

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 2nd year **students** of the Faculty of Foreign Students
majoring in 1-79 01 04 "Medical Care"

Topic: Biochemistry of nervous system. Biochemistry of connective tissue.

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. LEARNING AND EDUCATIONAL GOALS, MOTIVATION FOR MASTERING THE THEME, REQUIREMENTS FOR THE INITIAL LEVEL OF KNOWLEDGE

The nervous system appeared in living organisms at a later stage of evolution. It performs three main functions: provides the body with the external environment; carries out the highest level of regulation of metabolism; determines the adaptation of the organism to changing environmental conditions. In terms of chemical composition and metabolic processes, nervous tissue differs from other body systems. Neurons do not have direct contact with blood, as they are separated by the blood-brain barrier (BBB). This physiological feature determines the selective permeability of substances from the blood to the cells of the nervous system and determines the biochemical specificity of metabolism.

Purpose of the class: to study the features of the metabolism of the nervous tissue, the biochemical basis of its functioning in normal conditions and in various pathological conditions; to acquaint with the features of brain metabolism during hypoxia; to acquaint with the biochemical mechanisms of action on the brain of alcohol, drugs and hydrophobic toxic compounds. To form the skills and abilities to determine the activity of cholinesterase in blood plasma by the kinetic colorimetric method. To instill in students a sense of pride in their chosen profession and to form in them a culture of caring for their health.

Class objectives:

The student must know:

1. Features of metabolism in the brain of carbohydrates, lipids, proteins and macroergs.
2. Features of brain metabolism during hypoxia.
3. Biochemical mechanisms of electrogenesis in the nervous tissue and the mechanism of synaptic transmission.
4. Characterization and synthesis of the main neurotransmitters.
5. Mechanisms of action on the brain of alcohol, drugs and hydrophobic toxic compounds.
6. Disorders that cause the occurrence of pathological conditions of the nervous system: depression, parkinsonism, schizophrenia.

The student must be able to:

1. Determine the activity of cholinesterase in blood plasma by the kinetic colorimetric method and evaluate the diagnostic significance of the result.

2. CONTROL QUESTIONS FROM RELATED DISCIPLINES

- 2.1 Conducting colorimetric analysis (general chemistry, physics).
- 2.2 Features of the structure and function of the neuron and neuroglia. The structure and functions of the synapse (histology).
- 2.3 Biophysical mechanisms of the emergence and conduction of potentials (physiology).
- 2.4 Metabolism of glucose, lipids and amino acids. Metabolism of ethanol and hydrophobic xenobiotics. Low-energy states, causes and mechanism of development. Structure, localization and functions of ionic ATPases (Na/K, Ca, etc.). Qualitative reactions to the activity of enzymes in biological fluids (previous sections of biochemistry).

3. CONTROL QUESTIONS ON THE TOPIC OF THE CLASS

3.1 Biochemical features of metabolism in the brain of carbohydrates, lipids, proteins and macroergs. The concept of the blood-brain barrier. Features of brain metabolism during hypoxia.

3.2 Biochemical mechanisms of electrogenesis in nervous tissue. The mechanism of synaptic transmission: the role of membranes, receptors, enzymes and mediators.

3.3 Neurotransmitters (catecholamines, acetylcholine, GABA, DOPamine, histamine, serotonin): characteristics, synthesis (enzymes, reactions), receptors, effects.

3.4 Biochemical mechanisms of action on the brain of alcohol, drugs (opioids, cocaine, LSD-25, etc.) and hydrophobic toxic compounds. Biochemical mechanisms of development of alcoholism, drug addiction and substance abuse. Pathological conditions of the nervous system (depression, parkinsonism, schizophrenia).

3.5 Mechanisms of axonal transmission. The concept of axonal transport and its physiological role.

3.6 Biochemical mechanisms of memory.

3.7 Glutamate and glycine as neurotransmitters.

3.8 Specific proteins of the nervous tissue S-100, myelin proteins, tubulin, nerve growth factors, etc. Oligo- and polypeptides of the nervous tissue - anserine, carnosine, homocarnosine, liberins, statins, substance P, calcineurin, etc., their functions. Enkephalins, endorphins, their nature, mechanism of action and physiological role.

3.9 Features of brain metabolism during hypoxia.

4. PRACTICAL PART OF THE CLASS

Laboratory work No. 1 "Determination of cholinesterase activity in blood plasma by the enzymatic kinetic colorimetric method" is performed practically using a set of reagents (Vital). Laboratory work No. 2 "Inhibition of serum cholinesterase activity by proserin" is performed according to the publication "Biological Chemistry: Workbook" (in 2 hours, part 2) / A.N. Koval [and others]. - Gomel: GomGMU, 2020. - Part 2 - 88 p.

5. STUDY PROCESS

5.1 Introduction

5.2 Theoretical part of the class: control questions are considered, an oral survey of students is conducted, the tasks of the SSART are analyzed.

5.3 Practical part of the class: laboratory work No. 1 "Determination of cholinesterase activity in blood plasma by the enzymatic kinetic colorimetric method" is performed experimentally according to the instructions. Laboratory work No. 2 "Inhibition of serum cholinesterase activity by proserin" is performed using a workbook in biological chemistry.

5.4 The control of mastering the topic.

5.5 The final part of the class. Summing up, checking protocols, announcing tasks (topics of SSART abstract messages) for the next class.

6. QUESTIONS FOR SELF-CHECKING KNOWLEDGE

Self-control of knowledge on the topic "Biochemistry of the nervous system" is carried out by computer testing using the Moodle platform.

7. LITERATURE

1. Биохимия : учебник / под ред. Е.С. Северина. – 5-е изд., испр. и доп. – М.: ГЭОТАР-Медиа, 2020. – 768 с.: ил.
2. Схемы и реакции основных метаболических путей : учеб.-метод. пособие для студентов учреждений высш. образования, обучающихся по специальностям 1-79 01 01 "Лечеб. дело", 1-79 01 04 "Мед.-диагност. дело" / М-во здравоохранения РБ, УО "ГомГМУ", Каф. общей, биоорганической и биологической химии ; А.И. Грицук [и др.]. – Гомель: ГомГМУ, 2018. – 127 с. – Рек. УМО по высш. мед., фармацевт. образованию.
3. Baynes, J. W. Medical biochemistry / J.W. Baynes, M. H. Dominiczak ; ELSEVIER . – 2019. – 682 p.
4. Ferrier, D. R. Lippincott's Illustrated Reviews: Biochemistry / D. R. Ferrier ; Wolters Kluwer . – 2014. – 552 p.
5. Chatterjea, M. N. Textbook of Medical Biochemistry / M. N. Chatterjea, R. Shinde ; Jitendar P Vij. – 2012. – 876 p.
6. Vasudevan, D. M. Textbook of Biochemistry for Medical Students / D. M. Vasudevan, S. Sreekumari, K. Vaidyanathan ; Jitendar P Vij. – 2011. – 657 p.
7. Marks, D. B. Board Review Series: Biochemistry / D. B. Marks ; Harwal Publishing . – 1994. – 337 p.