

PROGRAM
professional exam in biology
upon admission to study for a bachelor's or a master's degree in medicine

The purposes of the professional entrance exam in biology are:

- to assess the level of educational achievements of entrants;
- to estimate the compliance of the entrant's knowledge and skills with the program requirements.

The content of the program is structured according to the levels of life organization and consists of the "Introduction" and sections: "Molecular level of life", "Cellular level of life", "Non-cellular life forms", "Organismic level of life", "Supraorganismic levels of life organization", "Historical development of the organic world". Each program section is divided by topics. Each topic contains the requirements for knowledge and subject skills of entrants.

The entrance test program is aimed at identifying the level of formation of knowledge and skills in the school "Biology", on the basis of which the entrants will be able to:

- characterize basic biological concepts, regularities, laws and theories, biological phenomena and processes;
- operate with concepts, explain the processes and phenomena of nature, confirming with examples from human life and activity, health care, achievements of biological science;
- compare life processes at different levels of organization (molecular, cellular, organismal, population-species, ecosystem, biosphere) and identify relationships between them;
- analyze cause-and-effect, functional, structural relationships and regularities in nature; classify objects;
- explain the effect of harmful habits on the body;
- apply biological knowledge to analyze situations arising in various spheres of life; perform calculations using mathematical apparatus;
- apply acquired knowledge in the analysis of biological information presented in various forms (graphics, tabular, text);
- justify the conclusions.

Name of the section, topics	Knowledge and skill
Introduction	Biology as a science of the phenomenon of life. Sections of biology. Famous scientists are biologists and their contributions to the development of biological knowledge. The main signs of living. Levels of life organization: molecular, cellular, organismal, population-species, ecosystem and biosphere.

Name of the section, topics	Knowledge and skill
<i>Molecular level of life organization</i>	
Elemental composition organisms	Classification of chemical elements according to their content in organisms (macroelements, including organogenic elements, trace elements). Consequences of insufficient or excess intake of chemical elements (I, F, Fe, Ca, K) in the human body and ways to eliminate their deficiencies. Endemic diseases.
Inorganic compounds in organisms	Role of water, salts, and other inorganic compounds in the body. Hydrophilic compounds. Hydrophobic compounds.
Organic compounds in organisms	Structure, properties, and functions of organic compounds. Concept of biopolymers and their monomers. Carbohydrates: monosaccharides, oligosaccharides, and polysaccharides. Features of structure, main properties, and functions of carbohydrates in living organisms. Lipids: structure, main properties, and biological functions. Proteins: structural features. Amino acids, peptides and polypeptides. Levels of structural organization of proteins. Properties of proteins. Denaturation, renaturation, and destruction of proteins. Functions of proteins in living organisms. Enzymes: structure, properties, and applications in human economic activity. Nucleic acid. Structure, nucleotides. The structure, properties and functions of DNA, the principle of complementarity. The concept of gene. Types of RNA. ATP, concept of macroergic bonds. Biologically active substances (vitamins, hormones, neurohormones, phytohormones, alkaloids, phytoncides), their biological role.
<i>Cellular level of life organization</i>	
The general structure and functioning of the cell	Basic provisions of modern cell theory. Membranes, their structure, properties and main functions. Plasma membrane. Transport of substances through membranes. Supra membrane complexes (cell wall, glycocalyx). Submembrane complexes (microfilaments, microtubules). Cytoskeleton, its functions. Cytoplasm and its components. Single-membrane organelles: endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles. Double-membrane organelles: mitochondria, plastids and their types (peculiarities of their structure and functions). Mutual transformations of plastids. Autonomy of mitochondria and chloroplasts in the cell. Other organelles: ribosomes, cell center, movement organelles. Cellular inclusions. The structure and functions of the nucleus. Chromosomes, features of structure and chemical composition. Homologous chromosomes. Autosomes and sex chromosomes. Karyotype. Chromosome set of the nucleus (haploid, diploid, polyploid). Types of cell organization (prokaryotic and eukaryotic). Features of the organization of prokaryotic cells. Features of the structure of the surface apparatus. Nucleoid of prokaryotes. Plasmids. Ribosomes. Flagella Pili.
Metabolism and energy conversion in the cell	Metabolism: anabolism (assimilation) and catabolism (dissimilation). Energy sources for organisms. Autotrophic (phototrophic, chemotrophic) and heterotrophic organisms. Stages of energy transformation in the body: preparatory, anaerobic (oxygen-free) and aerobic (oxygen). Aerobic and anaerobic respiration. Biosynthesis of proteins and its stages. Genetic code and its properties. Codon, anticodon, start codon, stop codon. Transcription. Genes (structural and regulatory). Exons, introns. Matrix synthesis processes (replication, transcription, translation). Photosynthesis. Basic processes. The total equation. The importance of photosynthesis.
Cell cycle. Reproduction	Cell cycle. Interphase. Mitosis, phases. Meiosis, its phases. Conjugation of homologous chromosomes. Crossing over. Forms of reproduction of organisms (sexual, asexual) and its meaning. Sexual reproduction. Processes of germ cell formation. Fertilization and its forms. Hermaphrodite and unisexual organisms. Parthenogenesis. Polyembryony. Genetic combinatorics during reproduction - conjugation, copulation. Methods of asexual reproduction of unicellular (division, schizogony, budding, sporulation)

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	and multicellular organisms (vegetative reproduction, sporulation). Clone. Cloning of organisms.
Ontogenesis	Individual development. Periods of individual development of organisms. The embryonic period of development, its stages in animals. Postembryonic period of development, its types and stages in animals and humans. Puberty (on the example of humans). Growth, its types and regulation. Regeneration. Life cycle. Simple and complex life cycles. Alternation of different generations in the life cycle. Embryo technologies.
Heredity and variability	Genetics. Methods of genetic research. Basic concepts: genetics, genes, allele, locus of a gene, dominant and recessive states of traits, homozygote, heterozygote, genotype, phenotype, heredity, possibility. Laws of heredity by G. Mendel, their explanation. Law of purity of gametes. Methods for testing the genotype of hybrid individuals. The intermediate nature of inheritance. Linked inheritance. Chromosomal theory of heredity. Genetic basis of sex determination in different groups of organisms. Sex ratio in populations. Sex-linked inheritance. Interaction of genes and its types. Solving tasks related to the inheritance of autosomal and sex-linked traits. Organization of the genome in different organisms. Cytoplasmic heredity. Modification (non-hereditary) variability, its properties and statistical regularities. Reaction rate. Variation series. Variation curve. Hereditary variability and its types: combinatorial and mutational. Types of mutations. Mutagenic factors. Spontaneous mutations. The law of homologous series of genetic variability. Tasks and methods of selection. Variety, breed, scar. Artificial selection, its forms. Systems of crossing organisms: intraspecific, hybridization (related - inbreeding, and unrelated - outbreeding crossing), interspecific (distant) hybridization. Heterosis. Peculiarities of selection of plants, animals, microorganisms. Polyploidy. Centers of diversity and origin of cultivated plants. Areas of domestication of animals. Biotechnology, genetic and cellular engineering. Genetically modified and chimeric organisms.
<i>Non-cellular life forms</i>	
Viruses, prions, viroids	Viruses: chemical composition, structure and reproduction. Mechanism of penetration of viruses into the host cells. Effect of viruses on the host. Prevention of viral diseases. Role of viruses in nature and human life. Prions, viroids.
<i>Organismic level of life</i>	
Bacteria	General characteristics of prokaryotes (bacteria, cyanobacteria). Peculiarities of the structure and life processes of prokaryotes (feeding, respiration, reproduction). Diversity and role of prokaryotes in nature and human life. Interaction of bacteria with other living organisms. Pathogenic bacteria and diseases caused by them. Measures to combat pathogens and prevention of infectious diseases.
Plants	General characteristics of plants. Plant nutrition (mineral nutrition, air nutrition - photosynthesis). Respiration of plants. Transpiration. Growth and development of plants. Irritability and movements of plants. Regulation of life processes. Life forms of plants. Unicellular and multicellular, higher and lower plants. Vegetative and generative organs of plants. Peculiarities of reproduction of plant organisms from different classes. Life cycles of higher plants (alternation of generations, sporophyte, gametophyte). Classification of plants. Algae, Spores, and Seeds (gymnosperms and angiosperms). Typical wild plants and cultural representatives of plants of various classes and families. Role of plants in nature and in human life. Plant life protection. Types of plants that need protection. Red Book, Green Book, Reserves, and national parks.

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Mushrooms. Lichens.	<p>General characteristics of the Kingdom of Mushrooms. Peculiarities of structure, metabolism, and interactions with other organisms.</p> <p>Role of mushrooms in nature and human life. Mycorrhiza.</p> <p>Lichens as symbiotic organisms. Structure and peculiarities of the life activity of lichens.</p> <p>Role of lichens in nature and their importance in human life.</p>
Animals	<p>General characteristics of the Kingdom of Animals. Principles of classification of animals.</p> <p>Features of the organization of unicellular and multicellular animals. General plan of the structure of the animal body.</p> <p>The types of animal development: direct and indirect (with complete and incomplete transformation). Peculiarities of animal behavior, seasonal phenomena. Role of animals in nature and human life.</p> <p>Interactions between animals and other living organisms.</p> <p>Diversity of animals. Main types: Amoebozoa, Spores, Infusoria, Hydrozoa, Platyhelminthes, Nematodes, Annelids, Molluscs, Arthropods, and Chordates (class Cartilaginous fish, Bony fish, Amphibians, Reptiles, Mammals and Birds). The main orders and families of representatives of the Mammals class.</p>
Human	<p>Humans in the system of the organic world.</p> <p>Tissues of the human body (epithelial, muscular, nervous and connective), their structure, and functions.</p> <p>Functional systems of organs. The human body as a whole. Homeostasis. Regulation of homeostasis and the systems involved in it.</p> <p>Organs of the locomotor system. Human skeleton and muscular system. Structure and functions. Diseases of the system and methods of their prevention.</p> <p>Digestive systems. Structure and functions. Nutrition and digestion. Energy needs of the body. The main stages of catabolism of proteins, carbohydrates and fats. Norms and food hygiene. Vitamins, their properties. Avitaminosis and hypo- and hypervitaminosis. Diseases of the system and methods of their prevention.</p> <p>Cardiovascular system. Structure and functions. Blood circulation. Lymphatic system. Structure and functions. Hematopoiesis. Diseases of the system and methods of their prevention. Immune system. Structure and functions. Immunity and its types. The liquid environment of the human body, its stability, and the interaction of the systems that form it.</p> <p>Respiratory system. Structure and functions. External and cellular respiration. Diseases of the system and methods of their prevention. Urinary system. Structure and functions. Diseases of the system and methods of their prevention.</p> <p>Systems that ensure the excretion of metabolic products (urinary, respiratory, digestive, skin), their interaction.</p> <p>Reproductive system. Structure and functions. Diseases of the system and methods of their prevention.</p> <p>Endocrine and nervous system. Structure and functions. Interaction and participation in the regulation of processes in the body.</p> <p>Sensory systems of the body: organs of vision, hearing, taste, smell, and balance. Role in the interaction of organisms with the environment. Regulation of functions. Reflex. Reflex arc. Thermoregulation. Hardening Hypodynamia.</p> <p>Higher nervous activity of the person. Unconditioned and conditioned reflexes. Formation of conditioned reflexes. Temporal nerve connection.</p> <p>Inhibition of conditioned reflexes. Dynamic stereotype. Physiological foundations of speech. First and second signal systems. Thinking and consciousness. Sensation, perception, attention, memory and its types, and emotions. Personality. Types of temperament. Character, giftedness, abilities. A dream and its meaning. Influence of alcohol, drugs, toxins, smoking, and stress factors on the human body.</p>
<i>Supraorganismic levels of life organization</i>	
Ecological factors. Environment and adaptation to it.	<p>Ecological factors: abiotic, biotic, and anthropogenic. Environmental laws and regulations.</p> <p>The main habitats of organisms: ground-air, water, and soil. Organism as a special habitat.</p> <p>Life forms of organisms. Forms of biotic relationships. Adaptation. Adaptive biological</p>

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	rhythms of organisms. Photoperiodism. Seasonal changes in the life of plants and animals. Specie. Species criteria. Areal Ecological niche. Structure of the species. Population. Characteristics and structure of the population, population waves. Gene pool of the population.
Ecosystems	Ecosystems, their composition and diversity. Relationships between populations in ecosystems. Energy conversion in ecosystems. Producers. Consumers. Reducers. Trophic chains. Trophic level. Trophic net. The rule of the ecological pyramid. Types of ecological pyramids. Development of ecosystems. Succession. Self-regulation of ecosystems. Agroecocenos.
Biosphere	Biosphere. Noosphere. The living substance of the biosphere, its properties and functions. The circulation of substances and energy flows in the biosphere as necessary conditions for its existence. Modern environmental problems: global population growth, soil erosion and pollution, growth of large cities, destruction of forests, irrational use of water and energy resources, possible climate changes, negative impact on biological diversity. Theory of V.I. Vernadsky about the biosphere and noosphere, its importance for avoiding the global ecological crisis.
<i>Historical development of the organic world</i>	
Basics of evolutionary theory. Historical development and the diversity of the organic world	Evolution. Phylogeny. Phylogenetic series. Basic principles of modern evolutionary theory. Synthetic theory of evolution. Microevolution. Natural selection. Species formation. Macroevolution. Biological progress and regression. Divergence and convergence, analogous and homologous organs, rudiments and atavisms, mimicry and its types. Evidence of evolution. Division of the Earth's geological history into eras, periods and epochs. The main events that took place in certain geological periods of the Earth's history. The modern system of the organic world. Principles of classification of organisms. Taxonomic units.

ASSESSMENT CRITERIA FOR ENTRANCE EXAMINATION IN BIOLOGY

The examination paper consists of 20 questions of a test nature. All questions have only one correct answer option.

General requirements

The commission evaluates the entrant's written answers to test tasks on a 100-point scale.

To receive a positive grade from the entrance test, the applicant needs to pass the minimum acceptable test threshold at the level of 0.30 or 30% of the total number of test points.

The received test scores for the entrance test are converted into a 100-point scale (with rounding to the nearest whole, according to the rules of mathematical rounding) according to the following algorithm:

$$O = O_{\min} + k \cdot (N - r \cdot T), \text{ where}$$

- O – mark from the entrance test on a 00-200 points scale;
- O_{\min} – the minimum score from the entrance test on a scale of 100-200 points, at which the entrant is allowed to participate in the competitive selection;
- k – the coefficient of transfer of test scores to a scale of 100-200 points, while:

$$k = 100 / T \cdot (1 - r)$$

- r – the minimum acceptable test threshold with an accuracy of up to 0.01, which is set in the range from 0 to 1, but not less than 0.10;

- T – the total number of test points that the entrant can receive during the entrance test;
N – the number of test points that the entrant received during the entrance test.

Provided that the number of test points that the entrant received during the entrance test (N) is "0", then the entrant receives an "unsatisfactory" grade and is not allowed to participate in the competitive selection.

Calculation of test points

For each correct answer to a test question, 5 test points are awarded. Incorrect answer - 0 points.

Total number of test points (T), which the entrant can receive during the entrance test - 100 test points.

The number of test points for the entrance test (N) is calculated as the sum of test points excluding test points removed for corrections in the answer sheet (if provided by the program).

Approved at a meeting of the admissions committee.

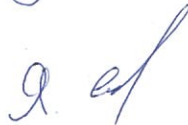
Protocol No. 11 of 08.04.2024

Responsible secretary of the
admissions committee



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Yaknenko O.M.