Lecture 15
Discipline: Bioorganic Chemistry
Lecturer: Associate Professor, Dr. Gulnaz Seitimova

Title: Ribonucleic acids (RNA). RNA classification, their structure and physiological role. RNA nucleotides and nucleosides, their structure, chemical properties. Tautomeric transformations of heterocyclic bases that make up nucleosides and RNA nucleotides.

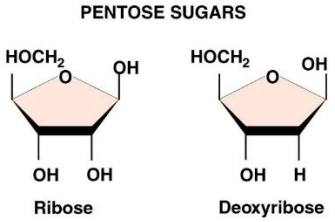
Objective: To explain the structural features of RNA, its classification, physiological functions, and the chemical properties and tautomeric behavior of RNA nucleotides, nucleosides, and their heterocyclic bases.

Main Questions: Definition and general composition of RNA. Classification of RNA types (mRNA, tRNA, rRNA, and others). Primary, secondary, and tertiary structures of RNA. Physiological role of RNA in protein synthesis and gene regulation. Structure and chemical properties of nucleotides and nucleosides in RNA. Purine and pyrimidine bases in RNA and their tautomeric transformations. Significance of tautomerism in replication and translation fidelity.

Key Notes and Theses

RNA Composition and Structure

- RNA is a single-stranded biopolymer composed of ribonucleotides.
- Each ribonucleotide contains ribose, a phosphate group, and a nitrogenous base.
- Nitrogenous bases: Purines – adenine (A), guanine (G); Pyrimidines – cytosine (C), uracil (U).



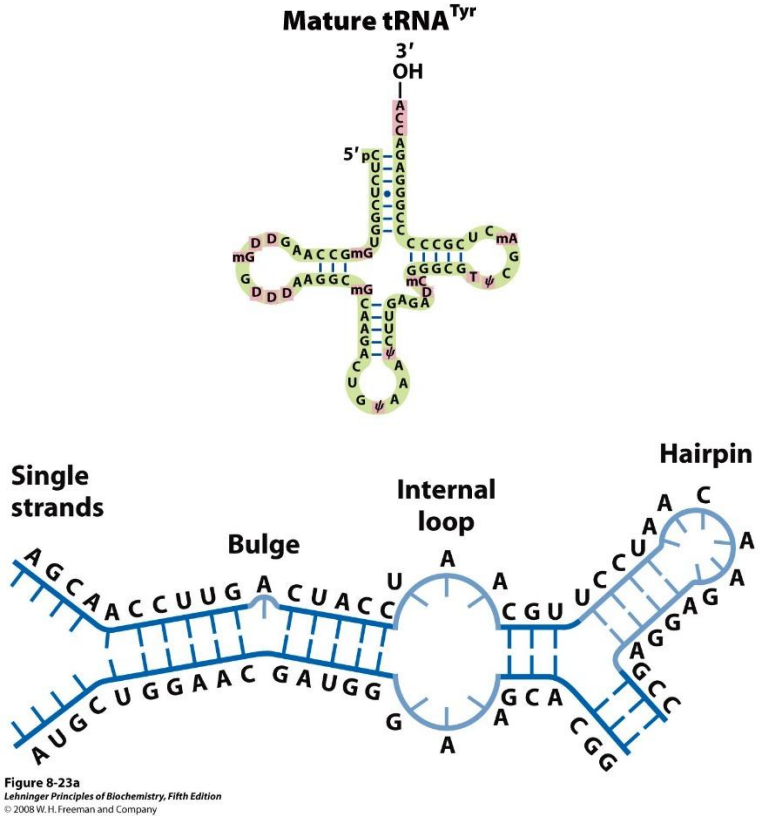
Classification of RNA

- mRNA (messenger RNA): carries genetic code from DNA to ribosomes for protein synthesis.
- tRNA (transfer RNA): transports specific amino acids to ribosomes.
- rRNA (ribosomal RNA): structural and catalytic component of ribosomes.
- Other RNAs: snRNA, miRNA, siRNA involved in splicing, gene regulation, and RNA interference.

RNA Structure

- Primary structure: linear sequence of ribonucleotides connected via 3'→5' phosphodiester bonds.
- Secondary structure: stem-loop and hairpin structures formed by intramolecular base pairing.

- Tertiary structure: folding into complex 3D conformations for functional activity (especially in tRNA and rRNA).



Physiological Role

- RNA plays a central role in gene expression, including transcription and translation.
- Participates in catalysis (ribozymes) and regulation of gene expression.
- Serves as an intermediary for the flow of genetic information (DNA → RNA → protein).

Nucleotides and Nucleosides in RNA

- Nucleosides = ribose + nitrogenous base (N-glycosidic bond).
- Nucleotides = nucleoside + phosphate group(s), can exist as mono-, di-, or triphosphates.
- Participate in enzymatic reactions, energy transfer (ATP, GTP), and signaling (cAMP).

Heterocyclic Bases and Tautomerism

- Purine and pyrimidine bases can exist in amino-imino and keto-enol tautomeric forms.
- Rare tautomeric forms can affect base pairing, potentially causing replication or translation errors.
- Tautomeric equilibrium depends on pH, temperature, and solvent environment.

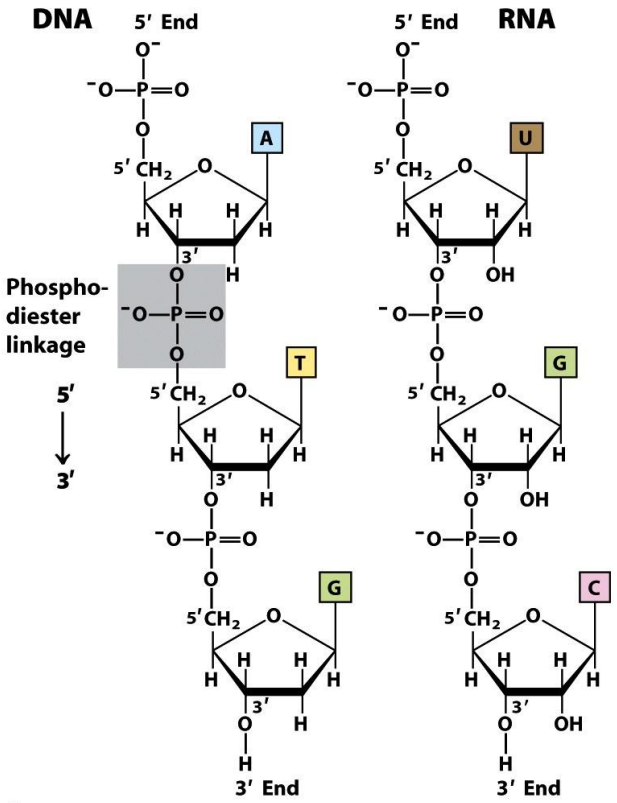


Figure 8-7
Lehninger Principles of Biochemistry, Fifth Edition

Questions for Knowledge Assessment

1. What are the structural differences between RNA and DNA nucleotides?
2. Name the main types of RNA and their physiological roles.
3. How does the secondary structure of RNA influence its function?
4. What is the chemical structure of ribonucleosides and ribonucleotides?
5. Describe tautomeric transformations of purine and pyrimidine bases in RNA.
6. Why is RNA essential for protein synthesis and gene regulation?
7. How do tautomeric forms influence fidelity during translation?

Recommended Literature

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