

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

Department of Biological Chemistry

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**METHODOLOGICAL RECOMMENDATIONS**

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

**Topic:** Biological oxidation 2. Tissue respiration. oxidative phosphorylation. Microsomal and peroxide oxidation.

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:**

To consolidate students' knowledge of the structure of the mitochondrial respiratory chain, to form their ideas about the principles of functioning of the complexes included in its composition, to master the method of determining the amount of catalase and to assess the diagnostic significance of this enzyme. 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. localization, role and mechanisms of functioning of the mitochondrial electron-transporting chain (ETC), the concept of tissue respiration, principles of coupling and dissociation;
2. the role and mechanisms of functioning of the microsomal respiratory chain;
3. features of the electronic structure of the oxygen atom and the principles of the formation of reactive oxygen species, as well as the body's ways to regulate their formation with the help of antioxidant protection.

#### ***The student should be able to:***

perform qualitative reactions to substrates of energy metabolism.

## 2. CHECKLIST OF THE QUESTIONS FROM RELATED SUBJECTS

- 2.1. The concept of the electromotive force of redox reactions (medical physics).
- 2.2. The electronic structure of the oxygen atom and its active forms (inorganic chemistry).
- 2.3. The essence of free radical processes (general chemistry).

## 3. CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON

3.1 Structure and function of mitochondria. Structure and function of mitochondrial electron transport chain (ETC). Redox potential of some mitochondrial ETC carriers.

3.2 Oxidative phosphorylation: coupling mechanisms, structure of proton ATP synthase, P/O ratio. P. Mitchell's chemiosmotic hypothesis, ATP formation mechanisms.

3.3 Uncoupling of oxidation and phosphorylation. Mechanism of action and biological significance of uncouplers and inhibitors. Effects of 2,4-dinitrophenol, channel-forming uncouplers, barbiturates, cyanides, antimycin A.

3.4 Disorders in the processes of tissue respiration and oxidative phosphorylation. Mitochondrial pathology. Examples of mitochondrial diseases.

3.5 Microsomal oxidation. Microsomal ETC: localization, structure, biological role. Similarities and differences between microsomal and mitochondrial ETC.

3.6 Peroxidation. Features of oxygen atom structure and the mechanisms of reactive

oxygen species (ROS) formation. Peroxidation in health and disease. Damaging effect of ROS on the cell.

3.7 Antioxidant defense (AOD): enzymatic and non-enzymatic. The role of enzymes (SOD, catalase, peroxidase), vitamins (A, C, E), glutathione and other metabolites. Oxidative stress as a result of imbalance between peroxidation reactions and the AOD system.

#### 4. PRACTICAL PART OF THE LESSON

Laboratory work No. 1 “Quantitative determination of catalase by Bakh and Zubkova” is carried out theoretically, according to the publication "Biological Chemistry: Workbook" (in 2 parts, part 1) / Gritsuk A.I. [and etc.]. - Gomel: GomSMU, 2021 .-- 76 p.

Laboratory work No. 2 “Determining of iron concentration in blood plasma by colorimetric method without deproteinization” is carried out with the set of reagents by Vital company.

#### 5. PROCESS OF THE LESSON

Introduction

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

5.3 The practical part of the lesson laboratory work “Quantitative determination of catalase according to Bach and Zubkova” is performed using a workbook on biological chemistry

5.4 Control of mastering the topic.

5.5 The final part of the lesson. Summing up, checking protocols.

#### 6. QUESTIONS FOR KNOWLEDGE SELF-CONTROL

Self-control of knowledge on the topic “Tissue respiration. Oxidative phosphorylation. Microsomal and peroxidation” is carried out by computer testing using the Moodle platform, access mode: <https://dl.gsmu.by/mod/quiz/view.php?id=5028>.

#### 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.