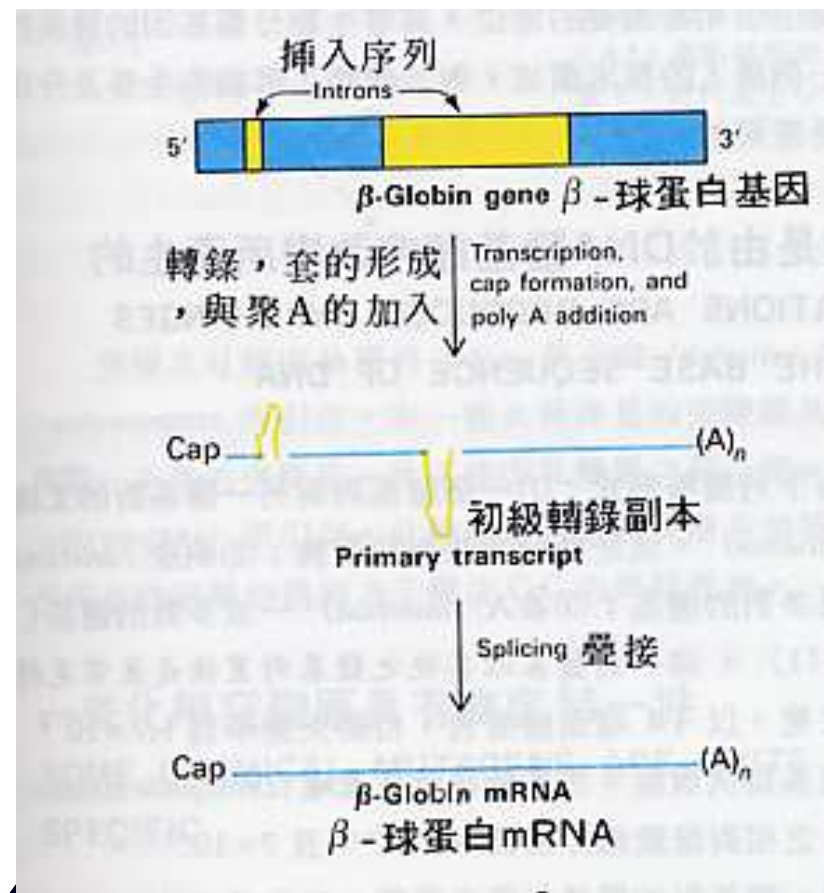
3'-CGCCGCTGCGCGTCAATTAGGGTGTGCGGCGGTCAAGGCGACCGCCGTAAAA-5'

DNA

5'-GCGGCGACGCGCAGT TAATCCCACAGCCGCCAGTTCCGCTGGCGGCATTTT-3'

Intron, Exon

Splicing, alternative splicing



Translation: mRNA → Protein

genetic code

表 26-4
遺傳密碼

第 一 個 位 置 (5' 端) <i>First position (5' end)</i>	第 二 個 位 置 <i>Second position</i>				第 三 個 位 置 (3' 端) <i>Third position (3' end)</i>
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

triplet system, codon

$4^3 = 64$ possible codon triplets.

61 \rightarrow 20 amino acids.

Protein

- A protein is a linear polymer of amino acids linked together by peptide bounds.
- 1. primary structure: the linear structure
- 2. secondary structure: α -helix, β -sheets, collagen helix
- 3. tertiary structure: 3D-domain
- 4. quaternary structure: several 3D-domains composed together

- Folding structure is defined by the three dimensional structure with minimal free energy.
- The structure of a protein determines its functionality.