

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

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: Carbohydrates 1. Digestion and absorption. Glycogen, fructose, and galactose metabolism.

Duration 4 hours

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

Gomel, 2025

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

Carbohydrates make up an insignificant part of the total dry weight of human body tissues - no more than 2%, while proteins, for example, account for up to 45% of the dry weight of the body. Nevertheless, carbohydrates perform a number of vital functions in the body, taking part in the structural and metabolic organization of organs and tissues. Glucose plays the main role in the metabolism of carbohydrates, since it is the main source of energy. Glucose can be converted to almost all monosaccharides, while the reverse conversion is also possible.

The purpose of the lesson:

To form students' ideas about the biological role, molecular mechanisms of digestion and absorption of carbohydrates, the pathways of carbohydrate metabolism in the cells of living organisms. To master the method of determining the activity of α -amylase in urine by the enzymatic kinetic method. Contribute to fostering a sense of pride in the chosen profession and develop a culture of respect for their health.

Lesson objectives:

The student should know:

1. Structure, biological role, molecular mechanisms of digestion and absorption of carbohydrates.
2. Mechanisms of carbohydrate transport across the membrane and the role of Na/K-ATPase in the active transport of carbohydrates.
3. The reaction of phosphorylation of glucose and its significance.
4. Ways of glucose-6-phosphate metabolism in body cells.
5. Reactions of converting galactose and fructose into glucose.
6. Glycogen metabolism: glycogenesis and glycogenolysis.

The student should be able to:

1. Analyze the activity of α -amylase in urine by the enzymatic kinetic method and to assess the diagnostic significance of the result obtained.

2. CHECKLIST OF THE QUESTIONS FROM RELATED SUBJECTS

- 2.1 The structure and classification of carbohydrates (bioorganic chemistry).
- 2.2 The mechanisms of digestion of food components in the gastrointestinal tract (human physiology).
- 2.3 Molecular mechanisms of transport of substances through membranes (biology, medical biophysics).
- 2.4 Functions of carbohydrates in the body. The role of fiber in the digestion process.

3. CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON

- 3.1 Structure, classification of carbohydrates. Characteristics of mono-, di- and polysaccharides. Homopolysaccharides: starch, glycogen, fiber. Heteropolysaccharides: acidic (hyaluronic acid, chondroitin sulfates, heparin) and neutral (neuraminic and sialic acids).
- 3.2 Digestion and absorption of carbohydrates in the gastrointestinal tract. Types of digestion (cavitary, luminal and endocellular), their characteristics. Functions of carbohydrates in the body. The role of fiber in the digestion process.

3.3 Mechanisms of transport of carbohydrates across the membrane (simple, facilitated diffusion, active transport). The role of Na^+/K^+ -ATP-ase in the active transport of carbohydrates. Glucose transporting proteins across the cell membrane: comparative characteristics of glucose transporting proteins.

3.4 Conversion of galactose and fructose into glucose in health and disease.

3.5 Significance of glucose phosphorylation. Metabolic pathways (formation and utilization) of glucose-6-phosphate. Scheme of carbohydrate metabolism in the body.

3.6 Glycogen metabolism (synthesis and mobilization), reactions, enzymes, regulation. Adenylate cyclase mechanism of glycogen mobilization. Glycogen metabolism in liver and muscles.

4. PRACTICAL PART OF THE LESSON

Laboratory work No. 1 "Analysis of α -amylase activity in urine by enzymatic kinetic method" is performed using a set of reagents for determining the activity of α -amylase in the serum and urine by the enzymatic kinetic method (α -amylase-Vital).

Laboratory work No. 2 "Detection of reducing sugars by the Trommer reaction" and laboratory work No. 3 "Digestion of carbohydrates in the gastrointestinal tract" are performed according to the publication "Biological Chemistry: Workbook" (2 parts, part 1) / Gritsuk A.I. [and etc.]. - Gomel: GomSMU, 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 No. 1 "Analysis of α -amylase activity in urine by enzymatic kinetic method" is performed experimentally according to the instructions. Laboratory work No. 2 "Detection of reducing sugars by the Trommer reaction" and laboratory work No. 3 "Digestion of carbohydrates in the gastrointestinal tract" are 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, announcing assignments for the next lesson.

Control questions on the topic "Carbohydrates-2" include knowledge of the reactions of the following metabolic pathways: glycolysis (with the final reactions of lactic acid and alcohol fermentation and aerobic glycolysis), the main reactions of the PDH complex, ethanol metabolic pathways.

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 (dl.gsmu.by).

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. Glycogen. In: Encyclopedia of Genetics, Genomics, Proteomics and Informatics. Springer, Dordrecht. – 2008. – Mode of access: https://doi.org/10.1007/978-1-4020-6754-9_6998. – Date of access: 06.01.2022.
6. Michael Lieberman et al. - Marks' Basic Medical Biochemistry. A Clinical Approach (4th ed.) – 2012. – 1014 p.