



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

**Far Eastern Federal University**  
(FEFU)


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**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 Genetics*

*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 " \_\_\_\_\_ 202 g №*
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## Annotation of disciplines "Molecular Genetics"

The total labor intensity of the discipline is 108 hours, 3 credits, is a variable part of the OBOR, is implemented in the 5th year and ends with a test.

The curriculum provides for 18 hours of lectures, 36 hours of practical classes, 18 hours of laboratory work, and 36 hours of independent work.

The language of the program is Russian.

Objective: to form students' understanding of the basic methods of analyzing the molecular organization and functioning of genetic material.

Tasks:

- to provide students with the necessary theoretical and practical knowledge in various areas of molecular genetics;
- deepening and consolidation of theoretical knowledge, its comprehensive use in the process of production activities.

The learning outcomes of the discipline (module) should be correlated with the indicators of competence achievement established in the BRI.

The totality of the planned learning outcomes in the discipline (module) should ensure the formation of all the competencies established by the BRI in the graduate.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name Competencies (result of mastering)	Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
Research & Development	PC-4 Able to understand and analyze, apply the principles of cellular and tissue organization of biological objects, biochemical and molecular-biological mechanisms of the development	PC-4.1 Analyzes biochemical and molecular-biological mechanisms of development of pathological processes in cells and tissues of the human body and applies the principles of cellular organization of biological objects	Knows biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body. Can apply the principles of cellular organization of biological objects. Owns skills of determining the biochemical and molecular-

of pathological processes in cells and tissues of the human body to preserve the health of the population		biological mechanisms of the development of pathological processes in the cells and tissues of the human body.
	PC-4.2 Understands the biochemical and molecular biological mechanisms of the development of pathological processes in the cells and tissues of the human body	<p>Knows biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.</p> <p>Can to apply biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.</p> <p>Owens skills in the use of biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body</p>
	PC-4.3 Understands and investigates the physical processes underlying the functioning of the body in normal and pathological conditions, understands the influence of physical factors on the functioning of biological systems, is able to study the physical structure of biologically important molecules in order to identify the relationship between the structure of substances and their biological activity	<p>Knows the physical structure of biologically important molecules and the physical processes underlying their functioning.</p> <p>Can determine the relationship between the physical structure and properties and the functions that perform them in the body.</p> <p>Owens skills in the study of the physical structures of biologically important molecules and the physical processes underlying their functioning</p>
	PC-4.4 Able to develop and apply health-saving	Knows technologies aimed at

		technologies	preserving the health of the population. Can apply health-saving technologies. Owns Ability to develop health-saving technologies
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	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	Applies methods of genetics, molecular and cellular biology to identify the mechanisms of pathological processes	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	Able to develop clinical diagnostic systems using knowledge and methods of genetics, molecular and cellular biology	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.
project	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	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

## I. GOALS AND OBJECTIVES OF MASTERING THE DISCIPLINE

Objective: to form students' understanding of the basic methods of analyzing the molecular organization and functioning of genetic material.

Tasks:

- to provide students with the necessary theoretical and practical knowledge in various areas of molecular genetics;
- deepening and consolidation of theoretical knowledge, its comprehensive use in the process of production activities.

The learning outcomes of the discipline (module) should be correlated with the indicators of competence achievement established in the BRI.

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Professional competencies of graduates and indicators of their achievement:

Task type	Code and name Competencies (result of mastering)	Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
Research & Development	PC-4 Able to understand and analyze, and apply the principles of cellular and tissue organization of biological objects, biochemical and molecular-biological mechanisms of the development of pathological processes in cells and tissues of the human body to preserve the health of the population	PC-4.1 Analyzes biochemical and molecular-biological mechanisms of development of pathological processes in cells and tissues of the human body and applies the principles of cellular organization of biological objects	Knows biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body. Can apply the principles of cellular organization of biological objects. Owns skills of determining the biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.
		PC-4.2 Understands the biochemical and molecular biological mechanisms of the development of pathological processes in	Knows biochemical and molecular-biological mechanisms of the development of pathological

		<p>the cells and tissues of the human body</p>	<p>processes in the cells and tissues of the human body.  Can  to apply biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.  Owns  skills in the use of biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body</p>
		<p>PC-4.3 Understands and investigates the physical processes underlying the functioning of the body in normal and pathological conditions, understands the influence of physical factors on the functioning of biological systems, is able to study the physical structure of biologically important molecules in order to identify the relationship between the structure of substances and their biological activity</p>	<p>Knows  the physical structure of biologically important molecules and the physical processes underlying their functioning.  Can  determine the relationship between the physical structure and properties and the functions that perform them in the body.  Owns  skills in the study of the physical structures of biologically important molecules and the physical processes underlying their functioning</p>
		<p>PC-4.4 Able to develop and apply health-saving technologies</p>	<p>Knows  technologies aimed at preserving the health of the population.  Can  apply health-saving technologies.  Owns  Ability to develop health-saving technologies</p>



<p>PC-6 Able to use modern knowledge and methods of genetics, molecular and cellular biology to solve professional problems</p>	<p>PP-6.1 Uses knowledge and methods of genetics, molecular and cellular biology to study living systems</p>	<p>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.</p>
	<p>PC-6.2 Applies methods of genetics, molecular and cellular biology to identify the mechanisms of pathological processes</p>	<p>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>
	<p>PC-6.3 Able to develop clinical diagnostic systems using knowledge and methods of genetics, molecular and cellular biology</p>	<p>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>
	<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. 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.</p>

project	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	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 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
Lab	Labs
Ave	Practical exercises
WED:	Student's independent work during the period of theoretical training
	And other types of work

## 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	Introduction to General Genetics	4	3	3	6	-	6	6	Questions for the test
2	Basic patterns of inheritance, interaction of genes	4	3	3	6	-	6	6	Questions for the test
Total:		4	18	18	36	-	36	36	Credit

### IV. STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE

#### **Section 1. Fundamentals of Molecular Genetics.**

Topic 1. Structure and structure of proteins. Amino acid composition of proteins. Peptides. Structural organization of proteins. Protein folding. Functions of chaperones.

Topic 2. Functions of DNA, RNA Primary structure of nucleic acids. The genome of prokaryotes and eukaryotes. DNA replication.

Topic 3. Regulation of transcriptional processes in prokaryotes and eukaryotes. Transcription in prokaryotes and eukaryotes. Transcription regulation. RNA processing.

Topic 4. Regulation of translation processes. Genetic code. Broadcast regulation.

#### **Section 2. Methods for studying the structure of nucleic acids and proteins.**

Topic 5. X-ray Diffraction Analysis in Molecular Genetics. X-ray diffraction analysis. Radioactive isotopes.

Topic 6. Chromatographic Research Methods in Molecular Genetics. Ultracentrifugation. Chromatography. Electrophoresis. Chemical modification of proteins.

Topic 7. Methods of biomass utilization. Biodegradation of foreign compounds and utilization of biomass. Genotyping by PCR.

Topic 8. Production of medicines in biotechnology. Production of medicines. Transgenic plants and animals

## **V. STRUCTURE AND CONTENT OF THE PRACTICAL PART OF THE COURSE**

### **Practical exercises (36 hours)**

#### **Class 1. Subject, objectives, history of genetics development.**

**Topic 1. Patterns of inheritance of traits. Subject and Methodology of Genetics. Stages of development of genetics.** The place of genetics in the system of biological sciences and its connection with practice. Heredity. Principles and methods of genetic analysis. Genes and alleles. Patterns of inheritance of traits in mono-, di- and polyhybrid crosses.

**Topic 2. Patterns of inheritance of traits.** Linked inheritance and crossing-over. Chromosomal theory. Extranuclear inheritance: plastid, plasmid, mitochondrial inheritance. Inheritance of endosymbionts and through infection.

**Topic 3. Evidence for the role of DNA in heredity.** Genes and enzymes. The Watson-Crick model as a basis for replication, mutagenesis and gene specificity. Properties of the genetic code. Gene theory.

Matrix processes: DNA replication, transcription, translation. Regulation of gene action. Operon concept. Features of gene regulation in eukaryotes.

**Topic 4. Types of variation: hereditary, modification, combinative and mutational, ontogenetic.** Korzynski-de Vries mutational theory. Spontaneous and induced mutational process. Classification of mutations. N.I. Vavilov's Law of Homologous Series in Hereditary Variability.

**Topic 5. Genetic analysis in prokaryotes: methods, features of processes leading to recombination.** Plasmids, episomes, MGEs, etc. Genetic engineering. Methods of gene isolation and synthesis. Vectors, recombinant DNA molecules, gene cloning.

**Topic 6. Man as an object of genetics.** Methods of Human Genetics. Genetic diseases. Human Genome Project.

### **Labs (18 hours)**

**Lab 1.** Patterns of inheritance of traits.

**Lab 2.** Patterns of inheritance of traits.

**Lab 3.** Evidence for the role of DNA in heredity.

**Lab 4.** Types of variation: hereditary, modification, combinative and mutational, ontogenetic.

**Lab 5.** Genetic analysis in prokaryotes: methods, features of processes leading to recombination.

**Lab 6.** Man as an object of genetics.

## 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 Attestation
1	Introduction to General Genetics	PC-4.1 Analyzes biochemical and molecular-biological mechanisms of development of pathological processes in cells and tissues of the human body and applies the principles of cellular organization of biological objects	<p>Knows biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.</p> <p>Can apply the principles of cellular organization of biological objects.</p> <p>Owns skills of determining biochemical and molecular-biological mechanisms of development of pathological processes in cells and tissues of the human body.</p>	Interview	Questions for the test
		PC-4.2 Understands the biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body	<p>Knows biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.</p> <p>Can to apply biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body.</p> <p>Owns skills in the use of biochemical and molecular-biological mechanisms of the development of pathological processes in the cells and tissues of the human body</p>	Colloquium	

		<p>PC-4.3 Understands and investigates the physical processes underlying the functioning of the body in normal and pathological conditions, understands the influence of physical factors on the functioning of biological systems, is able to study the physical structure of biologically important molecules in order to identify the relationship between the structure of substances and their biological activity</p>	<p>Knows the physical structure of biologically important molecules and the physical processes underlying their functioning. Can determine the relationship between the physical structure and properties and the functions that perform them in the body. Owns skills to study the physical structure of biologically important molecules and the physical processes underlying their functioning</p>	<p>Test</p>	
		<p>PC-4.4 Able to develop and apply health-saving technologies</p>	<p>Knows technologies aimed at preserving the health of the population. Can apply health-saving technologies. Owns ability to develop health-saving technologies</p>	<p>Colloquium</p>	

		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>Owns 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	
2	Basic patterns of inheritance, interaction of genes	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>Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.</p>	Interview	
		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>Owns skills in the application of fundamental knowledge and biophysical methods for the diagnosis of pathological conditions.</p>	Test	



		<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>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.</p>	Test	
		<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 physiological processes occurring in cells and tissues.</p> <p>Owns skills in studying the mechanisms of molecular interaction of cells, tissues and functional systems of organisms.</p>	Abstract	
		<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>Owns methods of molecular-genetic, cellular and physiological research</p>	Colloquium	

## VII. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Independent learning is both individual and collective educational activity carried out without the direct guidance of the teacher, but according to his tasks and under his control. Independent work is a cognitive learning activity, when the sequence of the student's thinking, his mental and practical operations and actions depends and is determined by the student himself.

Independent work of students contributes to the development of independence, responsibility and organization, a creative approach to solving problems at the educational and professional levels, which ultimately leads to the development of the skill of independent planning and implementation of activities.

The purpose of students' independent work is to acquire the necessary competencies in their field of training, experience in creative and research activities.

Forms of independent work of students:

- work with basic and additional literature, Internet resources;
- independent acquaintance with the lecture material presented on electronic media, in the library of an educational institution;
- preparation of abstract reviews of periodical press sources, reference notes, predetermined by the teacher;
- search for information on the topic with its subsequent presentation in the audience in the form of a report, presentations;
- preparation for classroom tests;
- Performing home tests;
- Performance of test tasks, problem solving;
- preparation of reports for presentation at a seminar, conference;
- filling in the workbook;
- writing essays, term papers;
- preparation for business and role-playing games;
- Writing a resume;
- preparation for tests and exams;
- other types of activities organized and carried out by the educational institution and student self-government bodies.

The RAP presents the main content of the topics, assessment tools: terms and concepts necessary for mastering the discipline.

In the course of mastering the course "Molecular Genetics", the student will have to do a large amount of independent work, which includes preparation for seminars and writing an essay.

Practical classes help students to master the educational material more deeply, acquire the skills of creative work on documents and primary sources.

Plans of practical classes, their topics, recommended literature, the purpose and objectives of its study are reported by the teacher in introductory classes or in the curriculum for this discipline.

Before starting to study the topic, it is necessary to familiarize yourself with the main questions of the practical lesson plan and the list of recommended literature.

When starting to prepare for a practical lesson, it is necessary, first of all, to refer to the lecture notes, sections of textbooks and manuals in order to get a general idea of the place and significance of the topic in the course being studied. Then work with additional literature, make notes on recommended sources.

In the process of studying the recommended material, it is necessary to understand the structure of the topic under study, highlight the main provisions, trace their logic and thereby delve into the essence of the problem under study.

It is necessary to keep records of the studied material in the form of a synopsis, which, along with visual memory, also includes motor memory and allows you to accumulate an individual fund of auxiliary materials for quick revision of what you have read, for mobilization of accumulated knowledge. The main forms of registration: plan (simple and extensive), extracts, theses.

In the process of preparation, it is important to compare sources, think over the material being studied and build an algorithm of actions, carefully think over your oral presentation.

At the practical lesson, each participant should be ready to speak on all the issues raised in the plan, and should be as active as possible when considering them. The speech should be convincing and reasoned, and a simple reading of the notes is not allowed. It is important to show your own attitude to what is being said, express your personal opinion, understanding, substantiate it and draw the right conclusions from what is said. At the same time, you can refer to notes and lectures, directly to primary sources, use knowledge of monographs and publications, facts and observations of modern life, etc.

A student who did not have time to speak at a practical lesson can present the prepared notes to the teacher for verification and, if necessary, answer the teacher's questions on the topic of the practical lesson in order to receive a credit grade on this topic.

Educational and methodological support of independent work of students in the discipline "Molecular Genetics" includes:

- characteristics of tasks for students' independent work and methodological recommendations for their implementation;

– requirements for the presentation and execution of the results of independent work;

– Criteria for evaluating the performance of independent work.

### **Methodological recommendations for the preparation of an abstract**

An essay is a creative activity of a student, which reproduces in its structure research activities to solve theoretical and applied problems in a certain branch of scientific knowledge. For this reason, coursework is the most important component of the educational process in higher education.

An essay, being a model of scientific research, is an independent work in which the student solves a problem of a theoretical or practical nature, applying scientific principles and methods of this branch of scientific knowledge. The result of this scientific research can have not only subjective, but also objective scientific novelty, and therefore can be presented for discussion by the scientific community in the form of a scientific report or a report at a scientific and practical conference, as well as in the form of a scientific article.

The abstract involves the acquisition of skills for building business cooperation based on ethical standards of scientific activity. Purposefulness, initiative, disinterested cognitive interest, responsibility for the results of one's actions, conscientiousness, competence are the personal qualities that characterize the subject of research activities that correspond to the ideals and norms of modern science.

An essay is an independent educational and research activity of a student. The instructor provides advice and evaluates the process and results. He provides an approximate topic of abstracts, clarifies the problem and topic of research together with students, helps to plan and organize research activities, appoints a time and a minimum number of consultations.

The teacher accepts the text of the essay for review at least ten days before the defense.

Traditionally, there is a certain structure of the abstract, the main elements of which, in the order of their arrangement, are the following:

1. Title page.
2. Task.
3. Table of Contents.
4. List of symbols, symbols and terms (if necessary).
5. Introduction.
6. Main part.
7. Conclusion.
8. References.
9. Applications.

The title page indicates: educational institution, graduating department, author, teacher, research topic, place and year of the abstract.

The title of the abstract should be as brief as possible and fully correspond to its content.

The table of contents (contents) reflects the names of the structural parts of the abstract and the pages on which they are located. It is advisable to place the table of contents at the beginning of the work on one page.

The presence of a detailed introduction is a mandatory requirement for the abstract. Despite the small volume of this structural part, its writing causes significant difficulties. However, it is the high-quality introduction that is the key to understanding the entire work, testifying to the professionalism of the author.

Thus, the introduction is a very important part of the abstract. The introduction should begin with a justification of the relevance of the chosen topic. When applied to an abstract, the concept of "relevance" has one peculiarity. How the author of the essay is able to choose a topic and how correctly he understands and evaluates this topic from the point of view of modernity and social significance, characterizes his scientific maturity and professional training.

In addition, in the introduction, it is necessary to identify the methodological base of the abstract, to name the authors whose works formed the theoretical basis of the study. A review of the literature on the topic should show the author's thorough familiarity with specialized literature, his ability to systematize sources, critically consider them, highlight the essential, and determine the main thing in the current state of study of the topic.

The introduction reflects the significance and relevance of the chosen topic, defines the object and subject, the purpose and objectives, and the chronological framework of the study.

The introduction concludes with a statement of general conclusions about the scientific and practical significance of the topic, the degree of its study and provision with sources, and the formulation of a hypothesis.

In the main part, the essence of the problem is stated, the topic is revealed, the author's position is determined, factual material is provided as an argument and to illustrate the proposed provisions. The author needs to demonstrate the ability to consistently present the material while simultaneously analyzing it. Preference is given to the main facts rather than small details.

The abstract ends with the final part, which is called the "conclusion". Like any conclusion, this part of the abstract plays the role of a conclusion conditioned by the logic of the research, which is in the form of a synthesis of the scientific information accumulated in the main part. This synthesis is a consistent, logically harmonious presentation of the results obtained and their correlation with the general

goal and specific tasks set and formulated in the introduction. It is here that the so-called "inferential" knowledge is contained, which is new in relation to the original knowledge. The conclusion may include suggestions of a practical nature, thereby increasing the value of the theoretical materials.

So, the conclusion of the abstract should include: a) the conclusions of the study; b) theoretical and practical significance, novelty of the abstract; c) the possibility of applying the results of the study is indicated.

After the conclusion, it is customary to place a bibliographic list of the references. This list is one of the essential parts of the abstract and reflects the independent creative work of the author of the abstract.

A list of the sources used is placed at the end of the work. It is drawn up either in alphabetical order (by the author's surname or the title of the book), or in the order in which references appear in the text of the written work. In all cases, the full title of the work, the names of the authors or the editor of the publication, if a team of authors participated in the writing of the book, data on the number of volumes, the name of the city and publishing house in which the work was published, the year of publication, the number of pages are indicated.

### **Guidelines for Preparing Presentations**

To prepare a presentation, it is recommended to use: PowerPoint, MS Word, Acrobat Reader, LaTeX beamer package. The simplest program for creating presentations is Microsoft PowerPoint. To prepare a presentation, it is necessary to process the information collected when writing the abstract.

Sequence of presentation preparation:

1. Clearly state the purpose of the presentation.
2. Determine what the format of the presentation will be: live performance (how long it will be) or e-mailing (what will be the context of the presentation).
3. Select all the content for the presentation and build a logical chain of presentation.
4. Identify the key points in the content of the text and highlight them.
5. Determine the types of visualization (pictures) to be displayed on slides in accordance with the logic, purpose and specifics of the material.
6. Choose the design and format the slides (the number of pictures and text, their location, color and size).
7. Check the visual perception of the presentation.

Types of visualization include illustrations, images, diagrams, tables. An illustration is a representation of a real-life visual series. Images, as opposed to illustrations, are metaphors. Their purpose is to evoke an emotion and create an attitude towards it, to influence the audience. With the help of well-thought-out and presented images, information can stay in a person's memory for a long time.

Diagram – visualization of quantitative and qualitative relationships. They are used for convincing demonstration of data, for spatial thinking in addition to logical thinking. A table is a concrete, visual and accurate display of data. Its main purpose is to structure information, which sometimes makes it easier for the audience to perceive the data.

*Practical tips for preparing a presentation*

- printed text + slides + handouts are prepared separately;
- Slides – visual presentation of information, which should contain a minimum of text, a maximum of images that carry a semantic load, look clear and simple;
- Textual content of the presentation – oral speech or reading, which should include arguments, facts, evidence and emotions;
- Recommended number of slides 17-22
- mandatory information for the presentation: topic, surname and initials of the speaker; Communication plan brief conclusions from all that has been said; list of references;
- Handouts – should provide the same depth and reach as a live performance: people trust what they can take with them more than fading images, words and slides are forgotten, and the handouts remain a constant tangible reminder; It is important to hand out handouts at the end of the presentation; Handouts should be different from slides, they should be more informative.

**Criteria for evaluating the abstract.**

The stated understanding of the abstract as an integral author's text determines the criteria for its evaluation: novelty of the text; the reasonableness of the choice of source; the degree of disclosure of the essence of the issue; compliance with the design requirements.

**Novelty of the text:** a) relevance of the research topic; b) novelty and independence in the formulation of the problem, formulation of a new aspect of the known problem in the establishment of new connections (interdisciplinary, intra-subject, integration); c) ability to work with research, critical literature, systematize and structure material; d) the manifestation of the author's position, the independence of assessments and judgments; e) stylistic unity of the text, unity of genre features.

**Degree of disclosure of the essence of the issue:** a) correspondence of the plan to the topic of the abstract; b) correspondence of the content to the topic and outline of the abstract; c) completeness and depth of knowledge on the topic; d) the validity of the ways and methods of working with the material; f) the ability to generalize, draw conclusions, compare different points of view on one issue (problem).

**Reasonableness of the choice of sources:** a) assessment of the literature used: whether the most well-known works on the topic of research are involved (including journal publications of recent years, the latest statistical data, summaries, references, etc.).

**Compliance with formatting requirements:** a) how correctly the references to the literature used, the list of references; b) assessment of literacy and culture of presentation (including spelling, punctuation, stylistic culture), knowledge of terminology; c) compliance with the requirements for the length of the abstract.

**The reviewer should clearly formulate** a comment and questions, preferably with references to the work (it is possible to specific pages of the work), to research and factual data that the author did not take into account.

**The reviewer can also indicate: whether the student has addressed** the topic before (essays, written works, creative works, Olympiad works, etc.) and whether there are any preliminary results; how the graduate conducted the work (plan, intermediate stages, consultation, revision and revision of the written or lack of a clear plan, rejection of the recommendations of the supervisor).

**The student submits an abstract for review no later than a week before the defense.** The reviewer is the teacher. Experience shows that it is advisable to familiarize the student with the review a few days before the defense. Opponents are appointed by a teacher from among the students. 10-20 minutes is enough for a student to make an oral presentation (this is about the time it takes to answer the exam tickets).

**Grade 5 is given if all the requirements for writing and defending an abstract are met: the problem is** identified and its relevance is justified, a brief analysis of various points of view on the problem under consideration is made and one's own position is logically stated, conclusions are formulated, the topic is fully disclosed, the volume is maintained, the requirements for external design are met, correct answers to additional questions are given.

**Grade 4 – the** main requirements for the abstract and its defense have been met, but at the same time there are shortcomings. In particular, there are inaccuracies in the presentation of the material; there is no logical consistency in judgments; the volume of the abstract is not maintained; there are omissions in the design; Incomplete answers were given to additional questions during the defense.

**Grade 3 –** there are significant deviations from the abstract requirements. In particular, the topic is covered only partially; factual errors were made in the content of the abstract or in answering additional questions; There is no conclusion during the defense.

**Grade 2 – the** topic of the abstract is not disclosed, a significant misunderstanding of the problem is revealed.



**The grade is "unsatisfactory"** – the student did not submit an abstract.

## **VII. LIST OF REFERENCES AND INFORMATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE**

### Reference citations

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4. Fundamentals of Genetics: Textbook / compiled by E. V. Kukushkina, I. A. Kukushkin. — 2nd ed. - Komsomolsk-on-Amur, Saratov: Amur Humanitarian and Pedagogical State University, IPR Media, 2019. — 145 c. — ISBN 978-5-85094-490-2, 978-5-4497-0138-1. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/85823.html>
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2690-3. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/109560.html>

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#### Further reading

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

1. Scientific electronic library eLIBRARY, a project of the Russian Foundation [for Basic Research www.elibrary.ru](http://www.elibrary.ru)
2. FEFU Scientific Library <http://www.dvfu.ru/web/library/nb1>
3. Electronic Library System Znanium.com
4. SSAU Electronic Library – <http://library.sgau.ru>
5. NEB – <http://elibrary.ru>
6. <http://www.twirpx.com/>
7. <http://e.lanbook.com> – Lan Publishing House. Electronic Library System.
8. <http://www.znanium.com> – Electronic Library System.
9. <http://biblio-online.ru> – Educational literature.

**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 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**

### **Lecture**

**The lecture is the-** main active form of classroom classes, the 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 main information, preferably with your own wording, which allows you to better remember the material. 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 Genetics", the following are used as forms of active learning: 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.

### **Labs**

They are used for conducting experiments, observations of phenomena and processes by students mainly in special laboratories, classrooms and with the use of technical means. This method stimulates action both in the preparation for research and in the process of its implementation. Laboratory work improves the quality of education, contributes to the development of cognitive activity in students, their logical thinking and creative independence. In the process of laboratory work, theoretical knowledge is deepened and concretized, and the ability to apply it in practice is developed. Skills in working with microscopes, tables and atlases are acquired. The student learns to analyze the data obtained, identify the norm and deviation from it, acquires the skills of working with a living object and physiological measuring devices, performing operations, conducting a comparative analysis, summarizing the material obtained and drawing conclusions. All this allows for a deeper understanding of the mechanisms of the functioning of a living organism and the principles of its interaction with the environment. Research skills and professional competencies are formed.

Traditionally, laboratory classes are the main type of training aimed at experimental confirmation of theoretical positions. In the course of a laboratory lesson, students perform one or more laboratory works (tasks) under the guidance of a teacher in accordance with the content of the educational material being studied. Students perform laboratory work aimed at:

- generalization, systematization, deepening of theoretical knowledge on specific topics of the academic discipline;
- formation of skills to accept the acquired knowledge in practical activities;
- development of analytical, design and constructive skills;
- development of independence, responsibility and creative initiative.

Necessary structural elements of the laboratory lesson:

- instruction given by the teacher;
- independent activities of students;
- Discussion of the results of the laboratory work (task).

Before completing the laboratory task (work), the students' knowledge is tested, i.e. their theoretical readiness to perform the task.

**A laboratory task (work) can be reproductive, partially exploratory and exploratory in nature.**

Works of a **reproductive** nature are distinguished by the fact that when conducting them, students use detailed instructions, which indicate: the purpose of the work, explanations (theory, main characteristics), equipment, apparatus, materials and their characteristics, the procedure for performing the work, tables, conclusions (without formulations), control questions, educational and special literature.

The works, which are of a **partial-exploratory** nature, are distinguished by the fact that during the conduct of the works, students do not use detailed instructions, they are not given the order of performing the necessary actions, students are required to independently select equipment, choose ways to perform work, instructive and reference literature.

**Exploratory** works are distinguished by the fact that students have to solve a problem that is new to them, relying on their theoretical knowledge.

The forms of organization of students for conducting a laboratory lesson - frontal, group and individual - are determined by the teacher, based on the topic, goal, and order of work. In the frontal form of organizing classes, all students do the same work. In the group form of organizing classes, the same work is carried out in teams of 2-5 people. With an individual form of organizing classes, each student performs an individual task.

The results of the laboratory task (work) are drawn up by students in the form of a report, the grades for the performance of the laboratory task (work) are indicators of the current performance of students in the academic discipline.

Research skills and professional competencies are formed.

### **Colloquia**

Colloquium is a collective form of consideration and consolidation of educational material. Colloquia is 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, questions are analyzed, and then, together with the teacher, they are discussed, which is aimed at consolidating the material, forming polemic skills, developing independence and critical thinking, the ability of students to

navigate in large information flows, to develop and defend their own position on problematic issues of the academic discipline.

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

**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.

## **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>Laboratory auditorium equipped with a multimedia complex Vladivostok, Russky Island, Ajax village, 10, aud. M420, area 74.6 m<sup>2</sup></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>Aquadistiller PE-2205 (5l/h); mixer; Laboratory scales AGN100; Magnetic stirrer PE-6100 (5 pcs.); Heated magnetic stirrer PE-</p>	<p style="text-align: center;">-</p>

Vladivostok, Russky Island, Ajax village, 10, aud. L406, area 30 m <sup>2</sup>	6110 M (2 pcs.); Electric heating tiles; A set of laboratory glassware, a set of porcelain mortars with pestles.	
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