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
Molecular and cellular mechanisms of carcinogenesis
Direction of training 06.04.01 Biology
(Molecular and Cell Biology)
Form of training: full-time

Course 1,2 semester 2,3
lectures - hour.
practical exercises - hour.
laboratory work 72 hours.
total hours of classroom load 72 hours.
independent work 72 hours.
including 36 hours of exam preparation.
Credit 2 semester
exam 3 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 ofScienceof the Republic of Russia dated 11.08.2020. № 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 the Implementing Structural Unit
Compiled by: Doctor of Biological Sciences, Professor Shevtsov M. A.

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 "__ № _____

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

Tasks:

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

Professional competencies of graduates and indicators of their achievement:

Task type	Code and name of professional competence (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.	He knows the structure and functions of the main biopolymers, their components and the complexes formed during their interaction, the genetic and epigenetic mechanisms of transmission, storage and implementation of hereditary information at the molecular level, the main aspects of the participation of the studied biopolymers in the mechanisms of carcinogenesis. It is able to distinguish the main molecular patterns of tumor and normal cells, to study the structure and functions of biopolymers, their components and complexes, 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 to determine the status of the cell.
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.	He knows the main processes occurring in a living cell and the influence of carcinogenic factors on them, as well as cellular mechanisms of protection against this effect. He is able to characterize in detail the main violations of cellular vital processes that occur during carcinogenesis, and the events that follow them. He has knowledge about the basic concepts of carcinogenesis and their reflections on the basic processes occurring in living cells
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.	He knows the basic methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism, the role of oncology as a derivative of the body's own cells. It is able to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells with the microenvironment and their special interaction with the cells of the immune system. He has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells in 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.	He knows the structure and functions of the main oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole, the main mutations associated with carcinogenesis. Able to analyze the structure of the function of oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole to determine pathogenic mutations that stimulate carcinogenesis 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 5 credit units (180 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
Lab	Labs
Lab 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.

2 semester

№	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 "Basic aspects of the biology of tumor cells. A Brief History of the Study of Malignant Tumors"	2	-	6	-	-	6	-	Questions for credit
2.	Section No2 "Mechanisms of regulation of the cell cycle, and its disorders associated with carcinogenesis"	2	-	6	-	-	6	-	Questions for credit
3.	Section No3 "Oncogenes and oncosuppressors. Two-shock model of carcinogenesis"	2	-	6	-	-	6	-	Questions for credit
4.	Section No4 "Carcinogenic agents"	2	-	6	-	-	6	-	Questions for credit
5.	Section No5 "Conditions of competitive environment of tumors"	2	-	6	-	-	6	-	Questions for credit
6.	Section No6 "Intercellular communication of cancer cells between themselves and the environment"	2	-	6	-	-	6	-	Questions for credit
	Total:	2	-	36	-	-	36	-	Credit

3 semester

№	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	
7.	Section No1 "Metastasis and mechanisms of formation of premetastic niches"	3	-	6	-	-	6	6	Exam Questions

8.	Section No2 "Immune surveillance of tumors"	3	-	6	-	-	6	6	Exam Questions
9.	Section No3 "The main types of therapies of malignant tumors"	3	-	6	-	-	6	6	Exam Questions
10.	Section No. 4 "Targeted therapy of cancer and the search for new targets."	3	-	6	-	-	6	6	Exam Questions
11.	Section No5 "Immunotherapy of oncology"	3	-	6	-	-	6	6	Exam Questions
12.	Section No6 "Features of oncology research"	3	-	6	-	-	6	6	Exam Questions
	Total:	3	-	36	-	-	36	36	Exam

THE STRUCTURE AND CONTENT OF THE THEORETICAL PART OF THE COURSE

Lecture classes are not provided for in the curriculum.

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

Practical classes are not provided for in the curriculum.

Laboratory work <u>in the 2nd semester</u> 36 hours

Laboratory work No. 1 "Basic aspects of the biology of tumor cells. A Brief History of the Study of Malignant Tumors" (6 hours)

Key moments in the history of the development of oncology. Modern ideas about the biology of cancer cells: the ability to infinite division, avoidance of immune effects, unlimited replicativeness of the genetic apparatus, initiation of inflammation, invasion and metastasis, induction of angiogenesis, genomic instability and increased tendency to mutations, resistance to cell death, metabolic pathologies, autonomy from the environment and the organism as a whole.

Laboratory work No2 "Mechanisms of regulation of the cell cycle, and its disorders associated with carcinogenesis" (6 hours)

Cell cycle. Major Restriction Points: The role of cyclins and cyclines depend onmy kinases in cell cycle regulation. Mechanisms of cell cycle arrest and activation of damage repair tools. Molecular mechanism of operation and life cycle of p53 protein as one of the main oncosuppressors.

Laboratory work No. 3 "Oncogenes and oncosuppressors. Two-shock model of carcinogenesis" (6 haces)

Lists of the main oncogenes and oncosuppressors and the biological role of protein products. Molecular substantiation of genetic predisposition to oncology. A two-shock model of carcinogenesis. The role of DNA repair mechanisms and translesion replication in the appearance of mutations associatedwith the development of oncology. Genetic instability of cancer cells.

Laboratory work No4 "Carcinogenic agents" (6 hoursace)

Chemical organic and inorganic carcinogenic factors. Viral agents. Human papillomavirus as a factor in the appearance of neoplasms. Physical factors inducing carcinogenesis: UV radiation, radioactive radiation, heat exposure and others.

Laboratory work No5 "Conditions of competitive environment of tumors" (6 hoursaces)

Genetic heterogeneity of tumor cells. Factors of hypoxia and starvation in tumor development. Invasive and expansive growth. Tumor-associated fibroblasts.

Laboratory work No.6 "Intercellular communication of cancer cells between themselves and the environment" (6 hours ofaces)

Vesicular transport of biomolecules. Paraclinic, distal and humoral intercellular communication. The formation of multivesicular bodies in the cell as a factor of specific intercellular interaction. Circulating non-coding DNA and RNA and their role in the development of oncology.

Exemplary topics of independent work of students

1. Immortalization of cells.
2. Mechanisms of programmed cell death.
3. The acquisition by cells of autonomy from the environment.
4. The history of the discovery of cyclins as regulators of the cell cycle.
5. Structural organization of cyclin-dependent kinases.
6. Chromotrypsis in carcinogenesis.
7. The special role of the protein p53.

8. MAPK kinase cascade.
9. Pathogenesis of hepatitis C virus.
10. Pathophysiology of oncological diseases.
11. Carcinogenic effects of arsenic
12. VRGF signaling.
13. HIF signaling.
14. Mechanisms of endocytosis.
15. Mechanisms of exocytosis.
16. RNA interference.

Laboratory work in the 3rd semester 36 hours

Laboratory work No1 "Metastasis and mechanisms of formation of premetastic niches" (6 hours)

Metastasis as a way to avoid adverse conditions by tumor cells. Epithleal mesenchymal transition. Mechanisms of formation of premetastic niches, as the main factor in the occurrence of secondary foci. Survival mechanisms of circulating tumor cells in the bloodstream. Chemokines as attractants of circulating tumor cells.

Laboratory work No2 "Immune surveillance of tumors" (6 hours)

Immune surveillance in the normal development of the body. The effect of natural killers on cancer cells as the first factor of the immune attack. Molecular mechanisms of cell phenotype changes associated with immune response avoidance. Immune inflammation in carcinogenesis.

Laboratory work No3 "The main types of therapy for malignant tumors" (6 hours)

The principle of action of chemotherapy. Mechanisms of initial and acquired resistance of tumor cells to chemotherapy. Mechanism of action of taxol. Radiotherapy: advantages and disadvantages. Gene therapy: advantages and disadvantages.

Laboratory work No. 4 "Targeted therapy of cancer and the search for new targets." (6 hours)

Introduction to theranostics as a promising direction of modern oncology. Classic targets and hit molecules in targeted tumor therapy. Strategies for finding and testing new targets.

Laboratory work No5 "Immunotherapy of oncology" (6 hours)

Mechanisms of cytotoxicity of immune cells in the normal development of the body. Advances in immunobiotechnology in the modification of immune cells. CAR-T Technology: Immune Point Technology: Complications related to immunotherapy subhoot.

Laboratory work No6 "Features of oncology research" (6 hours)

Features of cultivation of tumor cells *in vitro.* HeLa Cell Line: Cytotoxicity and Cell Proliferation Tests. Animal models in the study of tumor cell biology *in vivo.* Screening technique for antitumor drugs. Microscopy, as the main method of imaging the morphology of the cell.

Exemplary topics of independent work of students

1. Mechanisms of anoikis.
2. Mechanisms of cytotoxicity of natural killers.
3. Factors of weakening of immunity.
4. Therapeutic preporates based on technologies of targeted protein degradation.
5. Gene therapy of oncology.
6. Antitumor drugs based on natural ingredients.
7. The history of the discovery and development of CAR-T technology.
8. The history of the discovery and development of immune point technology.
9. Prospects for the development of immunotherapy.
10. Confocal microscopy.
11. Flow cytometry and cell sorting.
12. Immunodeficient mouse models.

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

2 SEMESTER

No p/n	Supervised sections / topics of the discipline	Achievement indicator code and name	Learning outcomes	Assessment tools	
				current control	Intermediate attestation
1.	Section No1 "Basic aspects of the biology of tumor cells. A Brief History of the Study of Malignant	PC-3.1 Studies the structure and functions of biopolymers, their components and complexes, mechanisms of storage, transmission and implementation	He knows the structure and functions of the main biopolymers, their components and the complexes formed during their interaction, the genetic and epigenetic mechanisms of transmission, storage and implementation of hereditary information at the molecular level, the main aspects of the participation of the studied biopolymers in the mechanisms of carcinogenesis. It is able to distinguish the main molecular patterns of tumor and normal cells, to study the structure and functions of biopolymers, their components and complexes,	Oral questioning	Questions for credit

	Tumors"	of 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. 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. 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.	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 to determine the status of the cell. He knows the main processes occurring in a living cell and the influence of carcinogenic factors on them, as well as cellular mechanisms of protection against this effect. He is able to characterize in detail the main violations of cellular vital processes that occur during carcinogenesis, and the events that follow them. He has knowledge about the basic concepts of carcinogenesis and their reflections on the basic processes occurring in living cells He knows the basic methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism, the role of oncology as a derivative of the body's own cells. It is able to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells with the microenvironment and their special interaction with the cells of the immune system. He has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells in a multicellular organism He knows the structure and functions of the main oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole, the main mutations associated with carcinogenesis. Able to analyze the structure of the function of oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole to determine pathogenic mutations that stimulate carcinogenesis Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole		
2.	Section No2 "Mechanisms of regulation of the cell cycle, and its disorders associated with carcinogenesis"			Oral questioning	Questions for credit
3.	Section No3 "Oncogenes and oncosuppressors. Two-shock model of carcinogenesis"			Oral questioning	Questions for credit
4.	Section No4 "Carcinogenic agents"			Oral questioning	Questions for credit
5.	Section No5 "Conditions of competitive environment of tumors"			Oral questioning	Questions for credit
6.	Section No6 "Intercellular communication of cancer cells between themselves and the			Oral questioning	Questions for credit

	environment"				

3 SEMESTER

No p/n	Supervised sections / topics of the discipline	Achievement indicator code and name	Learning outcomes	Assessment tools	
				current control	Intermediate attestation
1.	Section No1 "Metastasis and mechanisms of formation of premetastatic niches"	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 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. PC-3.3 Investigates the main methods of intermolecular interactions and mutual regulation of the	He knows the structure and functions of the main biopolymers, their components and the complexes formed during their interaction, the genetic and epigenetic mechanisms of transmission, storage and implementation of hereditary information at the molecular level, the main aspects of the participation of the studied biopolymers in the mechanisms of carcinogenesis. It is able to distinguish the main molecular patterns of tumor and normal cells, to study the structure and functions of biopolymers, their components and complexes, 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 to determine the status of the cell. He knows the main processes occurring in a living cell and the influence of carcinogenic factors on them, as well as cellular mechanisms of protection against this effect. He is able to characterize in detail the main violations of cellular vital processes that occur during carcinogenesis, and the events that follow them. He has knowledge about the basic concepts of carcinogenesis and their reflections on the basic processes occurring in living cells He knows the basic methods of intermolecular interactions and mutual regulation of the processes of functioning of a living cell as part of a multicellular organism, the role of oncology as a derivative of the body's own cells. It is able to study intermolecular interactions and mutual regulation of the	Oral questioning	Exam Questions
2.	Section No2 "Immune surveillance of tumors"			Oral questioning	Exam Questions
3.	Section No3 "The main types of therapies of malignant tumors"			Oral questioning	Exam Questions
4.	Section No. 4 "Targeted therapy of cancer and the search for new targets."			Oral questioning	Exam Questions
5.	Section No5 "Immunotherapy of oncology"			Oral questioning	Exam Questions
6.	Section No6 "Features of oncology research"			Oral questioning	Exam Questions

		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.	processes of functioning of tumor cells with the microenvironment and their special interaction with the cells of the immune system. He has the skills to study intermolecular interactions and mutual regulation of the processes of functioning of tumor cells in a multicellular organism He knows the structure and functions of the main oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole, the main mutations associated with carcinogenesis. Able to analyze the structure of the function of oncogenes and oncosuppressors, genomes as a whole, individual proteins and the proteome as a whole to determine pathogenic mutations that stimulate carcinogenesis Proficient in the methods of analyzing the structure of the function of genes and genomes, proteins and the proteome as a whole		

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

Main literature

1. Proshkina, E. N. Molecular biology: stress-reactions of cells : a textbook for universities / E. N. Proshkina, I. N. Yuraneva, A. A. Moskalev. — Moscow : Izdatelstvo Yurait, 2022. — 101 p. — (Higher education). — ISBN 978-5-534-08502-0. — Text : electronic // Educational platform Yurait [site]. — URL: https://urait.ru/bcode/493641

2. Polyakova, T. I. Biologiya celli : uchebnoe posobie / T. I. Polyakova, I. B. Sukhov. — St. Petersburg : Sankt-Peterburgskii medico-sotsial'nyi institut, 2015. — 56 p. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: https://www.iprbookshop.ru/74246.html

3. Pathomorphological and molecular-biological analysis of renal cell carcinoma. Diagnostics and prognosis : monograph / T.M. Cherdantseva, V.V. Klimachev, I.P. Bobrov, A.F. Lazarev. — Moscow : INFRA-M, 2020. — 230 p. — (Scientific thought). — DOI 10.12737/1020785. - ISBN 978-5-16-015251-6. - Text : electronic. - URL: https://znanium.com/catalog/product/1020785

4. Mayboroda, A. A. Molecular-genetic foundations of oncogenesis : uchebnoe posobie / A.A. Mayboroda. — Moscow : INFRA-M, 2020. — 125 p. + Add. materialy [Elektronnyi resurs]. – (Higher education: Specialist's degree). —

DOI 10.12737/1002295. - ISBN 978-5-16-014731-4. - Text : electronic. - URL: https://znanium.com/catalog/product/1002295

5. Konichev, A. S. Molecular biology : textbook for universities / A. S. Konichev, G. A. Sevastyanova, I. L. Tsvetkov. — 5th ed. — Moscow : Izdatelstvo Yurait, 2023. — 422 p. — (Higher education). — ISBN 978-5-534-13468-1. — Text : electronic // Educational platform Yurait [site]. — URL: https://urait.ru/bcode/517095

6. Maltsev, V. N. Fundamentals of Microbiology and Immunology : a textbook for secondary vocational education / V. N. Maltsev, E. P. Pashkov, L. I. Khaustova. — 2nd ed., ispr. and add. — Moscow : Izdatelstvo Yurayt, 2023. — 319 p. — (Vocational education). — ISBN 978-5-534-11566-6. — Text : electronic // Educational platform Yurait [site]. — URL: https://urait.ru/bcode/518091

Further reading

1. The Merkel Cell: Structure-Development-Function-Cancerogenesis. (2013). Germany: Springer Berlin Heidelberg.

2. Reichrath, J. (2007). Molecular Mechanisms of Basal Cell and Squamous Cell Carcinomas. Germany: Springer US.

3. Müller, O., Wagener, C., Stocking, C. (2017). Cancer Signaling: From Molecular Biology to Targeted Therapy. Germany: Wiley.

4. Cancer Cell Signaling: Methods and Protocols. (2003). Ukraine: Humana Press.

5. Metabolism in Cancer. (2018). Switzerland: Springer International Publishing.

6. Bunz, F. (2016). Principles of Cancer Genetics. Germany: Springer Netherlands.

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

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 "Fundamentals of Medical Knowledge", 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 presenting 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.

Colloquia

Colloquium is a collective form of consideration and consolidation of educational material. Colloquia are one of the types of practical classes designed for in-depth study of the discipline, conducted in an interactive mode. At the classes on the topic of the colloquium, questions are analyzed, and then, 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 navigate in large information flows, to develop and defend their own position on problematic issues of the academic discipline.

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

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

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

Press conference. The teacher instructs several students to prepare brief (thesis) messages. After the reports, students ask questions that are answered by the speakers and other members of the expert group. Based on the questions and answers, a creative discussion unfolds together with the teacher.

Case study method**.** The case-study method is a method of active problem-situation analysis based on learning by solving specific problems - situations (solving cases). The method of specific situations (case study method) refers to non-game imitative active learning methods and is considered as a tool that allows you to apply theoretical knowledge to solving practical problems. At the end of the lesson, the teacher tells a number of situations and offers to find solutions for those problems that are voiced in them. At the same time, the problem itself does not

have unambiguous solutions. Students should analyze the situation, understand the essence of the problems, offer possible solutions and choose the best of them. Thanks to the knowledge gained at the lecture, it is easy for the student to correlate the theoretical baggage of knowledge obtained with the real practical situation. Being an interactive method of teaching, it wins a positive attitude from students, who see in it an opportunity to show initiative, feel independent in mastering theoretical positions and mastering practical skills. No less important is the fact that the analysis of situations has a strong impact on the professionalization of students, contributes to their maturation, forms interest and positive motivation for learning. The method is aimed not so much at mastering specific knowledge or skills, as at developing the general intellectual and communicative potential of the student and teacher.

It is a teaching method designed to improve skills and gain experience in the following areas:

- identification, selection and problem solving;
- work with information – comprehension of the meaning of the details described in the situation;
- analysis and synthesis of information and arguments;
- work with assumptions and conclusions;
- evaluation of alternatives;
- decision-making;
- listening and understanding other people are group work skills. The main function of the case method is to teach students to solve complex unstructured problems that cannot be solved in an analytical way. The case activates students, develops analytical and communicative skills, leaving students alone with real situations.

The case study is designed to improve the effectiveness of educational activities: as an illustration for solving a certain problem, explaining a particular phenomenon, studying the features of its manifestations in real life, developing competence aimed at resolving various life and production situations (the use of the case involves individual and group work of students).

Brainstorming (brainstorming) is a widely used way of producing new ideas to solve scientific and practical problems. Its purpose is to organize collective mental activity to find non-traditional ways to solve problems.

The use of the brainstorming method in the educational process allows you to solve the following problems:

- creative assimilation of educational material by students;
- the relationship of theoretical knowledge with practice;

- activation of educational and cognitive activity of trainees;
- formation of the ability to concentrate attention and mental efforts on solving an urgent problem;
- formation of experience of collective mental activity.

The problem formulated in the brainstorming session should have theoretical or practical relevance and arouse the active interest of students. A common requirement to consider when choosing a problem for brainstorming is the possibility of many ambiguous options for solving a problem that is put forward to students as a learning task.

Tests and testing

Current control of the assimilation of the material is assessed by oral answers, tests, as well as paper testing.

From the assessments of laboratory, colloquiums, tests and testing, an assessment of this discipline is mainly 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: 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	
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, Saperny Peninsula, Ajax village, 10, aud. M 627	Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope 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

The following assessment tools are used for discipline:

1. Oral AboutPros

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. Molecular basis of carcinogenesis.
2. Molecular mechanisms of dysregulation of the cell cycle in cancer.
3. Target genes of carcinogenic agents: proncogens, oncoproteins, tumor suppressor genes.
4. Role in carcinogenesis of molecules that regulate nuclear transcription and the cell cycle (Rb, WT-1, p53, BRCA-1 and BRCA-2).
5. Molecules that regulate the conversion of the growth signal (NF-1 and the APC gene).
6. Regulatory function of cell surface receptors.
7. The role of regulators of apoptosis and DNA repair in the tumor transformation of the cell.
8. Immortalization.
9. Causes of telomerase activation in human tumor cells.
10. Molecular markers of unfavorable prognosis of the disease.
11. Molecular markers of micrometastases.
12. Markers of early stages of tumor formation.
13. The role of regulators of apoptosis and DNA repair in the tumor transformation of the cell.
15. Biosensory technologies.
16. Methods of DNA diagnostics.
17. Proteomic technologies.
18. Synthetic inhibitors of signal transduction.
19. Monoclonal antibodies.
20. Antisense oligonucleotides.
21. The role of cell repair systems in tumor transformation.
22. Features of metabolism of tumor cells.
23. Kinetic patterns of tumor growth.
24. Tumor neoangiogenesis.'
25. Antitumor immunity: immunological surveillance of the body.
26. Inflammation, atopy/autoimmunity, cancer

Assessment tools for intermediate attestation

2 semester

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. Benign and malignant tumors
2. Transplantable tumors.
3. Immunotherapy of tumors.
4. Molecular mechanisms of cell cycle regulation.
5. The main properties of malignant tumors
6. Infiltrative growth of malignant tumors
7. Cytokines and their role in maintaining homeostasis.
8. Oncogenic viruses.
9. The main modern hypotheses of carcinogenesis
10. Genetic individuality of the tumor.

11. Cell death in the pathological process: autophagy and tumor transformation.

12. Carcinogenesis and neoplasia, molecular and cellular mechanisms.

13. Andthe nbred lines of mice and their application in oncology research.

14. Molecular basis for the diagnosis of cell damage.

15. The role of regulation of apoptosis and DNA repair in tumor transformation.

16. Molecular markers of early stages of tumor formation.

17. Molecular markers of cell type, role in cytodiagnostics.

18. Oncogenes and oncosuppressors.

19. Gene therapy of malignant tumors.

20. Metastasis of tumors-mechanisms and stages.

21. Modeling of malignant neoplasms in animal models

22. Cancer and DNA repair system .

23. Mechanisms of tumors acquiring chemoresistance.

24. Heritability of predisposition to oncology.

25. Atypisms of tumor development.

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.

3 semester

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. The concept of tumor growth.

2. The main biological features of tumor tissue: autonomy of tumor growth, tumor atypism (morphological, functional, biochemical, antigenic), invasive growth, metastasis, recurrence.

3. The concept of tumor progression.

4. Clonal nature of tumors. Classification and nomenclature of tumors. Principles of tumor classification: histological, histogenetic, clinical and morphological, etc.

5. The main models used in experimental oncology; induced and transplantable tumors, spontaneous, cell and organ cultures.

6. The main characteristics of a malignant cell: uncontrolled growth, disturbances in the program of final differentiation, disturbances in the program of cell death, the ability to metastasize, strengthening the mechanisms of resistance to adverse effects.

7. Biochemical features of tumor cells. Features of energy metabolism of malignant tumors. Anaerobic and aerobic glycolysis. Synthesis of proteins and isoenzymes of embryonic type by tumors.

8. Molecular genetic changes in tumor cells. Oncogenes and oncoproteins. Cellular proto-oncogenes.

9. Classification of oncogenes: oncogenes, anti-oncogenes (p53, pRb, etc.), mutator genes, modulator genes.

10. Functions of oncoproteins (growth factors, membrane and cytoplasmic receptors, tyrosine kinases, transcription factors, regulators of apoptosis, etc.).

11. Mechanisms of activation of proto-oncogenes: deletion, mutation, amplification, chromosomal rearrangements. Methods for determining oncogenes and gene disorders.

12. Specific changes in the genome in the cells of malignant neoplasms, examples of tumors (chronic myeloid leukemia, Burkitt lymphoma, retinoblastoma, Wilms tumor). Prognostic significance of individual genetic abnormalities.

13. Features of proliferation of tumor cells. Signaling pathways leading to proliferation. Basic concepts about the mitotic cycle of the cell (cycle phases, growth fraction, cell loss factor; features of the kinetics of tumor cell proliferation).

14. Characteristics of the main stages of tumor progression. Neoangiogenesis in the tumor. Characteristics of the angiogenic phenotype, the role of modulator genes, suppressor genes.

15. Carcinogenesis as a multi-stage process. The accumulation of genetic disorders as the basis of neoplastic cell transformation. Concepts of initiation, promotion and progression of tumors.

16. Chemical carcinogenesis. Hygienic classification of chemical carcinogens IARC.

17. Classification of carcinogens by mechanism of action: genotoxic carcinogens (PAHs, nitroso compounds, aromatic amines, aflatoxins, direct-acting carcinogens), non-genotoxic (epigenomic) carcinogens. Mechanisms of their action.

18. Mechanisms of metabolic activation and deactivation of carcinogenic compounds in the body. Direct and indirect carcinogens.

19. Viral carcinogenesis.

20. Virogenetic concept of cancer of L.A. Zilber. The concept of an oncogenic virus.

21. The main groups of oncogenic viruses of humans and animals (adenoviruses, herpesviruses, papoviruses, retroviruses, etc.).

22. Human viral infections associated with the occurrence of tumors (papillomavirus infection, HIV, viral hepatitis B, infections caused by the Epstein-Barr virus, etc.).

23. Exogenous and endogenous viruses. Products of viral genes. Mechanisms of tumor transformation of cells with DNA and RNA containing viruses.

24. Human tumors associated with chronic viral infections.

25. Radiation carcinogenesis.

26. Radioactive elements and their tropism to various tissues. Cellular radiosensitivity. Radiosensitivity of tissues and organs. Radiosensitivity factors. The mechanism of carcinogenic action of ionizing radiation. Radioprotectors.

27. Models of radiation tumors in animals. Human radiation tumors. Ultraviolet radiation and cancer. The role of genetic predisposition in UV carcinogenesis.

28. The role of hormones in the development of malignant neoplasms of exocrine and endocrine glands, glands of mixed secretion and target organs (breast, ovaries, endometrium).

29. Mechanisms of hormonal carcinogenesis. Hormone-dependent tumors. Hormone-producing tumors. Experimental models of hormonal carcinogenesis.

30. The place of epidemiology in the study of the etiology of malignant neoplasms. The main methods of studying the epidemiology of tumors. The role, place and types of statistical research methods used in the study of tumor epidemiology.

31. The concept of risk factors. Structure and level of incidence of malignant tumors in the Russian Federation.

32. Morbidity and mortality rates from malignant tumors of the main localizations. Characteristics of the main indicators of the frequency of neoplasia.

33. Classification of malignant tumors by stages, international classification according to the TNM system.

34. General principles for determining the stage of the tumor process.

35. Development of neoplasia in experimental animals with the use of blastogenic substances (induced tumors).

36. Tumors induced by benzanthracene, methylcholanthrene, benzpyrene.

37. Tumors induced by external irradiation and incorporated radioactive substances.

38. Ultrastructural organization of tumor cells in experimental carcinogenesis.

39. Features of morphogenesis of tumors depending on the method of administration of the carcinogen.

40. Preparation of cell cultures. The main types of single-layer cell cultures: primary and transplantable. Preparation of primary cell cultures.

41. Preparation of monolayer transplantable cell cultures. Suspension cell culture. Serum-free media of exact chemical composition.

42. Cultivation of viruses in cell cultures.

43. The concept of experimental tumors. Classification of experimental tumors.

44. Models of experimental oncology. Modern methods of experimental carcinogenesis

45. Chemotherapy of malignant tumors.

46. Models and methods for studying the antitumor activity of various compounds (transplantable and spontaneous tumors, tumor heterografts, non-tumor objects).

47. Classification of antitumor drugs: the main groups of antitumor drugs, depending on the mechanism of their action.

48. Criteria for assessing the antitumor effect. Objective and subjective effect. Toxic reactions of antitumor therapy.

49. Toxic effect of antitumor drugs on hematopoiesis, gastrointestinal tract, liver function, kidney function, etc. Late complications.

50. Oncostatic and oncoprotective effect of antioxidants and drugs with antioxidant type of action

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.