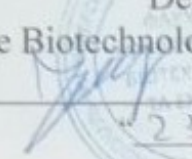
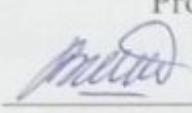
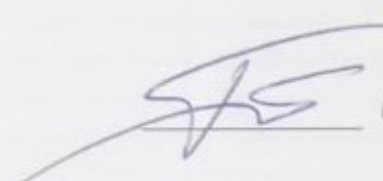


**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES  
OF UKRAINE**

Department of Analytical and Bioinorganic Chemistry & Water Quality

**"CONFIRMED"**  
Dean of the Plant Protection,  
the Biotechnologies and Ecology Faculty  
(Prof. Yulia Kolomiets)  
  
"25" 05 2024.

**"APPROVED"**  
at the meeting of the department of analytical  
and bioinorganic chemistry & water quality  
Protocol № 11 dated "24" 05 2024.  
  
Head of Department  
(Prof. Volodymyr Kopilevich)

**"REVIEWED"**  
Garantor of the AP  
Ecology Bachelor  
(Prof. Volodymyr Bogolyubov)  


**CURRICULUM OF ACADEMIC DISCIPLINE**

**BIOGEOCHEMISTRY**

Field of knowledge 10 Natural Sciences

Speciality 101 - Ecology

Educational program Ecology

Faculty of the Plant Protection, the Biotechnologies and Ecology

Author: Associate Professor, Cand Chem Sci Larysa Voitenko

(position, academic degree, academic rank)

Kyiv – 2024

## Description of the discipline Biogeochemistry

*(name)*

<b>Academic degree, specialty, academic programme</b>		
Academic degree	<i>bachelor's</i>	
Specialty	<i>101- Ecology</i>	
Academic programme	<i>Ecology</i>	
<b>Characteristics of the discipline</b>		
Type	optional	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	2	
Course project (work) (if any)	-	
Form of assessment	<i>exam</i>	
<b>Indicators of the discipline for full-time and part-time forms of university study</b>		
	Full-time	Part-time
Year of study	The 4th	-
Semester	The 7th	
Lectures	<i>15 hours</i>	
Laboratory classes	<i>30 hours</i>	
Self-study	<i>75 hours</i>	
Number of hours per week for full-time students	<i>3 hours</i>	

### **1. Aim, objectives, competences and expected learning outcomes of the discipline**

Aim is to acquire basic concepts, principles, and techniques of modern biogeochemistry as a top level of chemistry understanding and special application for the specialists in the field of ecology, environmental protection, and sustainable development. The discipline that involves the study of the chemical, physical, and biological processes and reactions that govern the composition of the natural environment (including the biosphere, the cryosphere, the pedosphere, the atmosphere, and the lithosphere): chemical aspects of life origin. In particular, it is to study of cycles of chemical elements, such as carbon and nitrogen, and their interaction with and incorporation into living things transported through earth scale biological systems in space through time.

### **Objectives:**

1. To develop the conceptual apparatus, general principles and fundamental provisions of biogeochemistry;
2. To study of the general geochemical organization of the biosphere;
3. To study of global biogeochemical cycles of elements;
4. To study of the geochemical evolution of the outer shells of the earth under the influence of the activity of living matter;
5. To study of the patterns of migration and concentration of various chemical elements depending on the internal and external factors, including those occurring in the biosphere as a result of anthropogenic impact;
6. To study of biogeochemical features of various endemic zones and endemic diseases;
7. To acquaintance with the techniques and methods of biogeochemical research used to study the processes of mass transfer and migration of chemical elements between living organisms and the environment, as well as for ecological and geochemical assessment of the state of the environment.

### ***Acquisition of competences:***

*Integral competence (IC):* The ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection, and sustainable environmental management, which involves the application of basic theories and methods of science about environments that are characterized by complexity and uncertainty of conditions.

#### *General competences (GC):*

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

GC8. Ability to conduct research at the appropriate level

GC10. The ability to evaluate and ensure the quality of performed works.

#### *Special (professional) competences (SC):*

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

SC 3. Ability to understand basic theoretical concepts regulations, concepts and principles of natural and of social and economic sciences.

SC7. Ability to monitor and evaluate current condition of environment based on analytical monitoring data.

#### *Expected Learning Outcomes (ELO):*

ELO 3. Understand the basic concepts, theoretical and practical problems in the field of natural sciences, which are necessary for analysis and decision-making in the field of ecology, environmental protection and balanced nature management.

ELO 14. Be able to create texts, make presentations and messages for professional audiences and the general public with observance of professional integrity and impossibility plagiarism.

ELO 18. Combine the skills of independent and team work to achieve results with an emphasis on professional integrity and responsibility of or decision-making.

ELO 19. Increase the professional level by continuing education and self-education.

ELO 21. To be able to choose optimal methods and tools for research, collection and data processing.

## 2. Programme and structure of the discipline for:

- full-time (part-time) form of study.

Modules and topics	Number of hours													
	Full-time form							Part-time form						
	weeks	total	including					total	including					
			l	p	lab	ind	s.st		l	p	lab	ind	s.st	
<b>Module 1. Biogeochemical characteristics of the ecosphere composition</b>														
<i>Topic 1.</i> Introduction. The object of research and the goal of the discipline. Life origin on the Earth: hypotheses and experimental.	1-3	22	2		6		14	26	2		2			22
<i>Topic 2.</i> The ecosphere, the chemical elements and biogeochemical laws.	3-5	20	2		6		12	20	2					18
<i>Topic 3.</i> Biogeochemical zoning	6	8	2				4	7						7
<i>Topic 4.</i> Endemic diseases as result of abnormal distribution of chemical elements in biosphere	7-8	12	2		4		4	9			2			7
<b>Total for module 1</b>	<b>8</b>	<b>62</b>	<b>8</b>		<b>16</b>		<b>38</b>	<b>62</b>	<b>4</b>		<b>4</b>			<b>54</b>
<b>Module 2. Biogeochemical cycles of the main bioactive chemical elements</b>														
<i>Topic 1.</i> The general notions of biogeochemical cycles. Biogeochemical cycles of gaseous (Nitrogen, Oxygen, Hydrogen) and Sedimentation types (Phosphorus, Sulfur). Biogeochemical barriers.	9-12	34	5		12		20	28	2		2			24
<i>Topic 2.</i> Biogeochemical cycles of micronutrients and toxic elements. Chemistry of preservatives and psychoactive compounds	13-15	24	2		2		17	30	2					28
<b>Total for module 2</b>	<b>7</b>	<b>58</b>	<b>7</b>		<b>14</b>		<b>37</b>	<b>58</b>	<b>4</b>		<b>2</b>			<b>52</b>
<b>Total hours</b>		<b>120</b>	<b>15</b>		<b>30</b>		<b>75</b>	<b>120</b>	<b>8</b>		<b>6</b>			<b>106</b>

### 3. Topics of laboratory classes

№	Topic title	Hours
1	Introduction. Safe rules in chemical laboratory. Qualitative methods of environmental chemical analysis. Probe sampling, conservation and storage of samples for analysis. Principles of statistic treatment of qualitative analytical results of environmental objects.	4
2	Express measuring of active residue chlorine (free, total) in chlorinated drinking water by photometric method using C-401 colorimeter.	4
3	Determination of nitrate content in natural fresh waters and drinking water by photometrical method according to DSTU 4078-2001 Water quality; determination of nitrate; part 3: spectrometric method using sulfosalicylic acid (ISO 7890 3:1998, MOD). Statistical treatment of analysis data.	4
4	Determination of ammonia content in natural fresh waters and drinking water by photometrical method according to DSTU ISO 7150-1-2003 Water quality - Determination of ammonium - Part 1: Manual spectrometric method. Statistical treatment of analysis data.	4
5	Determination of total iron content in tap water, buvette water and surface waters according to GOST 4011-72 Drinking water. Methods for determination of total iron. Statistical treatment of analysis data.	4
6	Determination of fluoride content in drinking water and a few sorts of leaf and packed according to GOST 4386-89 Drinking water. Methods for determination of fluorides mass. Statistical treatment of analysis data.	2
7	General chemical properties of alkaloids. Загальна характеристика алкалоїдів. Sublimation method for the caffeine dry extraction from tea leaves. Qualitative test of caffeine.	2
8	Determination of active oxygen content in detergents and oxygen-contained bleaches according to DSTU 2207.2-93 (GOST 22567.10-93) Synthetic detergents. Methods to determine total mass fraction of available oxygen.	6
	<b>Total</b>	<b>30</b>

### 4. Topics for self-study

№ s/n	Topic title	Hours
1	Anthropogenic stage of biosphere development. The concept of the noosphere. The noosphere as a natural step in the development of the Earth. Characteristic features of the noosphere: a) emergence of new landscapes (cultural, man-made, agricultural landscapes); b) man as the main active force of the noosphere, man-made migration of chemical substances; c) significant increase in volumes of information, new types of information; d) use of biosphere energy. Conditions (according to V.I. Vernadsky) for the complete transformation of the biosphere into the noosphere.	15
2	Landscape-geochemical zoning of Ukraine. Zonal and intrazonal provinces in Ukraine, endemic diseases in Ukraine. Influence of the geochemical environment on the evolution of plants. Adaptogenic plants: indifferent to changes in the concentration of chemical elements, common and unusual concentrators, endemic plants.	12
3	Biogeochemistry of the Earth's gas mantle. Value of atmospheric mass transfer of water-soluble forms of chemical elements. Vegetation as an absorber of gaseous pollutants.	6
4	Biogeochemistry of the lithosphere and pedosphere. Chemical composition of soils and bottom sediments. Types of migration of chemical elements in the pedosphere and lithosphere (hypogenic, supergenic and anthropogenic migration). Organic matter of the pedosphere.	6
5	Biogeochemistry of the hydrosphere. Classification of natural waters according to the level of mineralization, type of mineral matrix. Water requirements for different types of	8

	water use (drinking, irrigation, watering animals and poultry, fish farming, recreational purposes, etc.).	
6	Biochemical cycles of substances and energy in the biosphere. Cycle of elements that entered the biosphere as a result of mantle degassing (hydrogen, carbon, oxygen, nitrogen). Cycles of elements that entered the biosphere as a result of mobilization from the earth's crust (calcium, potassium, silicon, phosphorus).	12
7	Interaction between living and non-living nature is the basis of biogenic migration of substances. The concept of a small biological cycle of chemical elements. The energy of living matter is the driving force of the geochemical and biogeochemical circulation of substances.	8
8	Hydrogen (water) cycle. Chemical characteristics of hydrogen, its content in the lithosphere, atmosphere, living organisms, humus, plants. Water as a source of Hydrogen for the formation of organic substances. Water as a living environment. Total water content in the biosphere. Biogeochemical cycle of water, its duration. Provision of drinking water and the degree of its use in different countries. Water pollutants, their classification.	8
	<b>Total</b>	<b>75</b>

### **5. Tools for assessing expected learning outcomes:**

- Exam;
- Module tests;
- On-line tests (via Elern platform);
- Abstracts;
- Presentation of laboratory works.

### **6. Teaching methods:**

- Verbal method (lecture, discussion, interview);
- Practical method (laboratory classes);
- Visual method (demonstration method);
- Work with educational and methodical literature (summarizing, annotating, reviewing);
- Video method (multimedia, web-oriented);
- Independent work (task performance);
- Individual research work of students of higher education.

### **7. Assessment methods:**

- exam;
- written assessment;
- module tests;
- essays and reports;
- presentation of laboratory works.

### **8. Distribution of points received by students**

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

Student's rating, points	National grading of exams and credits	
	exams	credits
90-100	excellent	pass
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	fail

To determine a student's rating in the discipline  $R_{DIS}$  (up to 100 points), the received assessment rating  $R_A$  (up to 30 points) is added to the academic performance rating  $R_{AP}$  (up to 70 points):  $R_{DIS} = R_{AP} + R_A$ .

### 9. Teaching and learning aids

- e-learning course of the discipline (<https://elearn.nubip.edu.ua/course/view.php?id=2314>);
- lectures and presentations (in electronic form);
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students.

### 10. Recommended sources of information

1. Voitenko L. Chemistry with the foundations of biogeochemistry: manual. Kyiv: Naukova stolytsa, 2019. 400 p. (In Ukrainian).
2. Schlesinger W., Bernhardt E. Biogeochemistry: An Analysis of Global Change, Third Edition. Biogeochemistry: An Analysis of Global Change. 2013. San Diego: Academic Press. 672 p.
3. Voitenko, L.V. Lab workbook in Biogeochemistry for Bachelor students of Ecology. Lab Manual. Kyiv:Expo-druk. 2020. 98 p.
4. Основи біогеохімії: навчальний посібник / С. І. Цехмістренко, Н. В. Пономаренко, В. М. Поліщук, С. А. Поліщук, О. С. Цехмістренко; за редакцією С. І. Цехмістренко. Біла Церква, 2023. 183 с. URL: [https://rep.btsau.edu.ua/bitstream/BNAU/8492/1/Osnovy\\_%20bioheokhimii.pdf](https://rep.btsau.edu.ua/bitstream/BNAU/8492/1/Osnovy_%20bioheokhimii.pdf)