

Chemical Structure and Base Composition of DNA and RNA

1. Introduction

DNA (Deoxyribonucleic Acid) and RNA (Ribonucleic Acid) are nucleic acids that store, transmit, and express genetic information. Both are polymers of nucleotides, but they differ in their sugar, nitrogen bases, and structure.

2. Basic Building Unit: The Nucleotide

Each nucleotide consists of three components:

1. Nitrogenous Base – Purine or Pyrimidine
2. Pentose Sugar – Deoxyribose (in DNA) or Ribose (in RNA)
3. Phosphate Group

- ◆ Diagram: Structure of a Nucleotide (Base + Sugar + Phosphate Group)

3. Nitrogenous Bases

Type	DNA Bases	RNA Bases
Purines	Adenine (A), Guanine (G)	Adenine (A), Guanine (G)
Pyrimidines	Cytosine (C), Thymine (T)	Cytosine (C), Uracil (U)

4. Pentose Sugar

DNA contains deoxyribose sugar (H at 2' carbon), while RNA contains ribose sugar (OH at 2' carbon). This difference makes DNA more stable and RNA more reactive.

5. Structure of DNA

Watson and Crick (1953) proposed the double helix model of DNA. Two antiparallel polynucleotide chains form a right-handed double helix with complementary base pairing (A=T and G≡C).

- ◆ Diagram: Double Helix Structure of DNA (Labeled)

6. Base Composition – Chargaff's Rule

1. A = T and G = C
2. Purines = Pyrimidines
3. (A + G) / (T + C) ratio is constant for a species.

7. Structure of RNA

RNA is usually single-stranded and can fold into complex secondary structures. It replaces thymine with uracil. The main types are mRNA, tRNA, and rRNA.

- ◆ Diagram: Comparison between DNA and RNA structure

8. Comparison Between DNA and RNA

Property	DNA	RNA
Sugar	Deoxyribose	Ribose
Bases	A, T, G, C	A, U, G, C
Strands	Double-stranded	Single-stranded
Stability	Stable	Less stable
Location	Nucleus, mitochondria	Nucleus, cytoplasm, ribosome
Function	Genetic storage	Protein synthesis

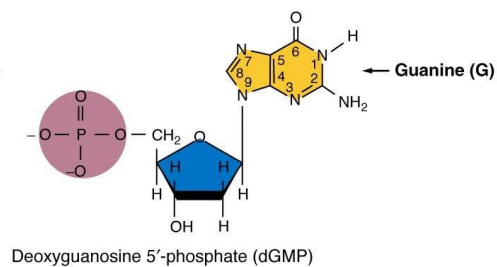
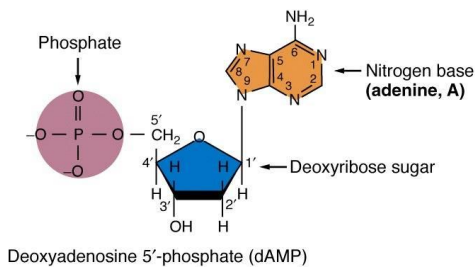
9. Bonds in Nucleic Acids

- N-glycosidic bond – between sugar and base
- Phosphoester bond – between sugar and phosphate
- Phosphodiester bond – between nucleotides in a chain
- Hydrogen bond – between bases of opposite strands

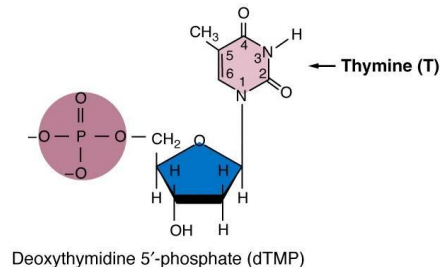
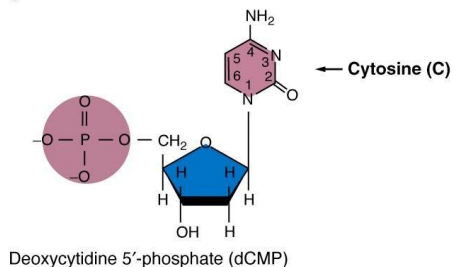
10. Summary

DNA and RNA are nucleic acids composed of nucleotide units. DNA is double-stranded and stable, serving as genetic material, while RNA is single-stranded and plays roles in gene expression and protein synthesis.

Purine nucleotides



Pyrimidine nucleotides



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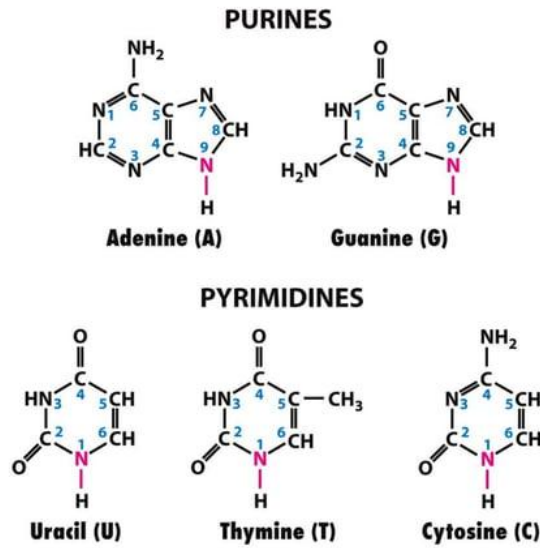
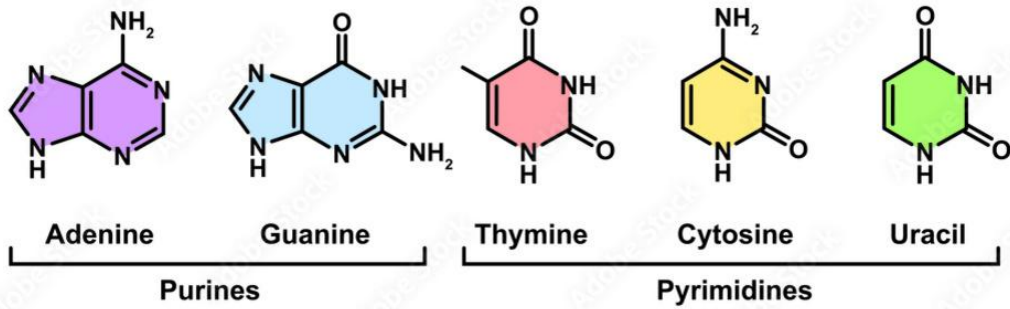


Figure 2-17
Molecular Cell Biology, Sixth Edition
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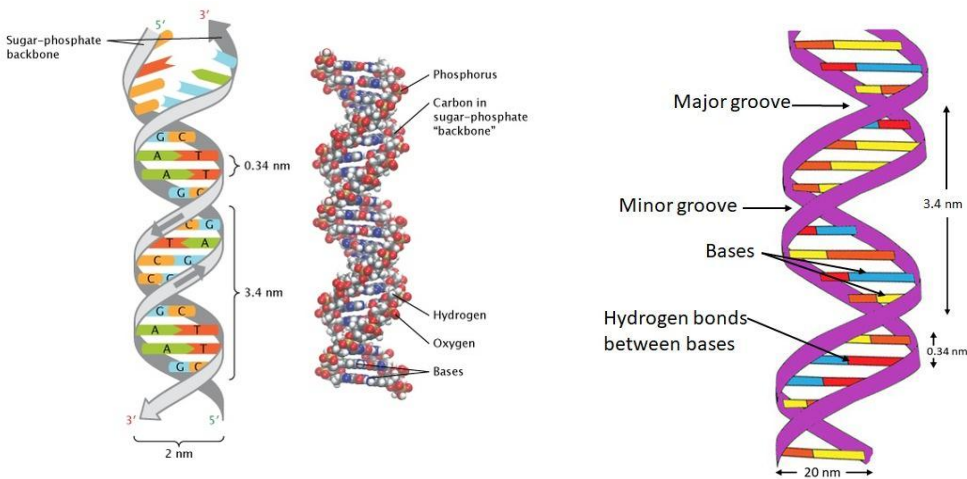


Table 7.2 Properties of major forms of DNA

Particulars	A DNA	B DNA	Z DNA
Helix	Right handed	Right handed	Left handed
Base pairs per turn	~11	~10.5	~12
Helical Diameter (nm)	2.6	2.0	1.8
Helical length (nm)	2.6	3.4	3.7
Shape	Broadest	Intermediate	Narrowest
Major Groove	Wide, deep	Narrow, deep	Flat
Minor Groove	Narrow, shallow	Broad, shallow	Narrow, deep

DNA vs RNA

NUCLEIC ACIDS

<ol style="list-style-type: none"> 1. Consists of double strands of polynucleotide 2. It is a bigger molecule with more than a million bases 3. It consists of an entirely double helix strand 4. Pentose: Deoxyribose 5. Bases: A,C,G & T 6. Only one type of DNA 7. DNA carries genetic information 8. DNA is found mainly in the nucleus, with small amounts in the mitochondria & chloroplasts 	<ol style="list-style-type: none"> 1. Consists of a single strand of polynucleotide 2. It is a smaller molecule with less than 1,000 bases 3. No double helix 4. Pentose: Ribose 5. Bases: A,C,G & U 6. Three different types of RNA: tRNA, mRNA & rRNA 7. The three different types of RNA are important in protein synthesis 8. RNA occurs mainly in the cytoplasm, with small amounts in the nucleus
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