



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

WORK PROGRAM OF THE DISCIPLINE

Molecular Biology of the Cell
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

Compiled by: Ph.D. 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 "*
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Abstract of the discipline

Molecular Biology of the Cell

The total labor intensity of the discipline is 4 credit units. 144 academic hours a. It is a discipline of the compulsory part of the EP, studied in the 3rd year and ends *with an exam*. The curriculum provides for 18 hours of lectures, 36 hours of laboratory work, 36 hours of practical hours, and 54 hours of independent work for the student.

The language of the program is Russian.

The purpose of the discipline is to specialize in theoretical training and deepening students' knowledge in the field of cellular molecular biology of the cell is a branch of biology, the subject of which is the cell, the elementary unit of life. The cell is considered as a system that includes individual cellular structures, their participation in general cellular physiological processes, ways of regulating these processes, as well as studying the basic properties and manifestations of life at the molecular level.

Objectives of the discipline:

- 1) development of students' holistic understanding of the molecular level of cell organization;
- 2) obtaining up-to-date knowledge about the structure, dynamics and functioning of molecular ensembles of cells, molecular mechanisms of cell development and functioning.

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

- develops methods of observation, identification, classification, reproduction and cultivation of living objects to solve professional problems;
- 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.

Competencies are obtained as a result of studying the disciplines of general biology, *developmental biology*, molecular and cell biology, the student should be ready to study such disciplines as methods of molecular and cell biology, biomedical cell technologies, lethal and tissue engineering, forming competencies:

- conducts fundamental and relevant research in molecular genetics, genetic and bioengineering, and molecular and biomedical technologies;
- changes the principles of obtaining and using enzymes, viruses,

microorganisms, cell cultures of animals and plants, products of their biosynthesis;
 -solves scientific and practical problems in the fields of genetics, breeding, genomics, proteomics, technologies for the production of pharmaceutical substances, medicines and nanotechnologies.

To the competence of graduates and indicators of their achievement:

Code and name of professional competence (result of mastering)	Code and name of the competency indicator
PC-6 Able to use modern knowledge and methods of genetics, molecular and cellular biology to solve professional problems	PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems
	PC-6.2 Applies methods of genetics, molecular and cellular biology to identify the mechanisms of pathological processes
	PC-6.3 Able to develop clinical diagnostic systems using knowledge and methods of genetics, molecular and cellular biology
	PC-6.4 Able to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis
PC-1 is able to carry out fundamental and applied projects to study physiological processes and phenomena occurring at the molecular, cellular, organ and systemic levels in the human and animal bodies	PC-1.1 Investigates the mechanisms of molecular interaction of cells, tissues and functional systems of organisms, studies the physiological processes occurring in them
	PC-1.2 Uses methods of molecular-genetic, cellular and physiological research to study physiological processes in the body

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems	Knows Modern methods of genetics and molecular and cellular biology for the study of living systems. Can Conduct research in genetics and molecular and cellular biology to study living systems. Owns skills in the use of research methods in the field of genetics and molecular and cellular biology for the study of living systems.
PC-6.2 Uses fundamental knowledge and biophysical methods to diagnose pathological conditions	Knows Methods of diagnosing pathological conditions. Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions. Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.
PC-6.3 Uses fundamental knowledge and biophysical methods to diagnose pathological conditions	Knows Methods of diagnosing pathological conditions. Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions. Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.

<p>PC-6.4 Able to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis</p>	<p>Knows research methods in the field of clinical laboratory diagnostics, molecular-genetic and cytological research methods.</p> <p>Can perform research in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies.</p> <p>Owens ability to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis.</p>
<p>PC-1.1 Investigates the mechanisms of molecular interaction of cells, tissues and functional systems of organisms, studies the physiological processes occurring in them</p>	<p>Knows interactions of cells, tissues and functional systems of organisms.</p> <p>Can distinguish between the physiological processes that take place in cells and tissues.</p> <p>Owens skills in studying the mechanisms of molecular interaction of cells, tissues and functional systems of organisms.</p>
<p>PC-1.2 Uses methods of molecular-genetic, cellular and physiological research to study physiological processes in the body</p>	<p>Knows methods of molecular-genetic, cellular and physiological research.</p> <p>Can apply methods of molecular-genetic, cellular and physiological research.</p> <p>Owens methods of molecular-genetic, cellular and physiological research</p>

For the formation of the above competencies within the discipline "Molecular Biology of the Cell" uses the following educational technologies and methods of active/interactive learning: business game, work in small groups, round table.

I. Goals and objectives of mastering the discipline:

Purpose: specialization of theoretical training and deepening of students' knowledge in the field of cell molecular biology of the cell – a branch of biology, the subject of which is the cell, the elementary unit of life. A cell is considered as a system that includes individual cellular structures, their participation in general cellular physiological processes, ways of regulating these processes, as well as studying the basic properties and manifestations of life at the molecular level.

Tasks:

2) development of students' holistic understanding of the molecular level of cell organization;

3) obtaining up-to-date knowledge about the structure, dynamics and functioning of molecular ensembles of cells, molecular mechanisms of cell development and functioning.

To the competence of graduates and indicators of their achievement:

Code and name of professional competence (result of mastering)	Code and name of the competency indicator
PC-6 Able to use modern knowledge and methods of genetics, molecular and cellular biology to solve professional problems	PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems
	PC-6.2 Applies methods of genetics, molecular and cellular biology to identify the mechanisms of pathological processes
	PC-6.3 Able to develop clinical diagnostic systems using knowledge and methods of genetics, molecular and cellular biology
	PC-6.4 Able to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis
PC-1 is able to carry out fundamental and applied projects to study physiological processes and phenomena occurring at the molecular, cellular, organ and systemic levels in the human and animal bodies	PC-1.1 Investigates the mechanisms of molecular interaction of cells, tissues and functional systems of organisms, studies the physiological processes occurring in them
	PC-1.2 Uses methods of molecular-genetic, cellular and physiological research to study physiological processes in the body

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems	Knows Modern methods of genetics and molecular and cellular biology for the study of living systems. Can Conduct research in genetics and molecular and cellular biology to study living systems. Owns

	skills in the use of research methods in the field of genetics and molecular and cellular biology for the study of living systems.
PC-6.2 Uses fundamental knowledge and biophysical methods to diagnose pathological conditions	Knows Methods of diagnosing pathological conditions. Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions. Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.
PC-6.3 Uses fundamental knowledge and biophysical methods to diagnose pathological conditions	Knows Methods of diagnosing pathological conditions. Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions. Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.
PC-6.4 Able to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis	Knows research methods in the field of clinical laboratory diagnostics, molecular-genetic and cytological research methods. Can perform research in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies. Owns ability to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis.
PC-1.1 Investigates the mechanisms of molecular interaction of cells, tissues and functional systems of organisms, studies the physiological processes occurring in them	Knows interactions of cells, tissues and functional systems of organisms. Can distinguish between the physiological processes that take place in cells and tissues. Owns skills in studying the mechanisms of molecular interaction of cells, tissues and functional systems of organisms.
PC-1.2 Uses methods of molecular-genetic, cellular and physiological research to study physiological processes in the body	Knows methods of molecular-genetic, cellular and physiological research. Can apply methods of molecular-genetic, cellular and physiological research. Owns methods of molecular-genetic, cellular and physiological research

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

The total labor intensity of the discipline is 4 credit units (144 academic hours), (1 credit corresponds to 36 academic hours).

III. Structure of the discipline:

The form of study is full-time.

№	Section Name Discipline	Se me ster	Number of hours by type of training and work of the student						Forms intermediate attestation	of
			Mil d	Lab	Bir d	OK	WE D	Cont rol		
1.	Topic 1-3	5	3	6	6	-	3	6	Exam Questions	
2.	Topic 4-6		3	6	6	-	3	6	Exam Questions	
3.	Topic 7-9		3	6	6	-	3	6	Exam Questions	
4.	Topic 10-12		3	6	6	-	3	6	Exam Questions	
5.	Topic 13-15		3	6	6	-	3	6	Exam Questions	
6.	Topic 16-18		3	6	6	-	3	6	Exam Questions	
	Total:	5	18	36	36	-	18	36	Exam	

IV. CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures 18 hours.

Topic 1. Structure, function and dynamics of cell biopolymers. History of creation.

Topic 2. Structure and function of nucleic acids. DNA.

Topic 3. Structure and function of nucleic acids. RNA.

Topic 4. Structure, function and dynamics of proteins.

Topic 5. Primary structure as the level of protein organization.

Topic 6. Classic examples of stereochemical principles of proteins on the example of hemoglobin and immunoglobulins.

Topic 7. Molecular cloning.

Topic 8. Molecular mechanisms of replication, repair and recombination.

Topic 9. Transcription in pro- and eukaryotes.

Topic 10. Biochemical Foundations of Matrix Syntheses.

Topic 11. Translation – protein biosynthesis.

Topic 12. Genomics.

Topic 13. Promising areas of research.

Topic 14. Levels of chromatin organization in eukaryotes.

Topic 15. Physicochemical Methods of Analysis of Nucleic Acids and Proteins.

Topic 16. Fluorescent biosensors

Topic 17. Molecular mechanisms of carcinogenesis.

Topic 18. Cell programming.

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

Laboratory work 36 hours.

Topic 1. Structure, function and dynamics of cell biopolymers. History of creation.

Topic 2. Structure and function of nucleic acids. DNA.

Topic 3. Structure and function of nucleic acids. RNA.

Topic 4. Structure, function and dynamics of proteins.

Topic 5. Primary structure as the level of protein organization.

Topic 6. Classic examples of stereochemical principles of proteins on the example of hemoglobin and immunoglobulins.

Topic 7. Molecular cloning.

Topic 8. Molecular mechanisms of replication, repair and recombination.

Topic 9. Transcription in pro- and eukaryotes.

Topic 10. Biochemical Foundations of Matrix Syntheses.

Topic 11. Translation – protein biosynthesis.

Topic 12. Genomics.

Topic 13. Promising areas of research.

Topic 14. Levels of chromatin organization in eukaryotes.

Topic 15. Physicochemical Methods of Analysis of Nucleic Acids and Proteins.

Topic 16. Fluorescent biosensors

Topic 17. Molecular mechanisms of carcinogenesis.

Topic 18. Cell programming.

Practical training 36 hours.

Topic 1. Structure and molecular dynamics of cell membranes.

Topic 2. Chromatin structure.

Topic 3. Molecular mechanisms of DNA replication.

Topic 4. Molecular mechanisms of DNA repair and recombination.

Topic 5. Transcription. Regulation of gene expression.

Topic 6. Genetic code. Translation mechanism.

Topic 7. Cytoskeleton: Architecture, Transport, and Molecular Dynamics.

Topic 8. Cell-to-cell communications, signaling pathways, control of cell reproduction and differentiation.

Self-paced work

Self-Assessment Questions

1. Provide a diagram of the structure and characterize the composition of the nucleotide molecule. Through what bonds are nucleotides connected to form a polynucleotide chain?

2. To give a comparative description of the structure of DNA and RNA molecules. What bonds form the double helix of DNA? Explain the principle of complementarity in the construction of the double helix, name complementary pairs of nucleotides.

3. To define the concept of "transcription", to explain the molecular mechanism of transcription: what is the matrix, what enzyme is used, where do the precursors for synthesis come from?

4. Define the concept of "broadcasting". Give a diagram and explain the mechanism of ribosomes. Determine the role of each form of RNA in protein synthesis.

5. Give a brief answer to the question: What does the genetic code express? Why is the code triplet? Which molecules act as a decoding mechanism?

6. Give a brief definition and formula of the central dogma of molecular biology. What are the functions of DNA in a cell? What syntheses are called matrix and why?

7. Based on the formula of the central dogma of molecular biology, explain what is the molecular basis of genotype and phenotype.

8. To define the concept of "replication", to explain the molecular mechanism and purpose of DNA replication.

9. General morphological characteristics of the nuclear apparatus of eukaryotic and prokaryotic cells.

10. The essence of the concept of chromosome continuity in the life cycle of the cell.
11. Chemical composition of chromatin What is DNP?
12. Levels of chromatin structural organization. Eu- and heterochromatin. What levels of chromatin organization are characteristic of the interphase nucleus?
13. What manifestations of mRNA transcription can be seen in a light and electron microscope?
14. Structure of chromosomes such as lamp brushes and polytene chromosomes, correspondence of their details to chromatin structures of ordinary nuclei.
15. Structure and function of the nucleolus. Explain the essence of rRNA processing.
16. Structure of the eukaryotic ribosome: subunits, parameters of RNA molecules, proteins.
17. What is nucleolar DNA amplification? Where is it known and what is it for?
18. Nuclear matrix and nuclear envelope: their structure and importance in the organization of chromatin work.
19. Structure and function of nuclear pores.
20. What is the route of transfer of ribosome subunits from the nucleolus to the cytoplasm?

VI. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Recommendations for students' independent work

The purpose of the student's independent work is to work meaningfully and independently, first with educational material, then with scientific information, to lay the foundations for self-organization and self-education in order to instill the ability to continuously improve one's professional qualifications in the future.

The process of organizing the student's independent work includes the following stages:

- preparatory (definition of goals, preparation of a program, preparation of methodological support, preparation of equipment);
- the main one (implementation of the program, the use of techniques for searching for information, assimilation, processing, application, transfer of knowledge, recording the results, self-organization of the work process);

- final (assessment of the significance and analysis of the results, their systematization, assessment of the effectiveness of the program and methods of work, conclusions on the directions of labor optimization).

In the process of independent work, the student acquires the skills of self-organization, self-control, self-management, self-reflection and becomes an active independent subject of educational activity. Independent work of students should have an important impact on the formation of the personality of a future specialist, it is planned by students independently. Each student independently determines the mode of his work and the measure of work spent on mastering the educational content in each discipline. He performs extracurricular work according to a personal individual plan, depending on his preparation, time and other conditions.

Methodical recommendations for students' independent work

In the process of mastering the material on the subject of the discipline, it is planned to perform independent work of students on the collection and processing of literary material to expand the field of knowledge in the discipline studied, which allows you to deepen and consolidate specific practical knowledge obtained in classroom classes. For the study and full mastering of the program material in the discipline, educational, reference and other literature recommended by this program, as well as specialized periodicals, are used.

In the course of independent preparation for classes, students take notes of the material, independently study questions on the topics covered, using educational literature from the proposed list, periodicals, scientific and methodological information, databases of information networks.

Independent work consists of such types of work as studying material from textbooks, reference books, video materials and presentations, as well as other reliable sources of information; Preparation for Zechet. To consolidate the material, it is enough to mentally reconstruct the material by flipping through the synopsis or reading it. If necessary, refer to the recommended educational and reference literature, write down incomprehensible points in the questions to clarify them in the upcoming lesson.

Preparation for practical exercises. This type of independent work consists of several stages:

- 1) Revision of the material studied. For this purpose, lecture notes, recommended basic and additional literature are used;

- 2) Deepening knowledge on the proposed topics. It is necessary to differentiate the available material in lectures and manuals in accordance with the points of the practical lesson plan. Separately, write down unclear questions and terms. It is better to do this in the margins of a lecture notes or a study guide.

Clarification should be carried out with the help of reference literature (dictionaries, encyclopedic publications, etc.);

3) Drawing up a detailed plan of performance, or calculations, solving problems, exercises, etc. In preparation for practical classes, students take notes of the material, prepare answers to the given questions on the topics of practical classes. In addition to the practical material, students independently study questions on the proposed topics, using educational literature from the proposed list, periodicals, scientific and methodological information, databases of information networks (Internet, etc.).

Requirements for the presentation and design of the results of independent work

There are no special requirements for the submission and registration of the results of this independent work.

Control over the implementation of the plan of independent work of students is carried out by the teacher in practical classes by means of a survey and by including in the final data set in the lesson from the plan of independent work.

VII. 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.	Topic 1-3	PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems	<p>Knows Modern methods of genetics and molecular and cellular biology for the study of living systems.</p> <p>Can Conduct research in genetics and molecular and cellular biology to study living systems.</p> <p>Owens skills in the use of research methods in the field of genetics and molecular and cellular biology for the study of living systems.</p>	test	Exam Questions
2.	Topic 4-6	PC-6.2 Applies methods of genetics, molecular and cellular biology to identify the mechanisms of pathological processes	<p>Knows Methods of diagnosing pathological conditions.</p> <p>Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions.</p> <p>Owens skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.</p>	colloquium	Exam Questions
3.	Topic 7-9	PC-6.3 Able to develop clinical diagnostic systems using knowledge and methods of genetics, molecular and cellular biology	<p>Knows Methods of diagnosing pathological conditions.</p> <p>Can to use fundamental knowledge and biophysical methods to diagnose pathological conditions.</p> <p>Owens skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.</p>	test	Exam Questions
4.	Topic 10-12	PC-6.4 Able to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order	<p>Knows research methods in the field of clinical laboratory diagnostics, molecular-genetic and cytological research methods.</p> <p>Can</p>	test	Exam Questions

		to identify the causes of the disease and make a diagnosis	perform research in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies. Owns ability to perform studies in the field of clinical laboratory diagnostics, molecular-genetic and cytological studies in order to identify the causes of the disease and make a diagnosis.		
5.	Topic 13-15	PC-1.1 Investigates the mechanisms of molecular interaction of cells, tissues and functional systems of organisms, studies the physiological processes occurring in them	Knows interactions of cells, tissues and functional systems of organisms. Can distinguish between the physiological processes that take place in cells and tissues. Owns skills in studying the mechanisms of molecular interaction of cells, tissues and functional systems of organisms.	test	Exam Questions
6.	Topic 16-18	PC-1.2 Uses methods of molecular-genetic, cellular and physiological research to study physiological processes in the body	Knows methods of molecular-genetic, cellular and physiological research. Can apply methods of molecular-genetic, cellular and physiological research. Owns methods of molecular-genetic, cellular and physiological research	colloquium	Exam Questions

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

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Further reading

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17. Stepanov V.M. Molecular biology. Structure and Function of Proteins [Elektronnyi resurs]: uchebnik/ Stepanov V.M. – Elektron. Text data. Moscow: Lomonosov Moscow State University, 2005. – 336 p. – Mode of access: <http://www.iprbookshop.ru/13144.html> . – EBS «IPRbooks»

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

1. <http://elementy.ru/> – Scientific Electronic Library
2. <http://zhelezyaka.com/>
3. <http://science.km.ru/> - electronic resource on different sections of biology
4. <http://molbiol.ru/> - Electronic Resource on Molecular Biology
5. <http://humbio.ru/humbio/cytology/00000d33.htm>
6. <http://biology-of-cell.narod.ru/>
7. http://webembryo.narod.ru/cel_biol.htm
8. <http://tsitologiya.ru/>
9. <http://www.NCBI.nlm.nih.gov/sites/enter?db=books>

List of information technologies and software

1. Microsoft Office Professional Plus 2010.
2. An office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.).
3. 7Zip 9.20 is a free file archiver with a high data compression ratio.
4. ABBYY FineReader 11 – Optical Character Recognition (OCR) software.

5. Adobe Acrobat XI Pro is a software package for creating and viewing electronic publications in PDF format.

6. ESET Endpoint Security – comprehensive protection for Windows-based workstations. Virtualization support + new technologies.

7. WinDjView 2.0.2 is a program for recognizing and viewing files with the DJV and DjVu formats of the same name.

8. Auslogics Disk Defrag is a program for optimizing the PC and fine-tuning the operating system.

IX. METHODOICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

In the process of studying the discipline "Molecular Biology of the Cell", a variety of methods and means of mastering the educational content are offered: lectures, seminars-colloquiums, testing, independent work of students.

A lecture is the main active form of classroom classes, explanation of fundamental theoretical sections, which involves intensive mental activity of the student. The lecture is cognitive, developmental, educational and organizing. Lecture notes help to assimilate the theoretical material of the discipline. When listening to a lecture, it is necessary to take notes of its rubrication, terminology, key words, definitions, formulas, graphic schemes.

When working at home with lecture notes, it is necessary to use the main textbook and additional literature that are recommended for this discipline.

When presenting a lecture course, the following forms of interactive learning are used: lecture-conversation, lecture-visualization, which are built on the basis of previous knowledge, including related disciplines. Presentations, interactive whiteboards, tables, and diagrams are used for illustration. In the course of the presentation of the lecture material, problematic and provocative questions are raised, elements of discussion are included.

Lecture-visualization. The lecture is accompanied by a computer presentation with basic texts (headings, formulations, key words and terms), illustrations of microscopic and ultramicroscopic images of cells, drawing diagrams and writing formulas on an interactive whiteboard, demonstration of visual tables and slides, which contributes to a better perception of the material presented.

Lecture-conversation – "dialogue with the audience" – is a common form of interactive learning and allows students to be involved in the learning process, as it creates direct contact between the teacher and the audience. Students are asked questions of a problematic, provocative or informational nature. Students themselves can also ask questions. Any of the students can offer their own answer, the other can

supplement it. This form of lecture allows you to involve all students in the work, to activate their attention, thinking, to gain collective experience, to learn how to formulate questions.

Seminar-colloquium. A colloquium is a collective form of consideration and consolidation of educational material. Colloquiums are one of the types of practical classes designed for in-depth study of the discipline, held in an interactive mode. In the classes on the topic of the colloquium, issues are analyzed, together with the teacher, they are discussed, which is aimed at consolidating the material, forming polemic skills, developing independence and critical thinking, and the ability of students navigate in large information flows, develop and defend their own position on problematic issues of the academic discipline.

As methods of interactive learning at colloquiums, the following are used: extended conversation, discussion, press conference.

A detailed 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.

Discussion in a group has a number of advantages. The discussion can be triggered by the teacher during the lesson or planned in advance.

Control tests. Blank or computer testing is used in the mode of choosing the correct answers, establishing the correspondence of concepts, marking details on diagrams, etc.

Guidelines for working with literature

It is necessary to make an initial list of sources. The basis can be the list of references recommended in the work program of the course. For the convenience of work, you can compile your own card index of selected sources (authors' surname, title, characteristics of the publication) in the form of a working file in the computer. Such a card index has an advantage, because it allows you to add sources, replace one with another if necessary, The initial list of references can be supplemented using the electronic catalog of the FEFU library.

When working with literature on a particular topic, it is necessary not only to read, but also to master the method of studying it: to make a brief synopsis, an algorithm, a scheme of the material read, which allows you to understand and remember it faster. It is not recommended to rewrite the text verbatim.

X. LOGISTICAL SUPPORT OF 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>Laboratory auditorium equipped with a multimedia complex</p> <p>Vladivostok, Russky Island, Ajax village, 10, aud. M420, area 74.6 m²</p>	<p>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; IPL T CR48 Control Controller Extension</p> <p>Aquadistiller PE-2205 (5l/h); Analytical balances Acculab ATL-2200d2-I scales; Laboratory scales Vibra SJ-6200CE (LEL=6200 g/0.1 g); Moisture meter AGS100; UV-1800 dual-beam spectrophotometer manufactured by Shimadzu; Rotary evaporator Hei-VAP Advantage ML/G3B; Magnetic stirrer PE-6100 (10 pcs.); Heated magnetic stirrer PE-6110 M (5pcs); Electric heating tiles; IRAffinity-1S infrared spectrophotometer with Fourier; Mold for the formation of suppositories for 100 cells; Pharmaceutical refrigerator; LC-20 Prominence liquid chromatograph with spectrophotometric and refractometric detector; Laboratory centrifuge PE-6926 with a rotor of 10×5 ml, a set of automatic Ecochem dispensers, a set of porcelain mortars, manual machines for packing capsules of sizes "0", "00", "1".</p>	<p style="text-align: center;">-</p>
<p>Reading rooms of the FEFU Scientific Library with open access to the collection (building A - level 10)</p>	<p>HP RgoOpe 400 All-in-One 19.5 (1600x900), Core i3-4150T, 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 Internet access speed 500 Mbps. Workplaces for people with disabilities are equipped with displays and Braille printers; equipped with: portable devices for reading flat-printed texts, scanning and reading machines, a video magnifier with the ability to adjust color spectrums; magnifying electronic magnifiers and ultrasonic markers</p>	<p style="text-align: center;">-</p>
<p>Laboratory Auditorium</p> <p>Vladivostok, Russky Island, Ajax village, 10, aud. L406, area 30 m²</p>	<p>Aquadistiller PE-2205 (5l/h); mixer; Laboratory scales AGN100; Magnetic stirrer PE-6100 (5 pcs.); Heated magnetic stirrer PE-6110 M (2 pcs.); Electric heating tiles; A set of laboratory glassware, a set of porcelain mortars with pestles.</p>	<p style="text-align: center;">-</p>