

Документ подписан простой электронной подписью

Информация о владельце:

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Должность: и.о. декана медико-биологического факультета

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**MINISTRY OF SCIENCE AND HIGHER EDUCATION**

**RUSSIAN FEDERATION**

**Federal State Autonomous Educational Institution of Higher Education**

**NORTH-CAUCASUS FEDERAL UNIVERSITY**

**APPROVED**

**Assoc. Prof. Kubanov S.I.**

**PhD in Medical Sciences**

**Dean Faculty of Medicine and Biology**

## **COURSE OUTLINE OF THE DISCIPLINE (MODULE)**

### **Developmental biology, embryology**

*Name of the discipline (module)*

- Specialty: 31.05.01 General Medicine
- Mode of training: Full-time
- Year of commencement of studies: 2026
- Delivered in Semester 1

Developed by:

Head of the Department of Anatomy and Histology

Dzhandarova T.I.

Stavropol, 2026

### 1. Aim and Objectives of Mastering the Discipline (Module)

- Aim of mastering the discipline. The purpose of studying the discipline "Developmental Biology, Embryology" is to acquire knowledge of the basic patterns of individual development of organisms, intrauterine human development as a fundamental component of the main life processes, the influence of various factors on the reproduction and development of organisms, necessary for further training in other fundamental medical disciplines, as well as for clinical and preventive disciplines.
- Objectives of mastering the discipline
  - to study the main stages of ontogenesis, phases of embryonic development, and to be able to present and illustrate with schematic drawings the main developmental processes in their actual sequence and interrelation;
  - to gain an understanding of the mechanisms of morphogenesis, cytodifferentiation, and growth;
  - to gain an understanding of the connection between ontogenesis and evolution;
  - to know the main causes of developmental anomalies;
  - to master skills in working with embryonic preparations, and to have an understanding of the methods for obtaining and studying embryonic material.

### 2. Place of the Discipline (Module) in the Structure of the Training (educational) Program

This discipline belongs to the compulsory disciplines of the basic part, and its study takes place in the 1st semester.

### 3. List of Potential Learning Outcomes for the Discipline (Module), Correlated with the Outcomes of Mastering the Educational Program

| Code and definition of the competence                                                                                                         | Code and definition of the indicator                                                                                                                                                                                                                                                       | Planned learning outcomes for the discipline (module) describing the stages of competency and indicator development |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| GPC-5. Capable of assessing morphofunctional, physiological states, and pathological processes in the human body to solve professional tasks. | AI-1 GPC-5. Assesses morphofunctional and physiological states and processes in the human body at the individual, group, and population levels to solve professional tasks.<br><br>AI-2 GPC-5. Identifies pathological states and processes in the human body to solve professional tasks. | Etiology and Pathogenesis                                                                                           |

#### 4. Volume of the Academic Discipline (Module) and Control \*

|                                                               |                                            |
|---------------------------------------------------------------|--------------------------------------------|
| Volume of classes: Total: 4 ECTS credits, 144 academic hours. | Full-time type of study, in academic hours |
| <b>Face-to-face work</b>                                      | 54                                         |
| Lectures / including practical training                       | 18                                         |
| Laboratory works / including practical training               | 36                                         |
| Practical classes / including practical training              |                                            |
| <b>Independent work</b>                                       | 54                                         |
| <b>Forms of control</b>                                       | 36                                         |
| Examination                                                   | 1                                          |
| Credit (Pass/Fail)                                            |                                            |
| Graded credit (Graded Pass/Fail test)                         |                                            |

\* The discipline (module) provides for the use of e-learning and remote learning technologies (unless otherwise set by the educational standard).

#### 5. Content of the Discipline (Module), Structured by Topics (Sections) with an Indication of the Hours and Types of Classes

| # | Section (topic) of the discipline and brief content | Competencies and indicators to be developed | Full-time training                                                                   |                   |                 | Forms of current control of academic progress |                         |
|---|-----------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------|-------------------|-----------------|-----------------------------------------------|-------------------------|
|   |                                                     |                                             | Contact work of students with the teacher / of them practical skills training, hours |                   |                 |                                               | Independent work, hours |
|   |                                                     |                                             | Lectures                                                                             | Practical classes | Laboratory work |                                               |                         |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          |   |   |    |            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---|---|----|------------|
| 1. | <p><b>Introduction to Developmental Biology and Embryology. The subject and objectives of developmental biology. Methods of developmental biology. Medical significance of experimental data in developmental biology. Interdisciplinary connections.</b></p> <p>The subject and objectives of developmental biology. Methods of developmental biology: descriptive, experimental embryological, cytological, cytochemical, molecular biological, biochemical, immunobiological, ecological, and genetic engineering. Medical significance of experimental data in developmental biology. Interdisciplinary connections.</p> <p>The origin and development of new individuals in ancient times, the foundation of embryology as a science (Hippocrates, Aristotle). The development of embryology after antiquity (Aldrovandi, Fabricius, Leeuwenhoek, Swammerdam, Malpighi, Haller, Leibniz). The discovery of parthenogenesis. Preformationism and its essence. W. Harvey's proclamation of epigenesis: "all life comes from the egg." The development of embryology in the 18th and 19th centuries. K.F. Wolff's justification of epigenesis. Supporters of epigenesis (I.F. Blumenbach, M. Rathke, H. Pander, and K. Baer). K. Baer's work marked a new stage in embryology. He laid the foundations for comparative embryology.</p> | <p>AI-1<br/>GPC-5<br/>AI-2<br/>GPC-5</p> | 2 | 2 | 54 | discussion |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---|---|----|------------|

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|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---|---|------------|
| 2. | <p><b>Comparative animal embryology is the foundation of the principles of embryonic development in organisms. Ontogenesis and phylogenesis. The relationship between phylo- and ontogenesis.</b></p> <p>Comparative animal embryology is the foundation of the principles of embryonic development in organisms. Ontogenesis and phylogenesis. The relationship between phylo- and ontogenesis. Müller-Haeckel's biogenetic law. The works of A.N. Severtsev, I.I. Schmalhausen, and P.P. Ivanov. The role of experimental embryology in understanding the most important principles of embryogenesis. Experimental embryology. The founders of experimental embryology are V. Roux, G. Spemann, D.P. Filatov, and M.M. Zavadovsky. Comparative-experimental approach in embryology (D.P. Filatov). Biochemical embryology. Developmental genetics. The biology of individual development is a new stage in the study of the laws of ontogenesis, which arose on the basis of the synthesis of the achievements of embryology, molecular biology, genetics, biochemistry, and cytology.</p> | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2 | 2 | discussion |
| 3. | <p><b>Sexual and asexual reproduction.</b></p> <p>Sexual and asexual reproduction. Morphological features of the reproductive organs of plants and animals. Differences between asexual and sexual reproduction. Features of germ cells. Gametogenesis. Spermatogenesis. Factors influencing spermatogenesis. Disorders of spermatogenesis. Infertility. Oogenesis and its characteristics.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   | 2 | discussion |

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| 4. | <p><b>Fertilization. Evolution of fertilization methods. Fertilization methods in terrestrial and aquatic organisms. External, mixed, and internal fertilization.</b></p> <p>Fertilization. Evolution of fertilization methods. Fertilization methods in terrestrial and aquatic organisms. External, mixed, and internal fertilization. Factors facilitating and hindering fertilization. Meeting of gametes, the issue of sperm attraction to the egg, gamones. The acrosomal reaction of sperm and its role in gamete union: physiological mono- and polyspermy. Egg activation. Two phases of activation: the activation pulse and the cortical reaction. Formation of the perivitelline space. The mechanism of egg defense against the penetration of supernumerary sperm in physiologically monospermic animals. Syngamy. Changes in egg metabolism (respiration, DNA replication, protein synthesis). Physicochemical changes in the egg after fertilization. Characteristics of the zygote in different organisms. Artificial insemination and its biological significance.</p> | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2 | 2 | discussio<br>n |
| 5. | <p><b>5Stages and processes of individual development. The concept of the embryonic and postembryonic stages of ontogenesis. Cleavage.</b></p> <p>The concept of the embryonic and postembryonic stages of ontogenesis. Cleavage. Cleavage types, their dependence on the amount of yolk, its distribution in the cytoplasm (complete: uniform and uneven; partial: discoidal, superficial) and the properties of the cytoplasm (radial, spiral, bisymmetric). Alternating holoblastic cleavage of mammals. Dependence of the cleavage type on the type of egg. The structure of the blastula in animals with different cleavage types and blastula formation in mammals. Blastoderm and blastocoel. Parts of the blastoderm: roof, fundus, marginal zone. Embryoblast, trophoblast. The structure of the cell cycle during synchronous cleavage divisions. Desynchronization of nuclear division and cell cycle reorganization; Asynchronous cleavage period.</p>                                                                                                                       | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   | 2 | discussio<br>n |

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| 6. | <b>Gastrulation: the essence of the process. Primary embryonic induction.</b><br>Gastrulation: the essence of the process. Primary embryonic induction. The main modes of gastrulation: migration (emigration, immigration), invagination, delamination, and epiboly. The primary mouth and, consequently, the division of animals into two lineages: protostomes and deuterostomes. Formation of the mesoderm. The teloblastic and enterocoelic pathways of mesoderm formation. The two-layered embryo is the result of gastrulation in the lancelet. Gastrulation in reptiles, birds, and mammals.       | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2 |  | 2 |  | discussion |
| 7. | <b>Neurulation: the concept of neurulation. Segmentation of the mesoderm. Segmentation genes.</b><br>The primitive streak and Hensen's node; movement of material and formation of the chordomesodermal primordium. Features of gastrulation in mammals (formation of the primary yolk sac cavity, formation of the secondary yolk sac cavity).                                                                                                                                                                                                                                                            | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   |  | 2 |  | discussion |
| 8. | <b>Cell growth and differentiation in the rudiments of individual organs.</b><br>Differentiation of germ layers. Growth and differentiation of cells in the rudiments of individual organs. Differentiation of the ectoderm and its derivatives. Differentiation of the endoderm and its derivatives. Differentiation of the foregut and development of the primary oral cavity, pharynx, esophagus, stomach, anterior half of the duodenum, lungs, liver, and part of the pancreas. Differentiation of the midgut and development of the duodenum. Methods for obtaining and studying embryonic material. | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   |  | 2 |  | discussion |
| 9. | <b>Processes of postembryonic individual development of organisms. Causes of anomalies. Biological age.</b><br>Processes of postembryonic individual development of organisms. Causes of anomalies. Biological age. Life cycles. Plant life cycle characteristics: alternation of gametophyte and sporophyte. Diversity of animal life cycles: free-living, parasitic, symbiotic, sedentary.                                                                                                                                                                                                               | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2 |  | 2 |  | discussion |

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| 10. | <b>Current state of the biology of reproduction and development of organisms. Cloning. Genetic engineering.</b><br>Current state of the biology of reproduction and development of organisms. Cloning. Genetic engineering.                                                                                                                            | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   |  | 2 |  | discussion |
| 11. | <b>Human embryonic development. Current state of human embryology.</b><br>Periods of human development. Biological processes underlying embryonic development – induction, determination, division, cell migration, growth, differentiation, cell interaction, cell death. Critical periods in human development.                                      | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2 |  | 2 |  | discussion |
| 12. | <b>General structure of the male and female gonads. Progenesis. Cytogenetic essence of gametogenesis.</b><br>Structure of the sperm and egg. Spermatogenesis. Oogenesis. Fertilization. The cytogenetic essence of gametogenesis. Distant and contact interactions of gametes. Capacitation, acrosome reaction. Penetration of the sperm into the egg. | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   |  | 2 |  | discussion |
| 13. | <b>Fertilization. The ovarian-menstrual cycle.</b><br>The ovarian cycle, its phases, and hormonal regulation. The uterine cycle, its phases, and hormonal regulation. Fertilization and its phases. The zygote.                                                                                                                                        | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |   |  | 2 |  | discussion |

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| 14. | <p><b>Formation of germ layers and extraembryonic organs.</b></p> <p><b>Differentiation of embryonic primordia.</b></p> <p><b>Placentation. The "mother-placenta-fetus" system.</b></p> <p>General characteristics of the cleavage process. Its biological significance.</p> <p>Features of synthetic processes during cleavage. Moments of maternal and paternal gene activation. Spatial organization of cleavage.</p> <p>Mechanisms of blastulation. Types of blastulas, the relationship of their structure to cleavage morphology. Gastrulation and the formation of major organ primordia in vertebrates: description and results of experimental analysis.</p> <p>Methods of gastrulation: delamination, immigration, epiboly, invagination, and various combinations thereof. Types of gastrulae. Methods of mesoderm formation. Axial mesoderm and its further differentiation: the lateral plate.</p> <p>Differentiation of embryonic primordia.</p> <p>Placentation. The mother-placenta-fetus system and its functional significance.</p> <p>Characteristics of this period. The advantage of hematotrophic nutrition over histiotrophic nutrition. Mechanisms of interaction between the "mother" and "fetus" subsystems, their role in fetal development, maintaining pregnancy, and preparing the mother's body for childbirth.</p> <p>The theory of critical periods in embryogenesis. Critical periods in human ontogenesis.</p> | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |  |  | 2 |  | discussion |
| 15. | <p><b>Characteristics of human organogenesis as the final stage of embryonic development, the formation of organs and their systems.</b></p> <p>The main stages of human organogenesis.</p> <p>Organogenesis, consisting of the formation of individual organs, constitutes the main content of the embryonic period.</p> <p>Embryonic induction is the most important consequence of the interaction between the germ layers.</p> <p>Neurulation as the beginning of organogenesis.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | AI-1<br>GPC-5<br>AI-2<br>GPC-5 |  |  | 2 |  | discussion |

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| 16. | <b>Regulatory factors of embryogenesis. The influence of exogenous and endogenous factors on embryogenesis.</b><br>The influence of exogenous and endogenous factors on embryogenesis. Mutagenesis. Mutagenic factors. Regulatory factors of embryogenesis. Genetic level of regulation. Intracellular level of regulation. Epigenetic level of regulation. Organismal level of regulation (nervous, endocrine, immune). Clinical aspects. | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2  |  | 2  |    | discussion |
| 17. | <b>Developmental defects and anomalies. Classification of developmental disorders.</b><br>Classification of congenital malformations – hereditary, exogenous (environmental), and multifactorial. Developmental defects phylogenetically determined and not associated with previous phylogenesis, i.e., non-phylogenetic. Prevention of congenital malformations.                                                                         | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2  |  | 2  |    | discussion |
| 18. | <b>18 Teratogens and the developmental disorders they cause.</b><br>Teratogenesis. Teratogenic factors. Endogenous teratogens. Exogenous teratogens. Consequences of exposure to teratogenic factors. Terminal teratogenic factor.                                                                                                                                                                                                         | AI-1<br>GPC-5<br>AI-2<br>GPC-5 | 2  |  | 2  |    | discussion |
|     | TOTAL in Semester                                                                                                                                                                                                                                                                                                                                                                                                                          |                                | 18 |  | 36 | 54 |            |
|     | TOTAL                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                | 18 |  | 36 | 54 |            |

*Interview (discussion),*

*Colloquium*

*Presentation of laboratory work*

*Presentation of abstract*

*Presentation of report*

*Presentation of project*

*Testing*

## 6. Assessment Tools Fund for the Discipline (Module)

The assessment tools fund (ATF) for the discipline (module) Developmental biology, embryology is based on the list of competencies to be mastered, indicating the stages of their formation in the process of mastering the discipline (module). The ATF provides an objective control over the achievement of the planned learning outcomes. The ATF includes:

- A description of indicators and criteria for evaluating competencies at various stages of their formation, a description of evaluation scales;
- Methodological materials determining the procedures for evaluating knowledge, skills, abilities and (or) work experience characterizing the stages of competency formation;
- Standard control tasks and other materials necessary for assessing knowledge, skills, and the level of mastery of the formed competencies in the process of mastering the discipline (module).

The ATF is an appendix to this discipline (module) program.

## **7. Methodological Guidelines for Students on Mastering the Discipline**

When starting work, each student must take into account the following provisions.

The discipline (module) is structured on a thematic principle; each topic represents a logically completed section.

The lecture material is dedicated to the consideration of key, basic provisions of the courses and the clarification of learning tasks assigned for the independent work of students.

Practical classes are conducted with the aim of consolidating the mastered information, acquiring skills for its application in solving practical problems in the relevant subject area.

Laboratory works are aimed at gaining practical experience in the relevant subject area.

The independent work of students is aimed at the independent study of additional material, preparation for practical and laboratory classes, as well as the execution of all types of independent work.

In order to successfully master the discipline, it is important to complete all types of independent work employing the recommended sources of information.

## **8. Educational, Methodological, and Informational Support for the Discipline**

### **8.1. List of Main and Additional Literature Required for Mastering the Discipline (Module)**

#### **8.1.1. List of Main Literature:**

1. Sadler, T. W. Langman's medical embryology. - 12th ed. -2012. -400 p.

#### **8.1.2. List of Additional Literature:**

1. Barresi M.J.F., Gilbert S.F. Developmental Biology. 12th ed, 2020. -1258 p.
2. Larry R. Cochard Netter's atlas of human embryology. Chicago, Illinois, 2012. -290 p.

### **8.2. List of Educational and Methodological Support for the Independent Work of Students in the Discipline (Module)**

1. Study Guide: Guidelines for Students on Organizing and Conducting Independent Work in the Course "Developmental Biology, Embryology." – Stavropol: SKFU, 2026.

2. Study Guide: Guidelines for Completing Laboratory Work in the Course "Developmental Biology, Embryology." – Stavropol: SKFU, 2026.

### **8.3. List of Resources of the Information and Telecommunications Network **Internet** Required for Mastering the Discipline (Module)**

<http://rudocor.net/> - Medical Portal

<http://www.e-reading.club/> - Large Online Library

<http://www.pubmed.com/> - Database of full-text medical articles

<http://www.spravocnikpolekarstvam.ru/> - Free online pharmacological reference

<https://dic.academic.ru/> - Dictionaries and Encyclopedias

<https://www.rmj.ru/> - Russian Medical Journal

## **9. List of Information Technologies Employed through the Discipline (Module), Including a List of Software and Information Reference Systems**

When delivering lectures, computer equipment and demonstrations of multimedia presentation materials are used. In seminars and practical classes, students deliver presentations prepared by them during the hours of independent work.

### **Information Reference Systems:**

Information-reference and information-legal systems used in the study of the discipline:

|    |                                                                                                                                                                                                    |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Electronic library system "University Library Online" - <a href="http://www.biblioclub.ru">www.biblioclub.ru</a> (Agreement No. 50-04/19 on the provision of information services from 13.05.2019) |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |                                                                                                                                                                                                |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2. | The electronic library system "IPRbooks" (LICENSE AGREEMENT No. 5168/19 dated 13.05.2019 for the provision of access to the electronic library system IPRbooks. Organization: IP Ar Media LLC) |
| 3  | "eLIBRARY.RU ": [Scientific Electronic Library]. – URL: <a href="http://elibrary.ru">http://elibrary.ru</a>                                                                                    |
| 4  | . Information and legal portal "Garant" - <a href="http://www.garant.ru/">http://www.garant.ru/</a>                                                                                            |
| 5  | Legal reference system Russian legislation and judicial practice are freely available - <a href="http://www.pravo.ru/">http://www.pravo.ru/</a>                                                |

#### **Software:**

|    |                                     |
|----|-------------------------------------|
| 1. | Alt Workstation 10                  |
| 2. | Alt Workstation K                   |
| 3. | Alt Server                          |
| 4. | Office software package – P7-Office |

### **10. Description of the Material and Technical Resources Required for the Educational Process for the Discipline (Module)**

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Lecture classes</b>    | A classroom equipped with multimedia equipment and technical training facilities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Laboratory classes</b> | The educational laboratory of "Cytology, Histology, Embryology" is provided with the following equipment and technical means of teaching: a set of educational furniture for 14 seats, a magnetic marker board, a set of educational furniture, a projector with a wall bracket, a computer with the necessary set of licensed software. Atlases on histology and cytology; Binocular light microscope; Trinocular light microscope; Microscope "MIKMED-1-vap .2-20 (Biolam p-15); Microscope "MIKMED-1var.1" (BIOLAM P-11); Microscope Biolam (P); Microscope MBS 9; Sets of micropreparations for general and specific histology; Sets of micropreparations for cytology; Set of micropreparations for embryology; Stages of development of human embryos (macropreparations contained in 10% formalin solution); Premature fetus. Animal embryos. |
| <b>Practical classes</b>  | A classroom, equipped with multimedia equipment and technical training facilities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Independent work</b>   | A room for the independent work of students, equipped with computer hardware with the capability to connect to the Internet network and provide access to the electronic information and educational environment of the university.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Practical training</b> | Carried out in the structural subdivisions of the university and (or) in organizations engaged in activities matching the profile of the respective training program, including its structural subdivision.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

### **11. Specific Features of Mastering the Discipline (Module) by Persons with Disabilities**

Students with disabilities shall be provided with special textbooks, teaching aids, and didactic materials, special technical training facilities for collective and individual use, the services of an assistant (helper) providing the necessary technical assistance to the students, as well as the services of sign language interpreters and tactile sign language interpreters.

The mastery of the discipline (module) by students with disabilities may be organized jointly with other students, as well as in separate groups.

Mastering the discipline (module) by students with disabilities is to be carried out taking into account the peculiarities of psychophysical development, individual capabilities, and health status.

In order to ensure the accessibility of higher education under the educational program for persons with disabilities, the following is provided during the mastery of the discipline (module):

- 1) for persons with visual impairments:
  - the presence of an assistant offering the student the necessary technical assistance, taking into account individual features (help taking the workplace, moving around, reading and formatting the task, including writing under dictation),
  - written tasks, as well as instructions on the procedure for their execution, are formatted in an enlarged font,
  - special textbooks, teaching aids, and didactic materials (having a large font or audio files), individual uniform lighting of at least 300 lux, if necessary, a magnifying device is provided to the student to complete the task;
- 2) for persons with hearing impairments:
  - the presence of an assistant providing the student with the necessary technical assistance, taking into account individual characteristics (helps to take a workplace, move around, read and format the task, including writing with dictation),
  - the availability of sound-amplifying equipment for collective use is ensured; if necessary, sound-amplifying equipment for individual use is provided to the student;
  - provision with proper sound means of reproducing information is ensured;
- 3) for persons with musculoskeletal disorders (including severe motor function impairments of the upper limbs or the absence of upper limbs):
  - written tasks are performed on a computer with specialized software or are dictated to an assistant;
  - at the request of the student, tasks may be performed verbally.

## **12. Specific Features of Implementing the Discipline with the Use of Distance Learning Technologies and E-Learning**

Subject to Part 1 of Article 16 of the Federal Law of December 29, 2012, No. 273-FZ On Education in the Russian Federation, e-learning shall be viewed as the arrangement of educational activities employing information contained in databases and used in the implementation of educational programs, as well as information technologies, technical means, and information and telecommunication networks that ensure the processing and transmission of the specified information via communication lines, and the interaction of students and pedagogical workers.

Remote (distance) learning technologies are understood as educational technologies implemented mainly with the use of information and telecommunication networks during the indirect (at a distance) interaction of students and pedagogical workers.

The implementation of the discipline may be carried out with distance learning technologies and e-learning in full or in part. The components of the Educational And Methodological Complex (EMC) of the discipline (working program of the discipline, assessment and methodological materials, forms of attestation) implemented with the use of distance learning technologies and e-learning contain an indication of their use.

When arranging educational activities with distance learning technologies and e-learning, asynchronous and synchronous methods of interaction between participants in educational relations via the information and telecommunications network Internet may be offered.

When using distance learning technologies and e-learning, the schedule for the discipline shall indicate: methods of interaction among participants in educational relations via the information and telecommunications network Internet (VCC – videoconferencing, ET – electronic

testing); links to the electronic information and educational environment of NCFU, to educational platforms and resources of other organizations to which open access is provided via the information and telecommunications network Internet; for synchronous learning – the time of online classes and instructors; for asynchronous learning – the authors of online courses.

When arranging intermediate attestation with distance learning technologies and e-learning, the Methodological Recommendations on the use of technical means ensuring the objective reliability of results when conducting intermediate and state final attestation for higher education educational programs – Bachelor's Degree programs, Specialist's Degree programs, and Master's Degree programs with distance learning technologies are used (Letter of the Ministry of Science and Higher Education of Russia dated December 7, 2020, # MN-19/1573-AN On sending methodological recommendations).

The implementation of the discipline with the use of e-learning and distance learning technologies is carried out using the electronic information and educational environment of NCFU, to which students are provided access via the information and telecommunications network Internet, or using the resources of other organizations, including platforms providing services for videoconferencing, online meetings, and distance learning (MTS-Link), as well as using the capabilities of social networks to carry out communication between students and instructors.

The educational and methodological support for a discipline shall be ensured with e-learning and distance learning technologies includes the working program presented in electronic form, educational and methodological manuals or a course of lectures, methodological guidelines for performing various types of educational activities of students provided for by the discipline, and other educational and methodological materials posted in the information and educational environment of NCFU.