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APPROVE

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**Collection**  
**annotations of work programs of disciplines**

**DIRECTION OF PREPARATION**

**06.04.01 Biology**

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**Name of the educational program "Molecular and Cell Biology (in English)"**

Full-time form of education

Normative period for mastering the program

(full-time education): 2 years

Starting year of preparation: 2023

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## Annotation to the work program of the discipline "Foreign language for special purposes"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 6 s.u. (216 hours). The curriculum provides for practical classes (136 hours), independent work (80 hours, of which 27 hours for exam preparation). The discipline is implemented on the 1st course in 1.2 semesters. Evaluation of learning outcomes: 1st semester - credit, 2nd semester - exam.

Goals and objectives of the discipline:

The purpose of studying the discipline "English for Academic Purposes" is to develop students' knowledge of the English language as applied to the professional field, including lexical and grammatical aspects, speech aspects (reading, writing, listening, speaking), cultural and linguistic and regional studies. This ensures the development of the ability and readiness to communicate in oral and written forms in English to solve the problems of professional activity.

Tasks:

- consistent, systematic development of students of all types of speech activity in English, providing general language literacy, as well as academic independence in mastering the best practices of various countries and cultures;
- maintaining previously acquired skills and abilities of foreign language communication and using them as a basis for the development of communicative competence in the field of professional activity;
- formation of a holistic view of the future profession through the inclusion of teaching methods that recreate the conditions of real professional activity, as well as business and social communication;
- promoting the development of personal qualities of students, leading to responsible and professional self-determination in the choice of forms and means of communication, supporting and strengthening the constructive format of intercultural interaction.

To successfully study the discipline "Foreign language for special purposes", students should have the following preliminary competencies:

- possession of lexical and grammatical categories in a foreign language at the level of graduates bachelor's or specialist's degree in natural sciences;

- willingness to improve their speech culture.

The planned learning outcomes in this discipline (knowledge, skills, possessions), correlated with the planned results of mastering the educational program, characterize the stages of formation of the following competencies:

Universal competencies of graduates and indicators of their achievement:

<b>Name of the category (group) of universal competencies</b>	<b>Code and name of the graduate's universal competence</b>	<b>Code and name of the indicator of achievement of universal competence</b>
Communication	UK-4 Able to apply modern communication technologies, including in a foreign language(s), for academic and professional interaction	UK-4.1 Creates various types of written and oral texts in Russian and a foreign language for academic and professional interaction. UK-4.2 Participates in the processes of professional communication in Russian and a foreign language, including with the use of modern communication technologies. UK-4.3 Presents the results of research and project activities at various public events, participates in academic and professional discussions in a foreign language.

<b>Code and name of the indicator of achievement of competence</b>	<b>Name of the assessment indicator (the result of training in the discipline)</b>
UK-4.1 Creates various types of written and oral texts in Russian and a foreign language for academic and professional interaction	Knows the types of written and oral texts in Russian and a foreign language
	He is able to create various types of written and oral texts in Russian and a foreign language for academic and professional interaction
	Has the skills to develop written and oral texts in Russian and a foreign language for academic and professional interaction
UK-4.2 Participates in the processes of professional communication in Russian and a foreign language, including with the use of modern communication technologies	Knows modern communication technologies
	Can participate in the processes of professional communication in Russian and a foreign language
	Has communication skills in Russian and a foreign language, including the use of modern communication technologies
UK-4.3 Presents the results of research and project activities at various public events, participates	Knows the results of research and project activities
	Is able to present the results of research and project activities at various public events in a foreign language

<b>Code and name of the indicator of achievement of competence</b>	<b>Name of the assessment indicator (the result of training in the discipline)</b>
in academic and professional discussions in a foreign language	Has the skills to present the results of research and project activities at various public events in a foreign language

## Annotation of the work program of the discipline "Synergetics"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 credit units (108 hours). The curriculum includes lectures (18 hours), practical classes (18 hours) and independent work (72 hours). Evaluation of learning outcomes: credit.

The discipline "Synergetics" is a basic biological discipline. The requirements for the "input" knowledge, skills and readiness of the student, necessary for mastering this discipline, include an understanding of all levels of organization and functioning of living systems, from molecular to population, given by a number of previously read disciplines: from biochemistry to ecology inclusive. Basic knowledge of physics, chemistry, mathematics, and computer science is also important for mastering the discipline.

Unlike most other disciplines, Synergetics focuses on synthetic rather than analytical research methodology, describes living systems as complex, emergent, systems whose development dynamics can be understood by considering them as a whole, not reducible to the sum of their components. In addition, this course examines a whole range of open, nonlinear, dynamic self-organizing systems, from physical to social, on the example of which the general principles of self-organization are traced, it is proved that without a synthetic consideration of such systems as a whole, it is impossible to adequately describe and predict their behavior. This approach is consistent with the understanding of synergetics as an interdisciplinary area of research, and allows us to consider the facts

The discipline is ideological, general descriptive in nature, and is not overloaded with mathematical apparatus, which distinguishes it from similar courses taught in physical and mathematical specialties.

The purpose of the discipline: to acquaint the student with the basic concepts of the synergetic worldview, with the general laws of self-organization of both inanimate and living systems, as well as the basics of the methodology for studying chaos and self-organization in dynamic systems.

Discipline tasks:

As a result of mastering the discipline, the student must:

know:

- the subject, tasks and methods of synergetics, its fundamental sections

necessary for a general understanding of the synergetic paradigm;

- the concepts of self-organization and deterministic chaos, including those applied to living systems at all levels of organization;
- methodology for studying self-organizing systems, including the concepts of strange attractors in phase space, catastrophes and the Feigenbaum sequence;
- principles of modeling the dynamics of biosystems;
- basic concepts of fractal geometry;
- the connection of fractal geometry with the processes of self-organization;
- the use of fractal geometry in describing the structure and dynamics of living systems.

be able to:

- apply knowledge of synergetics for a deeper, integrated consideration of general biological and special issues and tasks related to multicomponent developing systems;
- to see behind the particular patterns of individual disciplines the general conceptual phenomena of the development of open, dynamic, evolving systems.

own:

- methodology for studying open systems, describing them in the language of fractal geometry.

Universal competencies of graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of universal competence (result of development)	Code and name of the indicator of achievement of competence
	UK-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy.	UK-1.1 Analyzes the problem situation using a systematic approach and modern natural science knowledge, using reliable data and reliable sources of information. UK-1.2 Develops and substantively argues possible strategies for solving a problem situation based on a systematic and interdisciplinary approach, taking into account the parameters of the level of public health. UK-1.3 Develops a scenario for implementing the optimal strategy for solving a problem situation, taking into account the necessary resources, achievable results, possible risks and consequences.

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	OPK-1 Able to use and apply fundamental biological concepts and modern methodological approaches for setting and solving new non-standard tasks in the field of professional activity.	GPC-1.1 Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences. GPC-1.2 Analyzes trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training. GPC-1.3 Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.

Code and name of the indicator of achievement of competence	Stages of competence formation
GPC-1.1 Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences.	Knows modern topical problems, discoveries, developments in the field of biology and related sciences Able to find information, analyze, monitor current topical problems, major discoveries and methodological developments in the field of biological and related sciences Be proficient in information retrieval
GPC-1.2 Analyzes trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training.	Knows current trends in the development of scientific research and practical developments in his field of knowledge Can formulate innovative proposals for solving non-standard tasks Possess the skill of using in-depth general scientific and methodological information, set goals, objectives, interpret the data obtained.
GPC-1.3 Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.	Knows current issues in their professional activities Able to apply modern methodological approaches and methods for setting and solving new non-standard tasks Have the ability to decide new non-standard tasks in the field of professional activity

For the formation of the above competencies within the framework of the discipline "Synergetics" the following methods of active / interactive learning are used: lectures (collective discussion, lecture-conversation) and practical exercises (seminar-discussion).



## Annotation of the working program of the academic discipline "Molecular Biology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 credit units (108 hours). The curriculum includes lectures (18 hours), practical classes (36 hours), independent work (54 hours). Evaluation of learning outcomes: credit.

"Molecular Biology" is a fundamental discipline of the direction of preparation of Biology. It reveals the molecular structures and mechanisms of cell vital activity.

The purpose of mastering the discipline "Molecular Biology" is to deepen the theoretical training of students in the field of molecular biology - a section of cell biology that studies the basic properties and manifestations of life at the molecular level.

The tasks of mastering the discipline:

- development in students of a holistic view of the molecular level of cell organization;
- obtaining modern knowledge about the structure, dynamics and functioning of molecular ensembles of the cell, molecular mechanisms of development and functioning of cells.

As a result of studying this discipline, students develop the following competencies:

General professional competencies of graduates and indicators of their achievement

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	OPK-1 Able to use and apply fundamental biological concepts and modern methodological approaches for setting and solving new non-standard tasks in the field of professional activity	GPC -1.1 Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences.
		GPC -1.2 Analyzes trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training.
		GPC -1.3 Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.
	GPC -8 Able to use modern research equipment and computer technology to solve innovative problems in professional activities.	GPC -8.1 Works with technical documentation, if necessary, prepares proposals for the modification of technical means to solve innovative problems in professional activities.
		GPC -8.2 Uses types of modern equipment for field and laboratory research in the field of professional activity.
		GPC -8.3 Uses modern research equipment and computer technology to solve innovative problems in professional activities.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC -1.1 Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences.	Knows the main methodological developments in the field of biology
	Able to monitor modern topical biological problems
	Owns methods of working with scientific information
GPC -1.2 Analyzes trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training.	Knows trends in the development of scientific research and practical developments in the chosen field of professional activity
	Can formulate innovative proposals for solving non-standard tasks
	owns methods for solving scientific problems

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC -1.3 Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.	Knows modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity
	Can apply modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.
	owns modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.
GPC -8.1 Works with technical documentation, if necessary, prepares proposals for the modification of technical means to solve innovative problems in professional activities.	Knows with technical documentation
	Ability to prepare proposals for modification of technical means for solving innovative problems in professional activities
	owns technical means for solving innovative problems in professional activities
GPC -8.2 Uses types of modern equipment for field and laboratory research in the field of professional activity.	Knows types of modern equipment for field and laboratory research in the field of professional activity
	Ability to use equipment for field and laboratory research in the field of professional activity
	Proficient in laboratory research methods
GPC -8.3 Uses modern research equipment and computer technology to solve innovative problems in professional activities.	Knows modern research equipment and computer technology for solving innovative problems in professional activities
	Knows how to apply modern research equipment and computer technology for solving innovative problems in professional activities
	Proficient in working with research equipment and computer technology

## Annotation to the work program of the discipline "Philosophy of Natural Science"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). The curriculum includes lectures (10 hours), practical classes (18 hours), independent work (44 hours). The discipline is implemented on the 1st course in the 1st semester. Evaluation of learning outcomes: credit.

Goals and objectives of mastering the discipline:

Course Objectives:

- To reveal the philosophical foundations of modern scientific knowledge.
- Consider the basic principles and forms of implementation of scientific and technical activities at the present stage of development of scientific and technical culture.
- Reveal the scientific and technical features of architectural activity.

The objectives of the discipline are determined by the purpose of its study and can be defined as follows:

- To acquaint students with the current state of philosophical and methodological research of science;
- To give an idea of the nature of human scientific and technical activity;
- Consider the history of European science and technology;
- Determine the general principles of scientific knowledge;
- Present the main forms of scientific activity;
- To reveal the principles of artistic design.

Universal competencies of graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of universal competence (result of development)	Code and name of the indicator of achievement of competence
intercultural interaction	UK-5 Able to analyze and take into account the diversity of cultures in the process of intercultural interaction.	UK-5.1 Analyzes the socio-cultural parameters of various groups and communities and the socio-cultural context of interaction. UK-5.2 Builds socio-cultural communication and interaction, taking into account the necessary parameters of

		intercultural communication and socio-cultural context. UK-5.3 Builds professional interaction in a multicultural environment.
Self-organization and self-development (including health saving)	UK-6 Able to determine and implement the priorities of their own activities and ways to improve it based on self-assessment.	UK-6.1 Solves the problems of their own personal and professional development, determines and implements priorities for improving their own activities. UK-6.2 Uses technologies and skills to manage their cognitive activity and improve it based on self-assessment, self-control and the principles of self-education throughout life, including using health-saving approaches and techniques.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
UK-5.1 Analyzes the socio-cultural parameters of various groups and communities and the socio-cultural context of interaction.	Knows the philosophical foundations of intercultural interaction. Able to use the techniques of reflective thinking in the description of the intercultural diversity of society. Has the skills to perceive the intercultural diversity of society in the context of modern concepts of sustainable development.
UK-5.2 Builds socio-cultural communication and interaction, taking into account the necessary parameters of intercultural communication and socio-cultural context.	Knows the theoretical foundations of models of intercultural communication, taking into account the principles of sustainable development. Knows how to apply the principles of the concepts of sustainable development to the description of the problems of intercultural interaction. Possesses the skills of intercultural communication from the standpoint of solving the problems of modern concepts of sustainable development.
UK-5.3 Builds professional interaction in a multicultural environment	Knows the problems of intercultural interaction. Knows how to use techniques for building effective intercultural interaction. Has the skills to analyze the problems of intercultural interaction in the context of sustainable development prospects.
UK-6.1 Solves the problems of their own personal and professional development, determines and implements priorities for improving their own activities.	Knows the philosophical foundations of modern strategies for personal self-development in the context of the ideas of sustainable development. Able to identify the basic principles of strategies for self-development of the individual. Possesses the skills to perceive strategies for self-development of the individual, taking into account modern concepts of sustainable development.

<p>UK-6.2 Uses technologies and skills to manage their cognitive activity and improve it based on self-assessment, self-control and the principles of self-education throughout life, including using health-saving approaches and techniques.</p>	<p>Knows the historical prerequisites for the formation of the concepts of sustainable development and their philosophical issues.  Able to use the acquired knowledge when choosing possible strategies for self-organization and self-development.  Possesses the skills of critical reflection on the chosen strategy for self-development of the individual and self-assessment of his own progress in its implementation.</p>
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General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	<p>OPK-3 Able to use the philosophical concepts of natural science and understanding of modern biospheric processes for a systematic assessment and forecast of the development of the sphere of professional activity.</p>	<p>GPC-3.1 Uses the basic philosophical concepts of classical and modern natural sciences, the fundamentals of the doctrine of the biosphere, the main methods and results of environmental monitoring, models and forecasts for the development of biospheric processes.  GPC-3.2 Applies systems analysis methods to assess the environmental consequences of anthropogenic activities.  GPC-3.3 Predicts, based on regulatory and scientific methodology, the environmental consequences of the development of the chosen professional field, has experience in choosing ways to optimize technological solutions from the standpoint of environmental safety.  GPC-3.4 Predicts the development of the sphere of professional activity for system assessment based on the understanding of modern biospheric processes and the use of philosophical concepts of natural science.</p>

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
<p>GPC-3.1 Uses the basic philosophical concepts of classical and modern natural sciences, the fundamentals of the doctrine of the biosphere, the main methods and results of environmental monitoring, models and forecasts for the development of biospheric processes.</p>	<p>Knows the basic philosophical concepts of classical and modern natural sciences, the basics of the doctrine of the biosphere, the main methods and results of environmental monitoring, models and forecasts for the development of biospheric processes  Able to use in practice the philosophical concepts of natural science</p>

	owns the skills of searching and comparing options for a methodological solution to a given problem, taking into account possible criticism and limitations.
GPC-3.2 Applies systems analysis methods to assess the environmental consequences of anthropogenic activities.	Knows the methods of modern analysis Able to assess the environmental consequences of anthropogenic activities. Owns the methods of system analysis
GPC-3.3 Predicts, based on regulatory and scientific methodology, the environmental consequences of the development of the chosen professional field, has experience in choosing ways to optimize technological solutions from the standpoint of environmental safety.	Knows the methodology of scientific research Able to predict the environmental consequences of development, has experience in choosing ways to optimize technological solutions from the standpoint of environmental safety Possesses the skill of forecasting on the basis of normative and scientific methodology of environmental consequences in his professional field
GPC-3.4 Predicts the development of the sphere of professional activity for system assessment based on the understanding of modern biospheric processes and the use of philosophical concepts of natural science.	Knows modern concepts of natural science Able to predict the development of the sphere of professional activity for a systematic assessment based on an understanding of modern biospheric processes and the use of philosophical concepts of natural science owns the skills of synthesizing various information within the framework of the organization of research work

## Annotation to the work program of the discipline "Ecological and biological safety"

### 1. Goals and objectives of mastering the discipline:

The purpose of mastering the discipline "Ecological and biological safety" is to form students' scientific ideas about the nature of the biological transmission of pathogens of infectious diseases by blood-sucking arthropods in the interests of ensuring biological safety.

#### Tasks:

1. To form students' scientific ideas about the types and mechanisms of transmission and functioning of biological threats.
2. To form students' ideas about infections, invasions, epidemics and pandemics.
3. To form in students the skills of anti-epidemic measures in the interests of ensuring biological safety.

The learning outcomes for the discipline (module) should be correlated with the indicators of achievement of competencies established in the OBEP.

The work program of the discipline "Ecological and Biological Safety" was compiled for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order Ministry of Education and Science of Russia dated August 11, 2020 No. 934.

The discipline "Ecological and biological safety" was compiled for students in the educational program of the master's program 06.04.01 Biology, included in the basic part of the compulsory disciplines of the educational program of the magistracy "Molecular and Cell Biology (in English)".

The total labor intensity of mastering the discipline is 2 credit units (72 hours). The curriculum includes lectures (18 hours), practical classes (18 hours), independent work (36 hours). The discipline is implemented on the 1st course in the 2nd semester. Evaluation of learning outcomes: credit.

For the successful mastering of this academic discipline, a confident knowledge of general biological concepts from the field of the history of science, general biology, zoology, parasitology, ecology, microbiology, which must be formed by undergraduates in the previous period of study in the bachelor's degree, is required. Students will need knowledge of the basic concepts that must be formed within the previously studied disciplines: "Biology", "Ecology", "Microbiology".

A feature of this academic discipline is the deep immersion of students in the study of environmental and biological safety.



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

As a result of studying this discipline, students form the following competencies (elements of competencies):

Universal competencies of graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of the graduate's universal competence	Code and name of the indicator of achievement of universal competence
Systems and critical thinking	UK-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	UK-1.1 Analyzes a problem situation using a systematic approach and modern natural science knowledge, using reliable data and reliable sources of information UK-1.2 Develops and meaningfully argues possible strategies for solving a problem situation based on a systematic and interdisciplinary approach, taking into account the parameters of the level of public health UK-1.3 Develops a scenario for implementing the optimal strategy for solving a problem situation, taking into account the necessary resources, achievable results, possible risks and consequences.

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of the graduate's universal competence	Code and name of the indicator of achievement of universal competence
	GPC-4 Able to participate in the environmental impact assessment of territories and water areas, as well as technological production using biological methods for assessing environmental and biological safety	GPC-4.1 Uses the theoretical foundations, methods and regulatory documentation in the field of environmental expertise, features of the survey and assessment of the ecological state of territories and water areas, methods for testing the effectiveness and biosafety of products of technological production GPC-4.2 Uses professional knowledge and skills to develop and propose innovative tools and methods for environmental assessment

		<p>GPC-4.3 Participates in the environmental review of technological production using biological methods for assessing environmental and biological safety</p> <p>Applies the experience of planning an environmental review based on the analysis of available evidence</p> <p>GPC-4.4 Applies the experience of planning an environmental review based on the analysis of available evidence</p>
	<p>GPC-5 Able to participate in the creation and implementation of new technologies in the field of professional activity and control of their environmental safety using living objects</p>	<p>GPC-5.1 Applies the theoretical foundations and practical experience of using various biological objects in the field of professional activity, bio- and environmental safety</p> <p>GPC-5.2 Applies biosafety performance criteria</p> <p>GPC-5.3 Participates in the creation and implementation of new technologies in the field of professional activity and the control of their environmental safety using living objects</p> <p>GPC-5.4 Applies the experience of working with living objects promising for biotechnological processes, in accordance with the core activity</p>

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
UK-1.1 Analyzes a problem situation using a systematic approach and modern natural science knowledge, using reliable data and reliable sources of information	<p><b>Knows</b>main ways of searching for scientific information</p> <p><b>Can</b>analyze the problem situation using a systematic approach and modern natural science knowledge</p> <p><b>owns</b>methods of a systematic approach in solving professional problems</p>
UK-1.2 Develops and meaningfully argues possible strategies for solving a problem situation based on a systematic and interdisciplinary approach, taking into account the parameters of the level of public health	<p><b>Knows</b>the main criteria for the level of public health</p> <p><b>Can</b>assess possible risks and threats to public safety</p> <p><b>owns</b>various methods for solving a problem situation based on a systematic and interdisciplinary approach, taking into account the parameters of the level of public health</p>
UK-1.3 Develops a scenario for implementing the optimal strategy for solving a problem situation, taking into account the necessary	<p><b>Knows</b>basic strategies for solving problem situations</p> <p><b>Can</b>evaluate possible risks and consequences</p> <p><b>owns</b>various methods for solving a problem situation, taking into account the necessary resources, achievable results, possible risks and consequences</p>

resources, achievable results, possible risks and consequences	
GPC-4.1 Uses theoretical foundations, methods and normative documentation in the field environmental expertise, features of the survey and assessment of the ecological state of territories and water areas, methods for testing the effectiveness and biosafety of products of technological production	<p><b>Knows</b>regulatory documents, s of the field of environmental expertise</p> <p><b>Can</b>develop evidence-based recommendations for protecting the public from biological threats</p> <p><b>owns</b>environmental expertise skills</p>
GPC-4.2 Uses professional knowledge and skills to develop and propose innovative tools and methods for environmental assessment	<p><b>Knows</b>the simplest standard laboratory methods for detecting a biological threat</p> <p><b>Can</b>use professional knowledge and skills to develop and offer innovative tools and methods for environmental assessment</p> <p><b>owns</b>modern methods of ecological expertise</p>
GPC-4.3 Participates in the environmental review of technological production using biological methods for assessing environmental and biological safety Applies the experience of planning an environmental review based on the analysis of available evidence	<p><b>Knows</b>legal documentation in the field of environmental safety of technological production</p> <p><b>Can</b>analyze available evidence</p> <p><b>owns</b>skills in planning and conducting environmental impact assessments</p>
GPC-4.4 Applies the experience of planning an environmental review based on the analysis of available evidence	<p><b>Knows</b>main types of biological threat, their metabolism, mechanism of action, interaction with microbiota, mechanism of action on the macroorganism.</p> <p><b>Can</b>identify the main natural and anthropogenic contaminants of biological origin that are of epidemic importance</p> <p><b>owns</b>methods for studying metabolism, the mechanism of action of biological agents of epidemic importance</p>
GPC-5.1 Applies the theoretical foundations and practical experience of using various biological objects in the field of professional activity, bio- and environmental safety	<p><b>Knows</b>main Russian and international legislative acts in the field of biosafety</p> <p><b>Can</b>apply the norms of Russian and international law in the field of biosafety</p> <p><b>owns</b>environmental expertise skills</p>
GPC-5.2 Applies biosafety performance criteria	<p><b>Knows</b>main guidelines for the protection of the environment from the impact of contaminants of biological origin</p> <p><b>Can</b>develop programs to prevent biological threats</p> <p><b>owns</b>methods of implementation and control of programs on biological safety and sanitary protection</p>
GPC-5.3 Participates in the creation and implementation of new technologies in the field of professional activity and control of	<p><b>Knows</b>structure and biochemical mechanisms of functioning of living systems</p> <p><b>Can</b>work with laboratory animals</p> <p><b>owns</b>methods of implementation and control of environmental safety programs using living objects.</p>

<p>their environmental safety using living objects</p>	
<p>GPC-5.4 Applies the experience of working with living objects promising for biotechnological processes, in accordance with the core activity</p>	<p><b>Knows</b> the main promising living objects for biotechnological processes  <b>Can</b> use living objects in biotechnological processes  <b>owns</b> methods of work in accordance with the profile type of activity</p>

## Annotation of the work program of the discipline "Bioinformatics"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 credits. (72 hours). The curriculum provides for practical classes (36 hours) and independent work (72 hours). Evaluation of learning outcomes: credit.

The course "Bioinformatics" has a general biological significance. To fully master the course material, basic knowledge of general biology, cell biology, chemistry, genetics and molecular biology is required. This course covers the basic fundamental principles of modern molecular biology, the theory of indexing and information retrieval, the principles of storing and retrieving scientific information in computer networks, the alignment of the primary sequences of biological molecules, the basics of proteomics and the modeling of the three-dimensional structure of biomolecules.

The purpose of studying the discipline: to teach the student to apply methods based on modern information technologies to solve biological scientific problems.

Tasks:

- to acquaint the student with the current state of bioinformatics as a science and identify its current tasks, main successes and prospects for today;
- explain the basic principles of storage and retrieval of scientific information;
- to teach the student to use information resources to solve problems of molecular biology and evolutionary genetics.

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	OPK-6 Able to creatively apply and modify modern computer technologies, work with professional databases, professionally draw	GPC-6.1 Develops ways and prospects for the use of modern computer technologies in the biological sciences and education. GPC-6.2 Uses professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images,

	up and present the results of new developments.	has experience in modifying computer technologies for professional research. GPC-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.
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Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC-6.1 Develops ways and prospects for the use of modern computer technologies in the biological sciences and education.	Knows the methods of modern computer technologies in biological sciences and education Able to put into practice the knowledge of modern computer technologies in biological sciences and education Has the skills to work on modern computer equipment using methods
GPC-6.2 Uses professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images, has experience in modifying computer technologies for professional research.	Knows professional databases and data banks in his professional activities, Knows how to use professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images He has the skill of applying the mathematical apparatus in his professional field, the skill of working with databases, modifying computer technologies for the purpose of professional research.
GPC-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.	Knows the tools of modern computer technology Able to apply modern computer technologies, work with professional databases, draw up and present the results of new developments. Be proficient in working with modern computer equipment

## Annotation of the work program of the discipline "Biostatistics"

### Goals and objectives of mastering the discipline:

The purpose of mastering the discipline "Biostatistics" is to familiarize students with the methods and means of applied statistical analysis in biological research.

### Tasks:

study the principles of organization, theoretical foundations and computational aspects of the main sections of one-dimensional and applied multivariate data analysis;

teach the basic principles of interpreting the results.

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 credit units (108 hours). The curriculum includes lectures (18 hours), practical classes (36 hours) and independent work (54 hours). Evaluation of learning outcomes: credit.

Successful assimilation of the course requires prior knowledge of the basics of mathematical and statistical analysis, as well as an understanding of the physiology of organisms obtained at the previous level of education.

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

- the ability to take the initiative and make responsible decisions, being aware of the responsibility for the results of their professional activities;
- the ability to creatively perceive and use the achievements of science and technology in the professional field in accordance with the needs of the regional and world labor market; the ability to use modern methods and technologies (including information) in professional activities;
- the ability to work in a team, tolerantly perceiving social, ethnic, confessional and cultural differences;
- ability to self-organization and self-education;
- the ability to solve standard tasks of professional activity on the basis of information and bibliographic culture using information and communication technologies and taking into account the basic requirements of information security;
- the ability to understand the basic ideas about the diversity of biological objects, the importance of biodiversity for the sustainability of the biosphere, the

ability to use the methods of observation, description, identification, classification, cultivation of biological objects;

- the ability to apply modern experimental methods of working with biological objects in field and laboratory conditions, skills in working with modern equipment;

- the ability to substantiate the role of the evolutionary idea in the biological worldview; possession of modern ideas about the foundations of evolutionary theory, about micro- and macroevolution;

- the ability to apply basic ideas about the basics of general, systemic and applied ecology, the principles of optimal nature management and nature conservation, monitoring, assessing the state of the natural environment and wildlife protection;

- the ability to apply modern ideas about the basics of biotechnological and biomedical industries, genetic engineering, nanobiotechnology, molecular modeling;

- the ability to use knowledge of the basics and principles of bioethics in professional and social activities;

- willingness to use the legal norms of research work and copyright, as well as the legislation of the Russian Federation in the field of nature protection and nature management;

- ability and readiness to lead a discussion on socially significant problems of biology and ecology;

- the ability to operate modern apparatus and equipment to perform research field and laboratory biological work;

- the ability to put into practice the methods of compiling scientific and technical reports, reviews, analytical maps and explanatory notes, to present and critically analyze the information received and present the results of field and laboratory biological research;

- the ability to apply modern methods of processing, analysis and synthesis of field, production and laboratory biological information, the rules for compiling scientific and technical projects and reports.

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	OPK-6 Able to creatively apply and modify modern computer technologies, work with	GPC-6.1 Develops ways and prospects for the use of modern computer technologies in the biological sciences and education.



	professional databases, professionally design and present the results of new developments.	GPC-6.2 Uses professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images, has experience in modifying computer technologies for professional research. GPC-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.
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Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC-6.1 Develops ways and prospects for the use of modern computer technologies in the biological sciences and education.	Knows modern information technologies and software used in professional activities Able to apply modern information technologies and software in solving professional problems. Possesses the skills of collecting, processing, evaluating the reliability of the results and providing the information received through modern information technologies and software
GPC-6.2 Uses professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images, has experience in modifying computer technologies for professional research.	Knows professional databases and data banks in his professional activities, Knows how to use professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images He has the skill of applying the mathematical apparatus in his professional field, the skill of working with databases, modifying computer technologies for the purpose of professional research.
GPC-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.	Knows modern methods of processing and analyzing scientific and technical information Able to process, evaluate the results obtained, analyze the data, draw conclusions and present the results of the data obtained Possesses the skills of processing and analyzing information in the chosen field of professional activity

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

## Annotation to the work program of the discipline "Project Management and Research Methodology»

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). The curriculum includes lectures (10 hours), practical classes (18 hours), independent work (44 hours). The discipline is implemented on the 1st course in the 2nd semester. Evaluation of learning outcomes: credit.

### Goals and objectives of mastering the discipline

Course objective: The main goal of studying the discipline "Project Management and Methodology of Scientific Research" is to form a theoretical, practical and information base for undergraduates, necessary and sufficient for effective project management in the field of biosafety.

Course objectives: - mastering the basics of project management;

- study of approaches and methods of planning, organization and completion of project management processes;

- mastering the methodology of project management;

- mastery of project management tools;

- familiarization with information technologies in project management.

The totality of learning outcomes in the discipline "Project management and research methodology" provides formation of all the following competencies in the graduate:

Name of the category (group) of universal competencies	Code and name of universal competence (result of development)	Code and name of the indicator of achievement of competence
Project management	UK-2. Able to manage a project at all stages of its life cycle	UK-2.1. Develops the concept of the project within a specific problem field in the field of molecular and cellular biology, taking into account the possible results and consequences of the project, theoretically substantiates the concept. Formulates the goal, objectives, relevance, significance (scientific, practical, methodological and other, depending on the type of project)
		UK-2.2. Develops a project implementation plan taking into account

		possible resources, risks, scenarios, and other variable parameters, proposes procedures and mechanisms for monitoring the implementation and results of the project.
		UK-2.3. Carries out coordination and control in the process of project implementation, corrects deviations, makes additional changes to the implementation plan, if necessary, determines the areas of responsibility of team members.
	UK-3. Able to organize and manage the work of the team, developing a team strategy to achieve the goal	UK-3.1. Develops a team work strategy to achieve the set goal, organizes the selection of team members.
		UK-3.2. Organizes and corrects the work of the team, including on the basis of collegial decisions, distributes functional responsibilities, resolves possible conflicts and contradictions.
		UK-3.3. Coordinates the overall work, organizes feedback, controls the result, takes managerial responsibility.
Communication competencies	UK-4. Able to apply modern communication technologies, including in a foreign language(s), for academic and professional	UK-4.3. Presents the results of research and project activities at various public events, participates in academic and professional

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
UK-2.1. Develops the concept of the project within a specific problem field in the field of molecular and cellular biology, taking into account the possible results and consequences of the project, theoretically substantiates the concept. Formulates the goal, objectives, relevance, significance (scientific, practical, methodological and other, depending on the type of project)	Know: concept and main characteristics scientific projects. Be able to: analyze information in the fields of molecular and cellular biology; highlight problematic and topical issues; create a project concept. Possess: the skills of setting goals, objectives and determining the relevance of the project.
UK-2.2. Develops a project implementation plan taking into account possible resources, risks, scenarios, and other variable parameters, proposes procedures and mechanisms for monitoring the implementation and results of the project.	Know: concept and main characteristics project, the basics of resource planning Be able to: differentiate processes within project management in areas of expertise, determine the sequence and subordination of work based on various types of presentation of information about the project. Own: the concept of knowledge areas

	<p>project management, the concept of methodologies</p> <p>impact on bottom line indicators</p> <p>project efficiency</p>
UK-2.3. Carries out coordination and control in the process of project implementation, corrects deviations, makes additional changes to the implementation plan, if necessary, determines the areas of responsibility of team members.	<p>Know: the basics of project activities</p> <p>Be able to: draw up a work plan depending on the characteristics of the project life cycle and unforeseen circumstances affecting the project.</p> <p>Possess: the skills of planning scientific projects and experimental work.</p>
UK-3.1. Develops a team work strategy to achieve the set goal, organizes the selection of team members.	<p>Be able to: develop a team work strategy based on the goals and objectives of the project.</p>
UK-3.2. Organizes and corrects the work of the team, including on the basis of collegial decisions, distributes functional responsibilities, resolves possible conflicts and contradictions.	<p>Know: the basics of teamwork; stages of creating teams; definition of the role of participants and key executors of the project.</p> <p>Be able to: distribute tasks among project participants, taking into account qualifications and experience</p> <p>Possess: the skills of selecting participants and organizing a viable team.</p>
UK-3.3. Coordinates the overall work, organizes feedback, controls the result, takes managerial responsibility.	<p>Be able to: distribute areas of responsibility for the execution of tasks.</p> <p>Possess: teamwork management skills</p>
UK-4.3. Presents the results of research and project activities at various public events, participates in academic and professional	<p>Know: standard requirements for grant competitions, scientific projects and reporting to them.</p> <p>Be able to: draw up reports in accordance with GOSTs for scientific, present scientific results.</p> <p>Possess: skills of working with scientific and technical documentation; presentation skills.</p>

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (result of development)	Code and name of the indicator of achievement of competence
	OPK-1. Able to use and apply fundamental biological concepts and modern methodological approaches for setting and solving new non-standard tasks in the field of professional activity;	GPC -1.1. Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences.
		GPC -1.2. Analyzes the trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training.

		GPC -1.3. Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.
	OPK -2. Able to creatively use in professional activities the knowledge of fundamental and applied sections of disciplines (modules) that determine	GPC -2.1. Considers the theoretical foundations, traditional and modern methods of research in accordance with the profile type of activity.
		GPC -2.2. Forms new solutions by integrating various methodological approaches and creative use of special theoretical and practical knowledge.
		GPC -2.3. Uses in professional activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the direction of the profile
	OPK-7. Able in the field of his professional activity to independently determine the strategy and issues of research, make decisions, including innovative ones, choose and modify methods, be responsible for the quality of work and implementation of their results, ensure industrial safety measures when solving a specific problem;	GPC-7.1. Uses the main sources and methods of obtaining professional information, directions of scientific research corresponding to the direction
		GPC-7.2. Identifies promising problems and formulates principles for solving actual research problems based on the use of an integrated
		GPC-7.3. Develops methods for solving and coordinating the execution of individual tasks under the leadership of a group of researchers, taking into account safety requirements.
		GPC-7.4. Determines the strategy and issues of research, makes decisions, including innovative ones, chooses methods, is responsible for the quality of work and
		GPC-7.5. Uses methods for analyzing the reliability and assessing the prospects of the results of experiments and observations; -experience in generalization and analysis
		GPC-7.6. Applies the experience of presenting the results obtained in the form of reports and publications.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC -1.1. Monitors current topical issues, major discoveries and methodological developments in the field of biological and related sciences.	Know: theoretical foundations of biology and related sciences; modern trends in biology. Be able to: monitor scientific work and developments in their field of knowledge. Own: methods of analysis of scientific and technical literature; methods for assessing the quality of scientific work.

<p>GPC -1.2. Analyzes the trends in the development of scientific research and practical developments in the chosen field of professional activity, formulates innovative proposals for solving non-standard problems, using in-depth general scientific and methodological special training.</p>	<p>Know: theoretical foundations of critical and strategic technologies of the country and the world; directions of funded areas of science and practice. Possess: skills of work in systems of grant support of scientific and technical developments.</p>
<p>GPC -1.3. Applies modern methodological approaches and methods for setting and solving new non-standard tasks in the field of professional activity.</p>	<p>Be able to: put alternative solutions to known problems; apply existing methods to solve new problems.</p>
<p>GPC -2.1. Considers the theoretical foundations, traditional and modern methods of research in accordance with the profile type of activity.</p>	<p>Know: theoretical foundations of biology and related sciences; modern trends in biology. Be able to: monitor scientific work and developments in their field of knowledge. Own: methods of analysis of scientific and technical literature; methods for assessing the quality of scientific work.</p>
<p>GPC -2.2. Forms new solutions by integrating various methodological approaches and creative use of special theoretical and practical knowledge.</p>	<p>Be able to: put alternative solutions to known problems; apply existing methods to solve new problems.</p>
<p>GPC -2.3. Uses in professional activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the direction of the profile</p>	<p>Know: fundamental and applied sections of biology and biotechnology Be able to: use theoretical knowledge in biology and related sciences in drawing up the content of the project.</p>
<p>GPC-7.1. Uses the main sources and methods of obtaining professional information, directions of scientific research corresponding to the direction</p>	<p>Know: search engines for scientific papers and projects Be able to: monitor scientific work and developments in their field of knowledge.</p>
<p>GPC-7.2. Identifies promising problems and formulates principles for solving actual research problems based on the use of an integrated</p>	<p>Be able to: identify promising topics in the specialty based on the analysis of literary data</p>
<p>GPC-7.3. Develops methods for solving and coordinating the execution of individual tasks under the leadership of a group of researchers, taking into account safety requirements.</p>	<p>Know: Safety Be able to: compose tasks with the definition of specific methods Own: methods of compiling tasks taking into account security requirements</p>
<p>GPC-7.4. Determines the strategy and issues of research, makes</p>	<p>Know: definition and direction of innovative projects in the specialty</p>

decisions, including innovative ones, chooses methods, is responsible for the quality of work	
GPC-7.5. Uses methods for analyzing the reliability and assessing the prospects of the results of experiments and observations; -experience in generalization and analysis	Own: methods of statistical analysis
GPC-7.6. Applies the experience of presenting the results obtained in the form of reports and publications.	Possess: the skills of presenting scientific results

## Abstract of the work program of the discipline "Molecular biology of the cell"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 4 z.u. (144 hours). The curriculum includes lectures (18 hours), practical classes (18 hours), independent work (108 hours, of which 36 hours are for preparing for the exam). The discipline is realized on the 1st course in the 1st family. Assessment of learning outcomes: exam.

Goals and objectives of mastering the discipline:

Purpose: specialization of theoretical training and deepening of students' knowledge in the field of cellular molecular biology of the cell - a branch of biology, the subject of which is the cell, the elementary unit of the living. 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.

Tasks:

1) development in students of a holistic view of the molecular level of cell organization;

2) obtaining modern knowledge about the structure, dynamics and functioning of molecular ensembles of the cell, molecular mechanisms of development and functioning of cells.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.



	PC-3 Able to conduct studies of biopolymers, their components and complexes, structure and function of genes and genomes.	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.
	PC-4 Able to conduct scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and develop the resources of the World Ocean.	PC-4.1 Conducts substantiation of scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean.
		PC-4.2 Carries out applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.
		PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.
	PC-5 It is capable of conducting a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	PC-5.1 Studies the relationship of cells, tissues and functional systems of organisms.
		PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.
		PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	Knows – methodological foundations for designing, performing field and laboratory biological, environmental studies Can – develop rules and algorithms for designing, performing laboratory biological, environmental studies owns – skills in developing and improving new rules and design algorithms, performing laboratory biological, environmental studies
PC-2.2 Performs laboratory biological, environmental research	Knows

<p>using the scientific methodological foundations of fundamental research.</p>	<ul style="list-style-type: none"> <li>– modern classification of scientific research methods, specifics and limits of their applicability;</li> <li>– the specifics of research specific to various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research;</li> <li>– main methods of statistical analysis: correlation, regression and variance</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>– use the methods of statistical analysis to assess the reliability of data, compare empirical and theoretical sets, find the relationship between variables that characterize the state of the system</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>- the ability to independently analyze the available information, identify fundamental problems, set a task</li> </ul>
<p>PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.</p>	<p>Knows</p> <ul style="list-style-type: none"> <li>– the main modern field and laboratory methods for studying biology and ecology</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>– work on modern analytical equipment of a modern biological laboratory</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– modern research methods in ecology and biology</li> </ul>
<p>PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.</p>	<p>Knows</p> <ul style="list-style-type: none"> <li>– structure and functions of biopolymers, their components and complexes, mechanisms of storage, transfer and implementation of genetic information at the molecular level</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>– to determine the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– a method for determining the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transferring and implementing genetic information at the molecular level</li> </ul>
<p>PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication,transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.</p>	<p>Knows</p> <ul style="list-style-type: none"> <li>– processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- describe in detail and characterize the main processes occurring in a living cell</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– methods for identifying the main processes occurring in the cell</li> </ul>
<p>PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>	<p>Knows</p> <ul style="list-style-type: none"> <li>– basic terms and concepts of molecular biology; objects of study, research methods, modern concepts, achievements and limitations of natural sciences</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>– to use molecular biological knowledge for a deeper understanding of modern problems of biology; link advances in molecular biology with advances in modern genetics, immunology, genomics, proteomics, and medicine</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– skills in the operation of modern equipment and equipment for research and laboratory work; on the practical application of the issues considered in the course in protein and cell engineering, using it in biomedical research and in biotechnological industries</li> </ul>

<p>PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.</p>	<p>Knows  – structure and functions of genes and genomes  Can  – analyze the structure and functions of genes and genomes  owns  – skills of structural and functional analysis of individual proteins and the proteome as a whole</p>
<p>PC-4.1 Conducts substantiation of scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean.</p>	<p>Knows  – the current situation in the development of the scientific potential of the Russian Far East and the development of the resources of the World Ocean  Can  – to characterize the achievements of modern science in the field of molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean  owns  – the ability to substantiate scientific research in molecular and cellular biology</p>
<p>PC-4.2 Carries out applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.</p>	<p>Knows  – fundamental scientific research and development in the field of molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean  Can  – perform applied and exploratory research and development in molecular and cellular biology  owns  – skills in the use of applied and exploratory scientific research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean</p>
<p>PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.</p>	<p>Knows  – scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean  Can  – to interpret the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean  owns  – skills in analyzing the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean</p>
<p>PC-5.1 It studies the relationship of cells, tissues and functional systems of organisms.</p>	<p>Knows  – molecular, immunological and physiological aspects of the study of cells of multicellular, small-celled and unicellular organisms  Can  – to study the adaptation of tissue elements to the action of various biological, physical, chemical and other factors  owns  – skills of systemic analysis of the relationship between cells, tissues and functional systems of organisms – representatives of all kingdoms</p>
<p>PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.</p>	<p>Knows  – molecular, immunological and physiological aspects of the study of cells of multicellular, small-celled and unicellular organisms</p>

	<p>Can</p> <ul style="list-style-type: none"> <li>– to study the adaptation of tissue elements to the action of various biological, physical, chemical and other factors</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– skills of systemic analysis of the relationship between cells, tissues and functional systems of organisms – representatives of all kingdoms</li> </ul>
<p>PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.</p>	<p>Knows</p> <ul style="list-style-type: none"> <li>– a method for conducting a systematic analysis of the relationship between cells, tissues and functional systems of organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>– conduct a systematic analysis of the relationship of cells, tissues and functional systems of organisms</li> </ul> <p>owns</p> <ul style="list-style-type: none"> <li>– a method for conducting a systematic analysis of the relationship between cells, tissues and functional systems of organisms</li> </ul>

## Annotation of the work program of the academic discipline "Methodology and methods of teaching natural sciences"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). The curriculum provides for practical classes (18 hours), independent work (90 hours, of which 36 hours for exam preparation). The discipline is realized on the 1st course in the 1st family. Assessment of learning outcomes: exam.

Purpose: to prepare graduates who know their field of science well enough for teaching work.

### Tasks:

- 1) to acquaint students with elementary methods of conducting lessons (lectures and seminars, practical classes) at school and university.
- 2) prepare for difficult psychological and pedagogical situations.
- 3) to provide an understanding of the place of the teacher's work in the practical and spiritual life of mankind.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
pedagogical	PC-8 Able to form educational material, conduct lectures, seminars, practical and laboratory classes on higher education programs.	PC-8.1 Develops methodological materials on topics and forms of classes for higher education programs.
		PC-8.2 Forms educational and thematic material on higher education programs in accordance with methodological developments and regulatory requirements.
		PC-8.3 Conducts lectures, seminars, practical and laboratory classes on higher education programs.
	PC-9 Capable of presenting academic material in oral, written and graphic forms for various contingents of listeners.	PC-9.1 Develops educational materials on topics and forms of classes in oral, written and graphic forms for different contingents of listeners.
		PC-9.2 Presents educational material in oral, written and graphic forms for various contingents of students

	PC-10 Able to teach in general education institutions, as well as in educational institutions of higher education and to manage the research activities of students.	PC-10.1 Plans classes in educational institutions, as well as in educational institutions of higher education and the management of research activities of students.
		PC-10.2 Organizes classes in general educational institutions, as well as in educational institutions of higher education and the management of research activities of students.
		PC-10.3 Teaches in general education institutions, as well as in educational institutions of higher education and manages the research activities of students.
	PC-11 Able to use in teaching knowledge about the history of the development of marine biology in the Far East, the contribution of Far Eastern scientists to the research and scientific production potential of the country.	PC-11.1 Uses in teaching activities knowledge about the history of the development of marine biology in the Far East, the contribution of Far Eastern scientists to the research and scientific production potential of the country.
	PC-12 Able to form educational material, conduct lectures, seminars, practical and laboratory classes on vocational education programs for various contingents of students	PC-12.1 Develops methodological materials on topics and forms of classes in vocational education programs for various audiences of students
		PC-12.2 Forms, in accordance with methodological developments and regulatory requirements, educational and thematic material on vocational education programs for various contingents of students
		PC-12.3 Conducts lectures, seminars, practical and laboratory classes on vocational education programs for various audiences
	PC-13 Capable of teaching in professional educational organizations and management of research activities of students.	PC-13.1 Plans classes in the field of vocational training and additional professional education using the knowledge and methodology of vocational training.
		PC-13.2 Organizes classes in the field of vocational training and additional professional education, using the methodology in accordance with professional training.
		PC-13.3 Conducts training sessions in the field of vocational training and additional professional education, using knowledge and methodology in accordance with professional training.

		PC-13.4 Plans the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.
		PC-13.5 Organizes research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.
		PC-13.6 Supervises the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-8.1 Develops methodological materials on topics and forms of classes for higher education programs.	Knows fundamentals of natural sciences in the field of molecular and cellular biology Can develop methodological materials on topics and forms of classes in higher education programs owns skills in developing methodological materials on topics and forms of classes in higher education programs
PC-8.2 Forms educational and thematic material on higher education programs in accordance with methodological developments and regulatory requirements.	Knows methodological developments and regulatory requirements in the field of molecular and cellular biology Can to form educational and thematic material for higher education programs in the field of molecular and cellular biology owns skills of formation in accordance with methodological developments and regulatory requirements of educational and thematic material for higher education programs
PC-8.3 Conducts lectures, seminars, practical and laboratory classes on higher education programs.	Knows basics of pedagogical activity Can find the necessary literature for conducting lecture, seminar and practical classes; conduct lectures, seminars, practical and laboratory classes in an interactive form using modern technologies owns the necessary competencies for conducting lecture, seminar and practical classes
PC-9.1 Develops educational materials on topics and forms of classes in oral, written and graphic forms for various contingents of students.	Knows educational materials on topics and forms of classes in oral, written and graphic forms for various contingents of students in the field of molecular and cellular biology Can develop teaching materials on topics and forms of classes in oral, written and graphic forms for various contingents of students

	owns skills in the development of educational materials on topics and forms of classes in oral, written and graphic forms for various contingents of students
PC-9.2 Presents educational material in oral, written and graphic forms for various contingents of students	Knows ways of presenting educational material in oral, written and graphic forms for different contingents of students Can present educational material in oral, written and graphic forms for various contingents of students owns skills and methods of presenting educational material in oral, written and graphic forms for different contingents of students
PC-10.1 Plans classes in educational institutions, as well as in educational institutions of higher education and the management of research activities of students.	Knows fundamentals of research management Can plan classes in general educational institutions, as well as in educational institutions of higher education owns skills in planning classes in general educational institutions, as well as in educational institutions of higher education and the management of research activities of students
PC-10.2 Organizes classes in general educational institutions, as well as in educational institutions of higher education and the management of research activities of students.	Knows fundamentals of organization and management of research activities Can organize classes in general educational organizations, as well as in educational organizations of higher education and manage the research activities of students owns the skills of organizing classes in general educational organizations, as well as in educational organizations of higher education and managing the research activities of students
PC-10.3 Teaches in general education institutions, as well as in educational institutions of higher education and manages the research activities of students.	Knows basics of pedagogical activity Can conduct classes in general educational institutions, as well as in educational institutions of higher education and manage the research activities of students owns pedagogical skills of teaching in general educational institutions, as well as in educational institutions of higher education
PC-11.1 Uses in teaching activities knowledge about the history of the development of marine biology in the Far East, the contribution of Far Eastern scientists to the research and scientific production potential of the country.	Knows about Far Eastern scientists who contributed to the research and scientific and production potential of the country Can to use knowledge about the history of the development of marine biology in the Far East in pedagogical activity owns skills in applying knowledge in teaching activities knowledge about the history of the development of marine biology in the Far East, the contribution of Far Eastern scientists to the research and scientific production potential of the country
PC-12.1 Develops methodological materials on topics and forms of	Knows



<p>classes in vocational education programs for various audiences of students</p>	<p>fundamentals of natural sciences in the field of molecular and cellular biology  Can  develop methodological materials on the topics and forms of classes in higher education programs for various contingents of students  owns  skills in the development of methodological materials on topics and forms of classes in higher education programs for various contingents of students</p>
<p>PC-12.2 Forms, in accordance with methodological developments and regulatory requirements, educational and thematic material on vocational education programs for various contingents of students</p>	<p>Knows  methodological developments and regulatory requirements in the pedagogical and research field  Can  to form educational and thematic material on vocational education programs for various contingents of students  owns  the skills of using the formed educational and thematic material on vocational education programs for various contingents of students</p>
<p>PC-12.3 Conducts lectures, seminars, practical and laboratory classes on vocational education programs for various audiences</p>	<p>Knows  basics of pedagogical activity  Can  find the necessary literature for conducting lecture, seminar and practical classes for various contingents of students; conduct lectures, seminars, practical and laboratory classes in an interactive form using modern technologies  owns  the necessary competencies to conduct lecture, seminar and practical classes for various contingents of students</p>
<p>PC-13.1 Plans classes in the field of vocational training and additional professional education using the knowledge and methodology of vocational training.</p>	<p>Knows  methodology for professional training in biology  Can  plan classes in the field of vocational training and additional vocational education using the knowledge and methodology of vocational training  owns  skills in planning classes in the field of vocational training and additional vocational education using the knowledge and methodology of vocational training</p>
<p>PC-13.2 Organizes classes in the field of vocational training and additional professional education, using the methodology in accordance with professional training.</p>	<p>Knows  methodology and methods of teaching natural sciences  Can  organize classes in the field of vocational training and additional vocational education, using the methodology in accordance with professional training  owns  skills in organizing classes in the field of vocational training and additional professional education, using the methodology in accordance with professional training</p>
<p>PC-13.3 Conducts training sessions in the field of vocational training and additional professional education, using knowledge and methodology in accordance with professional training.</p>	<p>Knows  principles and methods of teaching  Can  conduct training sessions in the field of vocational training and additional professional education, using knowledge and methodology in accordance with professional training  owns</p>

	skills in conducting training sessions in the field of vocational training and additional professional education, using knowledge and methodology in accordance with professional training
PC-13.4 Plans the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.	Knows fundamentals of scientific design and research methodology Can plan the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology owns the skills of planning and implementing research activities of students in the field of professional interests using the knowledge of scientific design and research methodology
PC-13.5 Organizes research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.	Knows fundamentals of scientific design and research methodology Can organize research activities of students in the field of professional interests using the knowledge of scientific design and research methodology owns the skills of organizing research activities of students in the field of professional interests using the knowledge of scientific design and scientific research methodology
PC-13.6 Supervises the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology.	Knows research activities of students in the field of cell biology Can manage the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology owns the skills of managing the research activities of students in the field of professional interests using the knowledge of scientific design and research methodology

## Annotation of the work program of the discipline "Immunology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). The curriculum includes lectures (10 hours), practical classes (26 hours), independent work (72 hours, including 45 hours for exam preparation). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: exam.

**Target:** study of the structural and functional organization of the immune system, mechanisms of recognition, memorization and elimination of genetically alien structures, methods for studying the immune status.

### Tasks:

- 1) study of systemic, organ, tissue, cellular and molecular levels of reactions of innate and adaptive immunity, individual forms of the immune process;
- 2) familiarity with the mechanisms of recognition, memorization and elimination of genetically alien structures, methods for studying the immune status;
- 3) to teach how to use the knowledge of the fundamental principles of immunology and allergology in the pedagogical process and scientific research.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-1 Able to creatively use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the field of activity of molecular and cellular biology.	PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
		PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological representations and specialized knowledge in the field of professional activity
		PC-1.3 Uses in scientific and industrial and technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.	<p>Knows the features of working with scientific literature in the field of immunology and sources of information.</p> <p>Able to work with scientific and technical information and specialized literature, study the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.</p> <p>He has the skills to navigate in electronic databases and find the necessary information in the field of immunology.</p>
PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	<p>Knows the basic mechanisms of immunology at the molecular and cellular levels.</p> <p>Able to comprehend and formulate diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity.</p> <p>Has the skills to detect patterns and relationships between various processes in immunology and related disciplines.</p>
PC-1.3 Uses in scientific and industrial and technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology	<p>Knows about the features of scientific and production-technological activities, knowledge of fundamental and applied sections of disciplines that determine the field of activity of molecular and cellular biology.</p> <p>Knows how to use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines that determine the field of activity of molecular and cellular biology.</p> <p>He has the skills to apply the acquired knowledge of immunology in scientific, industrial and technological activities and the study of related disciplines.</p>

## Annotation of the work program of the academic discipline "Molecular Genetics, Human Genetics"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). The curriculum provides for lectures (18 hours), practical classes (18 hours), independent work (72 hours, of which 45 hours for preparing for the exam). The discipline is realized on the 1st course in the 1st family. Assessment of learning outcomes: exam.

### 1. Goals and objectives of mastering the discipline:

Target: the formation of master's students' understanding of the main methods of analysis of the molecular organization and functioning of the genetic material.

#### Tasks:

– to give students the necessary theoretical and practical knowledge in various areas of molecular genetics;

- deepening and consolidating theoretical knowledge, their comprehensive use in the process of production activities. Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-3 Able to conduct studies of biopolymers, their components and complexes, structure and function of genes and genomes.	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
<p>PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.</p>	<p>Knows the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transfer and implementation of genetic information at the molecular level  Able to study the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level  Possesses skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transferring and implementing genetic information at the molecular level</p>
<p>PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.</p>	<p>Knows the basic processes occurring in a living cell  Able to characterize in detail the main processes occurring in a living cell  Has knowledge of the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking</p>
<p>PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>	<p>Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism  Able to explore intermolecular interactions and mutual regulation of the processes of functioning of a living cell  Has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism</p>
<p>PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.</p>	<p>Knows the structure and functions of genes and genomes, individual proteins and the proteome as a whole  Able to analyze the structure of the function of genes and genomes, proteins and proteome  Owns methods for analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole</p>

## Annotation of the work program of the academic discipline "Commercialization of developments and technology transfer"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). The curriculum includes lectures (10 hours), practical classes (26 hours), independent work (72 hours). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: credit.

Purpose: to provide students with knowledge about the sources of funding for research and development work, the basics of intellectual property protection as an obligatory element in the process of commercialization and technology transfer, the formation of skills to critically evaluate and apply relevant information, as well as mastering the skills to perform a set of tasks related to search, evaluation, transfer and further support of science-intensive developments for their practical implementation in production and business.

### Tasks:

- the development by students of theoretical knowledge about the essence and objectives of the process of transfer and commercialization of the results of scientific research;
- mastering by students the methodology of transfer and commercialization of the results of scientific research;
- familiarization of students with the possibilities of using information databases and patent search tools to develop skills in filing patent applications;
- the formation of students' practical skills for the transfer and commercialization of the results of scientific research and the presentation of high-tech projects;
- development of students' skills in modeling the transfer and commercialization of the results of scientific research.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-4 Able to conduct scientific research in molecular and cellular	PC-4.1 Conducts substantiation of scientific research in molecular and cellular biology in order to develop the scientific potential of the

	biology in order to develop the scientific potential of the Russian Far East and develop the resources of the World Ocean.	Russian Far East and the development of the resources of the World Ocean.
		PC-4.2 Carries out applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.
		PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-4.1 Conducts substantiation of scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean.	Knows approaches to studying the attractiveness of participation in a science-intensive project for a strategic investor and technology partner Able to build theoretical models, analyze and meaningfully interpret the results obtained based on the description of scientific research Owns the methodology of scientific research
PC-4.2 Carries out applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.	Knows the features of the system of legal relations in the field of protection of intellectual property objects, the patterns of transfer and commercialization of the results of scientific research Knows how to use sources of scientific and technical information and collect and analyze the data necessary to solve the set scientific and economic problems Possesses the skills of interdisciplinary communication and the creation of interaction systems in a team of specialists of various profiles
PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.	Knows the main mechanisms for the implementation of technology transfer Knows how to analyze the initial data necessary to calculate economic and socio-economic indicators that characterize the state and prospects for the development of the technology market Owns modern methods of calculation and analysis of socio-economic indicators characterizing economic processes in the field of transfer and implementation of high-tech developments



## Annotation of the work program of the discipline "Modeling and analysis of big data in biology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). The curriculum includes lectures (10 hours), practical classes (26 hours), independent work (72 hours). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: credit.

Purpose: to give basic knowledge and ideas about the possibilities of practicing numerical methods of mathematical analysis, mathematical modeling, classification of mathematical models of biological objects.

### Tasks:

- 1) to form ideas about the applicability of numerical methods of mathematical analysis in relation to the mathematical modeling of biological systems;
- 2) introduce specific mathematical models that a research biologist can apply (adapt) to their research;
- 3) expand knowledge on the use of software in modeling biological processes.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-1 Able to creatively use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the field of activity of molecular and cellular biology.	PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
		PC-1.2 Understands and formulates diagnostic solutions to problems in molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
		PC-1.3 Uses in scientific and industrial and technological activities the knowledge of

		fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology
	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.	Knows features of working with scientific literature in the field of biology and sources of information. Can work with scientific and technical information and specialized literature, study the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases. owns skills to navigate in electronic databases and find the necessary information in the professional field.
PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows basic mechanisms of biology at the molecular and cellular levels. Can comprehend and formulate diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity. owns skills in detecting patterns and relationships between various processes in biology and related disciplines.
PC-1.3 Uses in scientific and industrial and technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology	Knows about the features of scientific and production-technological activities of knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology. Can to use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of the disciplines that determine the field of activity of molecular and cellular biology. owns

	the skills of applying the acquired knowledge of immunology in scientific and production-technological activities and the study of related disciplines.
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	Knows methodological foundations for designing, performing field and laboratory biological, environmental studies Can develop rules and algorithms for designing, performing laboratory biological, environmental studies owns skills in developing and improving new rules and design algorithms, performing laboratory biological, environmental studies
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows modern classification of scientific research methods, specifics and limits of their applicability; – the specifics of research specific to various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research; main methods of statistical analysis: correlation, regression and dispersion Can use the methods of statistical analysis to assess the reliability of data, compare empirical and theoretical sets, find the relationship between variables that characterize the state of the system owns the ability to independently analyze the available information, identify fundamental problems, set a task
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.	Knows the main modern field and laboratory methods for studying biology and ecology Can work on modern analytical equipment of a modern biological laboratory owns modern research methods in ecology and biology

## Annotation of the working program of the academic discipline "Molecular and cellular mechanisms of carcinogenesis"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 5 z.u. (180 hours). The curriculum includes laboratory work (72 hours), independent work (108 hours, of which 36 hours). The discipline is implemented in the 1st and 2nd year in the 2nd and 3rd semesters. Evaluation of learning outcomes: 2nd semester - credit, 3rd semester - exam.

### 1. Goals and objectives of mastering the discipline:

Purpose: to form competencies in the field of molecular and cellular mechanisms of carcinogenesis, pathomorphological and molecular features of malignant tumor cells, mastering methods for identifying and analyzing tumor cells.

#### Tasks:

- 1) Study of the main theories of carcinogenesis.
- 2) Analysis of the mechanisms of carcinogenesis at the molecular and cellular levels.
- 3) Mastering the basic methods of morphological and molecular typing of malignant neoplasms.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-3 Able to conduct studies of biopolymers, their components and complexes, structure and function of genes and genomes.	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of processes functioning of a living cell as part of a multicellular organism.

		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.
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Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.	<p>Knows the structure and functions of the main biopolymers, their components and the complexes formed during their interaction, genetic and epigenetic mechanisms for the transmission, storage and implementation of hereditary information at the molecular level, the main aspects of the participation of the studied biopolymers in the mechanisms of carcinogenesis.</p> <p>He is able to distinguish the main molecular patterns of tumor and normal cells, to study the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.</p> <p>He has skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transferring and implementing genetic information at the molecular level to determine the status of a cell.</p>
PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.	<p>Knows the main processes occurring in a living cell and the influence of carcinogenic factors on them, as well as cellular mechanisms of protection against this effect.</p> <p>Able to characterize in detail the main violations of cellular processes of vital activity that occur during carcinogenesis, and the events that follow them.</p> <p>Has knowledge of the basic concepts of carcinogenesis and their reflections on the main processes occurring in living cells</p>
PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.	<p>Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism, the role of oncology as a derivative of the body's own cells.</p> <p>He is able to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells with the microenvironment and their special mutual influence with cells of the immune system.</p> <p>Has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells as part of a multicellular organism</p>
PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.	<p>Knows the structure and functions of the main oncogenes and oncosuppressors, genomes in general, individual proteins and the proteome as a whole, the main mutations associated with carcinogenesis.</p> <p>Able to analyze the structure of the function of oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole to determine pathogenic mutations that stimulate carcinogenesis</p> <p>Owens methods for analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole</p>



## Annotation of the working program of the academic discipline "Research Seminar "Modern Problems of Molecular and Cellular Biology""

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). Curriculum practical classes 18 hours, independent work (90 hours). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: credit with assessment.

Goals and objectives of mastering the discipline:

Target: the formation of the necessary skills and competencies in students, allowing them to conduct research work both individually and collectively.

Tasks:

1. Holding career guidance work among students, allowing them to choose the direction and topic of research.

2. Teaching students the skills of academic work, including the preparation and conduct of research, writing scientific papers.

3. Discussion of projects and finished research papers of students.

4. Development of students' skills of scientific discussion and presentation of research results in the field of molecular and cellular biology.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-1 Able to creatively use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the field of activity of molecular and cellular biology.	PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
		PC-1.2 Comprehends and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
		PC-1.3 Uses in scientific and industrial and technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology

research	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.
research	PC-4 Able to conduct scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and develop the resources of the World Ocean.	PC-4.1 Carries out the rationale for scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean.
		PC-4.2 Performs applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.
		PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.	Knows standards adopted in healthcare, technical regulations, standards, recommendations, terminology, current classifications for high-quality maintenance of specialized documentation
	Can conduct a statistical assessment of their work and the activities of the organization using accounting and reporting specialized documentation
	owns skills in maintaining specialized documentation at all stages of professional activity
PC-1.2 Comprehends and formulates diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows diagnostic solutions for problems of molecular and cellular biology
	Can formulate diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts
	owns skills in making diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological



	concepts and specialized knowledge in the field of professional activity
PC-1.3 Uses in scientific and industrial and technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology	Knows Knows about the features of scientific and production and technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology
	Can Able to use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology
	owns Has the skills to apply the acquired knowledge of immunology in scientific, industrial and technological activities and the study of related disciplines
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	Knows methodological foundations for designing, performing field and laboratory biological, environmental studies
	Can develop rules and algorithms for designing, performing laboratory biological, environmental studies
	owns skills in developing and improving new rules and design algorithms, performing laboratory biological, environmental studies
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows – modern classification of scientific research methods, specifics and limits of their applicability; – the specifics of research specific to various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research; – main methods of statistical analysis: correlation, regression and variance
	Can use the methods of statistical analysis to assess the reliability of data, compare empirical and theoretical sets, find the relationship between variables that characterize the state of the system
	owns the ability to independently analyze the available information, identify fundamental problems, set a task
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.	Knows the main modern field and laboratory methods for studying biology and ecology
	Can work on modern analytical equipment of a modern biological laboratory
	owns modern research methods in ecology and biology
PC-4.1 Carries out the rationale for scientific research in molecular and cellular biology in order to develop the scientific potential of the Russian Far	Knows the current situation in the development of the scientific potential of the Russian Far East and the development of the resources of the World Ocean
	Can

East and the development of the resources of the World Ocean.	to characterize the achievements of modern science in the field of molecular and cellular biology in order to develop the scientific potential of the Russian Far East and the development of the resources of the World Ocean
	owns the ability to substantiate scientific research in molecular and cellular biology
PC-4.2 Performs applied and exploratory research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.	Knows fundamental scientific research and development in the field of molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean
	Can perform applied and exploratory research and development in molecular and cellular biology
	owns skills in the use of applied and exploratory scientific research and development in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean
PC-4.3 Interprets the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean.	Knows scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean
	Can interpret the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean
	owns skills in analyzing the results of scientific research in molecular and cellular biology aimed at developing the scientific potential of the Russian Far East and developing the resources of the World Ocean

## Annotation of the work program of the academic discipline "Biomedical Cellular Technologies"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 4 z.u. (144 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (108 hours, of which 45 hours for exam preparation). The discipline is realized on the 1st course in the 1st semester. Assessment of learning outcomes: exam.

Goals and objectives of mastering the discipline:

Target: To form competencies in the field of modern biomedical cellular technologies, to develop the knowledge of students in the field of cell biology in culture, to teach the main modern methods of manipulating living cells and their application to create cellular products, biotechnological systems based on them and new biomedical technologies.

Tasks:

1. The study of the theoretical foundations of cell biology in culture, to provide knowledge about the basic growth needs of cells in culture, their proliferation and differentiation.

2. Mastering the basic methods of cell cultivation, working with cells under aseptic conditions, preparation of nutrient media and supplements, preparation of sterile materials and laboratory glassware, methods of obtaining primary cultures, obtaining clones and maintaining the viability of transplanted cell lines, methods of cryopreservation of cell cultures.

3. Mastering the basic principles and methods of analysis of cultured cells, assessing the viability, growth, proliferation and differentiation of cells in culture.

4. Mastering the basic skills of using cultured cells to create biotechnological systems for the production of targeted biologically active substances and new biomedical technologies, including technologies based on the use of stem cells and biocompatible materials in the creation of implantable tissue engineering structures for the needs of regenerative medicine.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
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research	PC-1 Able to creatively use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the field of activity of molecular and cellular biology.	PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
		PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
		PC-1.3 Uses in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines that determine the field of activity of molecular and cellular biology
	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.
	PC-3 Able to conduct studies of biopolymers, their components and complexes, structure and function of genes and genomes.	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the	Knows the achievements of domestic and foreign science in the field of molecular and cellular biology

field of molecular and cellular biology using new technologies and electronic databases.	Able to work with scientific and technical information and specialized literature in the field of molecular and cellular biology using new technologies and electronic databases Has the skills to work with scientific and technical information and specialized literature, including the use of new technologies and electronic databases.
PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows actual problems of molecular and cellular biology Able to comprehend and formulate diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity Has the skills to comprehend and formulate diagnostic solutions to the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
PC-1.3 Uses in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines that determine the field of activity of molecular and cellular biology	Knows the fundamental and applied sections of the disciplines that determine the scope of molecular and cellular biology Able to use knowledge of fundamental and applied sections of molecular and cellular biology in scientific and production-technological activities Has the skills to use knowledge of fundamental and applied sections of molecular and cellular biology in scientific and production and technological activities
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	Knows the rules and algorithms for designing, performing laboratory biological, environmental studies Able to develop rules and algorithms for designing, performing laboratory biological, environmental studies. Possesses the skills of designing, performing laboratory biological, environmental studies
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows the scientific methodological foundations of fundamental research Able to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research Possesses skills and experience in performing laboratory biological and environmental studies
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.	Knows the methodological foundations of designing, performing laboratory biological, environmental studies Able to use modern equipment and computing systems in molecular and cellular biology Possesses the skills of designing, performing laboratory biological, environmental studies using modern equipment and computer systems
PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.	Knows the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transfer and implementation of genetic information at the molecular level Able to study the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level Possesses skills and methods for studying the structure and function of biopolymers, their components and complexes, mechanisms for storing, transferring and implementing genetic information at the molecular level

<p>PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.</p>	<p>Knows the basic processes occurring in a living cell  Able to characterize in detail the main processes occurring in a living cell  Has knowledge of the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking</p>
<p>PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>	<p>Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism  Able to explore intermolecular interactions and mutual regulation of the processes of functioning of a living cell  Has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism</p>
<p>PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.</p>	<p>Knows the structure and functions of genes and genomes, individual proteins and the proteome as a whole  Able to analyze the structure and function of genes and genomes, proteins and proteome  Owns methods for analyzing the structure and function of genes and genomes, proteins and the proteome as a whole</p>

## Annotation of the work program of the academic discipline "Comparative histology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 4 z.u. (144 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (108 hours, of which 45 hours for exam preparation). The discipline is realized on the 1st course in the 1st semester. Assessment of learning outcomes: exam.

Goals and objectives of mastering the discipline:

Purpose: Formation of students' knowledge about the phylogenetic development of the main types of tissues.

Tasks:

1. Formation of students' fundamental knowledge about the evolutionary process of formation and development of the main groups of body tissues of invertebrates and vertebrates.
2. Formation of students' skills in working with microscopic equipment for the study of finished micropreparations.
3. Formation of students' skills in making histological micropreparations of vertebrates and invertebrates.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-1 Able to creatively use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines (modules) that determine the field of activity of molecular and cellular biology.	PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
		PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
		PC-1.3 Uses in scientific and industrial-technological activities the knowledge of fundamental and applied sections of

		disciplines that determine the field of activity of molecular and cellular biology
	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.		
	PC-3 Able to conduct studies of biopolymers, their components and complexes, structure and function of genes and genomes.	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and specialized literature, studies the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.	Knows the methods of working with scientific and technical information and special literature Able to use scientific and technical information and special literature He has the skills to study the achievements of domestic and foreign science in the field of molecular and cellular biology using new technologies and electronic databases.
PC-1.2 Comprehends and formulates diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows diagnostic solutions to molecular and cellular biology problems Able to formulate diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts Has the skills to make diagnostic solutions to problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity
PC-1.3 Uses in scientific and industrial-technological activities the knowledge of fundamental and applied	Knows the fundamental and applied sections of the disciplines that determine the scope of molecular and cellular biology



sections of disciplines that determine the field of activity of molecular and cellular biology	Able to use in scientific and industrial-technological activities the knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cellular biology Has the skills to use knowledge of fundamental and applied sections of disciplines that determine the field of activity of molecular and cellular biology in scientific and industrial and technological activities
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	Knows algorithms for designing, performing laboratory biological, environmental studies. Able to develop rules and algorithms for designing, performing laboratory biological, environmental studies. Has the skills to develop rules and design algorithms, perform laboratory biological and environmental studies.
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows the basics of methods of laboratory biological, environmental research using the scientific methodological foundations of fundamental research Able to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research. Has the skills to perform laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.	Knows the methodological foundations of designing, performing laboratory biological, environmental studies Able to use modern equipment and computer systems in molecular and cellular biology. He has the skills to apply the methodological foundations of design, perform laboratory biological and environmental studies, use modern equipment and computer systems in molecular and cellular biology.
PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transfer and implementation of genetic information at the molecular level.	Knows the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level. Knows how to study the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level. He has the skills to study the structure and function of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.	Knows the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking. Able to describe the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking. Possesses the skills of a detailed description of the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.

<p>PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>	<p>Knows the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.  Able to explore the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.  He has the skills to study the main methods of intermolecular interactions and the mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>
<p>PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.</p>	<p>Knows the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.  He is able to analyze the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.  He has the skills to analyze the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.</p>

## Annotation of the work program of the academic discipline "Medical and pharmaceutical biotechnology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (72 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

**Course objective:** formation and development of general professional and professional competencies necessary for professional activities in the field of biotechnology for the production of drug substances, as well as preventive and diagnostic agents, using biotechnological methods of synthesis and transformation, as well as a combination of biological and chemical methods.

**Course objectives:** 1) study of technological regimes for growing microorganism-producers, tissue and cell cultures of plants and animals to obtain biomass, its components, metabolic products, targeted biosynthesis of biologically active compounds and other products, study of their composition and analysis methods, technical and economic evaluation criteria, creation of effective compositions biological preparations and development of methods for their application.

2) study of processes and apparatuses of microbiological synthesis, including physicochemical kinetics, hydrodynamics, mass and heat transfers in devices for fermentation, thickening of biomass, separation of cell suspensions, drying, granulation, extraction, isolation, fractionation, purification, control and storage of final target products.

3) mastering the methods and means of developing new technological processes based on microbiological synthesis, biotransformation, biocatalysis, immunosorption, biodegradation, biooxidation and the creation of biocomposting systems for various wastes, the treatment of industrial wastes (wastewater, gas emissions, etc.), the creation of closed technological schemes of microbiological production, the latter taking into account environmental issues.

4) mastering the methods and means of developing scientific and methodological foundations for the use of standard biosystems at the molecular, cellular, tissue and organismal levels in scientific research, quality control and safety

assessment of the use of pharmaceutical, medical, veterinary and perfumery and cosmetic biological products.

5) teaching students the ability to correctly assess the compliance of biotechnological production with the rules Good Manufacturing Practice (GMP), environmental safety requirements for bio-objects used in production and target products.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-2. Able to apply the methodological foundations of design, laboratory biological, environmental studies, use modern equipment and computer systems in molecular and cellular biology.	PC -2.1. Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC -2.2. Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC -2.3. Applies the methodological foundations of designing, performing laboratory biological, environmental studies, uses modern
research	PC -3. He is able to conduct research on biopolymers, their components and complexes, the structure and function of genes and genomes.	PC -3.1. He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC -3.2. It characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC -3.3. Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4. Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.
research	PC-7. Able to develop new drugs, conduct biomedical research using living organisms and biological systems	PC-7.1. Carries out the rationale for biomedical research with the aim of developing medicines using living organisms and biological systems of various levels of organization.

	of various levels of organization.	PC-7.2. Defines the goals and objectives of biomedical research and drug development. Plans biomedical research, selects the design of scientific research in accordance with the goals and objectives.
		PC-7.3. Conducts biomedical research using living organisms and biological systems of various levels of organization, analyzes the results.
		PC-7.4. Interprets the results of biomedical research and development in order to elucidate the molecular mechanisms of biochemical processes.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC -2.1. Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	<p>Knows:</p> <ul style="list-style-type: none"> <li>-basic concepts, formulas and laws of natural sciences in professional activities, methods of mathematical analysis and modeling, theoretical and experimental research;</li> <li>-biotechnological aspects used in biotechnology; objects of biotechnology and their biotechnological functions, principles of cell cultivation;</li> <li>-the essence of the methods of molecular genetics;</li> <li>-stages of selection of target products</li> </ul>
PC -2.2. Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	<p>Can:</p> <ul style="list-style-type: none"> <li>-conduct experimental research and testing according to a given methodology, use the mathematical processing of experimental data;</li> <li>-use the language of molecular biotechnology;</li> <li>-choose biological objects</li> </ul>
PC -2.3. Applies the methodological foundations of designing, performing laboratory biological, environmental studies, uses modern	<p>Owned by:</p> <ul style="list-style-type: none"> <li>-the basic laws of natural sciences in industrial microbiology and biotechnology, methods of mathematical analysis and modeling, theoretical and experimental research methods and principles for improving industrial microbiology and biotechnology;</li> </ul>
PC -3.1. He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.	<p>Knows:</p> <ul style="list-style-type: none"> <li>-resources of natural biocenoses as sources of biologically active substances (BAS);</li> <li>-ways, methods and principles of implementation and management of biotechnological processes</li> </ul> <p>Can:</p> <ul style="list-style-type: none"> <li>-to carry out biotechnological production processes and obtain biologically active substances;</li> <li>-to carry out biotechnological processes for the production and manufacture of medicines;</li> <li>-carry out step-by-step control and standardization of the drugs obtained</li> </ul> <p>Owned by:</p>

	<ul style="list-style-type: none"> <li>-ability to implement and manage biotechnological processes</li> </ul>
<p>PC -3.2. It characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>-modern achievements of biological sciences and biomedical technologies;</li> <li>-basic principles of regulation of metabolism and growth rate of microorganisms, methods of cultivation of microorganisms, quantitative characteristics of growth of cultures, equipment for cultivation of microorganisms, storage of microorganisms;</li> <li>-main producers and methods for obtaining biotechnological medicinal substances, their physical, chemical and pharmacological properties.</li> <li>-biotechnological processes in the production and manufacture of medicines;</li> <li>-the main stages of the biotechnological process;</li> <li>-resources of natural biocenoses as sources of biologically active substances (BAS);</li> <li>-ways, methods and principles of implementation and management of biotechnological processes</li> </ul> <p>Can:</p> <ul style="list-style-type: none"> <li>-to carry out biotechnological production processes and obtaining biologically active substances and individual components of microbial cells;</li> <li>-to carry out biotechnological processes for the production and manufacture of medicines;</li> <li>-carry out step-by-step control and standardization of the preparations obtained (determination of the antimicrobial activity of antibiotics, the activity of enzyme preparations, the viability of microorganisms);</li> <li>-carry out the isolation and purification of biologically active substances from biomass and culture fluid;</li> <li>-regulate and improve the biotechnological process in order to obtain a high-quality end product;</li> <li>-ensure compliance with the rules of industrial hygiene, environmental protection, labor protection and safety</li> </ul> <p>Owned by:</p> <ul style="list-style-type: none"> <li>-methods of controlled cultivation of microorganisms;</li> <li>-methods of immobilization of microorganism cells</li> <li>-technology for obtaining biologically active substances and individual components of microbial cells;</li> <li>-ability to implement and manage biotechnological processes</li> </ul>
<p>PC -3.3. Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>-theoretical foundations of the most important technological and microbiological processes and their practical application for the industrial production of valuable products of vital activity of microorganisms;</li> </ul>
<p>PC-3.4. Analyzes the structure and functions of genes and genomes, conducts structural and functional</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>-methods, instrumentation and technologies for the production of specialized biological products using</li> </ul>

<p>analysis of individual proteins and the proteome as a whole.</p>	<p>microbiological synthesis, biocatalysis, genetic engineering; fundamentals of microbial biotechnology, selection and genetic engineering of microorganisms; basic requirements for microorganisms - producers</p> <p>Can:</p> <ul style="list-style-type: none"> <li>- apply modern ideas about the basics of biotechnological production, genetic engineering in the selection and study of microorganism-producers; use knowledge about the basics of microbial biotechnology, breeding work to solve problems in the national economy</li> </ul> <p>Owned by:</p> <ul style="list-style-type: none"> <li>- modern ideas about the methods of genetic engineering, nanobiotechnology, molecular modeling for the purposes of biotechnology;</li> <li>- methods of independent search and analysis of information in the field of industrial microbiology and biotechnology;</li> <li>- methods of search, selection and research of microorganisms; knowledge of modern apparatus and equipment for research work</li> </ul>
<p>PC-7.1. Carries out the rationale for biomedical research with the aim of developing medicines using living organisms and biological systems of various levels of organization.</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>- innovative ways to create drugs based on the use of data from genomics, proteomics and bioinformatics;</li> <li>- new methods and techniques in the development, production and circulation of medicines;</li> <li>- methods for determining the good quality of producing microorganisms, determining the concentration of viable cells and their enzymatic activity.</li> </ul> <p>Can:</p> <ul style="list-style-type: none"> <li>- conduct research to improve the biotechnological process; use new methods and techniques in the field of designing medicines and diagnostic products.</li> </ul> <p>Owned by:</p> <ul style="list-style-type: none"> <li>- new methods and techniques in the field of designing medicines and diagnostic products;</li> <li>- physico-chemical, microbiological and biochemical methods of analysis to confirm the purity of the producer, the authenticity of medicines, the detection of impurities and quantification;</li> <li>- ability to participate in scientific research; the skills of introducing new methods and techniques in the field of designing medicines and diagnostic products.</li> </ul>
<p>PC-7.2. Defines the goals and objectives of biomedical research and drug development. Plans biomedical research, selects the design of scientific research in accordance with the goals and objectives.</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>- the physical nature of phenomena and processes in the body;</li> <li>- the structure of the human body in relation to the functions of systems and organs;</li> <li>- methods for constructing models of physiological systems at the subcellular, cellular, tissue and systemic levels of the human body;</li> <li>- methods for solving problems of identifying parameters and highlighting informative features on real clinical and experimental data;</li> </ul>

	<ul style="list-style-type: none"> <li>-methods for studying biochemical and physiological processes and phenomena occurring at the cellular, organ and system levels in the human body</li> </ul>
<p>PC-7.3. Conducts biomedical research using living organisms and biological systems of various levels of organization, analyzes the results.</p>	<p>Can:</p> <ul style="list-style-type: none"> <li>apply known models of body systems for the analysis of physiological processes and conditions.</li> <li>-identify the parameters of the models according to experimental data or according to the results of a clinical study;</li> <li>-carry out applied and practical projects on the study of biochemical, biophysical and physiological processes and phenomena occurring at the cellular, organ and system levels in the human body</li> </ul> <p>Owned by:</p> <ul style="list-style-type: none"> <li>-methods for studying biochemical and physiological processes and phenomena occurring at the cellular, organ and system levels in the human body;</li> <li>-methods for the implementation of applied and practical projects for the study of biochemical, biophysical and physiological processes and phenomena occurring at the cellular, organ and system levels in the human body</li> </ul>
<p>PC-7.4. Interprets the results of biomedical research and development in order to elucidate the molecular mechanisms of biochemical processes.</p>	<p>Knows:</p> <ul style="list-style-type: none"> <li>-theoretical foundations for obtaining various biotechnological products;</li> <li>-patterns of growth kinetics of microorganisms and formation of metabolic products;</li> <li>-methods of cultivating microorganisms; classification of enzymes; units of enzyme activity;</li> <li>-methods for obtaining enzyme preparations; applications of enzymes in medicine.</li> </ul> <p>Can:</p> <ul style="list-style-type: none"> <li>-to conduct the process of cultivation of microorganisms, cell cultures of plants and animals;</li> <li>-select the optimal conditions that stimulate the maximum accumulation of the target product;</li> <li>-carry out the isolation, identification and cultivation of microorganisms producing biomass and various metabolic products;</li> <li>-work with pure cultures of microorganisms, plants and animals;</li> <li>-isolate enzymes from various objects, investigate the properties and determine the kinetic parameters of enzymes;</li> <li>-evaluate the quantitative characteristics of the growth of microorganisms</li> </ul> <p>Owned by:</p> <ul style="list-style-type: none"> <li>-methods of working with microorganisms, cell cultures of plants and animals; rules for safe work in the laboratory;</li> <li>-methods for calculating the main parameters of biotechnological processes;</li> <li>-biotransformation methods;</li> </ul>



	-principles of obtaining, researching and using enzymes, viruses, microorganisms, cell cultures of animals and plants, products of their biosynthesis and biotransformation
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## Annotation of the work program of the academic discipline "Molecular bioengineering"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (72 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

Target:

Formation of modern ideas about the basic principles and methods of bioengineering, experimental and practical implementation of artificially created biosystems.

Tasks:

- 1) consider the current state and prospects for the development of bioengineering;
- 2) to study the basic principles, methods of bioengineering and ethical and biological safety issues related to this area of research and practical use;
- 3) to teach the ability to independently search and analyze information, use it in the process of scientific and practical activities.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.
	PC-3 Able to conduct studies of biopolymers, their components and	PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage,

	complexes, structure and function of genes and genomes.	transmission and implementation of genetic information at the molecular level.
		PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.
		PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.
		PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.
	PC-7 Able to develop new drugs, conduct biomedical research using living organisms and biological systems of various levels of organization.	PC-7.1 Carries out the rationale for biomedical research with the aim of developing medicines using living organisms and biological systems of various levels of organization.
		PC-7.2 Defines the goals and objectives of biomedical research and drug development. Plans biomedical research, selects the design of scientific research in accordance with the goals and objectives.
		PC-7.3 Conducts biomedical research using living organisms and biological systems of various levels of organization, analyzes the results.
		PC-7.4 Interprets the results of biomedical research and development in order to elucidate the molecular mechanisms of biochemical processes.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	<ul style="list-style-type: none"> <li>- Knows the basic rules and algorithms for designing, performing laboratory biological, environmental studies.</li> <li>- Able to apply the basic rules and algorithms for the design of laboratory biological, environmental studies.</li> <li>- Has the skills to develop rules and algorithms for laboratory biological and environmental research.</li> </ul>
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	<ul style="list-style-type: none"> <li>- Knows the scientific and methodological foundations of fundamental research.</li> <li>- Able to use mathematical and computer tools and methods for material analysis.</li> <li>- Owns modern methods of computational biology for the correct interpretation of the results of field collections, experiments, etc.</li> </ul>
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern	<ul style="list-style-type: none"> <li>- Knows the basics of designing, performing laboratory biological, environmental studies.</li> <li>- Knows how to apply the methodological foundations of designing, performing laboratory biological, environmental studies.</li> </ul>

equipment and computer systems in molecular and cellular biology.	- Has the skills to use modern equipment and computing systems in molecular and cellular biology.
PC-3.1 He studies the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level.	- Knows the structure and functions of biopolymers, their components and complexes, the mechanisms of storage, transmission and implementation of genetic information at the molecular level. - Able to analyze the structure and functions of biopolymers, their components and complexes. - Has the skills to analyze information about the structure and properties of biopolymers, transfer and reproduction of hereditary information, protein synthesis, regulation of these processes.
PC-3.2 Characterizes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking.	- Knows the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking. - Able to characterize the main processes occurring in a living cell. - Has the skills to analyze the main processes occurring in a living cell.
PC-3.3 Explores the main ways of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.	- Knows intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism. - Able to analyze intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism. - Has the skills to study the main processes of intermolecular interaction and regulation of processes in living cells.
PC-3.4 Analyzes the structure and functions of genes and genomes, conducts structural and functional analysis of individual proteins and the proteome as a whole.	- Knows the structure and function of genes and genomes. - Able to analyze the structure and function of genes and genomes. - Has the skills to conduct structural and functional analysis of individual proteins and the proteome as a whole.
PC-7.1 Carries out the rationale for biomedical research with the aim of developing medicines using living organisms and biological systems of various levels of organization.	- Knows the basic composition of drugs (active ingredients), as well as different types of living organisms and biological systems applicable for drug testing. - Able to justify biomedical research in order to develop medicines. - Possesses the skills of drug development methodology using living organisms and biological systems of various levels of organization.
PC-7.2 Defines the goals and objectives of biomedical research and drug development. Plans biomedical research, selects the design of scientific research in accordance with the goals and objectives.	- Knows about the types of biomedical research. - Knows how to define goals and objectives, plan biomedical research. - Possesses the skills of scientific research design in accordance with the goals and objectives.
PC-7.3 Conducts biomedical research using living organisms and biological systems of various levels of organization, analyzes the results.	- Knows the types of living organisms and biological systems of various levels of organizations, their application in biomedical research. - Able to analyze the results of biomedical research. - Has the skills to conduct biomedical research using living organisms and biological systems of various levels of organization.
PC-7.4 Interprets the results of biomedical research and development	- Knows the basic molecular mechanisms of biochemical processes.

in order to elucidate the molecular mechanisms of biochemical processes.

- Able to interpret the results of biomedical research and development.
- Has the skills to conduct biomedical research to elucidate the molecular mechanisms of biochemical processes.

## Annotation of the working program of the discipline "Methods of molecular and cellular diagnostics"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (72 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

**Target:** formation of systemic knowledge among students about modern methods of molecular and cellular diagnostics, mastering the main methods of molecular and cellular diagnostics in biomedical research.

### **Tasks:**

- 1) To acquaint masters with the current state of molecular and cellular diagnostics, its application in the clinic, and promising developments in this area.
- 2) To study the technologies of conducting experiments, analyzes and tests in molecular and cellular diagnostics.
- 3) To train masters to work in laboratory conditions, to apply in practice the basics of planning research work.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
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<p>PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.</p>	<p>Knows: Fundamental concepts of cell and molecular biology; methodology for setting up basic laboratory tests; approaches to the analysis of the received information.</p> <p>Can: Determine the goals and objectives of the experiment, choose the object and methods of research; develop and optimize the conditions for setting up an experiment, perform laboratory biological studies; draw logical conclusions based on the results of the experiment.</p> <p>Owned by: Skills in developing rules and design algorithms, performing laboratory research.</p>
<p>PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.</p>	<p>Knows: Fundamentals of molecular and cellular biology, biochemistry and biotechnology, fundamental principles of organization and functioning of living systems, methods and approaches to studying the structure and properties of biological objects, organic and inorganic compounds.</p> <p>Can: Identify a problem in the analysis of scientific literature and / or the results of their own experimental work, set original goals and objectives of a scientific experiment, choose the appropriate object and method of research; perform laboratory biological research using modern equipment and computing facilities; analyze the biological data obtained during the experiment, draw logical conclusions and conclusions.</p> <p>Owned by: Skills to perform laboratory research using the scientific methodological foundations of fundamental research.</p>
<p>PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.</p>	<p>Knows: Basic principles and stages of modern methods for analyzing the structure and properties of biological objects; the content of the main regulatory documents that ensure the conduct of research and production and technological biological work.</p> <p>Can: Apply in practice knowledge of the basics of organization and planning of research and production work using regulatory documents; analyze data and operate on the information received; collect the necessary theoretical and practical material for the implementation of research work.</p> <p>Owned by: Methods of organizing and conducting research and production and technological biological work; methods of independent analysis of available biological information; skills in working with library catalogs.</p>

## Annotation of the working program of the discipline "Reproduction and differentiation of cells"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 3 z.u. (108 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (72 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

### 1. Goals and objectives of mastering the discipline:

Purpose: mastering knowledge about cell reproduction and differentiation, studying the mechanisms of their regulation, mastering methods for analyzing the cell cycle, cell proliferation and differentiation.

### Tasks:

- 1) The study of the theoretical foundations of cell reproduction, the cell cycle, its stages and mechanisms of regulation.
- 2) Study of molecular mechanisms of cell differentiation, principles of differential gene expression.
- 3) Study of cell cycle pathologies.
- 4) Mastering the methods of analysis of reproduction and differentiation of cells.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-2 Able to apply the methodological foundations of design, laboratory biological, environmental research, use modern equipment and computer systems in molecular and cellular biology.	PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.



Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-2.1 Develops rules and algorithms for designing, performing laboratory biological, environmental studies.	<p>Knows the rules and algorithms for designing, performing laboratory biological, environmental studies</p> <p>Able to develop rules and algorithms for designing, performing laboratory biological, environmental studies</p> <p>Possesses the skills of designing and performing laboratory biological, environmental studies</p>
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	<p>Knows the scientific methodological foundations of fundamental research</p> <p>Able to perform laboratory biological, environmental studies</p> <p>Has the skills to perform laboratory biological, environmental studies</p>
PC-2.3 Applies the methodological foundations for designing, performing laboratory biological and environmental studies, uses modern equipment and computer systems in molecular and cellular biology.	<p>Knows the methodological foundations of designing, performing laboratory biological, environmental studies</p> <p>Able to use modern equipment and computing systems in molecular and cellular biology</p> <p>Possesses the skills of designing and performing laboratory biological, environmental studies using modern equipment and computer systems</p>

## Annotation of the work program of the discipline "Pathological histology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (36 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

Purpose: formation of students' understanding of histological changes that occur in the process of occurrence and development of various pathologies in the human body

Tasks:

1. Formation in students of fundamental knowledge about the changes occurring at the tissue level in the human body with the development of pathologies.
2. Formation of students' skills in working with microscopic equipment to assess the severity of pathological changes in finished preparations.
3. Formation of students' knowledge and skills in the manufacture of histological preparations, including those from pathologically altered tissues and organs.
4. Acquaintance of students with modern methods of cytological and histological diagnostics.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-6 Able to develop experimental models, methods of cytological diagnostics, morphometry, marker histo- and cytochemistry, etc.	PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions
		PC-6.2 Develops and critically evaluates the experimental modelresearch in the field of cytology and histology
		PC-6.3 Carries outhisto- and cytological diagnostics, morphometry, marker histo- and cytochemistry

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
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<p>PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions</p>	<p>Knows methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions  Able to evaluate the results of fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions  Owns methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions</p>
<p>PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology</p>	<p>Knows how to develop and evaluate an experimental research model in the field of cytology and histology  Able to evaluate the results of the evaluation of an experimental model of research in the field of cytology and histology  Has the skills to develop and evaluate an experimental research model in the field of cytology and histology</p>
<p>PC-6.3 Carries out histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry</p>	<p>Knows the methods and algorithms for histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry  Able to evaluate the results of histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry  Proficient in histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry</p>

## Annotation of the working program of the academic discipline "Pharmacology and toxicology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). Curriculum lectures (18 hours), laboratory work (18 hours), independent work (36 hours, of which 27 hours for exam preparation). The discipline is implemented in the 1st year in the 2nd semester. Assessment of learning outcomes: exam.

Purpose: students mastering the main provisions of general pharmacology and pharmacology of individual body systems, the mechanisms of action of drugs, knowledge of molecular targets for drugs, the development of future specialists in complex thinking, which allows predicting the positive and negative aspects of the effects of drugs, as well as their combinations, formation the ability to apply the acquired knowledge in professional activities.

### Tasks:

- to master the basic information on general pharmacology, the mechanisms of action of drugs on biological targets, pharmacokinetics, pharmacodynamics and the use of the main groups of drugs;
- to teach students the basic principles of preparing prescriptions and compiling prescriptions, the ability to write prescriptions for medicines in various dosage forms and combinations;
- be able to analyze the effect of drugs at the level of the organism, organ, cell, subcellular structures and molecules;
- know the principles of action of the main pharmacotherapeutic groups of medicinal substances, the issues of the molecular mechanism of their action and the safety profile;
- determine the indications and contraindications for prescribing drugs for major diseases;
- take into account the influence of various factors (gender, weight, age, medical history, comorbidities, use of other drugs, etc.) on drug therapy;
- have an idea of drug toxicology and principles of first aid for acute drug poisoning;

- predict and timely prevent the development of adverse side reactions of medicinal substances, based on aspects of the molecular action of drugs.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-6 Able to develop experimental models, methods of cytological diagnostics, morphometry, marker histo- and cytochemistry, etc.	PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions
		PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology
		PC-6.3 Carries out histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions	Knows patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions Can predict and carry out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions owns research planning skills in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions
PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology	Knows basics of cytology and histology Can develop and evaluate an experimental research model in the field of cytology and histology owns skills in developing and evaluating an experimental research model in the field of cytology and histology
PC-6.3 Carries out histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry	Knows methodology for histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry Can carry out histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry owns skills in histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry

## Annotation of the work program of the discipline "Neurobiology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). Curriculum lectures (10 hours), laboratory work (26 hours), independent work (72 hours). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: credit.

Target: formation of ideas about the functional organization of the nervous system, neural mechanisms of organization of reflex behavior and the principles of systemic organization of brain functions; on the basics of the physiology of the nervous tissue and the human central nervous system; principles of systemic organization of brain functions; physiological mechanisms of receiving and processing information by a living organism; on the physiology of human sensory systems that ensure adequate interaction of the organism as a whole with the environment.

Tasks:

1) to present as fully as possible the most significant achievements of the world and domestic neurobiology as a science that studies the structure, functioning, development, genetics, biochemistry, physiology and pathology of the nervous system;

2) to develop in students the skills of analytical and critical mastery of the works of outstanding researchers of the nervous system;

3) to show that the structure and functions of the human brain include various levels of study: from molecular to cellular (individual neurons), from relatively small associations of neurons, to large systems such as the cerebral cortex or cerebellum, and the highest level is the nervous system in general;

4) to contribute to the expansion of scientific horizons and improve the culture of psychological thinking of students.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-5 It is capable of conducting a systematic	PC-5.1 Studies the relationship of cells, tissues and functional systems of organisms.

	analysis of the relationships between cells, tissues and functional systems of organisms.	PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.
		PC-5.3 Conducts a systematic analysis of the relationships between cells, tissues and functional systems of organisms.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-5.1 Studies the relationship of cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- the relationship of cells, tissues and functional systems of organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- independently work with scientific and reference literature</li> <li>owns</li> <li>- basic concepts and terminology on the topic of the relationship of cells, tissues and functional systems of organisms</li> </ul>
PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- molecular, immunological and physiological aspects of the study of cells of multicellular and unicellular organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- to study the adaptation of tissue elements to the action of various biological, physical, chemical and other factors</li> <li>owns</li> <li>- skills of systemic analysis of the relationship between cells, tissues and functional systems of organisms – representatives of all kingdoms</li> </ul>
PC-5.3 Conducts a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- the theoretical part of the system analysis of the relationship of cells, tissues and functional systems of organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- conduct a systematic analysis of the relationship of cells, tissues and functional systems of organisms</li> <li>owns</li> <li>- a method for conducting a systematic analysis of the relationship between cells, tissues and functional systems of organisms</li> </ul>

## Abstract of the work program of the discipline "Development and pathology of the brain"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). Curriculum lectures (10 hours), laboratory work (26 hours), independent work (72 hours). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: credit.

Target: formation of ideas about the functional organization of the nervous system, neural mechanisms of organization of reflex behavior and the principles of systemic organization of brain functions; on the basics of the physiology of the nervous tissue and the human central nervous system; principles of systemic organization of brain functions; physiological mechanisms of receiving and processing information by a living organism; groups of benign and malignant neoplasms; features of brain aging.

Tasks:

1) present the most significant achievements of world and domestic science in the field of development and pathology of the brain, studying the structure, functioning, development, biochemistry, physiology and pathology of the nervous system and brain;

2) to develop in students the skills and abilities of analytical and critical development of the works of outstanding researchers of the brain;

3) to show that the structure and functions of the human brain include various levels of study: from molecular to cellular (individual neurons), from relatively small associations of neurons, to large systems such as the cerebral cortex or cerebellum, and the highest level is the nervous system in general;

4) contribute to the expansion of scientific horizons and improve the culture of psychological thinking of students.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
research	PC-5 It is capable of conducting a systematic	PC-5.1 Studies the relationship of cells, tissues and functional systems of organisms.



	analysis of the relationships between cells, tissues and functional systems of organisms.	PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.
		PC-5.3 Conducts a systematic analysis of the relationships between cells, tissues and functional systems of organisms.

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-5.1 Studies the relationship of cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- the relationship of cells, tissues and functional systems of organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- independently work with scientific and reference literature</li> <li>owns</li> <li>- basic concepts and terminology on the topic of the relationship of cells, tissues and functional systems of organisms</li> </ul>
PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- molecular, immunological and physiological aspects of the study of cells of multicellular and unicellular organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- to study the adaptation of tissue elements to the action of various biological, physical, chemical and other factors</li> <li>owns</li> <li>- skills of systemic analysis of the relationship between cells, tissues and functional systems of organisms – representatives of all kingdoms</li> </ul>
PC-5.3 Conducts a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	<p>Knows</p> <ul style="list-style-type: none"> <li>- the theoretical part of the system analysis of the relationship of cells, tissues and functional systems of organisms</li> </ul> <p>Can</p> <ul style="list-style-type: none"> <li>- conduct a systematic analysis of the relationship of cells, tissues and functional systems of organisms</li> <li>owns</li> <li>- a method for conducting a systematic analysis of the relationship between cells, tissues and functional systems of organisms</li> </ul>

## Annotation of the work program of the discipline "Modern problems of clinical morphology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). Curriculum lectures (18 hours), practical classes (18 hours), independent work (36 hours). The discipline is implemented in the 2nd year in the 3rd semester. Assessment of learning outcomes: credit.

Target: study of the structural foundations of diseases, their etiology and pathogenesis, pathomorphological manifestations, complications, outcomes and causes of death and their clinical comparisons to use the acquired knowledge in clinical departments and in the work of a doctor. The discipline is associated with the improvement of old and the introduction of new diagnostic methods (laboratory and instrumental).

### Tasks:

- acquisition by students of knowledge about the etiology, pathogenesis and morphology of diseases at different stages of their development (morphogenesis), the structural foundations of recovery, complications, outcomes and long-term consequences of diseases;
- acquisition of knowledge about new methods of in vivo morphological diagnostics of various human diseases;
- acquiring knowledge about the possibilities of clinical and morphological diagnostics aimed at the timely detection of diseases, determining the characteristics of their course and choosing the optimal treatment tactics;
- the study by students of affected tissues obtained from biopsies or surgical interventions.

### Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
Research	PC-5 It is capable of conducting a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	PC-5.1 It studies the relationship of cells, tissues and functional systems of organisms.
		PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.
		PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.

	PC-6 Able to develop experimental models, methods of cytological diagnostics, morphometry, marker histo- and cytochemistry, etc.	PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions
		PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology
		PC-6.3 Performs histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-5.1 It studies the relationship of cells, tissues and functional systems of organisms.	Knows the basics of cellular, tissue and organ communication. Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral. He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.
PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.	Knows the principles and mechanisms of cellular, tissue and organ communication. Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral. He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.
PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	Knows the principles and mechanisms of cellular, tissue and organ communication. Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral. He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.
PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions	Knows methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions Able to evaluate the results of fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions Owns methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions
PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology	Knows how to develop and evaluate an experimental research model in the field of cytology and histology Able to evaluate the results of the evaluation of an experimental model of research in the field of cytology and histology Has the skills to develop and evaluate an experimental research model in the field of cytology and histology
PC-6.3 Performs histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry	Knows the methods and algorithms for histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry Able to evaluate the results of histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry

	Proficient in histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry
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## Annotation of the work program of the discipline "Pathology"

The work program of the discipline was drawn up for students in the educational program of the master's program 06.04.01 Biology "Molecular and Cell Biology (in English)" in accordance with the requirements of the Federal State Educational Standard for the direction of training 06.04.01 Biology, approved by order of the Ministry of Education and Science of Russia dated 11.08.2020 city No. 934.

The total labor intensity of mastering the discipline is 2 z.u. (72 hours). The curriculum provides for practical classes (18 hours), independent work (54 hours). The discipline is realized on the 1st course in the 1st family. Assessment of learning outcomes: credit.

Purpose: students to master the knowledge of the mechanisms of pathological processes occurring in the human body in various diseases, molecular and cellular mechanisms for the development of pathologies, modern methods of correction.

Tasks:

1. Providing students with fundamental knowledge in the field of typical pathological processes and particular pathologies.
2. Training in the skills of analyzing the processes and mechanisms of the development of pathologies.
3. Acquaintance of students with modern approaches in the field of pathology, including oncopathology.

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (result of development)	Code and name of the indicator of achievement of competence
Research	PC-5 It is capable of conducting a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	PC-5.1 It studies the relationship of cells, tissues and functional systems of organisms.
		PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.
		PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.
	PC-6 Able to develop experimental models, methods of cytological diagnostics, morphometry, marker histo- and cytochemistry, etc.	PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions
		PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology
		PC-6.3 Performs histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
PC-5.1 It studies the relationship of cells, tissues and functional systems of organisms.	<p>Knows the basics of cellular, tissue and organ communication.</p> <p>Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p> <p>He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p>
PC-5.2 Explores the relationship of cells, tissues and functional systems of organisms.	<p>Knows the principles and mechanisms of cellular, tissue and organ communication.</p> <p>Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p> <p>He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p>
PC-5.3 Carries out a systematic analysis of the relationships between cells, tissues and functional systems of organisms.	<p>Knows the principles and mechanisms of cellular, tissue and organ communication.</p> <p>Able to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p> <p>He has the skills to assess the functional integrity of the human body, through the analysis of markers of cellular and tissue communication, including nervous and humoral.</p>
PC-6.1 Designs and carries out fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions	<p>Knows methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions</p> <p>Able to evaluate the results of fundamental research in the field of studying the patterns of structure and functioning of cells and tissues in normal, experimental and pathological conditions</p> <p>Owens methods and techniques for assessing the structure and functioning of cells and tissues in normal, experimental and pathological conditions</p>
PC-6.2 Develops and critically evaluates an experimental research model in the field of cytology and histology	<p>Knows how to develop and evaluate an experimental research model in the field of cytology and histology</p> <p>Able to evaluate the results of the evaluation of an experimental model of research in the field of cytology and histology</p> <p>Has the skills to develop and evaluate an experimental research model in the field of cytology and histology</p>
PC-6.3 Performs histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry	<p>Knows the methods and algorithms for histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry</p> <p>Able to evaluate the results of histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry</p> <p>Proficient in histo- and cytological diagnostics, morphometry, marker histo- and cytochemistry</p>