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 06, 2022

WORK PROGRAM OF THE DISCIPLINE
Big Data Modeling and Analysis in Biology
Direction of training 06.04.01 Biology
(Molecular and Cell Biology)
Form of training: full-time

Course 2 semester 3
lectures 10 hours.
practical exercises 26 hours.
laboratory work - hour.
total hours of classroom load 36 hours.
independent work 72 hours.
Credit 3 semester
exam is not provided

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 06, 2022 No. 2
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
2022

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: 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 mathematical modeling of biological systems;

2) introduce specific mathematical models that the research biologist can apply (adapt) to his research;

3) to expand knowledge on the use of software tools in the modeling of biological processes.

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-1 Is able to creatively use in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines (modules) that determine the scope of molecular and cell biology.	PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell 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 production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cell biology
	PC-2 is able to apply the methodological foundations of design, perform laboratory biological, environmental research, use modern equipment and computing complexes in molecular and cell biology.	PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.
		PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.
		PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.

Code and name of the competency achievement indicator	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases.	Knows features of work with scientific literature in the field of biology and sources of information. Can Workwith scientific and technical information and special literature, study the achievements of domestic and foreign science in the field of molecular and cell 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 the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows the basic mechanisms of biology at the molecular and cellular levels. Can 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. Owns skills in detecting patterns and the relationship between various processes of biology and related disciplines.
PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cell biology	Knows on the features of scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Can to use in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Owns skills in 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 the design, implementation of laboratory biological and environmental research.	Knows methodological foundations of design, implementation of field and laboratory biological, environmental studies Can develop rules and algorithms for designing, performing laboratory biological and environmental studies Owns skills in the development and improvement of new rules and algorithms for designing, performing laboratory biological, environmental research
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows modern classification of methods of scientific research, specifics and boundaries of their applicability; – the specifics of research characteristic of various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research; the main methods of statistical analysis: correlation, regression and variance

	Can use methods of statistical analysis to assess the reliability of data, compare empirical and theoretical systems, find the relationship between the variables that characterize the state of the system Owns the ability to independently analyze the available information, identify fundamental problems, set the task
PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.	Knows basic modern field and laboratory methods of biology and ecology research Can work on modern analytical equipment of a modern biological laboratory Owns modern methods of research in ecology and biology

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	Se me ster	Number of hours by types of training sessions and work of the student						Intermediate attestation forms
			Lek	Lab	Av e	OK	WE D	Cont rol	
1.	Topic 1	3	1	-	4	-	12	-	Questions for credit
2.	Topic 2-4		2	-	5	-	12	-	
3.	Topic 5		1	-	5	-	12	-	

4.	Topic 6-7		2	-	3	-	12	-	
5.	Topic 8		2	-	4	-	12	-	
6.	Topic 9		2	-	5	-	12	-	
	Total:	3	10	-	26	-	72	-	Credit

THE STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures of 10 hours.

Topic 1. Introduction.

Cybernetic ideas about the biosystem. Control system. Adaptation of the system. Trigger systems. Parallelogram rule. Negentropic ideas about the biosystem. Negentropy. Approaches to evaluation. Nonlinear Thermodynamics of Biosystems. Macroparameter, microparameter. Macro process and microprocess. Interaction of micro- and macro processes in the process of evolution. The kernel of the program/operating system in cybernetic devices.

Topic 2. The concept of a model.

The concept of a model. Pattern. Patterns in Biology and Medicine. Objects, goals and methods of modeling. Classification of mathematical models. Models in different sciences. Computer and mathematical models. The history of the first models in biology. Modern classification of models of biological processes. Regression, simulation, qualitative models. Principles of simulation modeling and examples of models. Specifics of modeling of living systems.

Topic 3. Differential and integral equations

The concept of the derivative and the ways of finding it (differentiation rules). Integral and methods of finding integrals. Geometric representation of the derivative, differentials and integrals. The physical meaning is differential equations. Multidimensional differential equations and their spaces. Differential and integral calculus software.

Topic 4. Stages of mathematical modeling

Organization of mathematical modeling. Plan of mathematical modeling. Stages of mathematical modeling. Problem Statement: Definition of the purpose of the analysis and the ways to achieve it. The study of the theoretical foundations and

the collection of information about the object of the original. Formalization. Choosing a solution method. Implement the model. Analysis of the information received. Verification of adequacy to the real object

Topic 5. Models described by systems of two autonomous differential equations.

Phase plane. Phase portrait. Phase space and phase trajectories. Isoclean method. The main isoclines. Stability of the stationary state. Linear systems. Types of special points: knot, saddle, focus, center. Examples. Predator-prey model.

Topic 6. Examples of mathematical models in biology and medicine.

Theory of bifurcations of dynamical systems. Z-transformation (Laurent transform). Cuvier's catastrophism. Catastrophe theory. Seven elementary catastrophes according to Tom. A Crease-type disaster. An "Assembly" type disaster. A Butterfly-type disaster. The Lastochkin Tail Disaster (Discriminator polynomial).

Topic 7. Examples of mathematical models in biology and medicine.

Analysis of some models of population growth. Malthus model. Verhulst's logistic model. Flow-through cultivator model.

Topic 8. Examples of mathematical models in biology and medicine.

Models of biochemical reactions – analytical reactions of enzymatic catalysis (Michaelis - Menten, Malthus, Higgins, Reich, Selkov). Oscillatory systems. Local model of the brusselator

Topic 9. Examples of mathematical models in biology and medicine.

Models of morphogenesis. Growth of colonies of microbes. Population range growth. Growth of a cancerous tumor. Nerve impulse models. Model of the dynamics of the state of ion channels.

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

Practical training of 26 hours.

Topic 1. Introduction.

Questions to the topic.

1.Cybernetic ideas about the biosystem.

2.Control system.

3.Adaptation of the system.

4.Trigger systems.

5.Parallelogram rule.

6.Negentropic ideas about the biosystem.

7. Negentropy. Approaches to evaluation.

8. Nonlinear Thermodynamics of biosystems.

9.Macroparameter, microparameter. Macro process and microprocess. Interaction of micro- and macro processes in the process of evolution.

10.The kernel of the program/operating system in cybernetic devices.

Topic 2. The concept of a model.

1.The concept of the model.

2.Pattern. Patterns in Biology and Medicine.

3.Objects, goals and methods of modeling.

4.Classification of mathematical models.

5.Models in different sciences.

6.Computer and mathematical models.

7.History of the first models in biology.

8.Modern classification of models of biological processes. Regression, simulation, qualitative models.

9.Principles of simulation modeling and examples of models.

10.Specifics of modeling of living systems.

Topic 3. Differential and integral equations

11.The concept of the derivative and the ways of its finding (differentiation rules).

12.Integral and methods of finding integrals.

13.Geometric representation of derivative, differentials and integrals. The physical meaning is differential equations.

14.Multidimensional differential equations and their spaces. Differential and integral calculus software.

Topic 4. Stages of mathematical modeling

15.Organization of mathematical modeling.

16.Plan of mathematical modeling.

17.Stages of mathematical modeling.

18.Problem Statement: Definition of the purpose of the analysis and the way to achieve it. The study of the theoretical foundations and the collection of information about the object of the original. Formalization.

19.Choice of solution method.

20.Implementation of the model.

21.Analysis of the information received.

22.Checking the adequacy of the real object

Topic 5. Models described by systems of two autonomous differential equations.

23.Phase plane.

24.Phase portrait.

25.Phase space and phase trajectories.

26.Isoclean method. The main isoclines. Stability of the stationary state. Linear systems.

27.Types of special points: knot, saddle, focus, center.

28.Examples. Predator-prey model.

29.Topic 6. Examples of mathematical models in biology and medicine.

30. Theory of bifurcations of dynamical systems.

31.Z-transform (Laurent transform).

32. Cuvier's catastrophism.

33.Catastrophe theory.

34.Seven elementary catastrophes according to Tom.

35.Fold-type disaster.

36."Assembly" type disaster.

37.Butterfly-type disaster.

38.The Crash of the "Lastochkin's Tail" (Discriminator of the Polynomial).

Topic 7. Examples of mathematical models in biology and medicine.

39.Analysis of some models of population growth.

40.Malthus model.

41.Ferhülsst's logistic model.

42.Model of flow-through cultivator.

Topic 8. Examples of mathematical models in biology and medicine.

43.Models of biochemical reactions – analytical reactions of enzymatic catalysis (Michaelis - Menten, Malthus, Higgins, Reich, Selkov).

44.Oscillatory systems.

45.Local model of the brusselator

Topic 9. Examples of mathematical models in biology and medicine.

46.Models of morphogenesis.

47.Growth of colonies of microbes.

48.Population range growth.

49. Growth of a cancerous tumor.

50.Nerve impulse models.

51.Model of ion channel state dynamics

Independent work

Sample abstract topics

1. Modeling based on neural networks.

2. Dynamic models in biology.

3. Software simulation procedures in biology.

4. System analysis and modeling in biology.

5. Cluster analysis of sputum cells and bronchoalveolar lavage.
6. Decision support systems (DSS) in medicine.
7. Modeling of migration processes of chemical compounds in the food chain.
8. Classification of information sources for modeling biological processes.

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.	Topic 1	PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases.	Knows features of work with scientific literature in the field of biology and sources of information. Can Workwith scientific and technical information and special literature, study the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases. Owns skills to navigate in electronic databases and find the necessary information in the professional field.	Poll	Questions for credit
2.	Topic 2-4	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 the basic mechanisms of biology at the molecular and cellular levels. Can 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. Owns skills in detecting patterns and the relationship between various processes of biology and related disciplines.	Poll	Questions for credit
3.	Topic 5	PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cell biology	Knows on the features of scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Can		Questions for credit

			to use in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Owns skills in applying the acquired knowledge of immunology in scientific and production-technological activities and the study of related disciplines.		
4.	Topic 6-7	PC-2.1 Develops rules and algorithms for the design, implementation of laboratory biological and environmental research.	Knows methodological foundations of design, implementation of field and laboratory biological, environmental studies Can develop rules and algorithms for designing, performing laboratory biological and environmental studies Owns skills in the development and improvement of new rules and algorithms for designing, performing laboratory biological, environmental research	Situational tasks	Questions for credit
5.	Topic 8	PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows modern classification of methods of scientific research, specifics and boundaries of their applicability; – the specifics of research characteristic of various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research; the main methods of statistical analysis: correlation, regression and variance Can use methods of statistical analysis to assess the reliability of data, compare empirical and theoretical systems, find the relationship between the variables that characterize the state of the system Owns the ability to independently analyze the available information, identify fundamental problems, set the task	Poll	Questions for credit

6.	Topic 9	PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.	Knows basic modern field and laboratory methods of biology and ecology research Can work on modern analytical equipment of a modern biological laboratory Owns modern methods of research in ecology and biology	Situational tasks	Questions for credit

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

Main literature

1. Mathematical modeling, numerical methods and complexes of programs: Collection of scientific works / Ghazaryan M.L., Muzaev I.D., Gioeva E.G. - Moscow :SIC INFRA-M, 2018. - 150 pp. ISBN 978-5-16-106772-7 (online). - Text : electronic. - URL: https://znanium.com/catalog/product/972756
2. Mathematical Modeling and Design : Ucheb. posobie / A.S. Kolomeychenko, I.N. Kravchenko, A.N. Stavtsev, A.A. Polukhin ; ed. by A.S. Kolomeichenko. — Moscow : INFRA-M, 2018. — 181 p. — (Higher education: Magistracy). — www.dx.doi.org/10.12737/textbook_59688803c3cb35.15568286. - ISBN 978-5-16-012890-0. - Text : electronic. - URL: https://znanium.com/catalog/product/884599
3. Golitsyna, O. L. Information systems and technologies : uchebnoe posobie / O.L. Golitsyna, N.V. Maksimov, I.I. Popov. — Moscow : FORUM : INFRA-M, 2021. — 400 p. — (Secondary vocational education). - ISBN 978-5-00091-592-9. - Text : electronic. - URL: https://znanium.com/catalog/product/1138895
4. Zamyatin, A. V. Intellectual analysis of data : uchebnoe posobie / A. V. Zamyatin. — Tomsk : Izdatel'skii Dom Tomskogo gosudarstvennogo universiteta, 2020. — 194 c. — ISBN 978-5-94621-898-6. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/116889.html
5. Gashev, S. N. Mathematical methods in biology: analysis of biological data in the Statistica system: a textbook for universities / S. N. Gashev, F. Kh. Betlyaeva, M. Y. Lupinos. — Moscow : Izdatelstvo Yurait, 2022. — 207 p. — (Higher education). — ISBN 978-5-534-02265-0. — Text : electronic // Educational platform Yurait [site]. — URL: https://urait.ru/bcode/492334
6. Dubrovskii, S. A. Metody paroslovy i analiza experimentalnykh data : uchebnoe posobie / S. A. Dubrovsky, V. A. Dudina, Y. V. Sadyeva. — Lipetsk : Lipetsk State Technical University, EBS ASV, 2015. — 62 c. — ISBN 978-5-88247-719-5. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/55640.html
7. Selivanova, I. A. Stroitel'i analiz algorithmov data processing : uchebno-metodicheskoe posobie / I. A. Selivanova, V. A. Blinov. — Ekaterinburg : Uralskii federal'nyi universitet, EBS ASV, 2015. — 108 c. — ISBN 978-5-7996-1489-8. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/68277.html

Further reading

1. Boev, V.D. Computer modeling / V.D. Boev, R.P. Sypchenko. - M. : Internet-Universitet Of Information Technologies, 2010. - 455 p. : ill., tablet., schemes.; http://biblioclub.ru/index.php?page=book&id=233705

2. Gallyamova S.E. Methodical recommendations for performing control work on the course "Computer modeling". / S.E. Gallyamova. - LLC "Kristina and K", Borisoglebsk, BSPI, 2007 – 67 p.

3. Kolesov, Yu.B. Modeling of systems: practicum on computer modeling: ucheb. pos. + CD for universities / Yu.B. Kolesov, Yu.B. Senichenkov. - SPb.: BHV-Petersburg, 2007

4. Kruchinin, V.V. Computer technologies in science, education and production of electronic engineering : textbook / V.V. Kruchinin, Yu.N. 2. Tanovitsky, S.L. Khomich. -Tomsk : Tomsk State University of Control Systems and Radioelectronics,

5. Rubin A.B. Biophysics. Vol. 2, Section 8, Chapter XXV.

6. Bagshaw K. Muscular contraction. M.: Mir. - 1985.

7. Deshcherevsky V.I. Mathematical models of muscle contraction. M: Nauka. – 1977 – 160 p.

8. Hill A. Mechanics of muscular contraction. M.: Foreign lit. - 1963.

9. Keener J. Mathematical Physiology / J. Keener, J. Sneyd. Springer-Verlag, - New York Inc. − 1998. − 766 p. – Sections 18.

10. Jantsch E. the self-organizing universe. — oxford, 1980. p. 84.

11. Mathematical modeling of living systems: [ucheb. posom 34 bie] / [O. E. Solovyova, V. S. Markhasin, i dr.; pod obshch. red. O. E. Solovyova; m-vo obrazovanie i nauka ros. federatsii, Ural, feder. un-t. — Ekaterinburg: izd-vo Ural, un-ta, 2013.

12. Burtseva A.D., Voronov M.P. Catastrophe Theory: Approaches to Research and Application // International Journal of Experimental Education. – 2016. – No 8. – p. 43-52;

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

1. http://elementy.ru/ – scientific electronic library
2. http://zhelezyaka.com/
3. http://science.km.ru/ - electronic resource on different sections of biology
4. http://molbiol.ru/ - Electronic Resource on Molecular Biology
5. http://humbio.ru/humbio/cytology/00000d33.htm
6. http://biology-of-cell.narod.ru/
7. http://webembryo.narod.ru/cel_biol.htm
8. http://tsitologiya.ru/

9. http://www.ncbi.nlm.nih.gov/sites/entrez?db=books

List of information technologies and software

1. Microsoft Office Professional Plus 2010.

2. An office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.).

3. 7Zip 9.20 is a free file archiver with a high degree of data compression.

4. ABBYY FineReader 11 – software for optical character recognition.

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

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

7. WinDjView 2.0.2 – a software to recognize and view the files with the same format DJV and DjVu.

8. Auslogics Disk Defrag – a software to optimize the PC and fine-tune the operating system.

VIII.METHODICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

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

The lecture is the main active form of classroom classes, explanations of the fundamental theoretical sections, which involves intensive mental activity of the student. The lecture is cognitive, developmental, educational and organizing in nature. The lecture notes help to assimilate the theoretical material of the discipline. When listening to the lecture, it is necessary to note its rubrication, terminology, keywords, definitions, formulas, graphic schemes.

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

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

Lecture-visualization. The lecture is accompanied by a computer presentation with basic texts (headings, formulations, keywords and terms),

illustrations of microscopic and ultramicroscopic images of cells, drawing diagrams and writing formulas on an interactive whiteboard, visual tables and slides are demonstrated, which contributes to a better perception of the material presented.

Lecture-conversation - "dialogue with the audience" - is a common form of interactive learning and allows you to involve students in the educational process, as it creates direct contact of the teacher with the audience. Students are asked questions of a problematic, provoking or informational nature. Students themselves can also ask questions. Any of the students can offer his answer, another can supplement it. This form of lecture allows you to involve all students in the work, activate their attention, thinking, gain collective experience, learn to formulate questions.

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

As methods of interactive learning at colloquia, the following are used: a detailed conversation, discussion, press conference.

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

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

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

Methodical instructions for working with literature

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

Working with literature on a particular topic, it is necessary not only to read, but also to learn the method of its study: make a brief summary, an algorithm, a scheme of the material read, which allows you to quickly understand it, remember it. It is not recommended to rewrite the text verbatim.

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
Laboratory auditorium equipped with a multimedia complex Vladivostok, Russky Island, Ajax village, 10, aud. M420, area 74,6 m²	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 control controller Aqua distiller PE-2205 (5l/h); Analytical scales Acculab ATL-2200d2-I; Laboratory scale Vibra SJ-6200CE (LSE=6200 g/0,1 g); Moisture meter AGS100; Dual-beam spectrophotometer UV-1800 manufactured by Shimadzu; Rotary evaporator Hei-VAP Advantage ML/G3B; Magnetic stirrer PE-6100 (10 pcs); Magnetic stirrer PE-6110 M with heating (5pcs); Electric heating tiles; Infrared spectrophotometer IRAffinity-1S with Fourier; Form for the formation of suppositories for 100 cells; Pharmaceutical refrigerator; Liquid chromatograph LC-20 Prominence with spectrophotometric and refractometric detector; Laboratory centrifuge PE-6926 with a rotor of 10×5 ml, a set of automatic dosers Ecochem, a set of porcelain mortars, manual machines for packing capsules in size "0", "00", "1".	-
Reading rooms of the FEFU Scientific Library with open access to the	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	-

fund (building A – level 10)	Wty Internet access speed 500 Mbps. Workplaces for people with disabilities are equipped with Braille displays and printers; equipped with: portable devices for reading flat-printed texts, scanning and reading machines video magnifier with the ability to regulate color spectra; magnifying electronic magnifiers and ultrasonic markers	
Laboratory auditorium Vladivostok, Russky Island, Ajax village, 10, aud. L406, area 30 m²	Aqua distiller PE-2205 (5l/h); mixer; Laboratory scale AGN100; Magnetic stirrer PE-6100 (5 pcs); Magnetic stirrer PE-6110 M with heating (2 pcs); Electric heating tiles; a set of laboratory utensils, a set of porcelain mortars with pistils.	-

X. VALUATION FUNDS

Code and name of the competency achievement indicator	Name of the assessment indicator (the result of training in the discipline)
PC-1.1 Works with scientific and technical information and special literature, studies the achievements of domestic and foreign science in the field of molecular and cell biology using new technologies and electronic databases.	Knows features of work with scientific literature in the field of biology and sources of information. Can Workwith scientific and technical information and special literature, study the achievements of domestic and foreign science in the field of molecular and cell 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 the problems of molecular and cellular biology by integrating fundamental biological concepts and specialized knowledge in the field of professional activity	Knows the basic mechanisms of biology at the molecular and cellular levels. Can 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. Owns skills in detecting patterns and the relationship between various processes of biology and related disciplines.
PC-1.3 Uses in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of molecular and cell biology	Knows on the features of scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Can to use in scientific and production-technological activities knowledge of fundamental and applied sections of disciplines that determine the scope of activity of molecular and cell biology. Owns skills in 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 the design, implementation of	Knows

laboratory biological and environmental research.	methodological foundations of design, implementation of field and laboratory biological, environmental studies Can develop rules and algorithms for designing, performing laboratory biological and environmental studies Owns skills in the development and improvement of new rules and algorithms for designing, performing laboratory biological, environmental research
PC-2.2 Performs laboratory biological, environmental research using the scientific methodological foundations of fundamental research.	Knows modern classification of methods of scientific research, specifics and boundaries of their applicability; – the specifics of research characteristic of various environmental disciplines, the main classes of models that are a reflection of real systems - objects of environmental research; the main methods of statistical analysis: correlation, regression and variance Can use methods of statistical analysis to assess the reliability of data, compare empirical and theoretical systems, find the relationship between the variables that characterize the state of the system Owns the ability to independently analyze the available information, identify fundamental problems, set the task
PK-2.3 Applies the methodological foundations of design, laboratory biological, environmental research, uses modern equipment and computing complexes in molecular and cellular biology.	Knows basic modern field and laboratory methods of biology and ecology research Can work on modern analytical equipment of a modern biological laboratory Owns modern methods of research in ecology and biology

The following assessment tools are used for discipline:

1. Poll
2. Situational tasks

Oral questioning.

Oral questioning allows you to assess the knowledge and logic of the student, the ability to use terminology, speech skills and other communication skills.

The training function is to identify details that for some reason were not sufficiently understood during the training sessions and in preparation for the test.

A survey is 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.

Examples of topics for oral inquiry

1. Effective techniques for performing user tasks in modern operating

systems.

2. Text mode file managers on the example of Far/

3.Diagnostics and configuration of the computer. Use of system utilities and the command line.

4. Enter and format tabular data.

5. Advanced features of text editors for formatting documents and inserting scientific graphics.

6. Presentation of the results of data analysis. Create presentations in Power Point.

7. Multimedia technology: the basics of working with sound and video.

8. Data processing in Excel. Use formulas and macros. Use macros for calculations in Excel.

9. Creation of databases.

10. Internet services: work with e-mail, ftp.

11. Search engines.

12. Creation of websites. Basics of HTML technology. Use of CSS.

13. Internet programming by means of JavaScript/

14. Implementation of mathematical algorithms in C++ in console applications.

15.Creation of Windows-based applications.

16. Choosing a method of statistical analysis

Situational tasks.

1. Descriptive statistics (mean, 95% confidence interval, median and quartiles) for the original and transformed data (logarithm, square root, angular conversion)

2. Selective comparisons for the case of two groups. Selection of a parametric (Student's t-criterion) or non-parmetric (Mann–Whitney criterion) method for quantitative indicators or analysis of the conjugation table (chi-squared criterion) for qualitative features with a justification for the choice. Writing the statistical part of the section "Material and methods", description of the results, graph, conclusion.

3. Selective comparisons for the case of three or more groups. Selection of parametric (variance analysis) or non-parmetric (Kraskel–Wallis criterion) comparison method or analysis of the conjugation table (chi-squared criterion, residue analysis) for qualitative features with a justification for selection. Multiple comparisons. Writing the statistical part of the section "Material and methods", description of the results, graph, conclusion.

4. Dependency analysis. Selection of linear regression method with justification. Regression equation, assessment of the quality of fitting with the

calculation of the coefficient of determination, assessment of statistical significance. Writing the statistical part of the section "Material and methods", description of the results, graph, conclusion.

5. During the experiment, the toxicity of water samples on the Biotester device was evaluated using paramecy culture. The toxicity of one sample in six consecutive measurements was as follows:

0,24 0,23 0,27 0,32 0,35 0,39

Calculate the mean and its standard error, determine the 95% confidence intervals for the average, calculate the coefficient of variation. What is alarming about the data obtained? What kind of experiment is necessary if such a picture is observed regularly?

6. In March-April, a series of experiments is planned to assess the effect of a number of drugs on the immunity indicators of white rats. In January, the technique was tested: in 8 intact animals, the bactericidal index of blood serum was determined. These values were:

97 98 97 96 96 95 90 94 .

In the control group of the first experiment conducted in March, the indices were:

89 96 91 74 78.

The values in the experiment only tended to differ with the controls, so it was proposed to increase the sample size by combining the trial winter and control spring groups into one. Is such a merger correct?

7. During the certification of the analytical laboratory, it was provided with control samples of milk with a given arsenic content. These values and the results of the determination in the laboratory are presented in the table. Is it, in your opinion, worth issuing a certificate to the laboratory?

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 zaeven. Zaeven for the discipline includes answers to 2 questions.

Methodical instructions for the delivery of zachyota

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

Duringthe study, students can use the work program of the discipline, as well as with the permission of the teacher conducting the test, reference literature and other manuals.

The time allowed to the student to prepare for the answer tothe z acouple should be no more than 40 minutes.

The presence ofunauthorized 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 attestation, students are given a grade of "zaread" or "not credited". If the student does not appear for credit, an entry "did not appear" is made in the statement.

Questions for credit

1. Cybernetic ideas about the biosystem.
2. Adaptation of the system.
3. Trigger systems.
4. Negentropic ideas about the biosystem. Negentropy.
5. The concept of a model. Pattern. Patterns in Biology and Medicine.
6. Objects, goals and methods of modeling. Classification of mathematical models.
7. Modern classification of models of biological processes.
8. The concept of the derivative and the ways of finding it (differentiation rules). The physical meaning is differential equations. Stages of mathematical modeling.
9. Phase plane. Phase portrait. Phase space and phase trajectories.
10. Cuvier's catastrophism**.**
11. Catastrophe theory.
12. Kinetic models. Modeling of membrane channel activity.
13. Population growth model. Exponential growth. Verhühlst model (logistician equation).

14. Population growth model taking into account "hunting". Dependence of sis behavior

15. themes from the hunting option.

16. Enzymatic reaction model. Deprospecting, research.

17. Reduction of the enzymatic model. Pseudostationary model.

18. Dependence of substrate-enzyme complex concentration and velocity

19. enzymatic reaction from the concentration of the substrate. Michaelis' constant.

20. Linuiver-Burke chart.

21. Model of competitive inhibition of enzymatic reaction.

22. Model of non-competitive inhibition of enzymatic reaction.

23. Modeling of cooperative phenomena in enzymatic reactions.

24. Inhibition by substrate. Trigger type response model.

25. Genetic trigger model.

26. Models of interacting species. Competition, symbiosis, predator-

27. victim. A model of competing species. Population triggers.

28. Predator-prey model.

29. Modified predator-prey model. Limit cycle.

30. Types of transport of substances in cells. Diffusion equation. Stationary diffusion. Characteristic distances and diffusion times.

Criteria for assigning a grade to a student on the test

Evaluation of the test	Requirements for the formed competencies
"credited"	"credited" is exhibited 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 in the answer the material of monographic literature, correctly justifies the decision made, has versatile skills and techniques for performing practical tasks in the methodology of scientific research.
"credited"	The grade "credited" 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 tasks, possesses the necessary skills and techniques for their implementation.
"credited"	The grade "credited" is given to the student if he has knowledge only of the basic material, but has not mastered its details, allows inaccuracies, insufficiently correct wording, violations of the logical sequence in the presentation of the program material, has difficulties in performing practical work.

"not credited"	The grade "not credited" 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, it is not credited to students who cannot continue their studies without additional classes in the relevant discipline.