

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:** Carbohydrates 2. Tissue carbohydrate metabolism. Anaerobic and aerobic glycolysis.

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

The key direction of tissue metabolism of carbohydrates is glucose catabolism. This biochemical pathway serves as the main supplier of energy for the vital processes of the body.

Aerobic catabolism of glucose to  $\text{CO}_2$  and  $\text{H}_2\text{O}$  involves aerobic glycolysis reactions and subsequent oxidation of pyruvate in common catabolic pathways. Anaerobic glycolysis involves the same reactions of a specific pathway for the breakdown of glucose to pyruvate, but with the subsequent conversion of pyruvate to lactate.

### **The purpose of the class:**

To form students' ideas about the ways of metabolism of glucose-6-phosphate in tissues, to introduce them to anaerobic breakdown of carbohydrates – lactic and alcohol fermentation, their role, regulation, similarities and differences, to consolidate educational material on the metabolism of ethanol in the body, the ways of its detoxification.

### **Class objectives:**

#### ***The student should know:***

1. Ways of glucose-6-phosphate metabolism in tissues and cells of the body, their role, regulation.
2. Aerobic glycolysis, structure and mechanism of operation of the pyruvate dehydrogenase complex.
3. Anaerobic digestion of carbohydrates: lactic acid and alcoholic fermentation - enzymes, reactions, similarities and differences.
4. Regulation of glycolysis and glycogenolysis. Pasteur effect.
5. Metabolism of ethanol in the body, ways of its detoxification.

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

1. Calculate the energy balance of carbohydrate oxidation under aerobic and anaerobic conditions.
2. Determine the LDH activity in blood plasma and to evaluate the diagnostic significance of the obtained result.

## 2. CHECKLIST OF THE QUESTIONS FROM RELATED SUBJECTS.

- 2.1 Functions of carbohydrates (bioorganic chemistry).
- 2.2. Metabolism and energy (physiology).

## 3. CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON.

3.1 Ways of glucose-6-phosphate metabolism in tissues (scheme of carbohydrate metabolism in organism).

3.2 Anaerobic catabolism of carbohydrates - glycolysis, glycogenolysis (enzymes, reactions). Kinase reactions of glycolysis. Substrate phosphorylation. Lactic acid and alcohol fermentation - enzymes, reactions, similarities and differences. Glycolytic oxidoreduction.

3.3 Ethanol metabolism in the body, detoxification pathways (alcohol DH, MEOS, catalase). The mechanism of the toxic effect of ethanol.

3.4 Aerobic glycolysis. Oxidative decarboxylation of pyruvate (enzymes, reactions). The structure of the pyruvate dehydrogenase complex. Vitamin B<sub>1</sub>. Structure, role in metabolism, picture of hypo- and avitaminosis. The total equation of the pyruvate dehydrogenase complex. Comparative characteristics of aerobic and anaerobic glycolysis.

3.5 Regulation of glycolysis and glycogenolysis. Pasteur effect (essence and mechanism). Activators and inhibitors of glycolysis and glycogenolysis.

3.6 Energy balance of carbohydrate oxidation.

3.7 Comparative characteristics of aerobic and anaerobic glycolysis. Glycolytic oxidoreduction. Activators and inhibitors of glycolysis and glycogenolysis.

3.8 Summary equation of the pyruvate dehydrogenase complex.

#### 4. PRACTICAL PART OF THE LESSON

Laboratory work No. 1 " Analysis of blood plasma LDH activity" is performed using a set of reagents for determining the activity of lactate dehydrogenase in serum or blood plasma by an optimized kinetic method (LDH-Vital).

Laboratory work No. 2 " Analysis of saliva glucose concentration by glucose oxidase method" is carried out according to the publication "Biological chemistry: Workbook for 2<sup>nd</sup> year students" (in 2 parts, part 1) / Gritsuk A.I. [and etc.]. - Gomel: GomGMU, 2021. – 76 p.

#### 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, the tasks of the SSART are analyzed.

5.3 Practical part of the lesson: laboratory work is performed. Laboratory work No 1 "Analysis of blood plasma LDH activity" is performed experimentally according to the instructions. Laboratory work No. 2 "Analysis of saliva glucose concentration by glucose oxidase method" 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 the protocols, announcing assignments for the next lesson.

Control questions on the topic "Carbohydrates-3" include knowledge of gluconeogenesis reactions.

#### 6 QUESTIONS FOR KNOWLEDGE SELF-CONTROL

Self-control of knowledge on the topic "Tissue metabolism of carbohydrates. Anaerobic and aerobic glycolysis "is carried out by computer testing using the Moodle platform. Access mode: <https://dl.gsmu.by/mod/quiz/view.php?id=5030>

#### 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.

5. YouTube channel "Biochemistry GSMU". Playlist "Carbohydrates". - access mode <https://www.youtube.com/playlist?list=PLxTvLc-IN5mYEfqXLyoV7uzokSBaL2kI>