

Federal State Autonomous Educational Institution of Higher Education  
«Peoples' Friendship University of Russia»

*Medical Institute*

Recommended MCSD

**SYLLABUS**  
(STUDY GUIDE)

**Subject**

**Normal Physiology**

**Recommended for the direction of training (specialty)**

**31.05.01 General Medicine**

**Program (profile, specialization)**

**General Medicine**

## 1. Goals and objectives of the discipline.

The discipline " Normal physiology " is aimed at obtaining basic knowledge about the functioning of the human body .

The purpose of studying the discipline " Normal physiology " is the student's acquisition of knowledge about the development of structures and functions of various systems of the body on the basis of modern achievements of physiological science, necessary for the formation of a natural scientific worldview and practical activities of a doctor .

The objectives of the discipline are:

1. Formation of students' general professional competence of the ability to assess morphofunctional, physiological states and pathological processes in the human body for solving professional problems .
2. Formation of systemic knowledge about the life of the organism as a whole, its interaction with the external environment and the dynamics of life processes, ideas about the basic laws of the functioning of the body's systems and the mechanisms of their regulation .
3. Teaching the most important methods of analyzing physiological mechanisms and the work of functional systems that maintain the homeostasis of the human body.
4. Acquisition of knowledge about the physiological foundations of clinical and physiological methods for studying body functions.

## 2. Place of discipline in the structure of EP of HE:

Discipline " Normal Physiology " refers to the basic component of block 1 of the curriculum .

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix of EP of HE.

Table No. 1

### Prior and subsequent disciplines aimed at the formation of competencies

| No. p / p                                | Code and name of competence | Preceding disciplines | Parallel disciplines | Subsequent disciplines |
|--|-----------------------------|-----------------------|----------------------|------------------------|
| <b>General professional competencies</b> |                             |                       |                      |                        |

|   |  |   |  |
|---|--|---|--|
| <p>OPK- 5 . Able to assess morphofunctional, physiological conditions and pathological processes in the human body to solve professional problems</p> | <p>Biology<br/>Molecular genetics in practical biology and medicine<br/>Medical elementology</p> | <p>Biochemistry<br/>Anatomy<br/>Histology, embryology, cytology<br/>Microbiology, Virology<br/>Molecular Physiology</p> | <p>Pathophysiology, clinical pathophysiology<br/>Propedeutics of Internal Medicine<br/>general surgery<br/>Topographic anatomy and operative surgery<br/>Dermatovenereology<br/>Neurology, medical genetics, neurosurgery<br/>Ophthalmology<br/>Forensic Medicine<br/>Faculty therapy<br/>Faculty surgery<br/>Occupational diseases<br/>Hospital therapy<br/>Anesthesiology, resuscitation, intensive care<br/>Hospital surgery, pediatric surgery<br/>Oncology, radiation therapy<br/>Maxillofacial Surgery</p> |
|---|--|---|--|

**3. Requirements for the results of mastering the discipline:**

The process of studying the discipline " Normal physiology - physiology of the maxillofacial region" is aimed at the formation of the following competencies:

table 2

**Formed competencies**

| Competencies | Competency name  | Competence achievement indicators   |
|--------------|--|---|
| GPC - 5      | <p>GPC-5. Being able to assess morphofunctional, physiological conditions and pathological processes in the human body to solve professional tasks</p> | <p>GPC-5.1. Mastering the algorithm of clinical, laboratory and functional diagnosis when dealing with professional tasks.</p> <p>GPC-5.2. Being able to evaluate the results of clinical, laboratory and functional diagnosis when dealing with professional tasks.</p> <p>GPC-5.3. Being able to determine morphofunctional, physiological states and pathological processes of the human body.</p> |

**4. Scope of discipline and types of educational work**

The total complexity of discipline is 5 credits .

**for full-time education**

| Type of educational work for full-time education | Total hours | Semesters / module |      |  |  |
|--|-------------|--------------------|------|--|--|
|  |             | 3                  | four |  |  |
| <b>Classroom lessons (total)</b>                 | 210         | 102                | 108  |  |  |
| Including:                                       |             |                    |      |  |  |
| <i>Lectures</i>                                  | 70          | 34                 | 36   |  |  |
| <i>Practical lessons</i>                         | -           | -                  | -    |  |  |
| <i>Seminars</i>                                  | -           | -                  | -    |  |  |
| <i>Laboratory work</i>                           | 140         | 68                 | 72   |  |  |
| <b>Independent work (total)</b>                  | 78          | 42                 | 36   |  |  |
| Including:                                       |             |                    |      |  |  |
|  |             |                    |      |  |  |
| Total labor intensity                            | 288         | 144                | 144  |  |  |
| Credits  | 8           | 4                  | 4    |  |  |

**5. Content of the discipline**

5.1. Contents of discipline sections

| No. p / p | The name of the discipline section | Section Contents   |
|-----------|------------------------------------|--|
| 1.        | Physiology of the blood            | Functions and composition of blood. Blood plasma. Corpuscular elements of blood, their functions. Leukocytes. Function of erythrocytes and blood hemoglobin. Blood groups. Rhesus factor. Blood clotting. Biophysical mechanisms. Clotting phases. The constancy of the internal environment (homeostasis). Blood constants. |

|    |   |  |
|----|---|--|
| 2. | Physiology of excitable tissues   | Excitability and its parameters. Excitation. Characteristics of excitable tissues. Biophysics of membranes and muscle contraction. Properties of the nerve fiber, nerve. Physiology of the synapse. Muscle physiology. Skeletal muscle and its functions. Muscle strength. Types and mechanisms of muscle contractions. Fatigue and performance, the relationship between structure and function.  |
| 3. | Physiology of the central nervous system. Physiology of the autonomic nervous system. | Reflex and its characteristics. The development of ideas about the reflex. Types of reflexes. Reflex regulation of visceral and somatic functions. General properties of the central nervous system. Coordination and integration into nutritive processes. Excitation and inhibition in the central nervous system. Basic properties of nerve centers. Private physiology of the central nervous system. Blood-brain barrier. Research methods of the central nervous system. Sympathetic, parasympathetic, metasymphathetic NA and their functions. ANS synapses . The role of the ANS in the development of adaptive responses. |
| 4. | Physiology of higher nervous activity   | Physiology of VND. Conditioned reflex , types, mechanisms of formation . Dynamic stereotype. Excitation and inhibition in the cerebral cortex. I and II signaling systems. Memory. Sleep , its mechanisms, phases . Motivation and emotion, social role. Motivation as the basis of personality. Sphere of consciousness, subconsciousness, superconsciousness . VNI methods and research .  |
| 5. | Physiology of sensory systems   | General properties of analyzer systems. The role of receptors and higher parts of the central nervous system in the perception of the external world. Physiology of vision. Physiology of hearing and vestibular apparatus. Skin analyzer. Taste and olfactory analyzers. Pain. The problem of pain in medicine. Pain perception mechanisms and pain relief.   |
| 6. | Physiology of GI tract  | General understanding of digestion. Digestive tract functions. Methods for studying digestive functions. Physiological bases of hunger and satiety. General principles of regulation of digestion processes. Motor and secretory functions of the digestive tract. Absorption of nutrients in the gastrointestinal tract. The role of the liver in digestion. Secretory function and digestion in various parts of the digestive tract.  |

|    |   |  |
|----|---|--|
| 7. | Physiology of excretion                 | Excretory system. Mechanisms of urine formation . Non-urinary functions of the kidneys. The kidneys as an organ of homeostasis. Bladder and urination. Methods and studies of renal function. The role of the kidneys in the development of adaptive reactions of the body.  |
| 8. | Physiology of the cardiovascular system | The cardiac cycle and its phases . Conductive system of the heart. The spread of excitement through the myocardium. Properties of the heart muscle. Phases of excitability. Extrasystole. Mechanisms of myocardial contractile activity. Nervous and humoral regulation of the heart. Research methods of the heart. Physiology of blood vessels. Basic laws of hemodynamics. Blood circulation in various parts of the vascular bed. Blood flow rate, blood pressure. Pulse. Microcirculation and lymph flow . Mechanisms of juxta and transcapillary blood flow. Mechanisms of lymph formation and exchange in interstitial spaces. Regulation of blood circulation. Vasomotor nerves. Hierarchy of vasomotor centers. Redistribution of blood. Blood flow research methods. |
| 9. | Respiratory physiology                  | External respiration. The role of the respiratory muscles. Change in pressure in the pleural cavity. Pulmonary volumes and capacities. Biophysics of gas exchange. Difference in partial pressures of gas in alveolar air, blood, tissues. Carriage of gases by blood. Oxygen transport mechanism. Dissociation curve of hemoglobin. Carrying out carbon dioxide. Respiration regulation. Breathing in changed environmental conditions. Features of breathing in the mountains. Deep diving breathing. Hypoxia and their manifestations.  |
| 10 | Endocrine Physiology                    | Hormones, mechanisms of action. General properties of hormones, the hierarchy in the activity of WBC. Private physiology of endocrine glands : thyroid and parathyroid glands, adrenal glands, pancreas, sex glands. Mechanisms for the integration of physiological functions.  |
| 11 | Metabolism and energy. Thermoregulation | The laws of thermodynamics. Biophysics of energy exchange. Entropy law. Entropic and nonentropic effects in organima . Basal metabolism and its determining factors . The exchange of proteins, fats, carbohydrates, vitamins and minerals. The arrival and consumption of substances in the body. Neurohumoral regulation of metabolism in the body. Physiological foundations of nutrition. Basic principles of the preparation of food rations. Body temperature and thermoreception .  |

## 5.2. Sections of disciplines and types of classes

### for full-time education

| <b>P / p No.</b> | <b>The name of the discipline section</b>   | <b>Lectures</b> | <b>Lab. work</b> | <b>CPC</b> | <b>Total hour.</b> |
|------------------|---|-----------------|------------------|------------|--------------------|
| 1.               | Physiology of blood   | 6               | 12               | 8          | 26                 |
| 2.               | Physiology of excitable tissues   | 6               | 15               | 8          | 29                 |
| 3.               | Physiology of the central nervous system. Physiology of the autonomic nervous system. | 10              | 17               | 10         | 37                 |
| 4.               | Physiology of higher nervous activity   | 6               | 12               | 8          | 26                 |
| 5.               | Physiology of sensory systems   | 6               | 12               | 8          | 26                 |
| 6.               | Digestive physiology  | 4               | 12               | 6          | 22                 |
| 7.               | Excretion, renal physiology   | 4               | 14               | 6          | 24                 |
| 8.               | Physiology of the cardiovascular system   | 10              | 12               | 8          | 30                 |
| 9.               | Respiratory physiology  | 8               | 11               | 6          | 25                 |
| 10.              | Endocrine regulation of physiological functions                                       | 4               | 5                | 4          | 13                 |
| 11.              | Metabolism and energy. Thermoregulation   | 6               | 18               | 6          | 30                 |

## 6. Laboratory workshop

| <b>P / p No.</b> | <b>The name of the discipline section</b> | <b>Name of laboratory work</b>   | <b>Labor intensity (hour.)</b> |
|------------------|---|--|--------------------------------|
| 1.               | Physiology of blood                       | "Counting leukocytes in Goryaev's chamber." "Counting erythrocytes", "Determination of hemoglobin content by the Sali method ", "Calculation of the color index of blood." "Determination of blood group and Rh factor." "Study of different types of hemolysis". "Study of the osmotic resistance of erythrocytes." "Determination of bleeding time." "Determination of clotting time". | 12                             |

|    |   |   |    |
|----|---|---|----|
| 2. | Physiology of excitable tissues   | Galvani's Experiments. "Determination of nerve and muscle irritation thresholds". "Effect of muscle relaxin (curare) on the neuromuscular synapse". "Bilateral conduction of excitation along the nerve." "Registration of single muscle contractions, dentate and smooth tetanus." Dynamometry. Study of the maximum voluntary strength and strength endurance of muscles. "The influence of various types of rest on the effectiveness of recovery of muscle performance."  | 15 |
| 3. | Physiology of the central nervous system. Physiology of the autonomic nervous system. | "Study of human unconditioned reflexes. Analysis of the reflex arcs of the knee and pupillary reflex". "Sechenovskoe braking". "Electroencephalography". "Investigation of cerebellar control of skeletal muscle motor activity." "Assessment of vegetative tone according to the Kerdo index ." "An approximate assessment of the vegetative tone of a person by the method of questionnaires." "Determination of the reactivity of the sympathetic division of the autonomic nervous system (orthostatic test)." "Determination of the reactivity of the parasympathetic division of the autonomic nervous system (clinostatic test)." Martinette's test (assessment of parameters of the cardiovascular system during exercise). "Hering's respiratory-cardiac reflex" | 17 |
| 4. | Physiology of higher nervous activity   | "Development of a conditioned pupillary reflex in humans." "Comparison of unconditioned and conditioned reflex reactions of human salivation." "Study of the distribution of attention." "Attention Switching Study". "Dependence of the amount of memory on the degree of meaningfulness of the material." "Determination of human temperament using the Eysenck questionnaire ." "Definition of typological features of GNI in humans according to I.P. Pavlov".  | 12 |
| 5. | Physiology of sensory systems   | "Determination of visual acuity". "Determination of the field of view (perimetry)". "Determination of the thresholds of gustatory sensitivity." "Determination of the role of smell in the emergence of gustatory sensations." Comparison of air and bone conduction ( Rinne test ). "Study of tactile sensitivity (esthesiometry)".  | 12 |
| 6. | Digestive physiology  | "Recording the motility of the small intestine of the frog. The effect of acetylcholine and adrenaline on the motility of the small intestine." "Study of the enzymatic properties of gastric juice". "Research on the effect of bile on fats."   | 12 |

|     |   |  |    |
|-----|---|--|----|
| 7.  | Excretion, renal physiology                     | "Determination of some components of urine using diagnostic strips." Solving situational tasks on the topic of the lesson. Analysis of the RAAS scheme.  | 14 |
| 8.  | Physiology of the cardiovascular system         | "Registration of an electrocardiogram. Interpretation of a normal electrocardiogram. " "Measurement of blood pressure in humans", "Evaluation of the parameters of the cardiovascular system at rest and during exercise."   | 12 |
| 9.  | Respiratory physiology                          | "Spirometry". "Conducting hypoxemic tests of Stange and Genchi "   | 11 |
| 10. | Endocrine regulation of physiological functions | "Determination of the concentration of glucose in human blood", "Construction of the glycemic curve during the glucose tolerance test"   | 5  |
| 11. | Metabolism and energy. Thermoregulation         | "Calculation of basal metabolic rate and daily energy expenditure." "Assessment of the state of human metabolism by analyzing body weight (calculations of body mass index and ideal body weight)." "Assessment of the distribution of body fat in a person according to the waist / hip index." "Evaluation of human body fat mass by caliperometry ". "Formulation and evaluation of food rations." "Study of temperature sensitivity ( thermoesthesiometry )" | 18 |

### 7. Practical lessons (seminars) are not provided

### 8. Material and technical support of the discipline:

For classes, group and individual consultations, monitoring and intermediate certification, classrooms 114, 116 and 126 and a lecture hall are used, located at the address: Moscow, st. Miklukho-Maclay, 8.

**Technical supply** : complex for laboratory work (BIOZHEZL) kymograph, stimulant, versatile tripod, horizontal myography, dissecting tool kit, a set of tables, carpal dynamometer, horizontal ergograph, counting chamber Goryaeva, gemometr Sali , multimedia installation, Colyclons Anti-A, Anti-B and anti-AB for determining blood groups according to the ABO system, tsoliklon Anti-D for determining the Rh factor according to the Rhesus system, stimulator, electrocardiographs EK1T-O7 and Axion , sphygmomanometer, phonendoscope, plethysmograph type 3547, multimedia installation, audiometer, Barani chair , Forster perimeter, Sivtsev tables, portable glucometer , electroencephalograph .

Classroom equipment: a set of specialized furniture, chalk board; a projection screen, a multimedia projector, computers with software that allows you to show slides, and conduct a milestone and final survey and multimedia projectors.

Audiovisual teaching aids: educational films.

Educational computer programs used in practical classes: program for testing " Mytest ".

Visual aids: tables on the topics studied (more than 50 pieces).

### 9. Information support of the discipline

a) software :

Volume Licensing Program ( Microsoft Subscription ) Enrollment for Education Solutions ( EES ) No. 56278518 dated 04/23/2019 (renewed annually, the program is assigned a new number).

**b) databases, information and reference and search systems:**

1. EBS of RUDN University and third-party EBS to which students have access on the basis of concluded agreements:

- Electronic library system RUDN - EBS RUDN <http://lib.rudn.ru/MegaPro/Web>

- EBS "University Library Online"

<http://www.biblioclub.ru>

- EBS Yurayt <http://www.biblio-online.ru>

- EBS "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)

- EBS "Doe" <http://e.lanbook.com/>

- TUIS: <http://esystem.pfur.ru/course/view.php?id=46>

2. Database of medical and biological publications:

- **NCBI:** <https://p.360pubmed.com/pubmed/>

- **RUDN University Bulletin:** access mode from the RUDN University territory and remotely <http://journals.rudn.ru/>

- **Library Elibrary.ru:** access on IP-addresses of People's Friendship University of address: <http://www.elibrary.ru/defaultx.asp>

- **ScienceDirect (ESD), " FreedomCollection ", "Cell Press" ID "Elsevier".** There is remote access to the database, access by IP-addresses of RUDN University (or remotely by individual login and password).

- **Google Academy (eng. Google Scholar ) - a free search engine for full texts of scientific publications of all formats and disciplines. Indexes full texts of scientific publications. Access mode:** <https://scholar.google.ru/>

- **Scopus - a scientometric database of the publishing house " Elsevier " .** There is remote access to the database.

Access by IP-addresses of RUDN University and remotely by login and password (Grant of the Ministry of Education and Science). Access mode: <http://www.scopus.com/>

- **Web of Science .** There is remote access to the database. Access to the platform is carried out by IP-addresses of the RUDN University or remotely. Remote access to WOS is activated without administrator intervention after registering on the platform from RUDN University

<http://login.webofknowledge.com/>

**10. Educational and methodological support of the discipline:**

**a) main literature**

1. Fundamentals of human physiology : textbook. In 2 volumes. T. 1 / N.A. Aghajanyan , I. G. Vlasova, N.V. Ermakova [and others]; Ed. IN AND. Torshina . - 5 th ed. Rev . and add. ; Electronic text data. - M.: Publishing house of RUDN University, 2017 .-- 524 p. : ill. - ISBN 978-5-209-06817-4. - ISBN 978-5-209-06816-7: 138.36. [http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn\\_FindDoc&id=460159&idb=0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=460159&idb=0) ,

2. Fundamentals of human physiology : textbook. In 2 volumes.Vol. 2 / N.A. Aghajanyan , I. G. Vlasova, N.V. Ermakova [and others]; Ed. IN AND. Torshina . - 5 th ed. Rev . and add. ; Electronic text data. - M.: Publishing house of RUDN, 2017 .-- 456 p. : ill. - ISBN 978-5-209-06817-4. - ISBN 978-5-209-07434-2: 138.36. [http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn\\_FindDoc&id=460012&idb=0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=460012&idb=0)

**b) additional literature**

1. Collection of control tasks in physiology for testing and independent work of a student: a textbook for practical exercises and independent work of students / V.I. Torshin , N.V. Ermakova, Z. V. Bakaeva, O. V. Mankaev ; Under total. ed. V.I. Torshina , N.V. Ermakova . - Electronic text data. - M.: Publishing house of RUDN University, 2017 .-- 533 p. - ISBN 978-5-209-08013-8 : 450.00. [http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn\\_FindDoc&id=461714&idb=0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=461714&idb=0)
2. Brin V.B. Human physiology in diagrams and tables: textbook / V.B. Brin . - SPb . : Publishing house " Lan " , 2017. - 608 p. - (Textbooks for universities. Special literature). - ISBN 978-5-8114-2054-4 [http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn\\_FindDoc&id=465025&idb=0](http://lib.rudn.ru/MegaPro/UserEntry?Action=Rudn_FindDoc&id=465025&idb=0)
3. Shatalova L.S., Torshin V.I. Human physiology : educational terminological dictionary for foreign medical students: In 2 hours. Part 1: AN / L.S. Shatalova, V.I. Torshin . - Electronic text data. - M.: Publishing house of RUDN, 2016 .-- 536 p. : ill. - ISBN 978-5-209-06134-2: 481.71. Electronic version.
4. Shatalova L.S., Torshin V.I. Human physiology : educational terminological dictionary for foreign medical students: In 2 hours. Part 2: O-Yu / L.S. Shatalova, V.I. Torshin . - Electronic text data. - M.: Publishing house of RUDN, 2017 .-- 456 p. : ill. - ISBN 978-5-209-07581-3: 304.24. Electronic version.

## **11. Methodical instructions for students on mastering the discipline (module)**

Each laboratory session includes:

- topic and questions for study;
- a specific list of skills and abilities that a student must master;
- control questions and tasks that allow you to determine the success of the assimilation of the studied material;
- questions for self-examination and tasks for independent work on topics are presented in the methodological developments for each section and posted on the TUIS platform: <http://esystem.pfur.ru/>

Detailed information, including theoretical material, a glossary and a list of recommended literature for students wishing to get acquainted with the topic under study in more detail, can be found on the TUIS platform: <http://esystem.pfur.ru> .

At the beginning of each laboratory lesson, it is planned to conduct a test control of the student's theoretical preparedness on the topic of the lesson.

At the end of each laboratory lesson, a student's Workbook is filled in, the file from which is available for download on the TUIS platform.

The passage section s completed a landmark knowledge control in the form of test control and delivery of completed reports of laboratory works on the subjects covered . In the process of midterm control, the student must show his knowledge and skills on the topic covered.

Examples of test items for preparation for classes, colloquia and exam are posted on the TUIS platform in the corresponding section of the discipline .

In the process of mastering the discipline within the framework of independent work, the student works with literature in the RUDN University library and uses the resources of the information and communication network "Internet".

## **Features of the implementation of discipline for people with disabilities and people with disabilities.**

Training in the discipline of disabled people and persons with disabilities (hereinafter HIA) is carried out by the teacher, taking into account the characteristics of psychophysical development, individual capabilities and health status of such students.

For students with musculoskeletal disorders and hearing disabilities, lectures will be accompanied by multimedia and handouts.

For students with visual disabilities, the use of technical means for enhancing residual vision is provided, as well as the possibility of developing audio materials.

In this discipline, training of disabled people and persons with disabilities can be carried out both in the classroom and remotely using the capabilities of the electronic educational environment (TUIS) and e-mail.

In the course of classroom training, various means of interactive learning are used, including group discussions, brainstorming, business games, project work in small groups, which makes it possible to include all participants in the educational process in active work on mastering the discipline. Such teaching methods are aimed at joint work, discussion, group decision-making, contribute to group cohesion and provide opportunities for communication not only with the teacher, but also with other students, cooperation in the process of cognitive activity.

Training of disabled people and persons with disabilities can be carried out according to an approved individual schedule, taking into account the characteristics of their psychophysical development and health status, which implies the individualization of the content, methods, pace of the student's learning activity, the ability to follow the specific actions of the student when solving specific problems, making the need, the required adjustments in the training process.

It provides for individual consultations (including counseling via e-mail), the provision of additional educational and methodological materials (depending on the diagnosis).

### **Methodological materials for the organization and conduct of laboratory work**

Laboratory work as a type of training is carried out in specially equipped educational laboratories (classrooms). Duration - at least two academic hours. The necessary structural elements of laboratory work, in addition to the independent activities of students, are instructing conducted by the teacher, as well as the organization of discussion of the results of the laboratory work.

The performance of laboratory work is preceded by a test of the students' knowledge (their theoretical readiness to complete the task).

Laboratory work can be of a reproductive, part-search and exploratory nature.

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

Works that are partially exploratory in nature are characterized by the fact that when they are carried out, students do not use detailed instructions, they are not given a detailed algorithm for performing the necessary actions, and require students to independently choose ways to perform work in the instructive and reference literature.

When performing work of a search nature, students must solve a new task (problem), relying on their theoretical knowledge.

When planning laboratory work, the developer finds the optimal ratio of reproductive, partial prospecting and prospecting work in order to ensure a high level of intellectual activity.

Forms of organization of students during laboratory work: frontal, team and individual.

With the frontal form of organizing classes, all students perform the same work at the same time.

In the case of a team-based organization of classes, the same work is performed by teams of 2-5 people.

With an individual form of organization of classes, each student performs his own individual task.

To increase the efficiency of laboratory work, the following are carried out:

- preparation of collections of tasks, tasks and exercises;
- development of control and diagnostic materials (funds of appraisal funds);
- combination of individual and group forms of work.

Grades for the performance of laboratory work, the results of which are entered in the student's notebook of laboratory work, are taken into account as part of the current control of the student's knowledge, which is carried out at the expense of the time allotted by the working curriculum for the study of the academic discipline.

**12. Fund of assessment tools for intermediate certification of students in the discipline (module):**

For attestation of students for the compliance of their personal achievements with the planned learning outcomes in the discipline, funds of assessment tools have been created (FOS is presented in Appendix 1).

The teacher has the right to change the number and content of assignments given to the student (learner), based on the contingent (level of preparedness).

The program has been drawn up in accordance with the requirements of the FSES HE.

**Developers:**

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