

Ministry of Health of the Republic of Belarus
Educational institution
"Gomel State Medical University"

Department of Biological Chemistry

Authors:

O.S. Logvinovich, Head of the Department, PhD (Biol. Sci.), Associate Professor

A.N. Koval, Associate Professor (position and title), PhD (Biol. Sci.)

A.V. Litvinchuk, Associate Professor (position and title), PhD (Biol. Sci.)

M.V. Gromyko, Senior Lecturer

Ye.M. Belous, Lecturer

METHODOLOGICAL RECOMMENDATIONS

for a practical lesson in the academic discipline "Biological Chemistry"
for 2nd year **students** of the Faculty of Foreign Students
majoring in 1-79 01 04 "Medical Care"

Topic: Biological oxidation 1. Krebs cycle. Ways of oxygen consumption in organism.

Duration 4 hours

Approved at the meeting of the Department of Biological Chemistry
(Protocol No. 10 dated 29.08.2025)

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1. TRAINING AND EDUCATIONAL OBJECTIVES, MOTIVATION FOR COMPLETION OF THE TOPIC, REQUIREMENTS FOR THE INITIAL LEVEL OF KNOWLEDGE

Bioenergetics is based on the only scientific point of view, according to which the laws of physics and chemistry are fully applicable to the phenomena of life, and the basic principles of thermodynamics are fully applicable to the transformations of energy in the body. However, the complexity and specificity of biological structures and the processes implemented in them determine a number of profound differences between bioenergetics and the energy of the inorganic world.

The purpose of the class:

Strengthen students' knowledge of ways and mechanisms of obtaining, depositing, utilizing and converting energy in living organisms, to form their ideas about the principles of the functioning of redox reactions, to master the method of determining the concentration of lactic acid in blood plasma and to assess the diagnostic significance of this indicator. To instill in students a sense of pride in their chosen profession and to form in them a culture of respect for their health.

Class objectives:

The student should know:

1. modern ideas about the principles, ways and mechanisms of obtaining, depositing, utilizing and converting energy in living organisms, the importance of redox reactions.
2. the structure of high-energy compounds and their role in the body, structure, principles of functioning and the role of the central metabolic pathway of the cell - TCA.

The student should be able to:

1. to determine the concentration of lactic acid in blood plasma by the enzymatic colorimetric method and to assess its diagnostic value.

2. CHECKLIST OF THE QUESTIONS FROM RELATED SUBJECTS

- 2.1. Elements of chemical thermodynamics. The first and second laws of thermodynamics. Gibbs energy (medical physics).
- 2.2. The essence and mechanism of redox reactions (general chemistry).
- 2.3. The structure of the coenzymes NAD^+ , NADP^+ , FAD , their role and the mechanism of participation in redox reactions (bioorganic chemistry).
- 2.4. The structure and function of mitochondria (cytology).

3. CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON

3.1 The history of the development of the theory of biological oxidation (BO). Views of A. Lavoisier, M.V. Lomonosov, F. Schönbein, A.N.Bakh, K. Engler, V.I. Palladin, H. Wieland. Bakh-Engler and Palladin-Wieland theories.

3.2 Modern concepts of BO. Principles of transformation and transmission of energy in living systems. Redox reactions (ORR), redox potential. Comparative characteristics of exo- and endothermic reactions.

3.3 Macroergic compounds, structure and biological role of ATP, causes of macroergicity. The ATP cycle is a pathway for the formation and use of ATP. Characteristics of ATP fragments.

3.4 BO substrates. Scheme of BO substrates formation from carbohydrates, lipids,

and proteins. BO enzymes, coenzymes. Vitamins PP, B₂. Their structure and role in energy metabolism.

3.5 Tricarboxylic acid cycle (TCA) - Krebs cycle as a common end point for the utilization of biological oxidation (BO) substrates. Reactions, enzymes, coenzymes, regulation and biological role. Comparative characteristics of TCA reactions.

3.6 Ways of utilization of oxygen in the body: mitochondrial, microsomal and peroxide.

4. PRACTICAL PART OF THE LESSON

Laboratory work No. 1 “Discovery of some substrates of TCA (citric and succinic acids)”, laboratory work No. 2 “Qualitative detection of cytochrome oxidase” are performed according to the publication "Biological Chemistry: Workbook" (in 2 parts, part 1) / Gritsuk A.I. ... [and etc.]. - Gomel: GomGMU, 2021 .-- 76 p.

Laboratory work No. 3 “Determination of the concentration of lactic acid in blood plasma by the enzymatic colorimetric method” is performed theoretically.

5. PROCESS OF THE LESSON

5.1 Introduction

5.2 The theoretical part of the lesson: control questions are considered, an oral survey of students is carried out.

5.3 Practical part of the lesson: laboratory work No. 1 “Discovery of some substrates of TCA (citric and succinic acids)”, laboratory work No. 2 “Qualitative detection of cytochrome oxidase” are performed using a workbook on biological chemistry. Laboratory work No. 3 “Determination of the concentration of lactic acid in blood plasma by the enzymatic colorimetric method” is performed manually.

5.4 Control of mastering the topic.

5.5 The final part of the lesson. Summing up, checking the protocols, announcing assignments for the next lesson.

6 QUESTIONS FOR KNOWLEDGE SELF-CONTROL

Self-control of knowledge on the topic “Krebs cycle. Oxygen consumption pathways in the body” is carried out by computer testing using the Moodle platform access mode: <https://dl.gsmu.by/mod/quiz/view.php?id=5027>.

7. LIST OF REFERENCES:

1. Harper's Illustrated Biochemistry / Victor W. Rodwell [and oth.]. — 30th edit. -New York[and oth.] : McGraw-Hill Education, 2015. — 817 p.

2. Meisenberg, G. Principles of medical biochemistry / G. Meisenberg, W. H. Simmons. — 4th ed. -Philadelphia: Elsevier, [2017]. — xii, 617 p.

3. Vasudevan, D. M. Textbook of biochemistry for medical students / DM Vasudevan, S Sreekumari. — 5th ed. — New Delhi : Jaypee brothers medical publishers, 2009. — xvi, 535 p.

4. Gritsuk, A. I. Biochemistry. P. 1 : lectures, notes / A. I. Gritsuk, A. N. Koval ; Gomel state medical University, Department of biochemistry. — Gomel, 2016. — 380 p.