

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 vitamins. Water-soluble and fat-soluble vitamins. Intervitamin relationships.

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. EDUCATIONAL AND UPBRINGING GOALS, MOTIVATION FOR MASTERING THE TOPIC, REQUIREMENTS FOR THE INITIAL LEVEL OF KNOWLEDGE: vitamins have exceptionally high biological activity and are required by the body in very small quantities. Not synthesized in the body (with the exception of vitamin D). Participate in metabolism as participants in biocatalysis (almost all water-soluble vitamins and vitamin K are coenzymes). Vitamins A, D, E are able to regulate the work of the genetic apparatus of the cell. For different species, the same compound may or may not be a vitamin.

The purpose of the class:

To consolidate ideas about the structure, metabolism and molecular mechanisms of action of water- and fat-soluble vitamins in the process of regulating metabolism. To master the method of quantitative determination of vitamin C in urine. 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 goals:

The student should know:

- 1.1 Chemical structure of water- and fat-soluble vitamins.
- 1.2 The role of vitamins in energy production.

The student must be able to:

- 1.3 Work with micropipettes.
- 1.4 Work with a semi-automatic biochemical analyzer.

2. CONTROL QUESTIONS FROM RELATED DISCIPLINES:

- 2.1 Chemical structure of water- and fat-soluble vitamins (bioorganic chemistry).
- 2.2 Titrimetric method for determining the concentration of substances (general chemistry).
- 2.3 The role of vitamin in metabolism and energy (human physiology).

3. CONTROL QUESTIONS ON THE TOPIC OF THE CLASS.

3.1 Classification of vitamins. Provitamins and antivitamins. Vitamin-like substances and other essential nutritional factors, their role.

3.2 Vitamins A, E, K. Chemical nature, role in metabolism. Intervitamin interactions on the example of antioxidant vitamins. A picture of hypo- and hypervitaminosis.

3.3 Vitamin D. Regulation of Ca-P metabolism. parathormone and calcitonin. Violation of Ca-P exchange. Rickets, osteomalacia, osteoporosis, causes and main clinical manifestations.

3.4 Vitamin PP and its coenzymes. Chemical nature, role in metabolism (on the example of PDC, TCA, glycolysis, PPP, participation in the work of Mt ETC, etc.). A picture of hypovitaminosis.

3.5 Vitamin B1 and its coenzyme. Chemical nature, role in metabolism (direct and indirect oxidative decarboxylation, transketolase reactions of PPP). Intervitamin interactions on the example of PDC. A picture of hypovitaminosis.

3.6 Vitamin B2 and its coferments. Chemical nature, role in metabolism (on the example of TCA, β -oxidation of fatty acids, PDC, structure of complexes Mt ETC, etc.). Picture of hypovitaminosis.

3.7 Vitamin B6 and its coenzyme. Chemical nature, role in metabolism (for example, the reaction of decarboxylation (Trp, Tyr, Gln, Glu) and transamination of amino acids (Asp, Ala)). A picture of hypovitaminosis.

3.8 Vitamin H and its coenzyme. Chemical nature, role in metabolism (on the example of carboxylation reactions in GNG, β -oxidation of fatty acids with an odd number of carbon atoms, synthesis of fatty acids). A picture of hypovitaminosis.

3.9 Vitamin B9 and its coenzyme. Chemical nature, role in metabolism (synthesis of pyrimidines and purines, role in Met, Ser and Gly metabolism). Vitamin B12 and its coenzymes. Chemical nature, role in metabolism (reactions of β -oxidation of fatty acids with an odd number of carbon atoms, role in Met metabolism). Intervitamin interactions of vitamins B9 and B12 on the example of Met metabolism.

3.10 Vitamin C. Chemical nature, role in metabolism (hydroxylation reactions, AOD, participation in the work of Mt ETC).

3.11 General characteristics and classification of vitamins. Group characteristics of vitamins. The history of the doctrine of vitamins (works by L. I. Lunin, K. A. Sosin, H. Eikman, K. Funk, F. G. Hopkins).

3.12 Hypovitaminoses and beriberi, their causes (alimentary, increased need, parenteral nutrition, gastrointestinal disease, helminthic invasions, the use of drugs and antivitamin, congenital disorders of vitamin metabolism).

3.13 Intervitamin interactions (the direct influence of vitamins on each other, the influence of one vitamin on the formation of the coenzyme form of another, joint participation in metabolic pathways).

3.14 Pantothenic acid and its coenzyme. Chemical nature, role in metabolism (on the example of transacetylation in TCA reactions, β -oxidation of fatty acids, PDC, etc.). A picture of hypovitaminosis.

4. PRACTICAL PART OF THE CLASS

Laboratory work No. 1 "Qualitative reactions to vitamin B₁". Laboratory work No. 2 "Qualitative reaction to vitamin B₂". Laboratory work No. 3 "Qualitative reaction to vitamin B₆". Laboratory work No. 4 "Qualitative reaction to vitamin E". Laboratory work No. 5 "Quantitative determination of vitamin C" (performed theoretically).

Laboratory work is performed according to the publication "Biological Chemistry: Workbook" (in 2 hours, part 2) / Koval A.N. [and etc.]. – Gomel: GomGMU, 2020, Part 2. – 88 p.

5. PROCESS OF THE CLASS:

5.1 Introduction

5.2 Theoretical part of the lesson: control questions are considered, the tasks of the UIRS are analyzed.

5.3 Practical part of the lesson: laboratory work is performed using a workbook in biological chemistry.

5.4 The control of mastering the topic.

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

6. QUESTIONS FOR SELF-CONTROL OF KNOWLEDGE

Self-control of knowledge on the topic "Biochemistry of vitamins" is carried out by computer testing using the Moodle platform access mode: <https://dl.gsmu.by/course/view.php?id=81>

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.