

Odessa National Medical University
Faculty Medical, International
Department of Medical Biology and Chemistry

“BIOLOGICAL AND BIOORGANIC CHEMISTRY”

Scope of the academic discipline	Total number of hours per discipline: 240 hours, 8 credits. Semesters: II-IV. 1-2 years of study
Days, time, place of educational discipline	According to the schedule of classes. Department of Medical Biology and Chemistry Odesa, st. Olhivska, 4. Main building of ONMedU, 2nd floor.
Teacher(s)	H.F. Stepanov, doctor of medical sciences, Associate Professor, head of the department. Associate Professors: candidate of biological sciences Storchylo O.V., candidate of chemical sciences Burdina Y.F., candidate of chemical sciences Shirykalova A.O., candidate of chemical sciences Grekova A.V. Senior teachers: candidate of biological sciences Vasylieva A.G., Kostina A.A. Assistants: Gridina I.R.
Contact information	Reference by phone: Kostina Alina Anatolyivna, head teacher of the department 712-31-05, responsible for organizational and educational work of the department Buryachkivska Oksana Leonidivna, laboratory technician of the department 728-54-78 E-mail: medchem@ukr.net Face-to-face consultations: from 2:00 p.m. to 5:00 p.m. every Thursday, from 9:00 a.m. to 2:00 p.m. every Saturday Online consultations: from 2:00 p.m. to 5:00 p.m. every Thursday, from 9:00 a.m. to 2:00 p.m. every Saturday. The link to the online consultation is provided to each group during classes separately.

COMMUNICATION

Communication with applicants will be conducted in the classroom (face-to-face). During distance learning, communication is carried out through the Microsoft Teams platform, as well as through e-mail correspondence, Viber messengers (through groups created in Viber for each group, separately through the head of the group).

REQUISITES OF THE EDUCATIONAL DISCIPLINE

The subject of study of the discipline is the chemical composition of living organisms (the human body) and the biochemical transformations to which the molecules that make up them are subject.

Prerequisites and post-requisites of the discipline (place of the discipline in the educational program):

Prerequisites: to study the course, higher education applicants need basic knowledge of medical biology, biophysics, medical chemistry, morphological disciplines, sufficient for perceiving the categorical apparatus of the subject, understanding the chemical nature of the main substances that make up living organisms and the biochemical processes that occur in them.

Post-requisites: mastering the educational material of the discipline "Biological and bioorganic chemistry" allows you to acquire knowledge and skills in the courses of molecular biology, genetics, physiology, pathology, general and molecular pharmacology, toxicology and propaedeutics of clinical disciplines, which involves the integration of teaching with these disciplines and the formation of skills knowledge of biological and bioorganic chemistry, primarily biochemical processes that take place in the body of a healthy and sick person, in the process of further education and professional activity.

The goal of the discipline: mastering by higher education applicants a system of knowledge about the peculiarities of biomolecules and the molecular organization of cellular structures, the general laws of enzymatic catalysis and the biochemical dynamics of the transformation of the main classes of biomolecules (amino acids, carbohydrates, lipids, nucleotides, porphyrins, etc.), molecular biology and genetics of informative macromolecules (proteins and nucleic acids), i.e. molecular mechanisms of heredity and implementation of genetic information, hormonal regulation of metabolism and biological functions of cells, biochemistry of special physiological functions.

Tasks of the discipline:

1. Acquisition of knowledge and skills to conduct biochemical research to identify normal and pathological components in biological fluids.
2. Analyze the results of biochemical research for the diagnosis of the most common human diseases.
3. To analyze the biochemical processes of metabolism and its regulation in ensuring the functioning of organs and systems of the human body.

Expected results:

As a result of studying the academic discipline, the applicant must:

Know:

- the structure of bioorganic compounds and the functions they perform in the human body;
- reactivity of the main classes of biomolecules, which ensures their functional properties and metabolic transformations in the body;
- biochemical mechanisms of pathological processes in the human body;
- peculiarities of diagnosing the physiological state of the body and the development of pathological processes based on biochemical studies;
- the relationship between the peculiarities of the structure and transformations in the body of bioorganic compounds as the basis of their pharmacological action as medicinal products;
- basic mechanisms of biochemical action and principles of targeted application of various classes of pharmacological agents;
- biochemical and molecular bases of physiological functions of cells, organs and systems of the human body;

- the functioning of enzymatic processes occurring in membranes and organelles for the integration of metabolism in individual cells;
- norms and changes in biochemical indicators used for the diagnosis of the most common human diseases;
- the importance of biochemical processes of metabolism and its regulation in ensuring the functioning of organs, systems and the entire human body.

Be able to:

- analyze the correspondence of the structure of bioorganic compounds to the physiological functions they perform in the human body;
- interpret the peculiarities of the physiological state of the body and the development of pathological processes on the basis of laboratory studies;
- analyze the reactivity of carbohydrates, lipids, amino acids, which ensures their functional properties and metabolic transformations in the body;
- to interpret the peculiarities of the structure and transformations of bioorganic compounds in the body as the basis of their pharmacological action as medicinal products;
- interpret the biochemical mechanisms of the occurrence of pathological processes in the human body and the principles of their correction;
- explain the basic mechanisms of biochemical action and the principles of targeted use of various classes of pharmacological agents;
- explain the biochemical and molecular bases of the physiological functions of cells, organs and systems of the human body;
- analyze the functioning of enzymatic processes occurring in membranes and organelles for the integration of metabolism in individual cells.

DESCRIPTION OF THE EDUCATIONAL DISCIPLINE

Forms and methods of education

The course will be taught in the form of lectures (32 hours), practical classes (128 hours), organization of higher education applicants' independent work (80 hours).

Teaching methods: lectures, explanations, conversations, multimedia presentations, laboratory work, problem solving, oral survey, testing, etc.

Content of the academic discipline

Content module 1.

Biologically important classes of bioorganic compounds. Biopolymers and their structural components.

Theme 1. Classification, nomenclature, isomerism of bioorganic compounds. The nature of chemical bonds. Types of chemical reactions.

Theme 2. Study of reactivity of alkanes, alkenes, arenes.

Theme 3. Structure and properties of hydroxo- and oxocompounds. Biologically active hydroxo- and oxocompounds.

Theme 4. Study of the reactivity of carboxylic acids and their heterofunctional derivatives (amino alcohols, hydroxy acids, keto acids and phenolic acids). Use of carboxylic acids in medicine.

Theme 5. Study of the properties of natural higher fatty acids. Triglycerides. Lipids.

Theme 6. Phospholipids. Biological significance and structure of the lipid component of biomembranes.

Theme 7. Carbohydrates. Structure and chemical properties of monosaccharides.

Theme 8. Structure and functions of di- and polysaccharides.

Theme 9. Chemical properties of carbohydrates. Qualitative reactions for the determination of carbohydrates.

Theme 10. Study of the amino acid composition of proteins and peptides.

Theme 11. Organization of protein structure. Physicochemical properties of proteins.

Protein precipitation reactions. Denaturation. Qualitative reactions for the determination of amino acids and proteins.

Theme 12. Classification, structure and significance of biologically active five-membered heterocyclic compounds with one and two heteroatoms.

Theme 13. Biologically important six-membered heterocycles with one and two heteroatoms. Condensed heterocycles.

Theme 14. Structure and biological role of nucleosides, nucleotides and nucleic acids

Content module 2.

General patterns of metabolism

Theme 15. The study of membranes.

Theme 16. General characteristics, properties of enzymes.

Theme 17. Cofactors and coenzymes.

Theme 18. Classification and nomenclature of enzymes enzymes.

Theme 19. Mechanism of action of enzymes. Kinetics of catalysis.

Theme 20. Citric acid cycle.

Theme 21. Molecular mechanisms of tissue respiration.

Theme 22. Peroxide and microsomal oxidation.

Content module 3.

Metabolism of carbohydrates, lipids and its regulation.

Theme 23. Intracellular catabolism of glucose.

Theme 24. Glycogenolysis. Aerobic oxidation of glucose.

Theme 25. Alternative pathways of monosaccharide metabolism.

Theme 26. Gluconeogenesis. Glycogen biosynthesis. Regulation of carbohydrate metabolism.

Theme 27. The role of lipids in the structure and functions of biological membranes.

Theme 28. Oxidation of fatty acids and glycerol.

Theme 29. Biosynthesis of glycerol, fatty acids, glycerides and phospholipids.

Theme 30. Cholesterol metabolism. Metabolism of acetoacetic acid.

Intermediate control for the semester.

Content module 4.

Metabolism of amino acids.

Molecular biology. Biochemistry of intercellular communications.

Theme 31. Ways of formation and maintenance of the pool of amino acids in the body. Deamination, decarboxylation of amino acids.

Theme 32. Transamination of amino acids.

Theme 33. Ammonia metabolism in the human body.

Theme 34. Amino acids nitrogen-free skeleton metabolism in the body. Hereditary enzymopathies of amino acid metabolism.

Theme 35. Catabolism of purine and pyrimidine nucleotides.

- Theme 36. Biosynthesis of purine and pyrimidine nucleotides.
- Theme 37. Biosynthesis of nucleic acids.
- Theme 38. Protein biosynthesis in ribosomes. Fundamentals of Molecular Genetics.
- Theme 39. Fundamentals of Molecular Genetics.
- Theme 40. Hormones general concept. Hypothalamus and pituitary gland hormones.
- Theme 41. Thyroid and parathyroid glands hormones. Regulation of phosphorus-calcium metabolism.
- Theme 42. Steroid hormones.
- Theme 43. Pancreas and adrenal medulla hormones.
- Theme 44. Local hormones.

Content module 5.

Biochemistry of tissues and physiological functions.

- Theme 45. Digestion of carbohydrates, lipids, proteins, nucleoproteins in the gastrointestinal tract.
 - Theme 46. Water-soluble vitamins B1, B2, B6, PP.
 - Theme 47. Water-soluble vitamins C, biotin, folic acid, B12, pantothenic acid.
 - Theme 48. Fat-soluble vitamins.
 - Theme 49. Biochemical characteristics and functions of blood.
 - Theme 50. Blood respiratory function.
 - Theme 51. Biochemistry of coagulation, anticoagulation and fibrinolytic blood systems.
 - Theme 52. Biochemistry of immune processes.
 - Theme 53. Biochemical functions of the liver. The role of the liver in the metabolism of bile pigments.
 - Theme 54. Detoxification function of the liver. Biochemistry of immune processes.
 - Theme 55. Urine formation mechanisms.
 - Theme 56. Pathobiochemistry of the kidneys.
 - Theme 57. Hormonal mechanisms of the water-salt balance regulation.
 - Theme 58. Muscle biochemistry.
 - Theme 59. Biochemistry of nervous tissue.
 - Theme 60. Biochemistry of connective tissue.
- Intermediate control for the semester.

List of recommended literature:

Basic:

1. Gubsky Yu.I., I.V. Nizhenkovska, Korda M.M. Biological and Bioorganic Chemistry: in 2 books. Book 2. Biological Chemistry: textbook. 2021. 544 p.
2. Satyanarayana U. Biochemistry. 5th edition. India 2020. 777 p.
3. Lehninger. Principles of Biochemistry. 7th edition. NY, United States. 2017.
4. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto. Biochemistry. 8th Revised edition. 2015.
5. Lippincott Illustrated Reviews: Biochemistry. Philadelphia :Wolters Kluwer, 2017. 560 p.
6. Baynes J., Dominiczak M. Medical Biochemistry. 5th Edition. Elsevier, 2018. 712 p.
7. Donald Voet, Judith G. Voet, Charlott W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level. ISBN: 978-1-118-91840-1 February 2016, 1184 P.

Additional:

1. William Marshall, Marta Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. Elsevier, 2020. 432 p.

2. Harper's Illustrated Biochemistry / V.W. Rodwell, D.A. Bender, K.M. Botham et al. – Mc Graw Hill Education, 2015. – 817 p.
3. Storchylo O. V. Membrane digestion and absorption of some nutrients in vitro and in vivo: Revision and analysis of own Data. *Journal of Gastrointestinal & Digestive System*. 2018. Vol. 8. DOI: 10.4172/2161-069X-C1-064 (12th Global Gastroenterologists Meeting and 3rd International Conference on Metabolic and Bariatric Surgery, Barcelona, Spain, 15-16 March 2018).
4. Storchylo O. V. (2019) Mechanisms of radioprotective and radiocorrective effects of dietary phytoadditive of milk thistle fruits. *Environment&Health*. 2019. №1 (90). P. 33-37. <https://doi.org/10.32402/dovkil2019.01.033>.
5. Storchylo Olha V. (2019) Mechanisms of the implementation of damage to the functions of the small intestine in two generations of posterity of irradiated rats. *Seventh International Conference on Radiation in Various Fields of Research (RAD 2019)*. June 10-14, 2019|Hunguest Sun Resort|Herceg Novy|Montenegro| www.rad-conference.org. P.452. https://www.rad-conference.org/Book_of_Abstracts-RAD_2019.pdf.
6. Construction features, chemical properties and the biological role of carbohydrates. Ia.F. Burdina, A.V. Grekova, S.V. Shcherbakov, T.A. Sidelnikova, K.V. Bevziuk. *Teaching aid*. Odesa, 2017,p. 44.
7. Lipids: classification, structural features, properties and biological role. Ia.F. Burdina, A.V. Grekova, S.V. Shcherbakov, T.A. Sidelnikova. *Teaching aid*. Odesa, 2017 p. 32.

EVALUATION

Current control: oral survey, testing, assessment of class activity.

Final control: exam.

Evaluation of the current educational activity in a practical lesson:

1. Evaluation of theoretical knowledge on the subject of the lesson:

- methods: survey, written work, solving a situational problem, solving test tasks;
- maximum score - 5, minimum score - 3, unsatisfactory score - 2.

2. Evaluation of intermediate control:

- methods: survey, written work, solving a situational problem, solving test problems;
- maximum score - 5, minimum score - 3, unsatisfactory score - 2.

The grade for one practical lesson is the arithmetic average of all components and can only have a whole value (5, 4, 3, 2), which is rounded according to the statistical method.

Current evaluation criteria for practical class:

Score	Evaluation criteria
Excellent «5»	The higher education applicant is fluent in the material, takes an active part in discussing and solving the situational problem, knows how to write the main biochemical reactions that occur in the body, determine the main biochemical indicators in biological objects and give them a medical (medico-biological) evaluation.

Good «4»	The higher education applicant has a good command of the material, participates in the discussion and solution of the situational problem, knows how to write the main biochemical reactions, determine the main biochemical indicators in biological objects and give them a medical and biological evaluation, but allows some insignificant mistakes (inaccuracies) in answering questions.
Satisfactory «3»	The higher education applicant does not have sufficient knowledge of the material, is unsure of participating in the discussion and solution of the situational problem, makes mistakes when writing basic biochemical reactions.
Unsatisfactory «2»	The higher education applicant does not know the material, does not take part in the discussion and solution of the situational clinical problem, has significant gaps in the knowledge of the program material, makes fundamental mistakes when explaining the laws of human metabolism, does not have the necessary practical skills.

Only those higher education applicants who have fulfilled the requirements of the training program in the discipline, have no academic debt, their average score for the current educational activity in the discipline is at least 3.00, and they have passed the test control according to the tests "KROK - 1" at least 90% (50 tasks) are admitted to the final control in the form of an exam. ». The test control of the "KROK-1" tests is conducted in the Educational and Production Complex of Innovative Technologies of Learning, Informatization and Internal Monitoring of the Quality of Education of the University at the last class before the exam.

Evaluation of the results of the higher education applicant s' training during the final control - exam.

The method of final control in the form of an exam is unified and involves the use of standardized forms. The number of questions submitted to the exam corresponds to the amount of credits assigned to the study of the academic discipline.

The examinational card form is standardized and consists of structural elements (components): theoretical questions and practical tasks (situational tasks, case-tasks, descriptions, etc.). Theoretical questions are short, simple, understandable and transparent, a complete answer to one theoretical question lasts no more than 5 minutes. Practical tasks are clearly and understandably formulated, a complete answer to one practical question lasts no more than 5 minutes. The timing of the exam is standard - no more than 30 minutes.

Each examinational card is accompanied by a check-list (answer standard), which provides full correlation with the examinational card, contains a similar number of structural elements (components), has answer standards, which are mandatory for providing complete answers to the questions.

During the exam, the higher education applicant receives an examinational card, and the examiners use a check-list for the corresponding card with standard answers and determine which mandatory components of the answer were named or not named by the higher education applicant.

The overall grade for the exam is calculated as the arithmetic average of all grades obtained for answers to theoretical questions and practical tasks on a traditional four-point scale, rounded to two decimal places.

The exam is held in the Educational and Production Complex of innovative Technologies of Learning, Informatization and Internal Monitoring of the Quality of Education of

the University during the examination sessions at the end of the semester (autumn and spring) according to the schedule.

9. Distribution of points received by higher education applicants of higher education

The obtained average score for the academic discipline for higher education applicants who have successfully mastered the work program of the academic discipline is converted from a traditional four-point scale to points on a 200-point scale, as shown in the table:

Conversion table of traditional to multi-point scale

National score for the discipline	The sum of scores for the discipline
Excellent («5»)	185 – 200
Good («4»)	151 – 184
Satisfactory («3»)	120 – 150
Unsatisfactory («2»)	Less than 120

A multi-point scale (200-point scale) characterizes the actual success of each higher education applicant in learning the educational component. The conversion of the traditional grade (average score for the academic discipline) into a 200-point grade is performed by the information and technical department of the University.

According to the obtained points on a 200-point scale, the achievements of the higher education applicants are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows you to evaluate the achievements of higher education applicants about the educational component who are studying in the same course of the same specialty, according to the points they received.

The ECTS scale is a relative-comparative rating, which establishes the higher education applicant's belonging to the group of better or worse among the reference group of fellow higher education applicants (faculty, specialty). An "A" grade on the ECTS scale cannot be equal to an "excellent" grade, a "B" grade to a "good" grade, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" according to the ECTS scale do not coincide with the limits of grades "5", "4", "3" according to the traditional scale. Higher education applicants who have received grades of "FX" and "F" ("2") are not included in the list of ranked higher education applicants. The grade "FX" is awarded to higher education applicants who have obtained the minimum number of points for the current learning activity, but who have not passed the final examination. A grade of "F" is assigned to higher education applicants who have attended all classes in the discipline, but have not achieved a grade point average (3.00) for the current academic activity and are not admitted to the final examination.

Applicants who study at the same course (same specialty), based on the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Conversion of the traditional grade from the discipline and the sum of points on the ECTS scale

Score on the ECTS scale	Statistical indicator
A	The best 10% of higher education applicants
B	The next 25% of higher education applicants

C	The next 30% of higher education applicants
D	The next 25% of higher education applicants
E	The next 10% of higher education applicants

The possibility and conditions of obtaining additional (bonus) points:

An higher education applicant can receive additional (bonus) points for completing individual tasks:

- participation and report in the scientific conference;
- participation in the subject olympiad in biochemistry, a report at the scientific circle;
- preparation of multimedia slides and design of tests;
- translations of scientific articles from foreign languages; abstract work on a certain topic.

INDEPENDENT WORK OF HIGHER EDUCATION ACQUIRES

Independent work involves preparation for each practical session

EDUCATIONAL DISCIPLINE POLICY

Deadlines and Rescheduling Policy:

- Absences of classes for non-respectable reasons are worked out according to the schedule of the teacher on duty.
- Absences due to valid reasons are processed according to an individual schedule with the permission of the dean's office.

Academic Integrity Policy:

Applicants must observe academic integrity, namely:

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

Unacceptable in educational activities for participants of the educational process are:

- using family or official ties to obtain a positive or higher grade during any form of control of learning outcomes or academic performance;
- use of prohibited auxiliary materials or technical means (cheat sheets, notes, micro-earphones, telephones, smartphones, tablets, etc.) during control measures;
- passing procedures for control of training results by fake persons.

For violation of academic integrity, higher education applicants may be held to the following academic responsibility:

- a decrease in the results of assessment of control work, assessment in class, credit, etc.;
- retaking the assessment (control work, credit, etc.);
- appointment of additional control measures (additional individual tasks, control works, tests, etc.);
- conducting an additional inspection of other works authored by the violator.

Attendance and Tardiness Policy:

Uniform: medical gown that completely covers outer clothing, cap, mask.

Equipment: notebook, pen.

State of health: applicants suffering from acute infectious diseases, including respiratory diseases, are not allowed to attend classes.

A higher education applicant who is late for class can attend it, but if the teacher has put "nb" in the journal, he must work out it in the general order.

Use of mobile devices:

Mobile devices may be used by higher education applicants with the permission of the instructor if they are needed for the assignment.

Behavior in the audience:

The behavior of applicants and teachers in the classrooms must be working and calm, strictly comply with the rules established by the Regulations on academic integrity and ethics of academic relations at Odessa National Medical University, in accordance with the Code of Academic Ethics and University Community Relations of Odessa National Medical University, Regulations on Prevention and detection of academic plagiarism in the research and educational work of higher education applicants of higher education, scientists and teachers of Odessa National Medical University.