

577.1
B60

**A.A. Mardashko, L.M. Mironovych,
G.F. Stepanov, O.V. Storchilo**

***Biological and
Bioorganical***

CHEMISTRY

Publishing House "Caravela" Kyiv

**A. A. Mardashko, L. M. Mironovych,
G. F. Stepanov, O. V. Storchilo**

***Biological and
Bioorganical
CHEMISTRY***



teaching textbook

Kyiv «Caravela» 2017

577.1(075-8)-20
M64

Recommended
by Ministry of Education and Science of Ukraine
(letter No 1.4/18-G-963 from 06.05.2008)

Recensents:

Gukov V. I.,

doctor of medical science, professor, Head of the Biological Chemistry
department of the Kharkiv National Medical University

Tarasenko L. M.,

doctor of medical science, professor, professor of the department
of Medical, Biologic and Bioorganic Chemistry of the
«Ukrainian medical stomatologic academy»

Zaporogchenko A. V.,

doctor of biological science, professor, Head of the Biological
Chemistry Department of the Odessa National Mechnikov University.

Mardashko A. A., Mironovych L. M., Stepanov G. F., Storchilo O. V.

M64 Biological and Bioorganical chemistry: teaching textbook.

Kyiv: Caravela, 2017. 240 p.

ISBN 978-966-2229-05-9

1- 2- , 3- 4-
“Crock-1”.

III-IV

The teaching textbook in the Biological and Bioorganic Chemistry for the students self-study contains the short explanation of all discipline chapters, answers the key control questions in the accordance to the Typical Program of the Ukraine health Ministry. This book will help in the orientation in the big volume of material not only to students of the 1-st and 2-nd course both, which study Bioorganic and Biochemical Chemistry, but to the students of 3-rd and 4-th course for the preparation to the license exam “Crock-1”. The book is written for the students of the High Medical School of the III - 1Y levels of accreditation.

© A. A. Mardashko, L. M. Mironovych,
G. F. Stepanov, O. V. Storchilo, 2017

ISBN 978-966-2229-05-9

© Publishing House «Caravela», 2017

CONTENTS

Section I. Biologically important classes of bioorganic compounds.

Biopolymers and their structural components.....	7
<i>Chapter 1. Theoretical basis of the structure and reactivity of bioorganic compounds.....</i>	7
1.1. Classification, nomenclature and isomerism of bioorganic compounds. The nature of chemical bonds.....	7
1.2. Classification of chemical reactions. Reactivity of alkanes, alkenes, arenes, alcohols, phenols, amines.....	14
1.3. Structure and properties of aldehydes and ketones.....	19
1.4. Oxidation of aldehydes and ketones.....	22
1.4. Structure, properties and biological significance of carboxylic acids.....	24
<i>Chapter 2. Higher fatty acids. Lipids. Phospholipids. -amino acids, peptides, proteins.....</i>	27
2.1. Higher fatty acids. Lipids. Phospholipids.....	27
2.2. Amino acid composition of proteins and peptides.....	31
2.3. Structural organization of proteins. Physico-chemical properties of proteins. Reactions deposition of proteins. Denaturation Levels of the structure of protein molecules.....	40
<i>Chapter 3. Carbohydrates. Monosaccharides. Oligo-and polysaccharides.....</i>	45
3.1. Carbohydrates. The structure and chemical properties of monosaccharides.....	45
<i>Chapter 4. Biologically active heterocyclic compounds. Nucleosides, nucleotides, nucleic acids.....</i>	52
4.1. Classification, structure and significance of heterocyclic compounds.....	52
4.2. Structure and biochemical functions of nucleosides and nucleotides.....	60
4.3. Structure and biological role of nucleic acids.....	61
Section II. The general pattern of metabolism.....	65
<i>Chapter 5. The biochemical components of cells.....</i>	65

Chapter 6. Enzymes and coenzymes, coenzyme function of vitamins.

Regulation of metabolism	68
6.1. Enzymes. Structure, physico-chemical properties of proteins, enzymes, classified by type of reaction.....	68
6.2. Mechanism of action and determination of enzyme activity.....	70
6.3. Kinetics of enzymatic catalysis. Enzyme inhibitors.....	70
6.4. Cofactors and coenzymes. Coenzyme functions of vitamins.....	72
Chapter 7. Basic laws of metabolism Citric acid cycle	74
7.1. Metabolism. Catabolism, anabolism. The general path of reform of proteins, carbohydrates, lipids.....	74
7.2. Citric acid cycle.....	75
Chapter 8. Molecular Basis of bioenergetics	77
8.1. Bioenergetics processes: biological oxidation, oxidative phosphorylation, ATP synthesis.....	77
8.2. Chemiosmotic theory of oxidative phosphorylation. Inhibitors and uncouplers of oxidative phosphorylation.....	80
8.3. Shuttle transport mechanisms across the membrane of mitochondria.....	86
8.4. The formation of free radicals, peroxides and antioxidants.....	90

Section III. Metabolism of carbohydrates, lipids, amino acids

and its regulation	93
Chapter 9. Carbohydrate metabolism and its regulation	93
9.1. Metabolism of carbohydrates. Anaerobic oxidation of glucose - glycolysis and glycogen - glycogenolysis.....	93
9.2. Aerobic oxidation of glucose. Alternative ways of sharing monosaccharides. The metabolism of fructose and galactose. Pentose phosphate pathway.....	97
9.3. Biosynthesis of glucose - gluconeogenesis and glycogen biosynthesis. Genetic metabolic glycogen.....	103
Chapter 10. Lipid metabolism and its regulation	108
10.1. Lipid Metabolism: catabolism of triacyl glycerols, the regulation of lipolysis. Metabolism of ketone bodies.....	108
10.2. The biosynthesis of the active form of higher fatty acids.....	114

10.3. Biosynthesis and biotransformation of cholesterol, bile acids. Pathology of lipid metabolism: steatorreya, obesity, atherosclerosis.....	119
--	-----

Chapter 11. Metabolism of amino acids.

Enzymopathology of amino acid metabolism.....	124
11.1. General ways of amino acids transformation.....	125
11.2. Detoxication of ammonia, urea biosynthesis.....	129
11.3. Specialized ways of sharing the noncyclic and cyclic amino acids. The biosynthesis of glutathione and creatine. Enzymopathology of amino acid metabolism.....	132

Section IV. Molecular Biology. Biochemistry

of intercellular communication.....	141
Chapter 12. Fundamentals of molecular biology.....	141
12.1. Biochemical functions of nucleotides and nucleic acids.....	141
12.2. Biosynthesis and catabolism of purine and pyrimidine nucleotides. Hereditary metabolic uric acid disturbances.....	141
12.3. Enzymes and molecular mechanisms of DNA replication. Transcription - RNA biosynthesis.....	147
12.4. Protein biosynthesis in ribosomes. Stages and mechanism of translation, regulation of broadcasting. Antibiotics inhibitors of transcription and translation.....	150
Chapter 13. Basics of molecular genetics.....	153
13.1. Regulation of gene expression in prokaryotes and eukaryotes.....	153
13.2. Molecular mechanisms of mutations. DNA reparation.....	154
Chapter 14. Molecular mechanisms of hormones action on target cells.....	155
14.1. Molecular-cellular mechanisms of the hormonal signal transfer.....	155
Chapter 15. Biochemistry hormonal regulation.....	159
15.1. Hormonal regulation of metabolism and cellular functions: the hormones of the hypothalamic-pituitary and thyroid gland. Regulation of calcium homeostasis.....	159
15.2. Hormones of the pancreas. Regulation of carbohydrate metabolism.....	166

15.3. Hormones of adrenal and sex glands. Physiologically active eicosanoids.....	172
---	-----

Section V. Biochemistry of tissues

and physiological functions.....	183
<i>Chapter 16. Biochemistry of human nutrition. Nutrition.....</i>	183
16.1. Mechanisms of digestion of nutrients in the digestive tract.....	183
16.2. Vitamins as components of nutrition: exogenous and endogenous hypovitaminosis.....	187
16.3. Lipid-soluble vitamins, antioxidants.....	196
<i>Chapter 17. Biochemistry and pathobiochemistry of blood.....</i>	201
17.1. Biochemical composition of blood in health and disease: acute phase inflammatory proteins, enzymes of blood plasma.....	201
17.2. Non-proteinaceous nitrogen-containing and nitrogen-free organic components of blood. Plasma lipoproteins.....	203
17.3. The respiratory function of erythrocytes. Acid-base status, the buffer system of blood.....	205
17.4. Coagulant, anticoagulant and fibrinolytic system of blood	209
17.5. Biochemistry of immune processes and biochemical mechanisms of immunodeficiency condition.....	216
<i>Chapter 18. Functional and clinical biochemistry of organs and tissues.....</i>	218
18.1. Biochemical functions of the liver. Porphyrin metabolism: the metabolism of bile pigments, Biochemistry of jaundice.....	218
18.2. Biotransformation of xenobiotics and endogenous toxins in the liver: microsomal oxidation, cytochrome P-450.....	223
18.3. Urine production in kidney. Normal and pathological components of urine.....	224
18.4. Biochemistry of muscle, muscle contraction and connective tissue.....	229
18.5. Biochemistry of nervous tissue. Pathobiochemistry of mental disorders.....	235
REFERENCES.....	240