

National University of Life and Environmental Sciences of Ukraine

Department of physiology, biochemistry plants and bioenergetic

"APPROVED"

Dean of Faculty of Plant protection,
Biotechnology and Ecology



Kolomiets Y.V.

23 " May 2024

"APPROVED"

at the meeting of the department
physiology, biochemistry plants and bioenergetic

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Head of department
(Prylutska S.V.)

"REVIEWED"

Program Coordinator "Ecology"
Program Coordinator

Volodymyr BOGOLYUBOV

WORK PROGRAM OF THE DISCIPLINE
BIOCHEMISTRY

Specialty 101 «Ecology»

Field of knowledge «Ecology»

Faculty Plant protection, Biotechnology and Ecology

Developer: Head of department, Dr of Sci., Prof. *Prylutska S.V.*, ass. Prof. *Tkachenko T.A.*

Description of discipline «BIOCHEMISTRY»

Field of knowledge, direction of training, specialty, education and qualification level		
Education degree	«Bachelor»	
Speciality	101 «Ecology»	
Field of knowledge	«Ecology»	
Characteristics of discipline		
Kind	Normative	
Total number of hours	120	
Number of ECTS	4	
Number of content modules	2	
Form of control	Exam	
Indicators discipline for full-time students		
	Full-time	Part-time
Year of training	2	
Semester	4	
Lectures	30 h	
Practical, seminars	-	
Labs	30 h	
Independent work	60 h	
Individual task	-	
Number of weekly hours for full-time students: classroom	4 h	

1. The aim, tasks, competencies and program results of the educational discipline

The discipline "Biochemistry" studies the chemical composition of the living organisms and environment, as well as the relationships between them. Comprehensive knowledge of the structure, physical, chemical and biological properties of inorganic and organic compounds, which are a component of the environment and all living things, their rational complementarity, are essential and necessary for the further application of the knowledge and skills of biotechnologists in their professional activities. In living nature, there is a constant balance between diversity and stability due to the presence of numerous regulatory mechanisms and communications, which are based on complex biochemical transformations. Therefore, the study of biochemical foundations lays the foundation for understanding the deep processes of interaction between different living organisms, both among themselves and in ecosystems.

The task of the study discipline Biochemistry is to acquaint students with the structure, properties of chemical elements and their compounds, the main classes of bioorganic compounds, their classification, functions and properties, biochemical mechanisms of adaptation of living organisms and the transformation of exo- and endogenous compounds. Theoretical aspects of the discipline are reinforced by students in laboratory classes in order to acquire and consolidate practical skills when working in a chemical, biochemical, biotechnological laboratory, which will allow

them to plan scientific research and analyze the obtained experimental data in the future.

The aim of the educational discipline "Biochemistry" is the formation of theoretical foundations and practical skills of modern physicochemical, spectral, molecular, biophysical, biochemical methods that are widely used in ecology and agrotechnology.

Theoretical aspects of the discipline are consolidated in laboratory classes, so students need to acquire and consolidate skills when working in a biochemical laboratory, which will allow them to plan scientific research and analyze the obtained experimental data in the future.

Competencies of the academic discipline:

Integral competences (IC):

The ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection and balanced nature management, which involves the application of basic theories and methods of environmental sciences, which are characterized by the complexity and uncertainty of conditions.

General competences (GC):

GC1. Knowledge and understanding of the subject area and professional activity.

Special (professional) competences (SC):

SC2. Ability to critically understand basic theories, methods and principles of natural sciences.

SC5. Ability to assess the impact of technogenesis processes on the state of the environment and identify environmental risks associated with production activities

Program learning results of the academic discipline (PLR):

PLR7. Solve problems in the field of environmental protection using generally accepted and/or standard approaches and international and domestic experience.

PLR21. Be able to choose optimal methods and tools for research, data collection and processing.

2. The program and structure of the educational discipline for:

- full-time full-time (full-time) form of higher education;
- shortened period of full-time (part-time) higher education.

The names of content modules and themes	Number , hours													
	full-time								part-time					
	numb er	tot al	including					total	including					
			1	pr	lab	ind	indep		1	pr	lab	ind	indep	
2	3	4	5	6	7	8	9	10	11	12	13	14		
Thematic Module I Molecular and chemical composition of living organisms and environment														
Theme 1. Introduction to the Biochemistry.	1	8	2	-	2	-	4							
Theme 2. Modern biochemical methods.	2	8	2	-	2	-	4							

Theme 3. The molecular and chemical composition of living organisms.	3	8	2	-	2	-	4							
Theme 4. The role of water in the life of living organisms. Buffer systems.	4	8	2	-	2	-	4							
Theme 5. The molecular and supramolecular organization of cells.	5	8	2	-	2	-	4							
Theme 6. Protein and amino acids.	6		2	-	2	-	4							
Theme 7. Carbohydrates.	7		2	-	2	-	4							
Theme 8. Nucleic acids.	8		2	-	2	-	4							
Theme 9. Lipids.	9		2	-	2	-	4							
Number for thematic module 1	72		18	-	18	-	36							
Module 2. Biotransformation of substances and biochemical levels of interaction between living organisms.														
Theme 1. Basic concepts of substance and energy metabolism in nature. Enzymatic reactions.	10	8	2	-	2	-	4							
Theme 2. Phytohormones.	11	8	2	-	2	-	4							
Theme 3. Secondary plant metabolites.	12	8	2	-	2	-	4							
Theme 4. Biological activity of xenobiotics	13	8	2	-	2	-	4							
Theme 5. Allelopathy and its role in the ecology of agrosystems	14	8	2	-	2	-	4							
Theme 6. Ecological and biochemical	15	8	2	-	2	-	4							

interaction of plants and animals													
Number for thematic module 2	48	12	-	12	-	24							
Total number	120	30		30		60							

3. Theme of Lab works

№	Theme	Number, hours
1	Determination of pH in water and soil	2
2	Osmotic properties of cells	2
3	Preparation of buffer solutions: acidic (acetate buffer system (CH ₃ COOH + CH ₃ COONa); hydrogen phosphate (K ₂ HPO ₄ + +KH ₂ PO ₄); bicarbonate (H ₂ CO ₃ + NaHCO ₃); hemoglobin (HHb + KHb); oxyhemoglobin (HHbO ₂ + KHbO ₂), basic (ammonia buffer: NH ₄ OH + NH ₄ Cl), phosphate buffer system, hydrogen carbonate buffer system (H ₂ CO ₃ , NaHCO ₃).	2
4	Qualitative determination of mineral substances. Ashing methods. Microchemical analysis of ash.	2
5	Qualitative reactions to non-protein nitrogenous compounds.	2
6	Color (qualitative) reactions to proteins and amino acids.	2
5	Qualitative reactions to nitrates in plant material.	2
7	Protein precipitation reactions. Physicochemical properties of proteins.	2
8	Isolation of proteins from plant material.	2
9	Qualitative reactions to monosaccharides.	2
10	Qualitative reactions to polysaccharides. Hydrolysis of starch and fiber.	2
11	Isolation of nucleoproteins from yeast.	2
12	Qualitative reactions to the components of nucleoproteins (proteins, monosaccharides (ribose and deoxyribose), purine bases, phosphoric acid).	2
13	Determination of chemical parameters of fats.	2
14	Evaluation of the content of dangerous chemicals. Qualitative reactions to mercury, lead, cadmium, dioxins	2
15	Determination of ammonium ions in groundwater	2
	Number	30

4. Theme of independent work

№	Theme	Number, hours
1	The history of the development of biochemistry. The contribution of outstanding domestic and foreign scientists to the development of biochemistry as a science.	4
2	Scientific discoveries in the field of Biochemistry. Nobel laureates.	4
3	Methods of isolation and purification, separation of proteins - salting out, electrophoresis, chromatography, Western blot analysis, PCR, etc.	4
4	Technologies for the selection and storage of biological materials (cell suspensions, tissues, blood, etc.).	4
5	Source of vegetable proteins. Characteristics of plant proteins and their importance. Amino acid composition of plant proteins.	4
6	The role of amino acids in the protection of agricultural crops from stress.	4
7	Biologically active substances of plant origin. Their role in the processes of photosynthesis and respiration.	4
8	Phytohormones and their regulatory role.	4
9	Accumulation of nutrients in plant cells and tissues. Ways of entry of substances into the cell and mechanisms of removal from the cell.	4
10	Selective accumulation of chemical and radioactive elements by plant organs and tissues. Consequences.	4
11	Structural, biochemical and physiological features/differences of plant and animal cells.	4
12	Plant antibiotics - classification, mechanism of action and role.	4
13	Molecular biological and biochemical mechanisms of action of chemical carcinogens. Stages, metabolic transformations, cell penetration, etc.	4
14	Plant tumors and their causes. Methods of preventing the development of the tumor process and fighting it.	4
15	Chemical composition of medicinal plants.	4
	Number	60

5. Means of diagnosing learning outcomes:

- exam;
- modular tests;
- essays;
- protection of laboratory work;

- presentations.

6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration method, demonstration method);
- working with educational and methodical literature (summarizing, summarizing, annotating, reviewing, writing an essay, preparing a presentation and report);
- video method (remote, multimedia, web-oriented, etc.);
- independent work (task performance).

7. Evaluation methods:

- exam;
- oral or written survey;
- modular testing;
- team projects;
- abstracts, essays;
- laboratory protection;
- presentations and speeches at scientific events.

8. Distribution of points,

which are received by those obtaining higher education. The assessment of the knowledge of a higher education student takes place on a 100-point scale and is translated into national assessments according to the table. 1 of the current "Regulations on examinations and assessments at NUBiP of Ukraine"

Student rating, points	National assessment based on the results of the compilation	
	exam	credit
90-100	excellent	Credited
74-89	good	
60-73	Satisfactorily	
0-59	Non-Satisfactorily	Non-Credited

To determine the rating of the student (listener) for mastering the discipline R_{DIS} (up to 100 points) the obtained rating for certification (up to 30 points) is added to the rating of the student (listener) for academic work R_{ew} (up to 70 points): $R_{DIS} = R_{ew} + R_{AT}$.

9. Educational and methodological support:

- electronic educational course of the educational discipline (on the eLearn educational portal of NUBiP of Ukraine - <https://elearn.nubip.edu.ua/course/view.php?id=3693>);

- abstracts of lectures and their presentations (in electronic form);
- textbooks, training aids, workshops;
- methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education.

10. Recommended sources of information

Basic:

1. D.L. Nelson, M.M. Cox. *Lehninger Principles of Biochemistry*. Publisher: W.H. Freeman (15th Edition), 2009, ISBN-10: 0-7167-7108-X. ISBN-13: 978-0-7167-7108-1. 1100 p.
2. Біологічна і біоорганічна хімія. Підручник у 2 томах/ Л.І. Остапченко, В.К. Рибальченко /– К.: Видавничо-поліграфічний центр «Київський університет», 2015. – 918 с.
3. Біохімія. Підручник / Л.І. Остапченко, Т.Р. Андрійчук, Ю.Д. Бабенюк та ін. / За ред. Л.І. Остапченко – К.: Видавничо-поліграфічний центр «Київський університет», 2012. – 796 с.
4. Біохімія. Підручник / Кучеренко М.Є., Бабенюк Ю.Д., Васильєв О.М., Виноградова Р.П., Войціцький В.М., Курський М.Д., Рибальченко В.К., Цудзевич Б.О. – К.: ВПЦ «Київський університет», 2002. – 480 с.
5. Молекулярна біологія. Підручник / Сиволоб А.В. – К.: ВПЦ «Київський університет», 2008. – 384 с.
6. Кучеренко М.Є., Бабенюк Ю.Д., Войціцький В.М. Сучасні методи біохімічних досліджень. К.: Фітосоціоцентр, 2001. – 424 с.

Additional:

1. Thomas D. Pollard, William C. Earnshaw, Ph. D. *Cell biology*. – Elsevier Science (USA), 2002. – 804 p.
2. Тарасенко Л.М., Непорада К.С., Григоренко В.К. *Функціональна біохімія*. – Вінниця, Нова книга, 2007. – 378с.
3. Губський Ю.І. *Біологічна хімія*. – Київ-Вінниця:, Нова книга, 2007. – 656с.

Information Resources.

1. Electronic bases of books, publications, encyclopedias, etc. (PubMed, HighWire). <http://review3d.ru/lehninger-a-nelson-d-l-cox-m-m-lenindzher-a-nelson-d-l-koks-m-m-principles-of-biochemistry-osnovy-bioximii>.
2. Electronic library: <http://review3d.ru/>.
3. <https://www.youtube.com/watch?v=ojhdTFmkY1c>
<https://www.youtube.com/user/amritacreate/videos>
<https://www.youtube.com/watch?v=FUo428guKt0>
<https://www.youtube.com/watch?v=CC3t67e2GsU>
<https://www.youtube.com/watch?v=QacQmS3aaTI>
<https://www.youtube.com/watch?v=HSGlfbV7W84>
<https://www.youtube.com/watch?v=JdXbTWfOc18>
https://www.youtube.com/watch?v=ZuhQtTX6_4U
https://www.youtube.com/watch?v=23W5Z_redfs