

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY
Educational and Scientific Institute of Medicine
Medical Biochemistry and Molecular Biology Department

«APPROVED»

Vice-rector of the higher education institution
of the Bogomolets National Medical University
for scientific, pedagogical and educational work,
Doctor of Medical Sciences, Professor
O. VLASENKO

WORK PROGRAM OF THE ELECTIVE DISCIPLINE

**«BIOGENIC ELEMENTS AND THEIR ROLE
IN HUMAN LIFE»**

Educational level:	<u>Second master's degree</u>
Branch of knowledge:	<u>I «Health care and social security»</u>
Specialty:	<u>I2 «Medicine»</u>
Educational program:	<u>Educational and professional program of the second (master's) level of higher education in the specialty I2 «Medicine»</u>

2026 - 2027 academic year



UB
НМУ імені О.О.Богомольця
№429/л-1 від 02.09.2026
Власенко О.М. (Проректор з науково-педагогічної та
навчальної роботи) 02.09.2026 12:18

Work program for the elective course “**Biogenic elements and their role in human life**” for students training for a second (master’s) level of higher education, specialty I2 “Medicine”.

Program developers: Head of department, PhD., associate professor L. Yanicka, professor of the institution of higher education, Doctor of Pedagogical Sciences, professor V. Slipchuk.

The work program was discussed and approved at a meeting of the Department of Medical Biochemistry and Molecular Biology.

Proceeding №1 on 26. 08. 2026

The work program was approved at a meeting of the Cycle Methodological Commission for Natural Sciences.

Proceeding №1 on 26.08.2026

Head of department, PhD.,

associate professor

L.V. Yanicka

Head of the cycle methodological commission

for natural sciences, PhD., associate professor

L.V. Yanicka

Guarantor of the educational

(educational and professional) program

Doctor of Medical Sciences, Professor

V.S. Melnyk

Head of the Department of Educational

and Methodological Work,

Licensing and Accreditation, PhD, Associate Professor

I.I. Kucherenko

1. Description of academic discipline VC 1.12 “Biogenic elements and their role in human life”

Name of indicators	Branch of knowledge, specialty, educational qualification	Characteristics of the discipline	
		Full-time education	Part-time education
Number of credits – 3	Branch of knowledge I “Health care and social security”	The variable component	-
Modules - 1	Specialty: I2 «Medicine»	Year of study – 1st	-
Content modules - 1		Semester – I or II	-
Individual research task			
Total number of credits/hours – 3/90			
Weekly hours for full-time education: classroom hours – 2.6; independent work of the student – 6.4	Educational qualification: Master of Medicine	Lectures: 10 hours;	-
		Practical: 20 hours;	
		Independent work: 60 hours;	
		Type of control: differentiated credit	

2. Objectives, expected learning outcomes, and criteria for assessing learning outcomes

The purpose of teaching an elective discipline «**Biogenic elements and their role in human life**» - formation of scientific outlook of future doctors, their study of classification, topography, daily requirement, toxicity, sources of supply, biological role and clinical manifestations of deficiency and excess of biogenic elements in the human body, application in medicine, development of theoretical thinking and ability to analyze the causes and consequences of pathological conditions in the human body in future practical activities *станів в організмі людини у майбутній практичній діяльності.*

The program competencies for the educational and professional program of specialty I2 “Medicine” which are developed through the study of the discipline “Biogenic elements and their role in human life” include (VC 1.12: GC 1-15; SC 21, 23-25; PLO 1-3, 21, 22, 24, 25, 27):

integral competence: ability to solve complex problems, including research and innovation in the field of medicine. Ability to continue learning with a high degree of autonomy;

general competence (GC):

GC1. Ability to abstract thinking, analysis and synthesis.

GC 2. Ability to learn and master modern knowledge.

GC 3. Ability to apply knowledge in practical situations.

GC 4. Knowledge and understanding of the subject area and understanding of professional activities.

GC 5. Ability to adapt and act in a new situation.

GC 6. Ability to make informed decisions.

GC 7. Ability to work in a team.

GC 8. Ability to interpersonal interaction.

GC 9. Ability to communicate in a foreign language.

GC 10. Ability to use information and communication technologies.

GC 11. Ability to search, process and analyze information from various sources.

GC 12. Determination and perseverance in relation to the tasks and responsibilities undertaken.

GC 13. Awareness of equal opportunities and gender issues.

GC 14. Ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine.

GC 15. Ability to preserve and enhance moral, cultural, scientific values and achievements of society based on understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use different types and forms of physical activity for active recreation and healthy lifestyle.

special (professional, subject) competencies (SC):

SC 21. Communicate own knowledge, conclusions and arguments on health and related issues to professionals and non-specialists, including students, in a clear and unambiguous manner.

SC 23. Ability to develop and implement scientific and applied projects in the field of health care.

SC 24. Compliance with ethical principles when working with patients, laboratory animals.

SC 25. Observance of professional and academic integrity, responsibility for the reliability of the obtained scientific results.

program Learning Outcomes (PLOs):

PLO 1 - Have a thorough knowledge of the structure of professional activity. Be able to carry out professional activities that require updating and integrating knowledge. To be responsible for professional development, the ability to further professional learning with a high level of autonomy.

PLO 2 - Understanding and knowledge of basic and clinical biomedical sciences at a level sufficient to solve professional problems in the field of health care.

PLO 3 - Specialized conceptual knowledge that includes scientific achievements in the field of health care and is the basis for research, critical thinking about problems in the field of medicine and related interdisciplinary problems, including the system of early intervention.

PLO 21 - Search for necessary information in professional literature and databases of other sources, analyze, evaluate and apply this information.

PLO 22 - Apply modern digital technologies, specialized software, statistical methods of data analysis to solve complex health care problems.

PLO 24. Organize the necessary level of individual safety (own and persons under their care) in the event of typical hazardous situations in the individual field of activity.

PLO 25. Clearly and unambiguously communicate own knowledge, conclusions and arguments on health care problems and related issues to specialists and non-specialists.

PLO 27. Communicate fluently in the state language and English, both orally and in writing, to discuss professional activities, research and projects.

Criteria for evaluation learning outcomes.

The evaluation of students' academic performance is regulated by the Regulations on the Procedure for Evaluating Students' Knowledge during Current and Final Examinations in Disciplines at Bogomolets National Medical University (Proceeding of the Meeting of the Academic Council of Bogomolets National Medical University № 4 dated November 28, 2023).

Current control for full-time students consists of all the points they have accumulated during all classroom sessions. For each stage of the class and element of current assessment, the student receives a traditional grade of “5”, “4”, “3”, “2”, which is converted into points according to the scale (distribution) provided for in the working curriculum, which was compiled and approved before the start of the elective discipline. If a student receives a traditional grade of “2” for a class, this grade is converted into 0 points.

The results of knowledge assessment for each component of the lesson, in particular tests, are evaluated according to the following scale:

59% or less correct answers – grade “2”;

60%–74% correct answers – grade “3”;

60%–74% correct answers – grade “3”;

75%–89% correct answers – grade “4”;

90%–100% correct answers – grade “5”.

The grade "Excellent" is awarded to a student who has performed high-quality independent student work, actively participated in the discussion of the most difficult issues on the topic of the class, gave at least 90% correct answers to standardized test tasks, answered written assignments without errors, performed practical work and solved a situational task with a full explanation of the medical and biological significance.

The grade "Good" is awarded to a student who has completed independent student work of high quality, participated in the discussion of complex issues on the topic of the class, gave at least 75% of correct answers to standardized test tasks, but made some minor mistakes in answering written assignments, performing practical work and solving a situational task (explaining the medical and biological significance).

The grade "Satisfactory" is awarded to a student who has completed independent student work, did not actively participate in the discussion of the most difficult issues on the topic, gave at least 60% correct answers to standardized test tasks, made significant mistakes in answering written assignments, performing practical work and solving a situational task (explaining the medical and biological significance).

The grade "Unsatisfactory" is awarded to a student who has performed poorly or not at all independent student work, did not participate in the discussion of issues related to the topic of the class, gave less than 60% of correct answers to standardized test tasks, made gross errors in answering written assignments or did

not answer them at all, did not perform practical work, did not solve a situational problem and did not explain the medical and biological significance.

Distribution of points received by students for the current control:

Traditional SCORE	POINTS	Converting to points					
		oral survey	test control	practical skills	written work	situational task	IW*
“5”	17	3	3	2	3	3	3
“4”	14	3	2	2	2	2	3
“3”	12	2	2	2	2	2	2
“2”	0	0	0	0	0	0	0

IW* - independent work

***Independent work** – these are mandatory tasks that the student must complete for each practical lesson (summary of theoretical issues, completion of tasks in the workbook, preparation of a protocol for practical work, study of vocabulary and terminology, study of additional literature in English in accordance with the methodological recommendations of the department).

For discipline

Number of lessons	Current assessment and independent work				IW	Sum of points for the discipline
	«5»	«4»	«3»	«2»		
10	17	14	12	0	5-30	0-200

Competency matrix

	IC	GC 1-15	SC 21	SC 23-25	PLO 1-3	PLO 21	PLO 22	PLO 24	PLO 25	PLO 27
VC 1.12	+	+	+	+	+	+	+	+	+	+

3. The structure of the discipline:

Names of content modules and topics	Number of hours			
	full-time education			
	Total	l	p	i.w.
1	2	3	4	5
<i>Content module 1.</i>				
Topic 1. Biogenic elements, their classification. The role of Oxygen, Carbon, Hydrogen and Nitrogen in human life.	11	1	2	8
Topic 2. Biological role of Phosphorus, Sulfur, Chlorine in the human body and clinical manifestations of their deficiency.	7	1	2	4
Topic 3. The biological role of macronutrients Sodium and Potassium in the mineral balance of the human body. The concept of ionophores and their role in the membrane transport of potassium and sodium ions.	11	1	2	8
Topic 4. The role of Calcium and Magnesium in the composition of biologically active substances in the human body. Clinical manifestations of their deficiency and excess.	7	1	2	4
Topic 5. The role of vital trace elements Copper and Ferrous in biochemical processes in the human body, clinical manifestations of	11	1	2	8

their deficiency.				
Topic 6. The biological role of vital trace elements (Zinc, Cobalt, Manganese, Chromium) in enzymes, hormones, and vitamins. Trace element deficiencies in the human body.	15	1	2	12
Topic 7. Biological role and properties of non-metal trace elements (Selenium and Iodine). The concept of antioxidants on the example of Selenium. Chemistry of bactericidal action of Iodine.	7	1	2	4
Topic 8. Biological role of conditionally essential trace elements in the human body and their quantitative content in the human body and child.	7	1	2	4
Topic 9. Biological and physiological role of potentially toxic trace elements and reasons for their increased content in the human body.	7	1	2	4
Topic 10. Biological role of toxic trace elements in the mineral balance of the human body. Clinical manifestations of toxic trace elements poisoning and correction of their excess.	7	1	2	4
Total	90	10	20	60

4. Theme of lecture

№	Topic title	hours
1	Biogenic elements, their classification. Biological role of Oxygen, Carbon, Hydrogen, Nitrogen, Phosphorus and Sulfur in the human body and clinical manifestations of their deficiency.	2
2	Biological role of macronutrients Sodium, Potassium, Calcium and Magnesium in the human body. Clinical manifestations of their deficiency and excess.	2
3	Biological role of vital trace elements (Copper, Ferrous, Zinc, Cobalt, Manganese, Chromium) in the human body and clinical manifestations of their deficiency.	2
4	The biological role and properties of the trace elements Selenium and Iodine, as well as conditionally essential trace elements in the human and child body. Clinical manifestations of their deficiency and excess.	2
5	Biological role of potentially toxic trace elements and toxic trace elements in the mineral balance of the human body. Clinical manifestations of toxic trace elements poisoning and correction of their excess.	2
Total		10

5. Seminar topics.

None.

6. Theme of practical lesson

№	Topic title	hours
1	Biogenic elements, their classification. The role of	2

	Oxygen, Carbon, Hydrogen and Nitrogen in human life.	
2	Biological role of Phosphorus, Sulfur, Chlorine in the human body and clinical manifestations of their deficiency.	2
3	The biological role of macronutrients Sodium and Potassium in the mineral balance of the human body. The concept of ionophores and their role in the membrane transport of potassium and sodium ions.	2
4	The role of Calcium and Magnesium in the composition of biologically active substances in the human body. Clinical manifestations of their deficiency and excess.	2
5	The role of vital trace elements Copper and Ferrous in biochemical processes in the human body, clinical manifestations of their deficiency.	2
6	The biological role of vital trace elements (Zinc, Cobalt, Manganese, Chromium) in enzymes, hormones, and vitamins. Trace element deficiencies in the human body.	2
7	Biological role and properties of non-metal trace elements (Selenium and Iodine). The concept of antioxidants on the example of Selenium. Chemistry of bactericidal action of Iodine.	2
8	Biological role of conditionally essential trace elements in the human body and their quantitative content in the human body and child.	2
9	Biological and physiological role of potentially toxic trace elements and reasons for their increased content in the human body.	2
10	Biological role of toxic trace elements in the mineral balance of the human body. Clinical manifestations of	2

	toxic trace elements poisoning and correction of their excess.	
Total		20

7. Topics for laboratory classes.

None.

8. Independent work

Preparation for practical classes	Number of hours	Type of control
1. Independent study of theoretical issues for practical classes. 2. Perform tasks in the workbook for independent study of the topic. 3. Preparation for test control.	60	In accordance with the criteria for evaluating the practical lesson

9. Individual work.

Individual work involves students doing research, taking part in academic conferences at the faculty, university, or other higher education institution, and preparing and publishing abstracts, research papers, or essays. It is assessed during the current academic year. Points for individual work range from 5 to 30, which are added to the current academic year. The current academic year can have a maximum of 200 points (170 for practical classes and 5 to 30 points for individual work).

10. Teaching methods

When teaching the elective course “Biogenic elements and their role in human life” a set of pedagogical methods is used:

Verbal: instruction on the safety of practical work, lecture, storytelling, explanation, class discussion.

Visual: demonstration, illustration.

Practical: practical work.

Methods differ in the logic of transferring and perceiving educational information:

The analytical method involves the logical decomposition of the whole into parts in order to study their essential features and properties.

Inductive - generalization of the studied pathways of biochemical transformations from the individual to the general.

Deductive - based on the study of educational material from the general to the individual, single.

The traductive approach involves drawing conclusions from the individual to the individual, from the partial to the partial, from the general to the general.

Methods of different levels of independent thinking:

The problem-based approach involves the teacher creating a problem situation and helping students identify and “accept” a problematic task.

Partially searching involves applicants in the search for ways, methods and means of solving a cognitive task.

The research method is aimed at involving students in the independent solution of a cognitive task using the necessary equipment.

11. Methods and forms of control, distribution of points received by students, evaluation

Oral and written assessment of the topic is carried out during lectures and practical classes.

Practical skills and abilities are assessed during practical classes through observation.

Independent work is assessed in written (written form includes both paper and/or electronic formats) and oral form.

The current control is carried out at each practical class in accordance with the specific objectives of the topic:

- independent work of the student in the workbook, which is carried out outside the classroom.
- test control (completion of test tasks in format “A”);
- oral questioning of theoretical material based on the student's study of theoretical questions from the department's methodological recommendations;
- performance of practical work with the mandatory formulation of conclusions regarding the results of biochemical studies;
- solving a situational problem similar to clinical cases in medicine.

Distribution of points received by students for the current control:

Traditional SCORE	POINTS	Conversion to points					
		oral survey	test control	practical skills	written work	situational task	IW*
“5”	17	3	3	2	3	3	3
“4”	14	3	2	2	3	2	2
“3”	12	2	2	2	2	2	2
“2”	0	0	0	0	0	0	0

IW* - independent work

Independent work – these are mandatory tasks that the student must complete for each practical lesson (summary of theoretical issues, completion of tasks in the workbook, preparation of a protocol for practical work, study of vocabulary and terminology, study of additional literature in English in accordance with the methodological recommendations of the department).

Distribution of points awarded to students for the discipline:

Number of lessons	Current assessment and independent work				Individual student work	Sum of points for the discipline
	«5»	«4»	«3»	«2»		
10	17	14	12	0	5-30	0-200

Individual work - preparation of essays on scientific topics of the department, presentations at student scientific club, scientific conference of the university or other higher education institution, preparation and publication of abstracts. Assessed during current studies. Points for individual work range from 5 to 30, which are added to current studies.

Form of control: differentiated credit.

Knowledge of the discipline is assessed using the following scale:

Score in points	Score on a national scale	Scale Score ECTS	
		Evaluation	Explanation
170-200	Excellent	A	<i>Excellent</i> (excellent performance only a few errors).
155-169	Good	B	Very good (above average with a few errors).
140-154		C	Good (generally correct performance with a certain number of significant errors).
125-139	Satisfactory	D	<i>Satisfactory</i> (not bad, but with a significant number of shortcomings).
111-124		E	<i>Sufficient</i> (implementation meets the minimum criteria).
60-110	Unsatisfactory	FX	<i>Unsatisfactory</i> (with the possibility of retaking).
1-59		F	<i>Unsatisfactory</i> (with mandatory re-study of the discipline).

The minimum score required to pass the course is 111.

12. Course policy: mandatory compliance with academic integrity by students, namely:

- independent completion of all types of work, tasks, and forms of assessment provided for in the work program of this elective discipline;
- references to sources of information when using ideas, developments, statements, and information;
- compliance with copyright and related rights legislation;
- provision of reliable information about the results of one's own (educational, scientific, creative) activities, research methods used, and sources of information.

13. Methodological support:

- work program for the elective discipline;
- syllabus for the elective discipline;
- textbooks and manuals in accordance with the list of literature;
- multimedia lectures;
- methodological recommendations for practical classes;
- methodological recommendations for independent work by students;
- electronic version:

<https://nmuofficial.com/zagalni-vidomosti/kafedri/departament-bioorganic-biological-chemistry/>

- <https://likar.nmu.kyiv.ua/md/course/view.php?id=121>
- electronic bank of test tasks for current monitoring of student achievement.

14. Recommended literature

The main:

1. Medical chemistry: textbook / V.O. Kalibabchuk, V. I. Halynska, L. I., Hrysbchenko et. al.; edited by V.O. Kalibabchuk. 7th edition. Kyiv: AUS Medicine Publishing, 2020. 224 p.

2. Medical chemistry: book for the medical faculty students / A. G. Kaplaushenko, A. I. Avramenko, B. O. Varynskyi [et al.]. Lviv: Marchenko T. V., 2021. 256 p.
3. General and Inorganic chemistry: textbook. Kalibabchuk V.O., Ohurtsov V.V., Halinska V.I., et al.: edited by V. O. Kalibabchuk. Kyiv: AUS Medicine Publishing, 2019. 456 p.

Additional

1. Chemistry of d-elements [Хімія d-елементів]: навч. посіб. / В.О. Калібабчук, В.Л. Сліпчук, О.М. Чхало. К.: Центр учбової літератури, 2017. 66 с.
2. Biogenic s, p, d – block elements, biological role, application in medicine: Educational and metodical recommendation / A. G. Kaplaushenko, I. A. Iurchenko, B. A. Varinskiy, M.A. Shcherbak, Yu.N. Kucheryavyi, Yu.G. Samelyuk. Zaporozhye: [ZSMU], 2015. 78 p.

Electronic resources

- <https://nmuofficial.com/zagalni-vidomosti/kafedri/departament-bioorganic-biological-chemistry/>
- <https://likar.nmu.kyiv.ua/md/course/view.php?id=121>