MINISTRY OF SCIENCE AND HIGHER EDUCATION OF RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education
Far Eastern Federal University
(FEFU)
SCHOOL OF BIOMEDICINE

AGREED
Head of OP
_____
(Signed) (Full name)

CLAIM
Director of the Department of Medical Biology and Biotechnology
_____
(Signed) (Acting Name)
December 30, 2021

WORK PROGRAM OF THE DISCIPLINE
Molecular genetics, human genetics
Direction of training 06.04.01 Biology
(Molecular and Cell Biology)
Form of training: full-time

Course 1 semester 1
lectures 18 h.
practical exercises 18 hours.
laboratory work - hour.
total hours of classroom load 36 hours.
independent work 27 hours.
including 45 hours to prepare for the exam.
exam 1 semester

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the direction of training 06.04.01 Biology, approved by the order of the Ministry of Education and Science of Russia dated 11.08.2020 No. 934.
The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology Protocol dated December 30, 2021 No. 5
Director of the Department of Implementing Structural Unit Ph.D., Associate Professor Kumeiko V.V.
Compiled by: Ph.D., Associate Professor Kumeiko V.V.

Vladivostok
2021

Reverse side of the RPD cover page

1. The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from "_____ __ № _____

2.The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from "__ № _____

3.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from "____ № _____

4.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from "_____ __ № _____

5.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from "_____ __ № _____

1. Goals and objectives of mastering the discipline:

Purpose: formation of the Master's student's understanding of the basic methods of analysis of the molecular organization and functioning of genetic material.

Tasks:

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

– deepening and consolidation of 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 (the result of mastery)	Code and name of the competency achievement indicator
research	PC-3 is capable of conducting research on biopolymers, their components and complexes, the structure and function of genes and genomes.	PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.
		PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking.
		PC-3.3The study of the main methods 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 competency achievement indicator	Name of the assessment indicator (the result of training in the discipline)
PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.	Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing 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, transmitting and implementing genetic information at the molecular level

PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking.	Knows the basic processes occurring in a living cell Able to characterize in detail the main processes occurring in a living cell Knowledge of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking
PC-3.3The study of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.	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 investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition 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.	Knows the structure and function 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 proteomes Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole

1. Labor intensity of discipline and types of training sessions in the discipline

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

Types of training sessions and work of the student in the discipline are:

Designation	Types of training sessions and work of the student
Lek	Lecture
Lek electr.	
Ave	Practical exercises
Pr electr.	
WED:	Independent work of the student during the period of theoretical training
including control	Independent work of the student and contact work of the student with the teacher during the period of intermediate certification

Structure of the discipline:

The form of training is full-time.

№	Name of the section Discipline	Semester	Number of hours by types of training sessions and work of the student						Intermediate attestation forms
			Lek	Lab	Ave	OK	WED	Control	
1.	Section No1	1	9	-	9	-	10	20	Exam Questions

2.	Section No2	1	9	-	9	-	17	25	Exam Questions
	Total:	1	18	-	18	-	27	45	Exam

THE STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures 18 hours.

Section 1. Fundamentals of Molecular Genetics.

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

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

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

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

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

Topic 5. X-ray diffraction analysis in molecular genetics. X-ray diffraction analysis. Radioactive isotopes.

Topic 6. Chromatographic research methods in molecular genetics. Ultracentrifugation. Chromatography. Electrophoresis. Chemical modification of proteins.

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

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

IV. STRUCTURE AND CONTENT OF THE PRACTICAL PART OF THE COURSE AND INDEPENDENT WORK

Practical training of 18 hours.

Topic 1. Patterns of inheritance of traits. The subject and methodology of genetics. Stages of development of genetics. The place of genetics in the system of biological sciences and its relationship with practice. Heredity. Principles and

methods of genetic analysis. Genes and alleles. Patterns of inheritance of traits in mono-, di- and polyhybrid crossings.

Topic 2. Patterns of inheritance of traits. Linked inheritance and crossover. Chromosome theory. Extranuclear inheritance: plastid, plasmid, mitochondrial inheritance. Inheritance of endosymbionts and through infection.

Topic 3. Proof of the role of DNA in heredity. Genes and Enzymes. Watson-Crick Model as the Basis of Gene Replication, Mutagenesis, and Specificity. Properties of the Genetic Code. Gene Theory.

Matrix processes: DNA replication, transcription, translation. Regulation of the action of genes. The concept of the operon. Features of gene regulation in eukaryotes.

Topic 4. Types of variability: hereditary, modificational, combinatorial, mutational, ontogenetic. Mutational theory of Korzynski-De Vries. Spontaneous and induced mutational process. Classification of mutations. The law of homological series in hereditary variability of N.I. Vavilov.

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

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

Independent work

Topic 1. "Genetic Engineering".

The student chooses one transgenic organism at his discretion, and describes it according to the following plan: the purpose of creation, the description of new properties, the description of the method of creation, the result, the possible impact of the organism on the environment.

Topic 2. "Human genetics": Hereditary human diseases caused by gene and chromosomal mutations (the student chooses one disease and in the abstract presents a description of one disease, its causes, clinical picture, frequency of occurrence).

1. Down syndrome
2. Edwards syndrome
3. Patau syndrome
4. Shereshevsky-Turner syndrome
5. Kleinfelter syndrome
6. Cystic fibrosis
7. Phenylketonuria

8. Galactosemia
9. Congenital hypothyroidism
10. Androgenital syndrome
11. Aniridia
12. Marfan syndrome
13. Neurofibromatosis
14. Huntington's Chorea
15. Ichthyosis
16. Hemophilia A
17. Osteogenesis imperfecta
18. Color blindness

V. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF INDEPENDENT WORK OF STUDENTS

Recommendations for independent work of students

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

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

- preparatory (setting goals, drawing up a program, preparing methodological support, preparing equipment);
- basic (implementation of the program, the use of methods of information retrieval, assimilation, processing, application, transfer of knowledge, fixation of results, self-organization of the work process);
- final (assessment of the significance and analysis of the results, their systematization, assessment of the effectiveness of the program and methods of work, conclusions on the directions of labor optimization).

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

according to a personal individual plan, depending on his preparation, time and other conditions.

Methodical recommendations for independent work of students

As the material on the subject of the discipline is mastered, it is planned to perform independent work of students on the collection and processing of literary material to expand the field of knowledge in the discipline under study, which allows you to deepen and consolidate specific practical knowledge gained in classroom classes. To study and fully master the program material on the discipline, educational, reference and other literature recommended by this program, as well as specialized periodicals, are used.

When independently preparing for classes, students take notes on the material, independently study the issues on the topics covered, using the educational literature from the proposed list, periodicals, scientific and methodological information, databases of information networks.

Independent work consists of such types of work as the study of material on textbooks, reference books, videos and presentations, as well as other reliable sources of information; preparation for the zechet. To consolidate the material, it is enough, flipping through the notes or reading it, mentally restore the material. If necessary, refer to the recommended educational and reference literature, write down incomprehensible moments in the questions to understand them in the upcoming lesson.

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

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

2) Deepening knowledge on the proposed topics. It is necessary to differentiate the available material in lectures, textbooks in accordance with the points of the plan of the practical lesson. Separately write out unclear questions, terms. It is better to do this in the margins of the lecture notes or textbook. Clarification should be carried out with the help of reference literature (dictionaries, encyclopedic publications, etc.);

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

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

There are no special requirements for the provision and design of the results of this independent work.

Control over the implementation of the plan of independent work of students is carried out by the teacher in practical classes by interviewing and by including in the final tasks specified in the lesson from the plan of independent work.

VI. MONITORING THE ACHIEVEMENT OF COURSE OBJECTIVES

No p/n	Supervised sections / topics of the discipline	Achievement indicator code and name	Learning outcomes	Assessment tools	
				current control	Intermediate-accurate certification
1.	Section 1. Fundamentals of Molecular Genetics	PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.	Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing 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, transmitting and	Testing	Exam Questions

			implementing genetic information at the molecular level		
		PC-3.2 Describes in detail the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking.	Knows the basic processes occurring in a living cell Able to characterize in detail the main processes occurring in a living cell Knowledge of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking	Interview	Exam Questions
2.	Section 2. Methods for studying the structure of nucleic acids and proteins	PC-3.3 Investigates the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.	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 investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition of a multicellular organism	Testing	Exam Questions

		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, individual proteins and the proteome as a whole Able to analyze the structure of the function of genes and genomes, proteins and proteomes Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole	Testing	Exam Questions

VII. LIST OF REFERENCES AND INFORMATION AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Main literature

1. Kosterin, O. E. Osnovy genetici. In 2 parts. Part 1. Basic concepts, sex definition and related issues, genetic recombination: textbook / O. E. Kosterin ; edited by V. K. Shumny. — Novosibirsk : Novosibirskiy gosudarstvennyi universitet, 2015. — 409 c. — ISBN 978-5-4437-0447-0. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/93472.html

2. Kosterin, O. E. Osnovy genetici. In 2 parts. Part 2. Chromosomal rearrangements, polyploidy and aneuploidy, mobile genetic elements and genetic transformation, genetics of quantitative traits and population genetics: textbook / O. E. Kosterin ; edited by V. K. Shumny. — Novosibirsk : Novosibirskiy gosudarstvennyi universitet, 2016. — 247 p. — ISBN 978-5-4437-0575-0, 978-5-4437-0484-5 (part 2). — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/93473.html

3. Medical Biology and General Genetics : textbook / R. G. Zayats, V. E. Butvilovsky, V. V. Davydov, I. V. Rachkovskaya. — 3rd ed. — Minsk : Vysheisha shkola, 2017. — 480 c. — ISBN 978-985-06-2886-2. — Text : electronic // Digital

educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/90714.html

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

5. Zhimulev, I. F. Obshchaya i molecular'naya genetica : uchebnoe posobie dlya vuzov / I. F. Zhimul'ev ; edited by E. S. Belyaev, A. P. Akifiev. — Novosibirsk : Sibirskoe universitetskoe izdatelstvo, 2017. — 480 c. — ISBN 978-5-379-02003-3. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/65279.html

6. Petukhova, E. V. Molecular biology with elements of genetics and microbiology : uchebnoe posobie / E. V. Petukhova, Z. A. Kanarskaya, A. Y. Krynitskaya. — Kazan : Kazan National Research Technological University, 2019. — 96 c. — ISBN 978-5-7882-2690-3. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/109560.html

7. Genetics : uchebnoe posobie / M. N. Sitnikov, Z. I. Bogotova, M. M. Bittueva [i dr.]. — Nalchik : Kabardino-Balkar State University named after Kh.M. Berbekov, 2019. — 119 p. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/110223.html

8. Fundamentals of Genetics / W. -S. Klag, M. -R. Cummings, S. -A. Spencer [et al.] ; translated by A. A. Lushnikov. — Moscow : Technosphere, 2021. — 982 c. — ISBN 978-5-94836-623-4. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/127993.html

9. Kosterin, O. E. Osnovy genetics : uchebnik / O. E. Kosterin. — 2nd ed. — Novosibirsk : Novosibirsk State University, 2022. — 650 c. — ISBN 978-5-4437-1323-6. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/128138.html

10. Genetics : textbook for universities / P. S. Katmakov, V. P. Gavrilenko, A. V. Bushov, E. I. Anisimova ; edited by P. S. Katmakov. — Moscow : Izdatelstvo Yurait, 2023. — 278 p. — (Higher education). — ISBN 978-5-534-14484-0. — Text : electronic // Educational platform Yurait [site]. — URL: https://urait.ru/bcode/519244

Further reading

1. Alikhanyan, S.I. General genetics / S.I. Alikhanyan, A.P. Akif'ev, L.S. Chernin. – M.: Vysshaya shkola, 1985. – 445 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:51675&theme=FEFU

2. Kartel', N.A. Genetics [Elektronnyi resurs]: entsiklopedicheskii slovar'/ N.A. Kartel', E.N. Makeeva, HOURS Mezenko. –Electron. text data. – Minsk: Belorusskaya nauka, 2011. – 992 c. http://www.iprbookshop.ru/10080.html

3. Obshchaya i molecular'naya genetica [Elektronnyi resurs]: uchebnoe posobie dlya vuzov / I.F. Zhimul'ev; ed. E.S. Belyaev, A.P. Akifiev. –Electron. text data. – Novosibirsk: Siberian University Publishing House, 2017. – 480 c. http://www.iprbookshop.ru/65279.html

4. Prikhodchenko, N.N. Fundamentals of human genetics / N.N. Prikhodchenko, T.P. Shkurat. – Rostov-on-Don, 1997. – 368 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:22318&theme=FEFU

5. Slyusarev, A.A. Biology with general genetics: textbook / A.A. Slyusarev. - M: Alliance. 2015. – 471 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:777136&theme=FEFU

6. Topornina, N.A. Genetics of man: practicum for universities / N.A. Topornina, N.S. Stokinskaya – M.: VLADOS, 2001. – 96 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:15677&theme=FEFU

7. Shchelkunov, S.N. Genetic engineering / S.N. Shchelkunov. – M.: Meditsina, 2004. – 496 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:6586&theme=FEFU

8. Efroimson, V.P. Genetics of genius / V.P. Efroimson. – M.: Tydex Ko, 2003. – 376 p. http://lib.dvfu.ru:8080/lib/item?id=chamo:3545&theme=FEFU

9.

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

1. http://elibrary.ru/ - scientific electronic library
2. http://molbiol.ru/ is an information resource on molecular biology
3. http://macroevolution.narod.ru/ is an electronic resource on evolutionary biology.
4. http://science.km.ru/- electronic resource on different sections of biology
5. http://elementy.ru/ is an information and cognitive resource dedicated to the natural sciences.
6. http://www.iprbookshop.ru/ is an electronic library system IPRbooks.
7. http://znanium. com/ - EBS "Znanium".
8. https://nplus1. ru/ - N+1, a popular science online publication on science, engineering and technology
9. http://antropogenez.ru/ - popular science information resource about human evolution

10. http://web.a.ebscohost.com/ehost/search/basic?sid=851485f8-6200-4b3e-aaab-df4ba7be3576@sessionmgr4008&vid=1&tid=2003EB is a collection of books on various sections from the EBSCOhost database.

11. http://rosalind.info/problems/locations/- resource for self-study of bioinformatics Rosalind.

12. http://www.ncbi.nlm.nih.gov/- website of the National Center for Biotechnology Information NCBI.

13. http://www.mendeley.com/- *Mendeley*: Free reference manager and PDF organizer; biblithecar program.

14. http:// www.ebi.ac.uk- website of the European Bioinformatics Institute

15. http:// www.scopus.com – Bibliographic database and Scopus citation index

16. http://thomsonreuters.com/thomson-reuters-web-of-science/ bibliographic database and Web of Science citation index

List of information technologies and software

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

VIII.METHODICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

Lecture

The lecture- is the main active form of conducting classroom classes, explaining the fundamental and most difficult theoretical sections of molecular

biology and the theory of genetic engineering, which involves intensive mental activity of the student and is especially important for mastering the subject. The lecture should always be cognitive, developmental, educational and organizing in nature. Lecture notes help to assimilate the theoretical material of the discipline. When listening to the lecture, it is necessary to take notes main information, preferably in your own wording, which allows you to better remember the material. The abstract is useful when it is written by the student independently.

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

To present a lecture course in the discipline "Neurobiology", the following are used as forms of active learning: lecture-conversation, lecture-visualization, which are based on the knowledge gained by students in the framework of the subjects preceding the course. To illustrate verbal information, electronic presentations, tables, video files, diagrams on the board are used. In the course of the presentation of the lecture material, problematic questions or questions with elements of discussion are posed.

Lecture – visualization

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

Lecture - conversation

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

learn how to form questions. The advantage of the lecture-conversation is that it allows you to attract the attention of students to the most important issues of the topic, determine the content and pace of presentation of the educational material, as well as determine the topics of interest to students, with the aim of possibly adjusting the form of the material taught.

Labs

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

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

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

Necessary structural elements of the laboratory lesson:

- instruction conducted by the teacher;
- independent activity of students;
- discussion of the results of the laboratory work (task).

Before performing a laboratory task (work), students' knowledge is tested - their theoretical readiness to perform the task.

Laboratory task (work) can be reproductive, partially search and search in nature.

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

The works, which are **of a partial-exploratory** nature, differ in that when conducting students do not use detailed instructions, they are not given the order of performing the necessary actions, students are required to independently select equipment, choose ways to perform work, instructional and reference literature.

Works of **a exploratory** nature are distinguished by the fact that students must solve a new problem for them, relying on their theoretical knowledge.

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

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

Research skills and professional competencies are formed.

IX. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

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

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

Logistics and Software Discipline

Name of special premises and premises for independent work	Equipment special premises and rooms for independent work	List of licensed software. Details of the supporting document
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 605	Multimedia audience: 236*147 cm Trim Screen Line; DLP Projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1	-

	EW330U Mitsubishi; Specialized Equipment Mount Subsystem CORSA-2007 Tuarex; Video Switching Subsystem: DVI DXP 44 DVI Protron Matrix Switch DVI 201 Tx/Rx Extron Twisted Pair Extension Cable; Audio Switching and Sound Amplification Subsystem; SI 3CT LP Extron Ceiling Mount Speaker; DMP 44 LC Extron Digital Audio Processor; Extension for IPL T CR Control Controller 48; Wireless LANs for trainees are provided with a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. HP All-in-One 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, WT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 422	Multimedia audience: Monoblock HP ProOne 400 G1 AiO 19.5" Intel Core i3-4130T 4GB DDR3-1600 SODIMM (1x4GB)500GB; Projection screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector, Mitsubishi FD630U, 4000 ANSI Lumen, 1920x1080; Mortise interface with TLS TAM 201 Stan automatic cable retraction system; Avervision CP355AF Visualizer; Microphone cordless radio system UHF band Sennheiser EW 122 G3 consisting of a wireless microphone and receiver; LifeSizeExpress 220-Codeconly- Non-AES video conferencing codec; Network video camera Multipix MP-HD718; Two 47" LCD panels, Full HD, LG M4716CCBA; Subsystem of audio switching and sound amplification; centralized uninterrupted power supply	-
690922, Primorsky Krai, Vladivostok, Russky Island,	Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope	-

Saperny Peninsula, Ajax village, 10, aud. M 627	with digital camera Altami BIO8 (2 pcs).	
Computer Class of the School of Biomedicine Aud. M723, 15 workplaces	Screen with electric drive 236 * 147 cm Trim Screen Line; Projector DLP, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; Subsystem of specialized fasteners of equipment CORSA-2007 Tuarex; Video switching subsystem: DVI DXP 44 DVI Pro Extron matrix switch; DVI twisted pair extender DVI 201 Tx/Rx Extron; Subsystem of audio switching and sound amplification; acoustic system for ceiling mounting SI 3CT LP Extron; digital audio processor DMP 44 LC Extron; extension for IPL T CR48 management controller; Wireless LANs for trainees are provided with a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. HP All-in-One 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, WT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	-

X. VALUATION FUNDS

Code and name of the competency achievement indicator	Name of the assessment indicator (the result of training in the discipline)
PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation of genetic information at the molecular level.	Knows the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing genetic information at the molecular level Able to investigate the structure and functions of biopolymers, their components and complexes, mechanisms for storing, transmitting and implementing 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, transmitting and implementing genetic information at the molecular level
PC-3.2 Detailedly characterizes the main processes occurring in a living cell: the processes of replication, transcription, translation, recombination, repair, processing of RNA and proteins, protein folding and docking.	Knows the basic processes occurring in a living cell Able to characterize in detail the main processes occurring in a living cell Knowledge of replication, transcription, translation, recombination, repair, RNA and protein processing, protein folding and docking
PC-3.3The study of the main methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism.	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 investigate intermolecular interactions and mutual regulation of the processes of functioning of a living cell Possesses the skills of studying intermolecular interactions and mutual regulation of the processes of functioning of a living cell in the composition 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.	Knows the structure and function 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 proteomes Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole

The following assessment tools are used for discipline:

1. Interview
2. Testing

Interview.

A means of control, organized as a special conversation of the teacher with the student on topics related to the discipline being studied, and designed to clarify the amount of knowledge of the student on a certain section, topic, problem, etc.

Topic 1. "Formation of ideas about the gene. Reparation. Recombination»

Interview Questions:

1. The main stages of development of the concept of the gene.
2. Evidence of mutational and recombination gene divisibility.
3. The concept of "one gene-one polypeptide chain".
4. Types of reparation processes.
5. Excisional DNA repair.
6. Types of recombinations, their meaning.
7. Molecular model of general recombination according to Hollide

Topic 2. "Population genetics"

Interview Questions:

1. Genetic structure of the population.
2. The Hardy-Weinberg Law: Its Meaning and Application.
3. Factors of population dynamics.
4. Genetic heterogeneity of populations and methods of its study.

Interview Score: Credited / Not Credited.

Evaluation criteria:

"Credited" is exhibited to the student if he has shown a sufficiently solid knowledge of the main provisions of the topic under study.

"Not credited" is exposed to the student if the answer revealed significant gaps in the knowledge of the main provisions of the topic.

Testing.

Testing is the most effective and objective form of assessing knowledge, skills and abilities, which allows to identify not only the level of educational achievements, but also the structure of knowledge, the degree of its deviation from the norm. Testing involves a standardized, verified procedure for collecting and processing data, as well as their interpretation, allows you to check the knowledge of students on a wide range of issues. Testing excludes the subjectivity of the teacher, both in the process of control and in the process of assessment.

Assessment tool 1. Test work

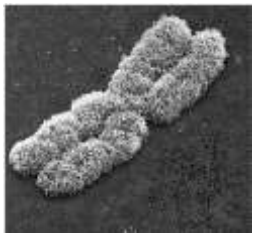
Test work is a tool for testing the skills to apply the acquired knowledge to solve problems of a certain type on a topic or section.

Topic "Cytological bases of heredity"

Example:

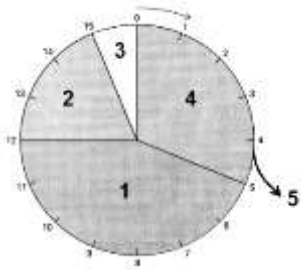
Option X

1. Determine the type of chromosome



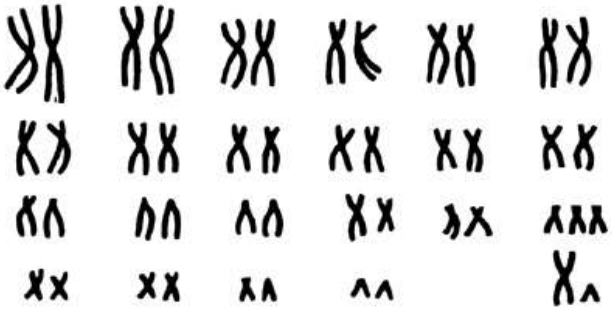
a) telocentric
b) acrocentric
c) submethacentric
d) metacentric

2. Identify the stages of the cell cycle



a) G1
b) S
c) G2
d) Mitosis
e) G0

3. Determine whose karyotype it is



a) healthy woman
b) healthy man
c) woman with Down syndrome
d) a man with Down syndrome
e) a woman with Shereshevsky Turner syndrome
f) a man with Patau syndrome
g) a man with a syndrome
h) Edwards

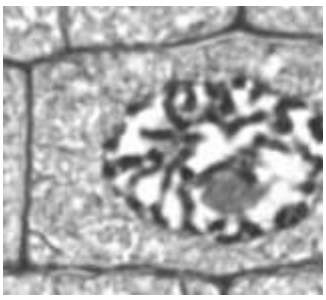
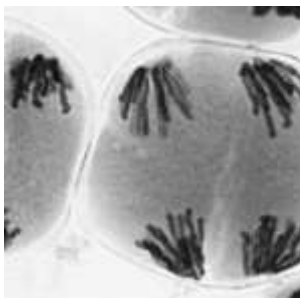
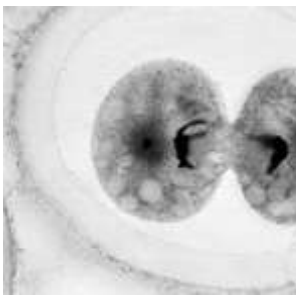
4. The result of mitosis are cells:

a) 2n4c
b) nc
c) n2c
d) 4n4c
e) 2n2c
f) 2nc

4. Define a stage

5. Define a stage

6. Define a stage

(select a through i from the list below the pictures*)*

a) Prophase mitosis ,
b) Metaphase of mitosis
c) Interface
d) Metaphase 2
e) Cytokinesis
f) Anaphase 2
g) Anaphase mitosis
h) Telophase mitosis
i) Telophase 2

8. Compare mitosis in plant and animal cells
9. Somatic conjugation
10. Periods G1, G0

The test work is assessed on a five-point scale,

Evaluation criteria:

correct answers to questions 1-7 are estimated at 0.3 points, for questions 8, 9 and 10 - at 1 point.

Assessment tool 2. Task Set

Didactic complex designed for independent work of the student and allowing to evaluate and diagnose the ability to synthesize, analyze, summarize factual and theoretical material with the formulation of specific conclusions, the establishment of cause-and-effect relationships

A set of 8 tasks on the topic "Inheritance patterns"

Option X

7). The color of the silver-sable mink (F) dominates over brown (standard - f). Homozygosity in the F gene leads to the death of puppies. Silver-sable mink has a sharp contrast in the color of down and covering hair. When crossing silver-sable minks with each other, 63 puppies were born.

1. How many types of gametes can a mother have?
2. How many genotypes did the F1 puppies have?
3. How many phenotypes did the F 1 puppies have?
4. What kind of phenotype cleavage is observed in F1 puppies?
5. How many wild (standard) puppies were born?

1). One of the parents has the second blood group, the child - the fourth. What blood type can the second parent have?

43). The black coarse-haired guinea pig was crossed with coarse-haired albino (In guinea pigs, the black coat color (B) dominates the white (b), coarse hair (R) over the smooth coat (r). The R and B genes are inherited independently. The offspring turned out to be 13 black coarse-haired, 15 coarse-haired albinos, 5 black smooth-haired and 5 smooth-haired albinos.

6. Indicate what kind of splitting the offspring will have according to two characteristics.

1. How many types of gametes can a mother give?
2. How many types of gametes can a father give?
3. Can they give cleavage with further crossing of smooth-haired albinos?
4. How many types of gametes can black smooth-haired guinea pigs produce?

77). Pastel minks (bb) have a pubescence of light brown to brown color, somewhat lighter in color mink falcon ($t^s t^s$). When they are crossed in F1, brown puppies of the standard type are born. From crossing F1 with each other, 254 brown puppies of the standard type, 82 types of pastels, 87 falcons and 27 new light beige coloring of the falcon pastel were born in F 2,254 brown puppies.

1. How many types of gametes could F1 hybrids produce?
2. How many different genotypes could there be in F2?
3. How many phenotypes did the$_{F2}$ hybrids have? What type of inheritance?
4. How many fully homozygous genotypes were there in F2? What color did they have?
5. How many of the F2 were the dominant genotypes for the 2 genes?

91). In goldfish, the genes S and s determine the light color of the body, the M gene - dark and it is epistatic to the genes S and s. The interaction of two non-allelic recessive genes m and s causes albinism.

When crossing homozygous dark (MMss) and light (mmSS) in coloration of fish, dark offspring F 1 appeared. Later, when crossing F1 with each other, 320 individuals appeared in F_2.

1. How many types of gametes do F1 hybrids produce?
2. How many different genotypes could F_2 hybrids have?
3. How many phenotypes could F_2 hybrids have?
4. How many individuals in F2 had dark body coloration?
5. How many individuals in F2 were albinos?

5). As a result of the study of one type of rye, he was found to have a strong variability in the pubescence of the stem (from 60 hairs on to the complete absence of pubescence). It was assumed that this variability is due to three pairs of polymeric

genes with cumulative action. When crossing a plant with a pubescent of 60 hairs on an unpubescent plant, 17 F1 plants were obtained from self-pollination of which 64 F2 plants were obtained. 1 см1 см

1. What was the pubescence of the F1 plants?
2. How many phenotypes will there be in F2?
3. How many F2 plants will have the same pubescence as F1?
4. How many F2 plants will have a stronger pubescence than F1?
5. How many F2 plants will be unpubescent?

163). In chickens, the B gene is localized on the X chromosome and is responsible for the ripple type of stainability. This gene is dominant in relation to the smooth type of stainability (b). The rippled chicken was paired with a heterozygous rooster. 80 chicks hatched.

1. How many rippled chickens have appeared from this crossing?
2. How many chickens were there with a smooth type of plumage?
3. How many hemizygotic cockerels were there from this crossing?
4. How many rippled chickens were there?
5. How many chickens had smooth plumage?

162). In Drosophila, the gene for white eye coloration (w) is localized on the sex chromosome, red-eyedness dominates white-eyedness. The body coloration gene is in the autosome, the gray (B) body dominates the black (b). A white-eyed female with a gray body interbreeds with a red-eyed black male. 172 flies have been bred.

1. How many red-eyed flies were hatched in F1, what sex were they?
2. How many white-eyed flies were bred in F1, what sex were they?
3. How many gametes can a hybrid female F1 give?
4. How many gametes can a hybrid male F1 give?
5. How many gray body flies were born?

Score for a set of tasks: credited / not counted.

Evaluation criteria:

"Credited" is exposed to the student with the correct solution of all problems, the task is considered solved correctly, with the correct answers to all the questions of the problem

"Not credited" is displayed to the student in case of an incorrect decision

Test Evaluation Criteria

evaluation	50-60 points (unsatisfactory)	61-75 points (satisfactory)	76-85 points (good)	86-100 points (excellent)

Methodological recommendations that determine the procedures for assessing the results of mastering the discipline

Assessment tools for intermediate attestation

Intermediate certification of students in the discipline is carried out in accordance with local fefu regulations and is mandatory. The form of reporting on the discipline is an exam.

Methodical instructions for passing the exam

The exam is taken by the leading teacher (associate professor, professor), for whom this type of educational load is assigned in an individual plan. The form of the exam is oral.

The time allowed to the student to prepare for the answer to the exam should be no more than 40 minutes. After this time, the student should be ready to respond.

The presence at the examination of unauthorized persons (except for persons carrying out the inspection) without the permission of the relevant persons (rector or vice-rector for academic affairs, director of the School, head of the OBOR or director of the department) is not allowed. Disabled persons and persons with disabilities who do not have the opportunity to move independently are allowed to take the exam with accompanying persons.

With an intermediate assessment, students are given a grade of "excellent", "good", "satisfactory" or "unsatisfactory". If the student does not appear for the exam, an entry "did not appear" is made in the statement.

Exam Questions

1. Methods of genetics, its importance, the main stages of the development of genetics. The role of domestic scientists in the development of genetics.

2. Methods of genetics: hybridological, cytological, mutational, molecular-genetic, mathematical, etc.

3. Chromosomes: structure and function. Hetero- and euchromatin regions of chromosomes. Karyotype, its characteristics.

4. Molecular organization of chromosomes. Chromatin packing levels. Nucleosomes.

5. Genetic material, genetic information. The role of the nucleus and chromosomes in the phenomena of heredity.

6. Cell cycle: its periods. Mitosis: phases of mitosis, genetic and biological role of mitosis.

7. Meiosis and sexual reproduction. Phases and stages of meiosis, its genetic role. Features of meiosis in plants and animals.

8. Common features and differences between mitosis and meiosis, their genetic role.

9. Homo- and heterozygosity. Conditions necessary for hybridological analysis. The significance of the works of G. Mendel.

10. Patterns of inheritance in mono- and dihybrid crossing. Allelic interaction of genes, the law of "purity" of gametes.

11. Patterns of inheritance in di- and polyhybrid crossings. Statistical nature of splitting.

12. Non-allelic gene interactions: complementarity, epistasis, pleiotropy, polymeria.

13. Non-allelic interaction of genes. Expressiveness and penetrance.

14. Extranuclear inheritance. Plastid and mitochondrial inheritance. Cytoplasmic male sterility in plants.

15. Extranuclear inheritance. Inheritance through infection, viruses, extrachromosomal elements. Maternal effect of the cytoplasm.

16. Genetics of sex. Sex chromosomes. Types of chromosomal sex determination. Balance theory of sex determination.

17. Inheritance of sex-restricted and sex-dependent traits. Adhesion to the floor.

18. Chromosomal theory of heredity of T. Morgan. Features of inheritance in gene chaining. Crossingover.

19. The main provisions of the chromosomal theory of heredity.

20. Frequency of recombinations and construction of genetic maps in eukaryotes. The importance of analyzing crossbreeding in the study of crossover.

21. Types of recombinations, their significance. Molecular model of general recombination according to Hollide

22. Evidence of the genetic role of nucleic acids. DNA and RNA. Dna model of J. Watson and F. Crick.

23. Genetic code. The structure and main features of the genetic code.

24. DNA replication. The concept of a replicon. Events in the replication fork. Genetic control of replication.

25. Nucleic acid functions in the implementation of genetic information (replication, transcription, translation).

26. Types of structural DAMAGE to DNA and reparative processes. Excisional DNA repair.

27. The concept of hereditary and non-hereditary variability. The norm of the genotype reaction.

28. Modification variability. Types of modifications, the mechanism of their occurrence, the meaning.

29. Mutation theory. Classification of the main forms of variability of genetic material.

30. Mutational process. The idea of mutations as rare, random, undirected changes in genetic material.

31. Mutagens and antimutagens. The idea of direct and reverse mutations, adaptive, neutral, lethal, generative, vegetative, recessive, dominant mutations.

32. Spontaneous and induced mutational process. Mutagens: classification, mechanism of action. Antimutagens. The mechanism of the mechanism of mutagenic action of base analogues.

33. Gene mutations: classification, mechanisms of their occurrence, genetic role.

34. Chromosomal rearrangements: types, mechanism of occurrence, value. The role of chromosomal mutations in evolution.

35. Genomic changes: polyploidy, aneuploidy. The role of polyploidy in evolution and selection.

36. Genetic and cellular engineering: their importance for solving problems of biotechnology, agriculture, medicine. Obtaining transgenic organisms.

37. Biochemical genetics: genes and enzymes. The concept of "one gene-one polypeptide chain".

38. The main stages of the development of the concept of the gene. Evidence of mutational and recombination gene divisibility.

39. Molecular structure of the gene in prokaryotes and eukaryotes. Intron-exon organization of genes in eukaryotes. Splicing.

40. Control of gene expression. The theory of Jacob and Monod. Genetic analysis of lactose operon.

41. Regulation of gene expression. The concept of an operon. Regulatory genes.

42. Genetic structure of the population. The Hardy-Weinberg Law: Its Application and Significance.

43. Factors affecting the dynamics of the genetic composition of the population. The main forms of selection in populations.

44. Organization of the genetic apparatus in bacteria. Methods used in genetic analysis in bacteria and bacteriophages.

45. Genetic analysis in prokaryotes and eukaryotes. Genetic recombination in bacteria: conjugation, transformation, transduction.

46. Transposons, plasmids, episomes. The role of mobile genetic elements in genetic processes.

47. Basics of genetic engineering. Methods of synthesis and isolation of genes. The concept of vectors. Methods of gene cloning.

48. Human genetics. Methods of studying human genetics. Genetic diseases. Human Genome Project

49. Hereditary human diseases caused by gene and chromosomal mutations.

50. Causes of hereditary and congenital diseases in humans. Genetic diseases.

Criteria for grading a student on the exam

Evaluation of the test	Requirements for the formed competencies
"Excellent"	The "excellent" grade is given to the student if he has deeply and firmly mastered the program material, exhaustively, consistently, clearly and logically coherently presents it, is able to closely link the theory with practice, freely copes with tasks, questions and other types of application of knowledge, and does not find it difficult to answer when modifying tasks, uses the material of monographic literature in the answer, correctly justifies the decision made, has versatile skills and techniques implementation of practical tasks on the methodology of scientific research.
"Good"	The "good" grade is given to the student if he firmly knows the material, correctly and substantively presents it, avoiding significant inaccuracies in the answer to the question, correctly applies theoretical provisions when solving practical questions and problems, possesses the necessary skills and techniques for their implementation.
"satisfactory"	The grade "satisfactory" is given to the student if he has knowledge only of the basic material, but has not mastered its details, admits inaccuracies, insufficiently correct wording, violations of the logical sequence in the presentation of the program material, has difficulties in performing practical work.
"unsatisfactory"	The grade "unsatisfactory" is given to a student who does not know a significant part of the program material, makes significant mistakes, uncertainly, with great difficulties performs practical work. As a rule, the grade "unsatisfactory" is given to students who cannot continue their studies without additional classes in the relevant discipline.