




MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education

Far Eastern Federal University
(FEFU)

INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

AGREED


Head of Educational
Program



V.V. Kumeiko
(Signed) (Surname)

CLAIM

Director of the Production Company
Structural subdivision



V.V. Kumeiko
(Signed) (Surname)
April 12, 2023

DISCIPLINE WORK PROGRAM (RAP)

"Molecular Pharmacology"

Area of study 06.03.01 Biology

Form of training: full-time

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the field of training 06.03.01 Biology, approved by the order of the Ministry of Education and Science of the Russian Federation dated 07.08.2020 No. 9 20

The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology, Minutes No. 3 dated April 12, 2023.

Director of the Department of Medical Biology and Biotechnology V.V. Kumeiko
Authors: Candidate of Biological Sciences, Associate Professor Kumeiko V.V.

Vladivostok
2022

1. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*

_____ 202 No.

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Abstract of the discipline

Molecular Pharmacology

The total labor intensity of the discipline is 3 credit units / 108 academic hours. It is a discipline of the compulsory part of the EP, studied in the 3rd year and ends *with a test*. The curriculum provides for *18* hours of lectures, *54* hours of practical work, and *36 hours* of independent work for the student.

Language: Russian.

Objective: to form basic ideas in the field of molecular basis of the physiological action of drugs and basic approaches to the search and development of new drug compounds and biochemical reagents. Familiarization with various groups of drugs created on the basis of natural compounds and their main representatives, as well as with the molecular mechanisms of their action.

Tasks:

- to introduce the history and main stages of the development of molecular pharmacology;
- to provide an understanding of the main stages of the search for leading compounds and methods of biotesting, including the use of computer modeling and magnetic resonance imaging;
- to consider and discuss the main stages of drug development and to give examples of the creation of medicines based on natural compounds;
- to consider examples of the most important molecular targets and to provide information on the molecular mechanisms of action of various drugs: antibiotics, antitumor drugs, analgesics, immunomodulators, antiviral substances, etc.;
- consider the problems of molecular diagnostics, including the use of molecular markers and approaches based on genomics, proteomics and metabolomics;
- to give an idea of the main approaches to the treatment of hereditary diseases and gene therapy;
- To instill in students skills related to the analysis of experimental data, to teach them to work with scientific and reference literature.

For successful study of the discipline, students should have the following preliminary competencies:

- comprehends the principles of structural and functional organization of biological systems;

- and uses physiological, cytological, histological, biochemical, biophysical methods of analysis to assess the state of living objects and monitor their habitat;
- and uses the basic laws of physics, chemistry, earth sciences and biology in his professional activities.

Competencies are obtained as a result of studying the disciplines of *biochemistry, general biology, molecular and cellular biology*, the student should be ready to study such disciplines as immunology, drug development that form competencies:

- analyzes the pharmacokinetics and pharmacodynamics of the studied objects based on knowledge of morphofunctional features, physiological states and pathological processes in the body;
 - To establish methods for the synthesis and analysis of specific nanostructured drugs;
 - to develop the technology of production nanostructured medicines;
- Conduct complex tests of experimental formulations of nanostructured drugs.

General professional competence of students, indicators of their achievement and learning outcomes in the discipline

Competency code and name (result of mastering)	Code and name of the competency indicator
OPK-6 is able to use the basic laws of physics, chemistry, Earth sciences and biology in his professional activities, apply methods of mathematical analysis and modeling, theoretical and experimental research, acquire new mathematical and natural science knowledge using modern educational and information technologies	OPK-6.1 Uses the basic laws of physics, chemistry, earth sciences and biology in professional activities
	OPK-6.2 Applies methods of mathematical analysis and modeling, theoretical and experimental research
	OPK-6.3 Acquires new mathematical and natural science knowledge using modern educational and information technologies
OPK-7 Able to understand the principles of modern information technologies and use them to solve problems of professional activity	OPK-7.1 Able to understand the principles of modern information technologies and use them to solve problems of professional activity
	OPK-7.2 Complies with information security standards in professional activities
	OPK-7.3 Creates and studies models of real-life natural science objects, processes or phenomena
OPK-8 is able to use methods of collecting, processing, systematizing and presenting field and laboratory information, apply skills of working with modern equipment, analyze the results obtained	OPK-8.1 Formulates conclusions and conclusions based on the results of the analysis of literature data, its own experimental and computational-theoretical work in the natural sciences
	OPK-8.2 Offers interpretation of the results of its own experiments and computational and theoretical work using the theoretical foundations of natural sciences

	OPK-8.3 Systematizes and analyzes the results of experiments, observations, measurements and theoretical calculations
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Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
OPK-6.1 Uses the basic laws of physics, chemistry, earth sciences and biology in professional activities	He knows the main pathways of metabolism of amino acids, proteins, carbohydrates, lipids, nucleotides, nucleic acids and the main disorders of their metabolism in the human body
	Is able to assess the informative value of various biochemical determinations for blood and urine analysis in some pathological conditions (diabetes mellitus, pathology of the liver, kidneys, heart)
	Possesses the skills to solve biochemical and professional problems
OPK-6.2 Applies methods of mathematical analysis and modeling, theoretical and experimental research	Knows methods of mathematical analysis and modeling, theoretical and experimental research
	Able to apply methods of mathematical analysis and modeling, theoretical and experimental research
	Proficient in the use of methods of mathematical analysis and modeling, theoretical and experimental research
OPK-6.3 Acquires new mathematical and natural science knowledge using modern educational and information technologies	Knows modern educational and information technologies
	Knows how to use modern educational and information technologies in their professional activities
	Proficient in researching professional, up-to-date databases
OPK-7.1 Able to understand the principles of modern information technologies and use them to solve problems of professional activity	Knows the principles of modern information technologies
	He is able to use the principles of modern information technologies to solve the problems of professional activity
	Proficient in the use of the principles of modern information technologies
OPK-7.2 Complies with information security standards in professional activities	Knows the norms of information security in the field of biology and medicine
	Knows how to comply with information security standards in the field of biology and medicine
	Proficient in compliance with information security standards in the field of biology and medicine
OPK-7.3 Creates and studies models of real-life natural science objects, processes or phenomena	Knows models of real-life natural science objects, processes or phenomena
	Is able to create models of real-life natural science objects, processes or phenomena
	Possesses the skills of creating and studying models of models of real existing natural science objects, processes or phenomena
OPK-8.1 Formulates conclusions and conclusions based on the results of the analysis of literature data, its own experimental and	Knows possible research methods, ways of statistical processing of research results
	Able to choose adequate research methods to test a hypothesis

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
computational-theoretical work in the natural sciences	Possesses the skills to reproduce suitable methods, use the necessary equipment, carry out statistical processing of results, formulate conclusions based on the results of research and observations
OPK-8.2 Offers interpretation of the results of its own experiments and computational and theoretical work using the theoretical foundations of natural sciences	Knows methods of statistical processing of experimental data
	Is able to document the results of experimental studies of the effects of medicinal substances and statistical data processing
	He knows how to choose a statistical criterion for processing experimental data, comparing the results of his own experiments with the results of other researchers
OPK-8.3 Systematizes and analyzes the results of experiments, observations, measurements and theoretical calculations	Knows the molecular mechanism of action of medicinal substances, their pharmacological properties and practical application in medicine
	Based on the knowledge of the general mechanisms of action of medicinal substances belonging to different chemical and pharmacological groups, he is able to analyze their pharmacological properties and foresee their therapeutic, side and possible toxic effects
	Possesses the skills of formulating conclusions about their significance and the possibility of application in practical medicine

Professional competence of students, indicators of their achievement and learning outcomes in the discipline

Competency code and name (result of mastering)	Code and name of the competency indicator
PC-3 Capable of conducting experimental studies of biologically active substances and developing medicines and medical devices	PC-3.1 Uses knowledge and methods of physiology, biochemistry, molecular and cellular biology to study the properties of biologically active substances
	PC-3.2 Able to apply molecular modeling methods for the development of drugs and medical devices
	PC-3.3 Capable of developing medicines and medical devices using pharmacological research methods and pharmaceutical technologies
	PC-3.4 Capable of developing nanosystems for the creation of medicines and medical devices
	PC-3.5 Capable of conducting preclinical trials of drugs and medical devices

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PC-3.1 Uses knowledge and methods of physiology, biochemistry, molecular and cellular biology to study the	Knows Methods of Physiology, Biochemistry, Molecular and Cellular Biology. Can

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
properties of biologically active substances	use the knowledge and methods of physiology, biochemistry, molecular and cellular biology. Owns skills in studying the properties of biologically active substances.
PC-3.2 Able to apply molecular modeling methods for the development of drugs and medical devices	Knows Molecular Modeling Methods for the Development of Drugs and Medical Devices. Can Apply molecular modeling methods to the development of drugs and medical devices. Owns methods of development of medicines and medical devices.
PC-3.3 Capable of developing medicines and medical devices using pharmacological research methods and pharmaceutical technologies	Knows methods of pharmacological research and pharmaceutical technologies. Can Apply pharmacological research methods and pharmaceutical technologies. Owns ability to develop medicines and medical devices.
PC-3.4 Capable of developing nanosystems for the creation of medicines and medical devices	Knows methods of pharmacological research and pharmaceutical technologies. Can apply development methods to the creation of medicines and medical devices. Owns the ability to develop nanosystems for the creation of medicines and medical devices.
PC-3.5 Capable of conducting preclinical trials of drugs and medical devices	Knows methods of preclinical testing of medicines and medical devices. Can conduct preclinical trials of medicines and medical devices. Owns skills in conducting preclinical trials of medicines and medical devices.

To form the above competencies within the framework of the discipline "Molecular Pharmacology", the following educational technologies and methods of active/interactive learning are used: business game, work in small groups, round table.

I. Goals and objectives of mastering the discipline

Objective: to form basic ideas in the field of molecular bases of physiological action of drugs and basic approaches to the search and development of new drug compounds and biochemical reagents. Acquaintance with various groups of drugs created on the basis of natural compounds and their main representatives, as well as with the molecular mechanisms of their action.

Tasks:

- to introduce the history and main stages of the development of molecular pharmacology;
- to provide an understanding of the main stages of the search for leading compounds and methods of biotesting, including the use of computer modeling and magnetic resonance imaging;
- to consider and discuss the main stages of drug development and to give examples of the creation of medicines based on natural compounds;
- to consider examples of the most important molecular targets and to provide information on the molecular mechanisms of action of various drugs: antibiotics, antitumor drugs, analgesics, immunomodulators, antiviral substances, etc.;
- consider the problems of molecular diagnostics, including the use of molecular markers and approaches based on genomics, proteomics and metabolomics;
- to give an idea of the main approaches to the treatment of hereditary diseases and gene therapy;
- To instill in students skills related to the analysis of experimental data, to teach them to work with scientific and reference literature.

To the competence of graduates and indicators of their achievement:

Competency code and name (result of mastering)	Code and name of the competency indicator
OPK-6 is able to use the basic laws of physics, chemistry, Earth sciences and biology in his professional activities, apply methods of mathematical analysis and modeling, theoretical and experimental research, acquire new mathematical and natural science knowledge using modern educational and information technologies	OPK-6.1 Uses the basic laws of physics, chemistry, earth sciences and biology in professional activities
	OPK-6.2 Applies methods of mathematical analysis and modeling, theoretical and experimental research
	OPK-6.3 Acquires new mathematical and natural science knowledge using modern educational and information technologies

OPK-7 Able to understand the principles of modern information technologies and use them to solve problems of professional activity	OPK-7.1 Able to understand the principles of modern information technologies and use them to solve problems of professional activity
	OPK-7.2 Complies with information security standards in professional activities
	OPK-7.3 Creates and studies models of real-life natural science objects, processes or phenomena
OPK-8 is able to use methods of collecting, processing, systematizing and presenting field and laboratory information, apply skills of working with modern equipment, analyze the results obtained	OPK-8.1 Formulates conclusions and conclusions based on the results of the analysis of literature data, its own experimental and computational-theoretical work in the natural sciences
	OPK-8.2 Offers interpretation of the results of its own experiments and computational and theoretical work using the theoretical foundations of natural sciences
	OPK-8.3 Systematizes and analyzes the results of experiments, observations, measurements and theoretical calculations

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
OPK-6.1 Uses the basic laws of physics, chemistry, earth sciences and biology in professional activities	He knows the main pathways of metabolism of amino acids, proteins, carbohydrates, lipids, nucleotides, nucleic acids and the main disorders of their metabolism in the human body
	Is able to assess the informative value of various biochemical determinations for blood and urine analysis in some pathological conditions (diabetes mellitus, pathology of the liver, kidneys, heart)
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OPK-6.2 Applies methods of mathematical analysis and modeling, theoretical and experimental research	Knows methods of mathematical analysis and modeling, theoretical and experimental research
	Able to apply methods of mathematical analysis and modeling, theoretical and experimental research
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OPK-6.3 Acquires new mathematical and natural science knowledge using modern educational and information technologies	Knows modern educational and information technologies
	Knows how to use modern educational and information technologies in their professional activities
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OPK-7.1 Able to understand the principles of modern information technologies and use them to solve problems of professional activity	Knows the principles of modern information technologies
	He is able to use the principles of modern information technologies to solve the problems of professional activity
	Proficient in the use of the principles of modern information technologies
	Knows the norms of information security in the field of biology and medicine

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
OPK-7.2 Complies with information security standards in professional activities	Knows how to comply with information security standards in the field of biology and medicine
	Proficient in compliance with information security standards in the field of biology and medicine
OPK-7.3 Creates and studies models of real-life natural science objects, processes or phenomena	Knows models of real-life natural science objects, processes or phenomena
	Is able to create models of real-life natural science objects, processes or phenomena
	Possesses the skills of creating and studying models of models of real existing natural science objects, processes or phenomena
OPK-8.1 Formulates conclusions and conclusions based on the results of the analysis of literature data, its own experimental and computational-theoretical work in the natural sciences	Knows possible research methods, ways of statistical processing of research results
	Able to choose adequate research methods to test a hypothesis
	Possesses the skills to reproduce suitable methods, use the necessary equipment, carry out statistical processing of results, formulate conclusions based on the results of research and observations
OPK-8.2 Offers interpretation of the results of its own experiments and computational and theoretical work using the theoretical foundations of natural sciences	Knows methods of statistical processing of experimental data
	Is able to document the results of experimental studies of the effects of medicinal substances and statistical data processing
	He knows how to choose a statistical criterion for processing experimental data, comparing the results of his own experiments with the results of other researchers
OPK-8.3 Systematizes and analyzes the results of experiments, observations, measurements and theoretical calculations	Knows the molecular mechanism of action of medicinal substances, their pharmacological properties and practical application in medicine
	Based on the knowledge of the general mechanisms of action of medicinal substances belonging to different chemical and pharmacological groups, he is able to analyze their pharmacological properties and foresee their therapeutic, side and possible toxic effects
	Possesses the skills of formulating conclusions about their significance and the possibility of application in practical medicine

Professional competence of students, indicators of their achievement and learning outcomes in the discipline

Competency code and name (result of mastering)	Code and name of the competency indicator
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PC-3.1 Uses knowledge and methods of physiology, biochemistry, molecular and cellular biology to study the properties of biologically active substances	Knows Methods of Physiology, Biochemistry, Molecular and Cellular Biology. Can use the knowledge and methods of physiology, biochemistry, molecular and cellular biology. Owns skills in studying the properties of biologically active substances.
PC-3.2 Able to apply molecular modeling methods for the development of drugs and medical devices	Knows Molecular Modeling Methods for the Development of Drugs and Medical Devices. Can Apply molecular modeling methods to the development of drugs and medical devices. Owns methods of development of medicines and medical devices.
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PC-3.4 Capable of developing nanosystems for the creation of medicines and medical devices	Knows methods of pharmacological research and pharmaceutical technologies. Can apply development methods to the creation of medicines and medical devices. Owns the ability to develop nanosystems for the creation of medicines and medical devices.
PC-3.5 Capable of conducting preclinical trials of drugs and medical devices	Knows methods of preclinical testing of medicines and medical devices. Can conduct preclinical trials of medicines and medical devices.

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
	Owns skills in conducting preclinical trials of medicines and medical devices.

II. Labor intensity of the discipline and types of training in the discipline

The total labor intensity of the discipline is 3 credits (108 academic hours), (1 credit corresponds to 36 academic hours).

The types of training and work of the student in the discipline are:

Designation	Types of Study Sessions and Student Work
Mild	Lecture
Lex electric.	
Ave	Practical exercises
Pp electric.	
WED:	Student's independent work during the period of theoretical training
	And other types of work

III. Structure of the discipline

The form of study is full-time.

№	Section Name Discipline	S e m e s t e r	Number of hours by type of training and work of the student						Forms of intermediate attestation
			Mild	Lab	Ave	OK	WE D	Contr ol	
1	Section I. History and Stages of Development of Molecular Pharmacology	5	5	-	14	-	9	-	Questions for the test No 1-10
2	Section II: Search for Leader Connections. Bioassay and Modelling Methods	5	3	-	12	-	9	-	Questions for the test No 11-20
3	Section III: Molecular Targets and Mechanisms of Drug Action	5	5	-	14	-	9	-	Questions for the test No 21-28

4	Section IV. Molecular Diagnostics. Hereditary Diseases and Gene Therapy	5	5	-	14	-	9	-	Questions for the test No 29-33
	Total:	5	18	-	54	-	36	-	Credit

IV. CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures (18 hours)

Section I. History and Stages of Development of Molecular Pharmacology (5 hours)

Topic 1. The subject of molecular pharmacology, its relation to classical pharmacology (2 hours)

General and Particular Pharmacology. Medication. The Role of Natural Compounds in Pharmacology. Hippocrates and Medicine of Ancient Greece. Claudius galene and the advent of galenic preparations.

Topic 2. Cell Theory. Discovery of vitamins. Discovery of Hormones and Neurotransmitters (2 hours)

Cell Theory. Discovery of vitamins. Discovery of hormones and neurotransmitters. Transformation of the chemistry of natural compounds into bioorganic chemistry. Determination of the biological functions of the main groups of biomolecules.

Topic 3. Types of Molecular Targets (1 hour)

Types of molecular targets, the main classes of macromolecules that act as molecular targets. The role of nucleic acids in the transmission of heritable properties. The role of polysaccharides and peptidoglycans as components of the cell walls of microorganisms. Eicosanoids and their role in the regulation of physiological processes. The development of modern pharmaceuticals and the emergence of molecular pharmacology.

Section II. Search for Leader Compounds. Biotesting and Modeling Methods (3 hours)

Topic 1. Search for Leader Connections (1 hour)

The main methods of searching for leading compounds are screening libraries of synthetic substances and searching for natural compounds with the production of sets of their derivatives and analogues. The Role of Organic Synthesis in the Production of Compound Libraries. Directional asymmetric synthesis of natural compounds. Biotechnological Approaches to the Creation of Compound Libraries. The main sources of natural substances and their study. Expeditionary research.

Topic 2. Biotesting and Modeling Methods (2 hours)

In *vitro* biotesting methods. In vivo biotesting. Laboratory animals and vivariums. Model diseases of laboratory animals. In *vivo* tests using magnetic resonance imaging. In silico biotesting. Molecular modeling. Simulation of the three-dimensional structure of the target protein. Search for lead compounds. Structure optimization and modeling of specificity and pharmacokinetic properties.

Section III: Molecular Targets and Mechanisms of Drug Action (5 hours)

Topic 1. Molecular Targets (1 hour)

Examples of molecular target enzymes include membrane enzymes, DNA biosynthesis enzymes, and protein kinases. Competitive and non-competitive inhibition. Allosteric enzyme effectors. Primary and secondary messengers. Types of receptors. Examples of receptor ligands. Agonists and antagonists. Types of ion channels. Ion channels of the heart muscle. Action potential and cardiogram. Cytoskeletal proteins as molecular targets of drugs. Ribosomes as molecular targets of drugs.

Topic 2. Types of Antibiotics and Their Molecular Mechanisms of Action (4 hours)

Ribosomes as molecular targets. Antibiotic resistance of microorganisms. Problems of finding new antimicrobial compounds. Quorum sensing and other features of the development of microbial infections.

Cell cycle and control of cell growth and development. Spread of tumor diseases. Hormone-dependent tumors. Main stages of carcinogenesis. Multidrug resistance. Apoptosis, its induction and regulation.

Antitumor nucleosides. Arabinocytosine. Antitumor agents acting on cytoskeletal proteins. Taxol and its analogues. Vincaalkaloids. Antitumor antibiotics. Rubromycin. Antitumor drugs of marine origin. Antitumor agents that induce cell death by stimulating the formation of reactive oxygen species. Activators of apoptosis of tumor cells. Stimulators of antitumor immunity. Carcinopreventive agents. Antioxidants.

The role of phospholipase a2 as a molecular target. Cyclooxygenases as molecular targets. Aspirin and other nonsteroidal anti-inflammatory drugs. Steroid anti-inflammatory medications. Peripheral and central nervous systems. Molecular mechanisms of nerve impulse transmission. Pharmacological correction of peripheral nervous system activity. Curare-alkaloids and medicines based on them. Pachycarpine as a ganglion blocker. Tropane alkaloids and anesthetic drugs created on their basis.

Pharmacological correction of central nervous system activity. Opium poppy alkaloids. Morphine and its analgesics that interact with opioid receptors. Ephedrine

and its analogues as CNS stimulants. Conotoxins are natural models for the creation of new drugs. A new analgesic drug "Prialt" (ziconotide).

Antiviral compounds. Viruses and viral infection. Types of viruses. Human immunodeficiency virus and AIDS. The main pharmacological targets used in the search for antiviral compounds are reverse transcriptase (revertase), viral integrase. Natural compounds with antiviral effects. Antiviral nucleosides. History of discovery. Azidothymidine. Acyclovir. Antiviral proteins. Interferons of endogenous origin and genetically engineered. Antiviral drugs of plant origin. Alpizarin. Inhibition of virus attachment to the cell. Sulfated polysaccharides. Problems of creating new antiviral drugs.

Cardiological drugs. Mechanisms of vasodilation: blocking calcium channels, increasing the level of cyclo-amp and protein kinase activity, c-GMP-dependent mechanisms through stimulation of protein kinase C, inhibition of the angiotensin-2 receptor, and others. Alpha and beta blockers. Drugs based on alkaloids of the reserpine group. Histochrome drugs for rehabilitation of myocardial infarction and resorption of hemophthalmos. Drugs that affect the biosynthesis of nitric oxide.

Section IV. Molecular Diagnostics. Hereditary Diseases and Gene Therapy (5 hours)

Topic 1. Molecular Diagnostics (2 hours)

History of Molecular Diagnostics. Urine therapy. Gabriel Andral and the first blood tests. Enzyme-linked immunosorbent assay for the presence of specific antibodies. Tumor cells and their biochemical differences from normal cells. Discovery of tumor markers. Bence-Jones protein, alpha-fetoprotein, prostate-specific antigen (PSA), and other tumor markers. Molecular markers of cardiovascular diseases: plasminogen activators, c-reactive protein, etc. Lectin-enzyme analysis. Polymerase chain reaction (Carey Mullis, 1983) and its role in modern molecular diagnostics. Pharmacogenomics. Diagnostics by metabolomics.

Topic 2. Hereditary Diseases and Gene Therapy (3 hours)

Most diseases are associated with damage to the genetic apparatus of cells. Inhibition of m-RNA by mi-RNA. Introduction of drug-activating genes into DNA. Insertion of genes that program cell death.

Introducing genes that alter antigens to make animals more similar in cellular characteristics to humans and use their organs for transplantation. Insertion of genes damaged in a particular patient.

V. THE CONTENT OF THE PRACTICAL PART OF THE COURSE AND INDEPENDENT WORK

Practical exercises (54 hours)

Class 1. Search for Antimicrobial Compounds Using Marine Invertebrate Extracts (8 hours)

1. Physicochemical methods of isolation and study of biopolymers and bioregulators from extracts of marine invertebrates.
2. The Significance and Place of Biological Tests in Modern Bioorganic Chemistry and Biotechnology.
3. Methods for determining the antibacterial activity of compounds.

Class 2. Inhibition of Clonogenic Properties of Tumor Cells by Extracts of Marine Invertebrates in Soft Agar (8 hours)

1. Methods for determining antitumor activity.
2. Models used to determine the clonogenic properties of tumor cells (Ehrlich ascites tumor, Lewis lung carcinoma (LLC), Walker carcinosarcoma 256).

Class 3. Introduction to Biotesting in *Silico* (8 hours)

1. Biosytesting *in silico*.
2. Molecular modeling.
3. Simulation of the three-dimensional structure of the target protein.
4. Search for lead connections. Optimization of structure and modeling of specificity and pharmacokinetic properties.

Class 4. Introduction to Magnetic Resonance Imaging (8 hours)

1. Laboratory animals, rules for working with them.
2. Introduction to the magnetic resonance imaging method.
3. Model diseases of laboratory animals.
4. View the tomograms obtained on the Pharmascan tomograph.
5. Interpretation of tomograms.

Class 5. Stimulation of macrophages with cucumarioside A2-2 (8 hours)

1. An effective immune-stimulating drug coumazide (cucumarioside A2-2).
2. Study of the physiological activity of triterpene glycosides of holothurians.
3. Molecular mechanisms of immunomodulatory action of cucumarioside A2-2.

Class 6. Use of inhibitors to reverse molecular interactions. Inhibition of the hemolytic effect of cucumarioside A2-2 by sterols (8 hours)

1. Hemolytic activity of triterpene glycoside of holothurium.

2. Molecular mechanisms of membranolytic action : triterpenex glycosideand holothurium.

Class 7. Immunofermet assay. Introduction to the method (6 hours)

1. Principle and types of enzyme-linked immunosorbent assay.
2. Enzymes used in enzyme-linked immunosorbent assay.
3. Instruments and software for enzyme-linked immunosorbent assay.

Self-study (36 hours)

Abstract Topics

1. The role of natural compounds in the creation of medicines and dietary supplements.
2. The Role of Secondary Metabolites of Marine Aquatic Organisms in the Development of Drugs.
3. *In vitro* and *in vivo* biotesterization methods.
4. Application of magnetic resonance imaging in clinical practice.
5. Biological activity of triterpene glycosides of holothurium.
6. Distribution of triterpene glycosides in natural objects.
7. Advantages of enzyme-linked immunosorbent assay

VI. MONITORING THE ACHIEVEMENT OF THE COURSE OBJECTIVES

Item No.	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Certification
1.	Section I. History and Stages of Development of Molecular Pharmacology	OPK-6.1 Uses the basic laws of physics, chemistry, earth sciences and biology in professional activities	<p>He knows the main pathways of metabolism of amino acids, proteins, carbohydrates, lipids, nucleotides, nucleic acids and the main disorders of their metabolism in the human body.</p> <p>He is able to assess the informative value of various biochemical determinations for blood and urine analysis in some pathological conditions (diabetes mellitus, pathology of the liver, kidneys, heart).</p> <p>Possesses the skills to solve biochemical and professional problems</p>	Test	Questions for the test No 1-10
		OPK-6.2 Applies methods of mathematical analysis and modeling, theoretical and experimental research	<p>He knows the methods of mathematical analysis and modeling, theoretical and experimental research.</p> <p>He is able to apply methods of mathematical analysis and modeling, theoretical and experimental research.</p> <p>Proficient in the use of methods of mathematical analysis and modeling, theoretical and experimental research</p>		
		PC-3.1 Uses knowledge and methods of physiology, biochemistry, molecular and cellular biology to study the properties of biologically active substances	<p>Knows Methods of Physiology, Biochemistry, Molecular and Cellular Biology.</p> <p>Can use the knowledge and methods of physiology, biochemistry, molecular and cellular biology.</p> <p>Owens skills in studying the properties of biologically active substances.</p>		

2.	Section II: Search for Leader Connections. Bioassay and Modelling Methods	OPK-6.3 Acquires new mathematical and natural science knowledge using modern educational and information technologies	<p>He knows modern educational and information technologies.</p> <p>She is able to use modern educational and information technologies in her professional activities.</p> <p>Proficient in researching professional, up-to-date databases</p>	At thePoll	Questions for the test No 11-20
OPK-7.1 Able to understand the principles of modern information technologies and use them to solve problems of professional activity		<p>He knows the principles of modern information technologies.</p> <p>He is able to use the principles of modern information technologies to solve problems of professional activity.</p> <p>Proficient in the use of the principles of modern information technologies</p>			
PC-3.2 Able to apply molecular modeling methods for the development of drugs and medical devices		<p>Knows Molecular Modeling Methods for the Development of Drugs and Medical Devices.</p> <p>Can Apply molecular modeling methods to the development of drugs and medical devices.</p> <p>Owns methods of development of medicines and medical devices.</p>			
3.	Section III: Molecular Targets and Mechanisms of Drug Action	OPK-7.2 Complies with information security standards in professional activities	<p>He knows the norms of information security in the field of biology and medicine.</p> <p>He knows how to comply with information security standards in the field of biology and medicine.</p> <p>Proficient in compliance with information security standards in the field of biology and medicine</p>	Test	Questions for the test No 21-28
OPK-7.3 Creates and studies models of real-life natural science objects, processes or phenomena		<p>Knows models of real-life natural science objects, processes or phenomena.</p> <p>Is able to create models of real-life natural science objects, processes or phenomena.</p>			

			Possesses the skills of creating and studying models of models of real existing natural science objects, processes or phenomena		
		PC-3.3 Capable of developing medicines and medical devices using pharmacological research methods and pharmaceutical technologies	Knows methods of pharmacological research and pharmaceutical technologies. Can Apply pharmacological research methods and pharmaceutical technologies. Owns ability to develop medicines and medical devices.		
		PC-3.4 Capable of developing nanosystems for the creation of medicines and medical devices	Knows methods of pharmacological research and pharmaceutical technologies. Can apply development methods to the creation of medicines and medical devices. Owns the ability to develop nanosystems for the creation of medicines and medical devices.		
4.	Section IV. Molecular Diagnostics. Hereditary Diseases and Gene Therapy	OPK-8.1 Formulates conclusions and conclusions based on the results of the analysis of literature data, its own experimental and computational-theoretical work in the natural sciences	Knows possible research methods, ways of statistical processing of research results. Able to choose adequate research methods to test a hypothesis. Possesses the skills to reproduce suitable methods, use the necessary equipment, carry out statistical processing of results, formulate conclusions based on the results of research and observations	Residency	Questions for the test No 29-33
		OPK-8.2 Offers interpretation of the results of its own experiments and	He knows the methods of statistical processing of experimental data.		

		<p>computational and theoretical work using the theoretical foundations of natural sciences</p>	<p>He is able to draw up the results of experimental study of the effect of medicinal substances and statistical processing of data. He knows how to choose a statistical criterion for processing experimental data, comparing the results of his own experiments with the results of other researchers</p>		
		<p>OPK-8.3 Systematizes and analyzes the results of experiments, observations, measurements and theoretical calculations</p>	<p>He knows the molecular mechanism of action of medicinal substances, their pharmacological properties and practical application in medicine. Based on the knowledge of the general mechanisms of action of medicinal substances belonging to different chemical and pharmacological groups, it is able to analyze their pharmacological properties, to foresee their therapeutic, side and possible toxic effects. Possesses the skills of formulating conclusions about their significance and the possibility of application in practical medicine</p>		
		<p>PC-3.5 Capable of conducting preclinical trials of drugs and medical devices</p>	<p>Knows methods of preclinical testing of medicines and medical devices. Can conduct preclinical trials of medicines and medical devices. Owns skills in conducting preclinical trials of medicines and medical devices.</p>		

VII. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Guidelines for writing and formatting an abstract

Abstracting of educational and scientific literature involves an in-depth study of individual scientific works, which should ensure the development of the necessary skills for working on the book. All this will contribute to the expansion of scientific horizons, the improvement of their theoretical training, and the formation of scientific competence.

Textbooks, individual monographic studies and articles on issues provided for by the program of the academic discipline are offered for abstracting. When selecting literature on the chosen issue, it is necessary to cover the most important areas of development of this science at the present stage. Particular attention should be paid to those literary sources that (directly or indirectly) can help the specialist in his practical activities. However, this section also includes works and individual studies on issues that go beyond the discipline being studied. It is recommended to use this literature if you want to expand your knowledge in any branch of science.

Along with literature on general issues, students are supposed to read literature taking into account the profile of their professional activity, obtained independently. Not all the proposed literature is equal in content and volume, so different approaches to its study are possible. In one case, it can be a general abstract of several literary sources of different authors devoted to the consideration of the same issue, in the other case, it can be a detailed study and abstract of one of the recommended works or even its separate sections, depending on the degree of complexity of the issue (problematic). In order to decide what to do in each case, you should consult with the teacher.

The choice of a specific work for the abstract should be preceded by a detailed acquaintance with the list of all literature given in the curriculum of the discipline. It is recommended to first familiarize yourself with the selected work by looking at the subheadings, highlighted texts, diagrams, tables, and general conclusions. Then it is necessary to read it carefully and thoughtfully (delving into the ideas and methods of the author), making notes on a separate sheet of paper about the main provisions and key issues. After reading, you should think over the content of the article or a separate chapter, paragraph (if we are talking about a monograph) and briefly write it down. Only strict definitions and formulations of laws should be written out verbatim. Sometimes it's helpful to include one or two examples to illustrate. In the event that there are unclear passages, it is recommended to read the following exposition, as it can help to understand the previous material, and then return to the comprehension of the previous exposition.

The result of the work on literary sources is an abstract.

When preparing an abstract, it is necessary to highlight the most important theoretical provisions and substantiate them independently, paying attention not only to the result, but also to the methodology used in the study of the problem. Reading scientific literature should be critical. Therefore, it is necessary to strive not only to assimilate the main content, but also the method of proof, to reveal the features of different points of view on the same issue, to assess the practical and theoretical significance of the results of the reviewed work. A very desirable element of the abstract is the expression by the listener of his own attitude to the ideas and conclusions of the author, supported by certain arguments (personal experience, statements of other researchers, etc.).

As mentioned above, abstracts of monographs and journal articles of a research nature must contain a definition of the problem and specific objectives of the research, a description of the methods used by the author, as well as the conclusions that he came to as a result of the research. The proposed literature for abstracting is constantly updated.

Instructions for writing essays:

General requirements for the abstract:

The abstract should be written according to the standard scheme, including:

- Title page
- contents
- introduction
- Main part
- Conclusion of the E
- List of references.

It is desirable to include tables and (or) figures in the text of the abstract: diagrams, graphs. The volume of the abstract: 10-20 pages of A4 format computer layout in the Times New Roman editor, with 1.5 intervals, in 14 fonts. The title of the topic of the essay should fully correspond to the chosen option.

The structure of the abstract should meet the standard requirements for writing essays: introduction, justification for the choice of topic, presentation of the topic, conclusion. More detailed requirements for the written design of the abstract are presented in the Procedure "Requirements for the design of written works performed by FEFU students and listeners" http://law.wl.dvgu.ru/docs/treb_2012.pdf

Approximate list of abstract topics:

1. Mechanisms of energy production in mitochondria.
2. The liver is its role in the human body.
3. Alcoholism and drug addiction are metabolic disorders.
4. Influence of trace elements on enzyme activity.

5. Metabolic connections of the Krebs cycle.
6. Types of jaundice.
7. Biotransformation of xenobiotics in the body.
8. Cholesterol fund in the human body and ways of its consumption.
9. Biological role of iron, molybdenum and zinc.

Criteria and Indicators Used in the Evaluation of the Educational Essay

Criteria	Indicators
1. Novelty of the abstracted text Max. – 5 points	- relevance of the problem and topic;- novelty and independence in the formulation of the problem, in the formulation of a new aspect of the problem selected for analysis;- the presence of the author's position, independence of judgments.
2. Degree of disclosure of the essence of the problem Max. – 5 points	- correspondence of the plan to the topic of the abstract;- correspondence of the content to the topic and plan of the abstract;- completeness and depth of disclosure of the main concepts of the problem;- validity of ways and methods of working with the material;- ability to work with literature, systematize and structure the material;- ability to generalize, compare different points of view on the issue under consideration, argue the main provisions and conclusions.
3. Reasonableness of the choice of sources Max. – 5 points	- the range and completeness of the use of literary sources on the problem;- attraction of the latest works on the problem (journal publications, materials of collections of scientific papers, etc.).
4. Compliance with Registration Requirements Max. – 5 points	- correct formatting of references to the literature used;- literacy and culture of presentation;- knowledge of terminology and conceptual apparatus of the problem;- compliance with the requirements for the volume of the abstract;- culture of design: highlighting paragraphs.
5. Literacy Max. - 5 points	- absence of spelling and syntax errors, stylistic errors;- absence of typos, abbreviations of words, except for generally accepted ones;- literary style.

Guidelines for Maintenance, Submission Requirements and Criteria for Evaluating the Outline

A synopsis (from the Latin conspectus – review) is a written text in which the content of the main source of information is briefly and consistently stated. To take notes is to bring to some order the information gleaned from the original. The process is based on the systematization of what has been read or heard. Notes can be made both in the form of precise excerpts, quotations, and in the form of a free presentation of meaning. The manner of writing the synopsis, as a rule, is close to the style of the original source. If the synopsis is written correctly, it should reflect the logic and semantic connection of the information being recorded.

In well-made notes, it is easy to find specialized terminology that is clearly explained and clearly highlighted for memorizing the meanings of various words.

Using the outline information, it is easier to create meaningful creative or scientific works, various essays and articles.

Note-taking rules

1. Read the text carefully. Along the way, mark incomprehensible places, new words, names, dates.
2. Make inquiries about the persons and events mentioned in the text. When recording, do not forget to put reference data in the fields.
3. When reading the text for the first time, make a simple outline. When re-reading, try to summarize the main points of the text, noting the author's arguments.
4. The final stage of note-taking consists of re-reading the previously marked passages and writing them down consecutively.
5. When taking notes, you should try to express the author's thought in your own words.
6. Strive to ensure that one paragraph of the author's text is conveyed in one, maximum two sentences.

When taking notes of lectures, it is recommended to adhere to the following basic rules.

1. Do not start writing down the material from the first words of the teacher, first listen to his thought to the end and try to understand it.
2. Start writing at the moment when the teacher, having finished the presentation of one idea, begins to comment on it.
3. In the synopsis, it is necessary to highlight individual parts. It is necessary to distinguish between headings, subheadings, conclusions, to separate one topic from another. Selection can be done with an underline or a different color (just don't turn the text into colorful pictures). It is recommended to indent paragraphs and points of the plan, white lines to separate one thought from another, and numbering. If definitions, formulas, rules, and laws can be made more visible in the text, they are framed. Over time, you'll have your own selection system.
4. Create your entries using accepted conventions. When taking notes, be sure to use a variety of signs (they are called signal signs). These can be pointers and directional arrows, exclamation and question marks, combinations PS (afterword) and NB (pay attention). For example, you can denote the word "therefore" with a mathematical arrow \Rightarrow . Once you've developed your own character set, it's easier and faster to create an outline and then study it.
5. Don't forget about abbreviations (abbreviated words), equal and inequality signs, more and less.
6. Abbreviations are very useful for creating a correct outline. Be careful, though. Connoisseurs believe that abbreviations such as "d-t" (to think) and similar

ones should not be used, since later a large amount of time is spent on deciphering, and after all, the reading of the synopsis should not be interrupted by extraneous actions and reflections. The best thing to do is to develop your own system of abbreviations and use them to denote the same words (and nothing else) in all entries. For example, the abbreviation "g-t" will always and everywhere be the word "to speak," and the capital "P" will be the word "work."

7. Undoubtedly, foreign words will help to organize a good synopsis. The most common among them are English. For example, the abbreviated "ok" successfully denotes the words "excellent", "wonderful", "good".

8. Complex and lengthy reasoning should be avoided.

9. When taking notes, it is better to use declarative sentences, avoid independent questions. Questions are appropriate in the margins of the outline.

10. Do not try to record the material verbatim, in this case the main idea is often lost, and it is difficult to keep such a record. Discard secondary words, without which the main idea is not lost.

11. If there are terms in the lecture that you do not understand, leave a place, clarify their meaning with the teacher after the lesson.

Evaluation criteria:

86-100 points are given to the student if the abstract is presented in the most understandable form, has a plan, schemes and drawings in the structure, reveals all the basic concepts and questions given above;

76-85 points are given to the student if the abstract is presented in a sufficiently understandable form, has schemes and/or drawings in the structure, reveals more than half of the main concepts and questions;

75-61 points are given to the student if the abstract is presented in a relatively understandable form and reveals half of the main concepts and questions;

60-50 points are given to the student if the outline is presented in an incomprehensible form and reveals less than half of the main concepts and questions.

VIII. LIST OF REFERENCES AND INFORMATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Reference citations

1. Gaevy, M. D. Pharmacology: textbook / M.D. Gaevy, L.M. Gaevaya; Ed. by Acad. V.I. Petrova. — Moscow: INFRA-M, 2017.— 454 p. — (Higher education). — www.dx.doi.org/10.12737/8237. – ISBN 978-5-16-009135-8. – Text : electronic. – URL: <https://znanium.com/catalog/product/761735>

2. Kosarev V.V., Babanov S.A. Klinicheskaya farmakologiya i rational'naya farmakoterapiya: Uchebnoe posobie [Clinical pharmacology and rational

pharmacotherapy: Textbook]. Moscow: Vuzovskiy uchebnik: NITs Infra-M, 2012. – 237 p. + CD-ROM. (binding, cd rom)ISBN 978-5-9558-0258-9. – Text : electronic. – URL: <https://znanium.com/catalog/product/261014>

3. Paramonova N. S., Kharchenko O. F. Klinicheskaya farmakologiya: uchebnoe posobie [Clinical pharmacology: textbook]. - Minsk: Vysheishaya shkola, 2012. — 320 c. — ISBN 978-985-06-2120-7. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/20217.html>

4. K. K. Kevra, A. V. Khapalyuk, L. N. Gavrilenko [i dr.] [i dr.] [Clinical pharmacology: textbook] / M. K. Kevra, A. V. Khapalyuk, L. N. Gavrilenko [i dr.] ; edited by M. K. Kevre. - Minsk: Vysheishaya shkola, 2015. — 575 c. — ISBN 978-985-06-2454-3. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/48005.html>

5. Malevannaya V. N. Obshchaya farmakologiya: uchebnoe posobie [General pharmacology: textbook]. — 2nd ed. — Saratov : Nauchnaya kniga, 2019. — 159 c. — ISBN 978-5-9758-1757-0. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/81075.html>

6. Osnovy farmakologii = Essentials of Pharmacology: textbook / V. I. Kozlovskiy, V. P. Vdovychenko, O. A. Borisenok, V. V. Goncharuk. - Minsk: Vysheishaya shkola, 2019. — 288 c. — ISBN 978-985-06-2768-1. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/120053.html>

7. Fomina M. V., Bibartseva E. V., Sokolova O. Ya. - Orenburg: Orenburg State University, EBS ASV, 2015. — 109 c. — ISBN 978-5-7410-1303-8. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/54172.html>

8. Belyaev V. A., Fedota N. V., Gorchakov E. V. Pharmaceutical Chemistry: Educational and Methodological Manual. Stavropol: AGRUS Stavropolskogo gos. agrarnogo un-ta, 2013. 160 p. (in Russian). – ISBN 978-5-9596-0946-7. – Text : electronic. – URL: <https://znanium.com/catalog/product/515025>

9. Samylina I.A., Yakovlev G.P. Pharmacognosiya: uchebnik dlya vuzov [Pharmacognosiya: textbook for higher education institutions]. Moscow: GEOTAR-Media, 2014. 969 p. (in Russian). <https://lib.dvfu.ru/lib/item?id=chamo:816759&theme=FEFU>

10. Chupak-Belousov, V.V. Pharmaceutical Chemistry : Course of Lectures: Textbook. 2 : 4 course / V. V. Chupak-Belousov. Moscow: Binom, 2014. 614 p. (in Russian). <https://lib.dvfu.ru/lib/item?id=chamo:833828&theme=FEFU>

Further reading

1. Mashkovskiy M. D. Medicinal'nye sredstva: posobie dlya vrachov [Medicines: a manual for doctors]. Moscow, Novaya Volna Publ., 2006. – 1216 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:237360&theme=FEFU>
2. Shimanovsky N.L., Epinetov M.A., Melnikov M.Ya. Moscow , Fizmatlit Publ., 2010. – 623 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:299676&theme=FEFU>
3. Alyautdin R. N., Balabanyan V. Yu., Bondarchuk N. G. et al.; edited by R. N. Alyautdin. Moscow, GEOTAR-Media Publ., 2013. – 827 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:730324&theme=FEFU>
4. Primrose, S. Genomics. Role in Medicine: Educational Edition / S. Primrose, R. Twyman; edited by E. D. Sverdlov, S. A. Limborskaya; transl. from English - Moscow: Binom. Lab.znaniya, 2008. – 277 p. (in Russian). <http://elibrary.ru/item.asp?id=19542883>
5. Natural compounds. Synthesis, Chemical Structure and Biological Activity: Selected Works / G. B. Elyakov; [guest editor V. A. Stonik] ;. VI-k: Dalnauka, 2007. 351 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:265439&theme=FEFU>
6. Human Biochemistry: Textbook in 2 vols. / R. Murray, D. Grenner, P. Mayes (et al.); transl. by V. V. Borisov, E. V. Dainichenko. Moscow : Mir BINOM. Lab. Znanie Publ., 2009. – 381 p. (in Russian). <http://lib.dvfu.ru:8080/lib/item?id=chamo:277691&theme=FEFU>

List of resources of the information and telecommunication network
"Internet"

1. <http://elibrary.ru/> - Scientific Electronic Library
2. <http://science.km.ru/> - electronic resource on different sections of biology
3. <http://elementy.ru/> is an informational and educational resource dedicated to natural sciences.
4. <http://www.iprbookshop.ru/> is the IPRbooks electronic library system.
5. <http://znanium.com/> - EBS "Znaniy".
6. <https://nplus1.ru/> - N+1, a popular science online publication about science, engineering and technology
7. <http://antropogenez.ru/> is a popular science information resource about human evolution
8. <http://web.a.ebscohost.com/ehost/search/basic?sid=851485f8-6200-4b3e-aaab-df4ba7be3576@sessionmgr4008&vid=1&tid=2003EB> is a collection of books on various sections from the EBSCOhost database.

9. <http://rosalind.info/problems/locations/>- resource for self-study of bioinformatics Rosalind.
10. <http://www.ncbi.nlm.nih.gov/> website of the- National Center for Biotechnology Information (NCBI).
11. <http://www.mendeley.com/>- *Mendeley*: Free reference manager and PDF organizer; Librarian Program.
12. [http:// www.ebi.ac.uk](http://www.ebi.ac.uk) – website of the European Bioinformatics Institute
13. [http:// www.scopus.com](http://www.scopus.com) – Scopus bibliographic database and citation index
14. <http://thomsonreuters.com/thomson-reuters-web-of-science/> Web of Science bibliographic database and citation index

List of information technologies and software

1. Microsoft Office Professional Plus 2013 is an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.);
2. 7Zip 16.04 is a free file archiver with a high compression ratio;
3. Adobe Acrobat XI Pro – a software package for creating and viewing electronic publications in PDF format;
4. AutoCAD Electrical 2015 – three-dimensional computer-aided design and drafting system;
5. ESET Endpoint Security 5 – comprehensive protection for Windows-based workstations. Virtualization support + new technologies;
6. WinDjView 2.0.2 – a program for recognizing and viewing files with the same DJV and DjVu formats; SolidWorks 2016 is a CAD software package for automating the work of an industrial enterprise at the stages of design and technological preparation of production
7. Compass-3D LT V12 – Three-Dimensional Simulation System
8. Notepad++ 6.68 – Text Editor

IX. METHODOICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

Lecture

A lecture is the main active form of classroom classes, an explanation of the fundamental and most difficult theoretical sections of molecular biology and the theory of genetic engineering, which involves intensive mental activity of the student and is especially important for mastering the subject. A lecture should

always be cognitive, developmental, educational and organizing. Lecture notes help to assimilate the theoretical material of the discipline. When listening to a lecture, you need to Take notes of the main information, preferably with your own wording, which allows you to remember the material better. An outline is useful when it is written by the student independently.

In the lecture, the teacher gives only a small part of the material on certain topics that are presented in the textbooks. In addition, the instructor informs students about what additional information can be obtained on the topics discussed, and from what sources. Therefore, when working with lecture notes, it is always necessary to use the main textbooks, additional literature and other recommended sources on this discipline. It is this serious work of the student with the lecture material that allows him to achieve success in mastering new knowledge.

To present a lecture course on the discipline "Molecular Pharmacology" as forms of active learning, the following are used: lecture-conversation, lecture-visualization, which are built on the basis of knowledge received by students in the framework of subjects preceding the course. Electronic presentations, tables, video files, and blackboard diagrams are used to illustrate verbal information. In the course of the lecture material, problematic questions or questions with elements of discussion are posed.

Lecture – visualization

The lecture is accompanied by the demonstration of tables, electronic presentations, video files - such a combination of ways of presenting information significantly simplifies its mastering by students. Verbal presentation of the material should be accompanied and combined with the visual form. The information presented in the form of diagrams on the board, tables, slides allows you to form problematic questions, and contribute to the development of professional thinking of future specialists.

Lecture-conversation

Lecture-conversation, "dialogue with the audience", is the most common form of active learning and allows students to be involved in the educational process, since there is direct contact between the teacher and the audience. Such contact is achieved during the lecture, when students are asked questions of a problematic or informational nature, or when they are invited to ask the teacher questions themselves. Questions are offered to the entire audience, and any of the students can offer their own answer; another can complement it. In the course of the educational process, this allows you to identify the most active students and activate those who do not participate in the work. This form of lecture allows you to involve students in the work process, attract their attention, stimulate thinking, gain collective experience, and learn how to form questions. The advantage of a lecture-

conversation is that it allows you to draw students' attention to the most important issues of the topic, determine the content and pace of the presentation of educational material, as well as determine the topics that are most interesting to students, in order to possibly adjust the form of the material taught.

An extended conversation involves the preparation of students on each issue of the lesson plan with a single list of recommended mandatory and additional literature. Reports are prepared by students on a pre-proposed topic.

A dispute in a group has a number of advantages. A dispute can be caused by the teacher during the lesson or planned by him in advance.

Press conference. The teacher assigns several students to prepare short (thesis) reports. After the presentations, students ask questions, which are answered by the speakers and other members of the expert group. Based on the questions and answers, a creative discussion unfolds together with the teacher.

Case study method.The case-study method is a method of active problem-situational analysis based on learning by solving specific problems (case solving). The method of specific situations (case-study method) refers to non-game imitation active teaching methods and is considered as a tool that allows you to apply theoretical knowledge to solving practical problems. At the end of the lesson, the teacher tells a series of situations and offers to find solutions for those problems that are voiced in them. At the same time, the problem itself does not have unambiguous solutions. Students must analyze the situation, understand the essence of the problems, propose possible solutions and choose the best one. Thanks to the knowledge gained at the lecture, it is easy for the student to correlate the theoretical knowledge received with a real practical situation. As an interactive teaching method, it gains a positive attitude from students, who see it as an opportunity to take the initiative, feel independent in mastering theoretical provisions and mastering practical skills. No less important is the fact that the analysis of situations has a strong impact on the professionalization of students, contributes to their maturation, forms interest and positive motivation for learning. The method is aimed not so much at mastering specific knowledge or skills, as at developing the general intellectual and communicative potential of the student and the teacher.

It is a learning method designed to improve skills and gain experience in the following areas:

- identifying, selecting and solving problems;
- working with information – comprehending the meaning of the details described in the situation;
- analysis and synthesis of information and arguments;
- working with assumptions and conclusions;
- evaluation of alternatives;

- decision-making;
- Listening to and understanding other people is a group work skill. The main function of the case method is to teach students to solve complex unstructured problems that cannot be solved in an analytical way. The case activates students, develops analytical and communicative skills, leaving students face to face with real situations.

The case study is designed to increase the effectiveness of educational activities: as an illustration for solving a certain problem, explaining a particular phenomenon, studying the features of its manifestations in real life, developing competence aimed at solving various life and work situations (the use of the case involves individual and group work of students).

Brainstorming is a widely used way of generating new ideas to solve scientific and practical problems. Its goal is to organize collective thinking to find non-traditional ways to solve problems.

The use of the brainstorming method in the educational process allows you to solve the following tasks:

- creative assimilation of educational material by students;
- connection of theoretical knowledge with practice;
- • activation of educational and cognitive activities of students;
- formation of the ability to concentrate attention and mental efforts on the solution of an urgent task;
- formation of the experience of collective thinking activity.

The problem formulated in the brainstorming class should have theoretical or practical relevance and arouse the active interest of students. A common requirement that must be taken into account when choosing a problem for brainstorming is the possibility of many ambiguous solutions to the problem, which is put forward to students as a learning task.

Quizzes & Testing

Current control of material assimilation is assessed by oral answers, tests, as well as paper testing.

Assessments of laboratories, colloquiums, tests and testing mainly form the grade for this discipline.

LOGISTICAL SUPPORT FOR DISCIPLINE

Training sessions on the discipline are held in rooms equipped with appropriate equipment and software.

The list of logistical and software of the discipline is given in the table.

Logistical and software of the discipline

Name of special rooms and rooms for independent work	Equipment special rooms and rooms for self-study	List of licensed software. Details of the supporting document
<p>690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 605</p>	<p>Multimedia audience: Electric Screen 236*147cm Trim Screen Line; DLP Projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP ceiling mount speaker system; Extron DMP 44 LC Digital Audio Processor; Extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x 2 MIMO (2SS) access points. Моноблок HP ProOne 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, BT, usb kbd/mse, Win7Pro (64-bit) +Win8.1Pro(64-bit), 1-1-1 Wty</p>	<p style="text-align: center;">-</p>
<p>690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 422</p>	<p>Multimedia audience: HP ProOne 400 G1 AiO 19.5" Intel Core i3-4130T 4GB DDR3-1600 SODIMM (1x4GB)500GB; Projection screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector, Mitsubishi FD630U, 4000 ANSI Lumen, 1920x1080; Mortise interface with TLS TAM 201 Stan automatic cable retraction; Avervision CP355AF visualizer; Sennheiser EW 122 G3 UHF microphone lavalier radio system consisting of wireless microphone and receiver; Video conferencing codec LifeSizeExpress 220- Codeonly-Non-AES; Multipix MP-HD718 Network Video Camera; Two 47" Full HD LG M4716CCBA LCD panels; Audio switching and sound reinforcement subsystem; Centralized</p>	<p style="text-align: center;">-</p>

	uninterrupted power supply	
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 627	Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope with digital camera Altami BIO8 (2 pcs.).	-
Computer class of the School of Biomedicine aud. M723, 15 workplaces	Electric Screen 236*147cm Trim Screen Line; DLP projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP Ceiling Mount Speaker System Extron DMP 44 LC Digital Audio Processor; extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. Monoblock HP RgoOpe 400 All-in-One 19.5 (1600x900), Core and3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi- Fi, VT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	-