Ministry of Education and Science of Ukraine

V. N. Karazin Kharkiv National University

APPROVED:
Vice-chairman of the admissions committee of
V. N. Karazin Kharkiv National University

_____ Oleksandr HOLOVKO

PROGRAM OF THE ADMISSION EXAM IN BIOLOGY
to study for a bachelor's degree (MASTERS of Medical Sciences)
on the basis of complete general secondary education
(for foreign citizens and stateless persons)

Kharkiv - 2026

EXPLANATORY NOTE

Program for admission exam in BIOLOGY is developed according to PROGRAM of independent external evaluation of learning outcomes in Biology, obtained on the basis of complete secondary education, taking into account the State Standard of complete secondary education approved by the Government of Ukraine and dated in November 23 2011 (№ 1392), and relevant biology curricula.

The content of the program is divided into thematic blocks according to the key elements of the content of biology curricula for students of general secondary education. The program consists of 5 sections: (1) "Introduction. Chemical composition, structure and functioning of cells. Realization of hereditary information", (2) "Modes of inheritance and variability", (3) "Biodiversity", (4) "Human body as a biological system", (5) "Fundamentals of ecology and evolutionary theory". Chapters are divided into topics, which define the content and scope of requirements for learning outcomes and skills of participants of subject external evaluation of biology, as well as specific elements of the content of certain concepts, lists of biological objects that are members of admission examinations to recognize visually and to characterize.

The program focuses on the acquisition of subject skills by students of general secondary education institutions and their achievement of certain learning outcomes in terms of methods of scientific cognition; basic provisions of biological laws, rules, theories, patterns, hypotheses; essence of biological processes and phenomena; structure and features of biological objects; modern biological terminology and symbolism; skills: to explain, establish connections, make diagrams, obtain information from tabular data and graphical images, recognize biological objects by their image, classify, analyze, compare and draw conclusions, use knowledge in everyday life (justify the rules of behave in the environment, disease prevention measures, methods of home care).

Section 1. Introduction. Chemical composition, structure and functioning of cells. Implementation of hereditary information.

1.1 Introduction

Fundamental characteristics of the living being. Levels of organization of life, biological systems and their characteristics.

Research methods in biology. The value of biological research in human life.

KNOW AND UNDERSTAND

Fundamental properties and functions of living beings. Levels of organization of life and biological systems: molecular, cellular, organismal, ecosystem, biosphere. Research methods in biology: comparative and descriptive, experimental, modeling, monitoring.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish the levels of organization of life and biological systems by their characteristics. Make a research plan. Choose a research method. Determine the purpose, conditions of the study, the necessary equipment, the sequence of experiments. Analyze the results of biological experiments, which can be presented in the form of descriptions, tabular information, graphs, charts, etc.

1.2 The chemical composition of the cell

Classification of chemical elements according to their content in organisms. Consequences of insufficient or excessive intake of chemical elements (I, F, Fe, Ca, K) and ways to eliminate their deficiency.

Organic and inorganic compounds and their role in the body. Water, its main properties and role in the body. Water as a solvent, hydrophobic and hydrophilic compounds.

Biopolymers: the concept of their structure and conformation.

Carbohydrates: monosaccharides (ribose, deoxyribose, glucose, fructose), oligosaccharides (sucrose, lactose), polysaccharides (starch, cellulose, chitin, glycogen). Basic properties and functions of carbohydrates in organisms.

Lipids (fats, waxes, steroids, phospholipids). Basic properties and functions of lipids in the body.

Proteins. Amino acids as protein monomers. Levels of structural organization of proteins. Denaturation and renaturation of proteins. Basic biological functions of proteins. Enzymes, their properties and principles of functioning.

Nucleic acids. Nucleotide structure. Structure and functions of DNA. The principle of complementarity. Nucleotide sequence and the concept of gene. Properties of DNA. RNA and its types (mRNA, rRNA, tRNA).

ATP. The role of ATP in energy supply.

KNOW AND UNDERSTAND

Macronutrients, including organogenic elements. Biological role: water, oxygen, ions Na^{+}, K^{+}, SI^{-}, Ca^{2+}, Mg^{2+}. Structure, basic properties and functions of proteins, carbohydrates, lipids (for example fats and phospholipids), nucleic acids, ATP. Features of spatial organization of proteins, nucleic acids, polysaccharides (starch, cellulose). The role of chemical bonds (covalent, ionic, hydrogen), hydrophobic interaction in the structural organization of macromolecules. Properties and principles of enzyme function. The role of ATP in energy supply. Meaning of concepts and terms: biopolymer, monomer, macronutrients, organogenic elements, microelements, hydrophilic and hydrophobic compounds, denaturation, renaturation, replication, enzymes, coenzymes, active enzyme center, conformation, principle of complementarity, gene, macroergic connection, endeavor.

BE ABLE TO

Determine the correctness of the application of concepts and terms mentioned. Distinguish macronutrients (including organogenic elements) and microelements, levels of structural organization of protein (primary, secondary, tertiary, quaternary structure), globular and fibrillar proteins, types of RNA (mRNA, rRNA, tRNA). Set relationship between physical-chemical properties and biological role of water. Compare DNA and RNA by chemical composition and structure. Propose measures to prevent human diseases that occur in conditions of excess or deficiency of chemical elements (I, F, Fe, Ca, K) in the human body or in the natural environment. Solve basic exercises in molecular biology: determine the molecular weight of a substance (protein, nucleic acid) by the mass of one of its components, the length of the nucleic acid molecule, its composition.

1.3 Structure and functioning of eukaryotic cells

The cell as an elementary unit of living things. Methods of cell research. Basic properties and principles of eukaryotic cell structure.

Cell membranes, their chemical composition, structure, properties and basic functions. Transport of substances across cell membranes.

Cytoplasm, its components: cytoskeleton, organelles and inclusions.

Single-membrane organelles: endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles. Double-membrane organelles: mitochondria, plastids (chloro-, leuko - and chromoplasts). Mitochondria: structure, functional role. Chloroplasts: structure, functional role. Autonomy of mitochondria and chloroplasts in the cell. Ribosomes: structure, functional role. Centrioles. Organelles of movement (flagella, cilia). Nucleus: structure, functional role. Chromosomes: chemical composition, structure, functional role. Haploid and diploid sets of chromosomes. Homologous chromosomes. The main states of chromosomes: interphase noncompact and overcompact in the process of cell division. Chromosome doubling due to DNA replication. Morphology of supercompact / mitotic / chromosomes. The concept of karyotype. Nucleolus, its functional role.

KNOW AND UNDERSTAND

Cell research methods: microscopy (light, electron), differential centrifugation. The structure and function of cell components. Chemical composition of the cell membrane. The role of membranes in cellular interaction. Mechanisms of transport of substances across membranes. Features of eukaryotic cell organization. Basic states of chromosomes. The role of the nucleus in the storage, transmission and sale of hereditary information. The value of karyotype stability for the existence of the species. The reasons for differences in the structure of cells of plants, animals and fungi. Meaning of concepts and terms: eukaryotes, active and passive transport of substances across the membrane, endocytosis (phagocytosis, pinocytosis), exocytosis, plasmolysis, deplasmolysis, cristae, thylakoids, lamellae, matrix, stroma, cytoplasm, plasmodesms, organosomes homologous chromosomes, haploid and diploid sets of chromosomes, chromatin, nucleosome, centromere, chromosome arms, karyotype.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Characterize the cell as an elementary unit of living things. Visually recognize the cells of plants, animals and their components. Establish a relationship between the structure and functions of cell components. Distinguish: active and passive transport of substances across the membrane, exo- and endocytosis, phago- and pinocytosis; haploid and diploid sets of chromosomes; become chromosomes. Compare the organization of cells of plants, fungi, animals.

1.4 Metabolism and energy conversion

Metabolism (metabolism), its general characteristics. The unity of the processes of synthesis and breakdown of substances in the body.

Autotrophic and heterotrophic types of nutrition.

Mycotrophic organisms.

Cleavage of substances in the body (oxygen-free, oxygen). The concept of glycolysis, fermentation. The concept of cellular respiration. Mitochondria as the energy station of the cell.

Photosynthesis. The main processes occurring in light-dependent and light-independent reactions / light and dark phases / photosynthesis. The role of chlorophyll in light-dependent reactions / light phase / photosynthesis. The value of photosynthesis for the existence of the biosphere.

The concept of chemosynthesis.

KNOW AND UNDERSTAND

The essence and meaning: the processes of anabolism, catabolism; preparatory stage of decomposition of organic substances; glycolysis; fermentation; oxygen stage of decomposition of organic substances; photosynthesis; chemosynthesis. The role of enzymes in ensuring metabolic processes. Energy sources for photo-, chemo- and heterotrophic organisms. Carbon sources for auto- and heterotrophic organisms. Sources of organic substances for heterotrophic organisms. Examples of autotrophic (photosynthetic: cyanobacteria, algae, plants; chemosynthetic: iron bacteria, sulfur and nitrifying bacteria), heterotrophic and mycotrophic (euglena green, insectivorous plants) organisms. The meaning of concepts and terms: metabolism, anabolism, catabolism, autotrophic organisms, phototrophic organisms, chemotrophic organisms, heterotrophic organisms, mycotrophic organisms, photosynthesis, chemosynthesis, glycolysis, fermentation, cellular respiration, Krebs cycle.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Classify organisms by source of: energy; carbon; organic matter. Write the total equations of the processes of photosynthesis and respiration. Compare: respiration and photosynthesis; fermentation and respiration. Analyze chemical and energy results: stages of decomposition of organic compounds (preparatory, oxygen-free, oxygen); light-dependent / light phase / and light-independent / dark phase / photosynthesis reactions.

1.5 Preservation and sale of hereditary information

Genes, their structure and functional role. Mosaic structure of the eukaryotic gene (exons and introns). The concept of the genome.

Transcription: matrix synthesis of RNA molecules. The concept of transcription regulation.

Protein biosynthesis (translation). Genetic code and its main properties. The role of mRNA, tRNA and ribosomes in protein biosynthesis. DNA replication: a semi-conservative principle. The concept of DNA repair. DNA replication and cell cycle. Interphase and cell division. The number of DNA molecules and chromosomes at different stages of the cell cycle. Mitosis, the main processes that occur during mitosis. Meiosis and its features in comparison with mitosis. Functional role of meiosis. The concept of DNA recombination during meiosis. Crossingover.

The formation of gametes and their association in the zygote during fertilization. Sexual reproduction. The main forms of asexual reproduction of organisms (division by mitosis, budding, spore reproduction, vegetative reproduction).

Individual development of the organism (ontogenesis). Embryonic development. The main stages of embryonic development in chordates (zygote fragmentation, blastula and gastrula formation). The phenomenon of embryonic induction. The concept of cell differentiation during embryonic development. Stem cells. Post-embryonic development in animals and its main types (indirect and direct).

KNOW AND UNDERSTAND

Gene structure. Features of genome organization of pro- and eukaryotes. The role of enzymes in ensuring the processes of transcription and translation. Methods of transcription regulation on the example of lactose operon of prokaryotes and alternative splicing of eukaryotes. The essence and biological significance: biosynthesis of proteins and nucleic acids; mitosis, meiosis, crossover; sexual and asexual reproduction, parthenogenesis, polyembryony, fertilization; alternation of generations in the life cycle of organisms of direct and indirect development of animals. Stages of embryonic development in animals (fragmentation, formation of morula, blastula, gastrula, cell differentiation, histogenesis, organogenesis), the phenomenon of embryonic induction. Biological significance of reproduction. Meaning of concepts and terms: heredity, variability, gene, genome, exons, introns, transcription, translation, genetic code, interphase, cell cycle, DNA recombination, crossingover, ontogenesis, embryo, embryonic induction, blastula, gastrulation, gametes, zygote, mitosis, meiosis.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Compare: mitotic and meiotic cell divisions; sexual and asexual reproduction; structure of male and female gametes; direct and indirect development of multicellular animals; possibilities and mechanisms of regeneration of an organism at plants and animals. Analyze: stages of the cell cycle; phases of mitosis and meiosis; stages of germ cell formation; periods of ontogenesis in plants and animals. Determine the benefits of a particular form (method) of reproduction. Distinguish: methods of reproduction; forms of fertilization; methods of vegetative propagation of plants and animals. Classify the types of growth of organisms of different kingdoms. Visually recognize: the cell at different stages of mitotic division; embryo at different stages of embryonic development. Solve basic exercises in replication, transcription, translation.

Section 2. Patterns of heredity and variability

2.1. Genetics - the science of patterns of heredity and variability of organisms

Classical methods of genetic research. Basic concepts of genetics. Basic regularities of gene functioning in prokaryotes and eukaryotes.

KNOW AND UNDERSTAND

Methods of genetic research (hybrid, genealogical, population-statistical, cytogenetic, biochemical, twin), their features and diagnostic value. Basic regularities of gene functioning in

prokaryotes and eukaryotes. Meaning of concepts and terms: allele, genotype, phenotype, dominant allele, recessive allele, homozygote, heterozygote, pure line, hybrid.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish: alleles of one and different genes; homozygotes and heterozygotes; genotype and phenotype; dominant and recessive states of symptoms. Identify situations in which it is advisable to use a certain method of genetic research.

2.2. Patterns of heredity of organisms

Regularities of heredity established by G. Mendel.

Method of checking the genotype of hybrid individuals (analytical crossing).

Multiple action of genes. A trait as a result of the manifestation of many genes. Gene interaction. Linked inheritance.

Chromosomal theory of heredity.

Genetic basis of sex determination in different groups of organisms. Chromosomal sex determination. Inheritance linked to the article.

Chromosomal analysis as a method of detecting disorders in the structure of the karyotype.

Hereditary diseases and defects of man, diseases of man with hereditary predisposition, their causes. Modern molecular genetic methods of research of human heredity.

KNOW AND UNDERSTAND

Gamete purity rule. Laws of uniformity of first-generation hybrids (dominance), and splitting, independent combination of traits, their statistical nature. Intermediate nature of inheritance (incomplete dominance). Codominance on the example of determining human blood groups. Cytological bases of Mendel's laws of heredity. The causes of deviations in phenotypic cleavage from the typical quantitative ratios established by Mendel. Types of interaction of alleles of one and different genes. Mechanisms for determining sex. Causes of linked (including sex) inheritance. The main provisions of the chromosomal theory of heredity. Causes of hereditary human diseases. Modern molecular genetic methods of research of human heredity. The meaning of concepts and terms: sex chromosomes, autosomes, homo- and heterogametic sex, analytical crossing, gene pool, hereditary diseases.

BE ABLE TO

Distinguish: types of interaction of alleles of one gene (complete dominance, incomplete dominance, codominance); types of inheritance of traits in humans (autosomal recessive, autosomal dominant, sex-linked). Determine: the distribution of offspring phenotypes after crossing organisms with certain genotypes (and vice versa); possible genotypes for this phenotype (and vice versa). Analyze: karyotypes, human pedigrees; the results of monohybrid and dihybrid crossing and determine the type of inheritance of traits. Compare the consequences of analytical crossing in independent and linked inheritance. Solve typical problems in genetics on: monohybrid and dihybrid crossing; interaction of alleles of one gene (complete and incomplete dominance, codominance); linked to the article of inheritance. Justify: the integrity of the genotype; the importance of studying the laws of heredity for human practice.

2.3 Patterns of variability of organisms

Modification (non-hereditary) variability, its causes. The reaction rate. Variation series and variation curve.

Genetic variability and its species, and combinatorial and mutational. Sources of combinatorial variability. Mutations and their properties. Types of mutations (genomic, chromosomal, point; somatic and generative). Mutagenic factors (physical, chemical and biological).

KNOW AND UNDERSTAND

Sources of combinatorial and mutational variability. Causes of modification variability. Causes of mutations. The role of the interaction of genotype and environmental conditions in the formation of the phenotype. Adaptive nature of modification changes. Values

of combinatorial variability. Properties of mutations. Significance of mutations in nature and human life. Regularities of combinatorial and mutational variability. Meaning of concepts and terms: combinatorial variability, modification variability, reaction rate, mutations, mutagenic factors.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Recognize hereditary and non-hereditary variability; types of hereditary variability. Distinguish: mutagenic factors; types of mutations. Compare: types of hereditary variability; mutational and modification variability.

Analyze: variation series and variation curve. Justify: measures to protect the body from the effects of mutagenic factors; the role of mutations in the evolution of organisms.

2.4. Selection of organisms. Biotechnology

The concept of plant variety, animal breed, strain of microorganisms. Artificial selection (individual and mass). Related and unrelated crossbreeding, interspecific (remote) hybridization, their genetic and biological consequences. Hybrid vigor and its genetic basis.

The concept of basic methods and tasks of selection.

Methods of molecular genetics as a basis of modern biotechnologies: polymerase chain reaction, genetic engineering, DNA cloning, cell engineering. Cloning of organisms. Genetically modified organisms (GMOs): principles of creation and directions of use.

KNOW AND UNDERSTAND

Methods and tasks of selection. Features of selection of plants, animals, microorganisms. Meaning: laws of genetics for selection; polyploidy in plant breeding. Biological significance of the phenomenon of hybrid vigor. Causes of hybrid vigor. Ways to overcome the sterility of interspecific hybrids. Principles of creation and application of genetically modified and chimeric organisms. Areas of research and modern advances in biotechnology. The meaning of concepts and terms: variety, breed, strain, artificial selection, hybridization, inbreeding, outbreeding, hybrid vigor, cloning, clone, genetically modified organisms, chimeras.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish: forms of artificial selection, systems of crossing organisms. To determine the genetic consequences of different systems of crossing organisms. Predict the consequences of modern biotechnology. Assess the benefits and possible risks of using genetically modified organisms.

Section 3. Biodiversity

3.1 Systematics - the science of diversity of organisms

Biodiversity of our planet as a consequence of evolution. Modern system of the organic world (domains: Archaea, Bacteria, Eukaryotes). Basic taxonomic units used in the taxonomy of organisms. Kind as the basic systematic unit. Biological concept of the species. Modern criteria of the species. The concept of phylogenetic taxonomy. Methods of graphical representation of the affinity of systematic groups of organisms.

KNOW AND UNDERSTAND

The modern system of the organic world. Modern principles of scientific taxonomy of organisms. Basic taxonomic units. The principle of hierarchy of taxa in taxonomy. The principle of double names of organisms. The essence of the biological concept of the species. Modern criteria of the species. The meaning of concepts and terms: biodiversity, domain, taxonomic unit, taxonomy, nomenclature, classification, species, taxon, phylogeny, phylogenetic taxonomy, monophyletic group, cladogram, phylogenetic tree.

BE ABLE TO

Determine: the correctness of the application of the taxonomic position of the species in the system of the organic world. Analyze trophic reflections of the affinity of systematic groups of organisms. Establish the level of affinity of species based on the analysis of their karyotypes.

3.2 Viruses. Viroids. Prions

Features of the organization and functioning of viruses. Hypotheses of the origin of viruses. The role of viruses in evolution, the concept of horizontal gene transfer. Ways of penetration of viruses into the bodies of plants, animals and humans. Interaction of viruses with the host cell. Use of viruses in genetic engineering and biological methods of pest control. Prevention of human viral diseases. The concept of vaccination.

The concept of viroids, prions.

KNOW AND UNDERSTAND

Chemical composition, structure and reproduction of viruses. Mechanisms of penetration of viruses into human bodies, animals, plants, bacteria. Ways out of the virus from the cell.The effect of the virus on the host cell. Examples of human diseases caused by viruses (polio, influenza, AIDS, hepatitis, encephalitis, measles, mumps, SARS). The meaning of concepts and terms: viruses, capsid, supercapsid, viroids, prions, vaccination, biological control method.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize bacteriophages, adenoviruses, tobacco mosaic viruses, influenza, human immunodeficiency. To substantiate measures for the prevention of human viral diseases, the need for global control of viral infections of humans, animals and plants in modern conditions. Assess the prospects for the use of viruses in biotechnology .

3.3. Prokaryotic organisms

Cell structure of prokaryotes. Prokaryotic organisms (archaea, bacteria), features of their organization and functioning. Types of nutrition (photo- and chemosynthesis, heterotrophic) and respiration (anaerobic and aerobic) of prokaryotic organisms. Reproduction (division and budding of cells) and exchange of hereditary information (conjugation) in prokaryotic organisms. Relationships of prokaryotic organisms with other organisms (mutualism, commensalism, parasitism). The role of prokaryotes in nature and human life. Pathogenic bacteria and human diseases caused by them. Prevention and treatment of bacterial diseases.

KNOW AND UNDERSTAND

The structure of prokaryotic cells. Features of organization, nutrition, respiration, reproduction of prokaryotic organisms. The value of archaea and bacteria. Examples of bacteria (Escherichia coli, Vibrio cholerae, Staphylococcus aureus, cyanobacteria: spirulina, nostok). Examples of human diseases caused by bacteria (sore throat, diphtheria, pertussis, tuberculosis, cholera, typhoid, scarlet fever, botulism, salmonellosis, tetanus), ways of their transmission. The meaning of concepts and terms: prokaryotic organisms, nucleoid, conjugation, incisation, mutualism, commensalism, parasitism, nitrification, denitrification, nitrogen fixation.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize the forms of bacteria. Distinguish between archaea and bacteria. Compare the structure of pro- and eukaryotic cells. Establish the type of relationships of prokaryotes with other organisms. Justify measures for prevention and treatment of bacterial diseases. Evaluate the prospects for the use of bacteria in biotechnology.

3.4 Algae

Features of the structure and vital processes of unicellular and multicellular algae. Representatives of algae: Green algae (chlamydomonas, chlorella, ulotrix, spirogyra, ulva), diatoms (pinularia, navicula), brown algae (kelp, fucus, sargassum), red algae (porphyry, phyllophora, coral).

KNOW AND UNDERSTAND

Features of the structure and processes of life activity green, diatoms, brown, worms are algae. Distribution, variety and significance of algae on the example of these representatives. Necessary conditions for the spread of algae. The meaning of concepts and terms: zoospores, mat, pyrenoid.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize these species of algae. Explain the peculiarities of the structure of algae as a result of adaptation to the habitat.

3.5 Plants. Vegetative organs and vital functions of plants

Plant cells. The main groups of plant tissues: permanent - integumentary (skin, bark), conductive (vessels, sieve-like tubes), basic (photosynthetic, storage, including endosperm, mechanical); generative - apical and lateral.

General characteristics of plants. The value of plants.

Root. Types of roots (main, additional, lateral). Root system and its types (rod, fibrous). Root zones and their functions. The internal structure of the root in the area of root hairs. Modifications of the root (roots, tubers, respiratory, respiratory, tenacious, air, roots - suckers).

Shoot, its main parts (node, internode, leaf sinus). Types of shoots: erect, ascending, round, tenacious, creeping, creeping. The bud is a rudimentary shoot. The structure of the bud (scales, growth cone, rudimentary leaves).

Varieties of buds by location on the shoot (apical and lateral / axillary /), by structure (vegetative and generative / flower). Shoot structure: stem and leaves. Branching of a shoot, formation of a crown.

Shoot modifications: underground (rhizome, underground stem tuber, bulb, bulb) and aboveground (whiskers, tendrils, aboveground stem tuber, thorns).

Stem. Internal structure of a wooden stem (core, wood, cambium, bast, bark, core rays, annual rings).

Leaf: external structure (leaf base, petiole, leaf blade, stipules), internal structure (main tissue - columnar and spongy, stomata, veins (wood, bast), cuticle, skin), functions. Veining of leaves: parallel, arcuate, finger-shaped, pinnate, forked. Leaf arrangement: alternate, opposite, annular. Leaf variations (tendrils, thorns, scales, leaf-traps of insectivorous plants). Vital functions of plants: nutrition (mineral, photosynthesis), respiration, transpiration. Movement of substances on the plant. Plant growth and development. Plant movements (growth, hygroscopic). Regulation of vital functions in plants.

KNOW AND UNDERSTAND

Features of plant cell structure. Types of plant tissues, their structure and function. Signs that distinguish plants from other eukaryotic organisms. Functions of vegetative organs of plants. Features of external and internal structure of vegetative organs of plants. Features of the structure of roots, underground modifications of the shoot. Biological significance of changes in vegetative organs. The relationship between parts of the plant body. Mechanisms that ensure the movement of substances through the plant. Features and significance in the life of plants of mineral nutrition, processes of photosynthesis, respiration, transpiration, November. Conditions necessary for photosynthesis. Methods of regulation of transpiration. Influence on the level of transpiration of the state of the atmosphere around the leaf, the state of the soil, the size and number of leaves, the number of stomata. Adaptation to reduce transpiration. Plant growth regulators. The meaning of concepts and terms: vascular-fibrous bundle, cambium, xylem, phloem, ascending and descending flows of substances, root pressure, suction power of leaves, phytohormones, volatile, evergreen plants.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize: plant tissues, vegetative organs grew; types of roots; types of root and systems; root changes and; root zones; elements of the internal structure of the root in cross section; elements of the shoot; types of branch branching; types of shoots, changes of a shoot; elements of the internal structure of the wooden stem; elements of the outer and inner structure of the leaf; types of veining and leaf placement; simple and complex leaves; petiolate and sessile leaves; axillary leaves; kidney structure elements; types of kidneys. Compare: fibrous and taproot root systems; generative and vegetative buds in structure and function; processes of

photosynthesis and respiration in plants. Establish: correspondence between cells and types of plant tissues; the relationship between the structure and functions of plant tissues; the relationship between the structure and functions of the autonomic s bodies. Distinguish: ascending and descending flows of substances, growth and hygroscopic movements of plants. Explain: the causes of plant cell changes; features of plant structure as a result of their adaptation to life on land. Prove the integrity of the organism p donkeys.

3.6 Generative organs of angiosperms

Flower structure: peduncle; perianth; stamen (anther, nests with pollen, structure of pollen grains, stamen thread); sepals (calyx); petals (corolla); perianth; pistil (receptacle, column, ovary (upper and lower) with germinal sacs in the seed germ). Flower functions. Variety of flowers (unisexual and bisexual, glabrous, with simple and double perianth). Flower formula. Inflorescence. Types of inflorescences (simple - tassel, beginning, head, basket, shield, umbrella, simple ear; complex - complex ear, panicle, complex shield, complex umbrella). Pollination and its varieties (self-pollination and cross-pollination). The main methods of cross-pollination (by wind, insects). Adaptations of plants to the method of pollination. Double fertilization in flowering plants.

Seed and fruit formation. Functions of seeds and fruit. Seed structure: skin with a hole, embryo (embryonic root, subcotyledonary knee, cotyledon, scar). The structure of the fruit (three-layer wall and seeds). Types of fruits: dry (achene, grain, nut, bean, box, pod, pod), juicy (simple - stone fruit, pumpkin, berry, orange, apple; prefabricated - prefabricated stone, strawberry; fruit. Period of rest and germination conditions seeds.

KNOW AND UNDERSTAND

The structure and function of the flower, seed, fruit. Biological significance: inflorescences, fruits, double fertilization, pollination, dormancy of seeds. Features of structure: seeds of monocotyledonous and dicotyledonous plants; different types of fruits. The meaning of concepts and terms: pollen tube, pollen inlet, endosperm.

BE ABLE TO

Visually recognize and characterize: elements of flower structure, seeds; flowers unisexual and bisexual, glabrous, with simple and double perianth; types of inflorescences; types of fruits. Distinguish: bisexual, unisexual, sterile flowers; monoecious and dioecious plants; flowers with simple and double perianth; simple and complex inflorescences; dry (opening and non-opening) and juicy fruits; monoecious and multi-seeded fruits. Analyze the flower formula. Establish the relationship between the structure and functions of the parts of the flower. Determine: the method of pollination by the structure of the flower; the method of distribution of fruits by their structure.

3.7 Plant diversity. Reproduction of plants

The concept of plant life cycle (alternation of asexual and sexual generations). General characteristics, peculiarities of distribution, importance of mosses, Lycopodiaceae, Equisetaceae, ferns, gymnosperms, angiosperms. Variety of plants: Mosses; Lycopodiaceae; Equisetaceae; Ferns; Angiosperms (ginkgo biloba, pine, Welwitschia amazing, ephedra); Angiosperms.

Forms and methods of plant reproduction.

KNOW 1 UNDERSTAND

General features of plants of these groups (features of structure and reproduction, predominant in the life cycle of the generation, its features). Influence of features of structure and reproduction on distribution of plants. The reasons for the dominance of angiosperms in modern flora. Differences of monocotyledonous angiosperms. Significance in nature and human life of plants of these groups. Forms and methods of plant reproduction. Biological significance of vegetative propagation of plants. The meaning of concepts and terms: reproduction, life cycle, spores, sporophytes, gametophytes, sporangia, gametangia, archegonia, antheridia.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize: the specified species of plants; methods of vegetative propagation (grafting, grafting, layering, root sprouts, modified shoots). Distinguish: sexual and asexual generation of mosses, ferns, Lycopodiaceae**,** Equisetaceae; forms and methods of plant propagation. Compare: sexual and asexual reproduction of plants; life cycle of spore-propagating plants and seed-propagating plants; gymnosperms and angiosperms by structure and peculiarities of reproduction.

3.8 Mushrooms

General characteristics of fungi. Features of the structure and processes of life on the example of mushrooms, molds and yeasts. Fungi saprotrophs, parasites, symbiotrophs. The importance of fungi in nature and human life. Variety of fungi: mushrooms, molds, fungi-parasites of plants. The use of mushrooms in the food industry and pharmacology.

KNOW AND UNDERSTAND

Differences of fungi from plants and animals. Features of the structure of mushrooms, molds, yeasts. The role of fungi in nature. The meaning of concepts and terms: mycelium (mycelium), hyphae, fruiting body , osmotrophic diet, mycorrhiza, saprotrophs, symbiotrophs.

BE ABLE TO

Determine the correctness of the application of these concepts and terms; Visually recognize and characterize the structural elements of mushrooms and molds. Distinguish: mushrooms and molds; mushrooms with tubular and lamellar hymenophore. Compare the principles of organization, features of the structure and vital processes of fungi and other eukaryotic organisms. Determine the relationship of fungi with other organisms. Evaluate the possibilities of using mushrooms in human economic activity.

3.9 Lichens

Lichens are associations of true fungi with photosynthetic organisms (algae and cyanobacteria). Structure and features of life (nutrition, reproduction) of lichens. Calcareous, deciduous, bushy lichens. The importance of lichens in nature and human life.

KNOW AND UNDERSTAND

Features of thalamus structure and nutrition of lichens. Methods of lichen reproduction.

Causes that determine the endurance of lichens. The meaning of concepts and terms: rhizoids, soredia, isidia, bioindicators.

BE ABLE TO

To determine the correctness of the application of these concepts and terms; visually recognize and characterize these species of lichens; distinguish between calcareous, deciduous, bushy lichens; homeomeric and heteromeric thallus.

3.10 Unicellular heterotrophic eukaryotic organisms

Free-living and parasitic species of unicellular heterotrophic eukaryotic organisms. Inhabitants of freshwater: amoeba, ciliate. Features of the structure and processes of life (nutrition, respiration, excretion, osmoregulation, movement, irritability, reproduction, incisors). Human parasites (dysenteric amoeba, Plasmodium falciparum) their features. Diseases caused by parasitic unicellular (amoebic dysentery, malaria), and their prevention.

KNOW AND UNDERSTAND

Habitats, methods of reproduction of unicellular heterotrophic eukaryotic organisms. Structure, signs and manifestations of life of amoeba protea, ciliates Differences between auto-, heterotrophic organisms. The meaning of the concepts and terms heterotrophs, cyst, contractile vacuoles, digestive vacuoles, pseudopods, cilia, vegetative nucleus, generative nucleus, final host, intermediate host.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize these unicellular heterotrophic organisms and elements of their structure. Justify measures for the prevention of diseases caused by parasitic unicellular organisms.

3.11 Sponges

Sponges are primary multicellular animals that are at the non-tissue level of the organization. Features of the structure and processes of life on the example of barberry. The role of sponges in nature and human life.

KNOW 1 UNDERSTAND

Features of the body structure of sponges. Processes of nutrition, respiration, excretion, reproduction of sponges. Lifestyle of sponges. The meaning of concepts and terms: mesoglea.

BE ABLE TO

Determine the correctness of the application of their concepts and terms. Visually recognize the structural elements of the body of the sponge. Distinguish the type and cells of sponges.

3.12 True multicellular animals. General features of the structure and processes of life

Animal tissues. Types of body symmetry (bilateral, radial). Types of body cavity (primary, secondary, mixed). Body covers. Organ systems: musculoskeletal (external and internal skeleton, hydroskeleton, muscles), digestive system (closed and through intestines, digestive glands), circulatory system (closed, open), nervous system (diffuse, ganglionic, tubular), a variety of respiratory organs (gills, trachea, pulmonary sacs, lungs) and excretion (kidneys, malpighian vessels, metanephridia, protonephridia). Sense organs. Irritability and movement. Forms of animal reproduction. Germ cells, fertilization. Animal development.

KNOW AND UNDERSTAND

Features of the organization of the body of animals. Organs, organ systems of animals and their functions. A variety of body coverings, respiratory organs, secretions, animal senses. Forms of reproduction, insemination of animals. Germ cells and gonads of animals. Types of animal development. Manifestations of animal life. The meaning of concepts and terms: animals, ectoderm, endoderm, mesoderm, two-layer and three-layer animals, body symmetry, body cavity, body coverings, irritability, direct and indirect development, fertilization, hermaphrodites, development cycle / life cycle.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize the organs and systems of animal organs, type of circulatory system, type of nervous system, type of body symmetry. Compare: transport of substances in animals of different groups; digestive, circulatory, respiratory, nervous systems of animals of different groups; the structure of the skeleton, the brain of vertebrates. Distinguish: types of skeleton; body cavity types; types of animal development; ways of moving animals, type of intestines, forms of fertilization.

3.13 Behavior of animals

Congenital and acquired behavior. Forms of animal behavior: research, food, protective, hygienic, reproductive (search for partners, parental behavior and care for offspring), territorial, social.

Ways to orient animals. Homing. Animal migration. Animal communications. Elementary mental activity.

KNOW AND UNDERSTAND

Adaptive value of behavioral reactions of animals. Biological significance of innate and acquired animal behavior. Examples: animal migrations; ways of orientation, communication of animals; forms of behavior; use of tools by animals. The meaning of concepts and terms: instinct, learning, animal behavior, migration, homing, groups of animals, elementary mental activity.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish forms of animal behavior. Explain: changes in the behavior of animals with age; cyclical changes in animal behavior.

3.14 Diversity, distribution, importance of animals

Poor, or Intestinal, their diversity: jellyfish Aurelia, hydra, sea anemone, corals. Flatworms. Variety of parasitic flatworms: Mammals (hepatic and feline mammals), tapeworms (bovine and porcine tapeworms, echinococcus).

Nematodes, or Roundworms. Variety of parasitic nematodes (human roundworm, pinworm, Trichinella).

Annelida and their diversity: Polychaeta and oligochaeta, leeches (medical leech).

Arthropoda.

Shellfish. Variety of crustaceans (crayfish, crabs, shrimp, daphnia, cyclops, woodlice), the role in nature and human life.

Arachnids, their diversity (spiders: cross spider, karakurt, tarantula; mites: scabies itch, dog mite).

Insects, their diversity: Cockroaches (cockroach red), Orthoptera (grasshopper green locust Wandering), Coleoptera / Beetles / (May chafer, sun, stag beetle, Colorado potato beetle), Hymenoptera (bees honey, ants), Lepidoptera and / Butterflies / (white cabbage, silkworm, mahogany), Diptera (housefly, malaria mosquito). Parasitic and blood-sucking insects (fleas, lice, bed bugs, mosquitoes, geese, gnats) as vectors of human pathogens.

Mollusks / Crumbs /. Variety of mollusks: gastropods (grape snail, pond, slugs), bivalves (toothless, pearl mussels, mussels), cephalopods (squid, cuttlefish, octopuses).

Chordates, general features of the structure and processes of life. Variety of chordates.

Pisces. Variety of fish: Cartilaginous fish (sharks and stingrays), Bony fish - Sturgeon (sturgeon), Herring (herring), Salmon (salmon), Perch (pike perch, perch), crustaceans (goby, bream, crucian).

Amphibians, or Amphibians. Variety of amphibians: Tailless (pond frog, common toad), Legless (ringworm), Tailed (spotted salamander, newt).

Reptiles, or Reptiles. Variety of reptiles: Scales (agile lizard, common viper, common snake), Turtles (marsh turtle, sea turtle), Crocodiles (Nile crocodile, alligator).

Birds. Variety of birds: Keelless (ostriches, kiwis), Kilegrudy - Penguin-like (emperor penguin), Woodpecker, (Great spotted woodpecker), Chicken-like (quail, grouse, pheasant, bank chickens), Goose-like (Whooper Swan, Mallard, Gray Goose), Falcon (Great Hawk, Golden Eagle), Owl (Eared Owl), Stork (White Stork, Gray Heron), Crane (Gray Crane), Sparrow Gray (rook, crow), city swallow, great tit).

Mammals. Variety of mammals: Primordial animals - oviparous mammals (duckbill, echidna); Marsupials (kangaroos, koalas); Placental mammals: Insectivorous (common hedgehog, mole), Bats (oregano, bat), Rodents (marmot, squirrel, beaver, house mouse, hamster, rat, nutria), Predators (wolf, dog, fox, tiger, lion) , lynx, domestic cat, polar bear, brown bear, forest marten, sable), Cetaceans (blue whale, sperm whale, killer whale, white dolphin), even-toed ungulates: ruminants: wild boar, hippopotamus, ruminants: bison, roe deer, elk, sheep), Equidae (domestic horse, Przewalski's horse, zebra, kulan, rhino), Primates (lemurs, monkeys, macaques, baboons, orangutans, chimpanzees, gorillas).

KNOW AND UNDERSTAND

General features of arthropods, mollusks, chordates. Features of structure, processes of vital activity, reproduction and development, way of life, behavior: intestinal for example hydra; flatworms on the example of planaria milky white; roundworms on the example of human roundworm; ringworms on the example of earthworms; crustaceans on the example ofcrayfish; arachnids on the example of a cross spider; insects on the example of a beetle; fish on the example of river perch ; amphibians on the example of a pond frog; reptiles on an example of lizard Warbler; birds on the example of a pigeon; mammals on the example of a rabbit or rat. Features of distribution, structure and processes of life, cycles of development of parasitic worms. Characteristic features, diversity, role in nature and human life of animals within these taxa and representatives. The structure of bird eggs. Signs of adaptation of animals to the conditions of existence in water, on land, in soil (insects to flight; fish to life in water; reptiles to

life on land; amphibians to water-terrestrial way of life; birds to flight). Signs of adaptation of animals to parasitism on the example of parasitic worms and arthropods. Seasonal phenomena in the life of animals (fish, amphibians, reptiles, birds, mammals). The reasons for the spread of animals of different taxa on the globe. Relationships of animals with each other and with other organisms. Ways of infecting humans with parasitic animals.

BE ABLE TO

Visually recognize these representatives of animals, the characteristic features of animals of these taxa, compare the elements of body structure with representatives of animals on the example of these species. Distinguish: life forms of intestinal (jellyfish, polyps); brood and nesting birds; settled, nomadic and migratory birds; insects with complete and incomplete transformation; sea fish, freshwater, passable. Classify animals: by habitat; ways of life, movement, nutrition; type of development. Compare: the structure of the eggs of birds and reptiles; features of external, internal structure and sense organs of different groups of animals.

Establish: the relationship between the structure and lifestyle of animals; complications in the structure of animals of different taxa. Justify measures to prevent diseases caused by parasitic worms.

Section 4. The human body as a biological system.

4.1 The structure of the human body

Tissues of the human body, their structure and function.

Organs, organ systems.

Regulatory systems of the human body.

KNOW AND UNDERSTAND

Man's place in the organic world. Types of tissues of the human body (nervous; epithelial: integumentary epithelium, glandular epithelium; muscular: striated skeletal, striated cardiac, unstriated / smooth /; internal environment (blood, lymph, bone, cartilage, connective tissue), their functions. The meaning of concepts and terms: tissue, organ, physiological system of organs, functional system of organs, nervous regulation, humoral regulation, immune regulation, homeostasis.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize types of tissues, organs, systems of human organs. Identify the main features of the structure of tissues of different types. Establish: correspondence between cells and tissue types; the relationship between the structure and function of tissues of the human body. Prove the participation of regulatory systems in ensuring homeostasis. To substantiate judgments about the human body as a holistic and open biological system.

4.2 Nervous regulation. The human nervous system

A neuron is a structural and functional unit of the nervous system. Reflex principle of the nervous system. Reflex arc, its components and functioning. Central and peripheral nervous systems. Structure and functions of the spinal cord and brain. Autonomic nervous system (sympathetic and parasympathetic divisions). The influence of the autonomic nervous system on the body.

KNOW AND UNDERSTAND

Functions of the nervous system. The principle of the nervous system. Structural features of the nervous system. Functions of the spinal cord, brain and its departments, somatic nervous system, autonomic nervous system. Location and functional significance of the cortical areas of the cerebral hemispheres. Negative effects of alcohol and smoking on the nervous system. Meaning of concepts and terms: neuron, neuroglia, nerve, nerve center, nerve node, reflex, reflex arc, synapse, central nervous system, peripheral nervous system, autonomic nervous system, somatic nervous system, white matter, gray matter, myelin sheath, media , cranial nerves, spinal nerves, meninges, furrows, gyri.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize: elements of the structure of the neuron; components of the reflex arc;elements of the structure of the spinal cord; parts of the brain; the fate of the cerebral hemispheres. Distinguish: sensitive, motor, mixed nerves; influence of sympathetic and parasympathetic nervous systems on the activity of the organism.

4.3 Humoral regulation. Human endocrine system

Functions and structure of the endocrine system. Endocrine glands (endocrine and mixed glands). Hormones and neurohormones, their influence on vital processes. Functions of endocrine and mixed secretion glands, consequences of their violation. Differences between nervous and humoral regulation of physiological functions of the body.

KNOW AND UNDERSTAND

Factors of humoral regulation. Organs of the endocrine system, their functions. Location of endocrine glands in the human body. Features of the structure and functioning of the endocrine glands. Consequences of hyper- and hypofunction of endocrine glands. The role of the nervous system in the regulation of endocrine glands. The importance of the endocrine system in maintaining homeostasis and adaptation of the organism. Properties of hormones. The principle of regulation of hormone secretion. The meaning of concepts and terms: hormones, neurohormones, endocrine glands, hypothalamic-pituitary system.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize endocrine glands. Distinguish glands of external, internal and mixed secretion. Correlate hormones and endocrine glands. To characterize the influence of hormones on metabolic processes in the human body. Compare nervous and humoral regulation. Justify measures for the prevention of diseases associated with dysfunction of the endocrine glands

4.4 The internal environment of the human body. Blood. Lymph

The internal environment of the human body.

Blood functions. Blood composition: plasma, shaped elements (erythrocytes, leukocytes, thrombocytes). Blood groups of the ABO system. The concept of rhesus factor. Blood Transfusion. Blood coagulation.

The composition and functions of the lymph.

KNOW AND UNDERSTAND

Components of the internal environment of the human body (blood, lymph, tissue / intercellular / fluid). Functions of blood, lymph. Composition of blood, blood plasma, lymph, tissue / intercellular / fluid. Microscopic structure of blood. Blood parameters are normal (glucose, hemoglobin, erythrocyte count, leukocytes, erythrocyte sedimentation rate / ESR /). Causes of blood incompatibility during transfusion. Rules of blood transfusion. Physiological essence and significance of blood clotting. Phases of blood clotting. Blood clotting factors (thromboplastin, prothrombin, fibrinogen, vitamin K, calcium ions). Mechanisms to prevent intravascular coagulation. Hematopoietic organs (red bone marrow, spleen, lymph nodes, thymus / thymus). Meaning of concepts and terms: rhesus factor, rhesus conflict, donor, recipient, agglutination, anemia, hemophilia, hemolysis.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Characterize blood components. Visually recognize the shaped elements of the blood and determine the main features of their structure. Establish the relationship between the structure and function of blood cells. Compare: the composition of blood, lymph, tissue / intercellular / fluid; blood groups of the ABO system in terms of agglutinogens and agglutinins. Determine the compatibility of blood groups. Draw a diagram: the relationship of the components of the internal environment, the interaction of blood clotting factors and aanalyze blood counts and studies.

4.5 Human circulatory and lymphatic systems

The structure of the circulatory and lymphatic systems. Blood circulation, its regulation. The structure of the heart. Properties of the heart muscle. Cardiac cycle, its phases. The work of the heart, its regulation.

Blood vessels, their structure and function. Large and small circulatory system. Blood pressure.

Lymphatic system, its structure and functions. Lymphatic circulation.

KNOW AND UNDERSTAND

Features of the structure of the heart muscle. The main properties of the heart muscle (excitability, conductivity, contractility, automation / automatism /). Functions of heart and venous valves. The rate of contraction of the human heart at rest. The duration of the cardiac cycle and its phases. The value of blood pressure is normal. The value of blood circulation. Features and significance of lymph circulation. Lymph node functions. Negative effects of alcohol and smoking on the cardiovascular system. The meaning of concepts and terms: blood circulation, blood pressure, blood pressure, arteries, veins, capillaries, coronary vessels, lymphatic capillaries, myocardium, epicardium, endocardium, pericardium, conduction system of the heart, cardiac cycle, systole, diastole, pulse.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. To characterize: big and small circles of blood circulation; blood flow through blood vessels (blood pressure, blood flow velocity); heart function; phases of the cardiac cycle; regulation of the heart (influence of the nervous and endocrine systems, calcium and potassium ions). Compare: the structure of arteries, veins, capillaries; blood and lymphatic capillaries. Establish the relationship between structure and function: heart; blood vessels. Visually recognize: circulatory system (heart, aorta, pulmonary arteries, pulmonary veins, vena cava); large and small circulation; elements of the structure of the heart (left and right ventricles, the right and left atrium of the heart valves - butterfly / mitral / tricuspid, pulmonary, aortic). Analyze the quantitative indicators of the circulatory system. Predict changes in the circulatory system during exercise. Explain the consequences: impaired lymph flow, blood circulation; increase / decrease in heart rate, blood pressure. Distinguish between types of bleeding and choose the method of home care. Justify measures for the prevention of cardiovascular diseases.

4.6 Immunity. Human immune system

Immunity, its types. Immune system, its composition and features of functioning. Mechanisms of antigen-antibody interaction.

Allergic reactions. The concept of immunocorrection and immunotherapy. Prevention of infectious human diseases.

KNOW AND UNDERSTAND

Functions of the immune system. Organs of the immune system (central - bone marrow, thymus; peripheral - spleen, lymph nodes, tonsils, formation of lymphoid tissue), their functions. Cells of the immune system (B-lymphocytes, T-lymphocytes, macrophages), their functions. Substances with protective properties (immunoglobulins / antibodies /, interferons, lysozyme). Negative effects of alcohol on the immune system. Concepts and terms: immunity, specific immunity, innate immunity, artificial immunity, natural immunity, innate immunity, cellular immunity, humoral immunity, therapeutic serum, vaccine antigen, antibody imunocorrection, immunodeficiency, immunomodulators, autoimmune processes, allergies.

BE ABLE TO

Distinguish types of immunity. Compare: innate and acquired immunity; therapeutic serum and vaccine. Explain the mechanisms of interaction of antigen-antibody systems. Justify measures for the prevention of infectious human diseases.

4.7 Breathing. Human respiratory system

Structure and functions of the respiratory system. Gas exchange processes in the lungs and tissues. Respiratory movements. Inhalation and exhalation processes. Neurohumoral

regulation of respiration. The concept of vital capacity of the lungs. Composition of inhaled, exhaled and alveolar air. Voice apparatus and its functioning.

KNOW AND UNDERSTAND

The value of respiration. Stages of respiration. The structure and functions of the respiratory organs (nasal cavity, nasopharynx, larynx, trachea, bronchi, lungs). Respiratory processes and their regulation. The main indicators of respiration (frequency, depth of respiration), their value at rest. Components and functions of the vocal apparatus. The process of formation of voice and speech sounds. Negative effects of alcohol and tobacco smoking on the vocal apparatus and respiratory function. Meaning of concepts and terms: respiration, gas exchange, external respiration, internal / tissue / respiration, air / respiratory / pathways, vital capacity of the lungs, tidal volume, reserve volume, residual air, pleural cavity, respiratory muscles, respiratory movements, epiglottis cartilage, respiratory center.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize the respiratory system. Establish the relationship between the structure and functions of the respiratory system. Compare: the composition of inhaled, exhaled, alveolar air; gas exchange in the lungs and tissues. To make the scheme of a gas exchange in lungs and fabrics. Predict changes in the respiratory system: during exercise; under the influence of environmental stimuli. Explain the essence of the negative effects of smoking on the respiratory system and vocal apparatus. Justify measures for the prevention of diseases of the respiratory system and vocal apparatus.

4.8 Digestion. Human digestive system

Structure and functions of the digestive system. Digestive glands (salivary, liver, pancreas). Digestive juices. Structure and functions of teeth. Digestion in the mouth, stomach, intestines. Parietal digestion. Absorption. Regulation of digestive processes.

KNOW AND UNDERSTAND

The value of digestion. Functions of the digestive system. Digestive processes and their regulation. The structure of the digestive organs, their functions. The structure and meaning of teeth, human dental formula. The composition of saliva, gastric, pancreatic, intestinal juices, bile. Features of digestion in different parts of the digestive tract. The value of the intestinal microflora. The essence of the processes of swallowing, digestion, absorption. The role of digestive glands, enzymes in digestion. Negative effects on the digestion of alcoholic beverages and tobacco. The value of the concepts and terms: digestion, digestive and tract, digestive glands, digestive juice and, digestive enzymes (pepsin, trypsin, chymotrypsin, lipase, amylase, Maltase) secretion, absorption, peristalsis, peritoneum, duodenum, small intestine, ileum, cecum, appendix, colon, rectum, swallowing center.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize: digestive organs, elements of tooth structure, types of teeth. Correlate digestive enzymes and digestive juices. Establish the relationship between: the external structure and functions of the teeth; structure and functions of the digestive system. Recognize the signs of poisoning and choose a way to provide home care. Justify prevention measures: diseases of the teeth, digestive organs; food poisoning.

4.9 Metabolism and energy conversion in the human body

Nutrition and metabolism. The concept of balanced / rational / nutrition. Protein, lipid, carbohydrate, water-mineral metabolism.

The concept of drinking water quality.

The role of enzymes, ATP in ensuring metabolic processes. Vitamins, their role in metabolism. Metabolic disorders associated with a lack or excess of certain vitamins.

Negative effect on the metabolism of toxic substances. Neutralization of toxic compounds in the human body. Neurohumoral regulation of metabolic processes.

KNOW AND UNDERSTAND

Functional significance for the human body of proteins, fats, carbohydrates, vitamins, water and mineral salts. Human food and energy needs. The importance of a balanced diet. Consequences of vitamin deficiency. Features of neutralization of toxic compounds in the human body. The meaning of concepts and terms: metabolism / metabolism /, vitamins, toxins, balanced / rational / nutrition.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. To make schemes of a metabolism of carbohydrates, lipids, proteins in a human body. Compare the energy and plastic value of different substances. Distinguish between fat-soluble and water-soluble vitamins. Correlate vitamins and foods. Analyze the diet. Properly assess the importance of drinking water quality and a balanced diet for good health.

4.10 Selection. Human urinary system

Structure and functions of the urinary system. Structure and function of the kidneys. Nephron as a structural and functional unit of the kidneys. Processes of formation and excretion of urine, their regulation. The role of the kidneys in the implementation of water-salt metabolism.

KNOW AND UNDERSTAND

The value of the selection. Organs of excretion of metabolic products. Organs and functions of the urinary system. Structure and function of the kidneys. The role of the kidneys in water-salt metabolism. The structure of the nephron. Processes of formation and excretion of urine, their regulation. The composition of urine. Negative effects of alcohol on kidney function. Meaning of concepts and terms: nephron, cortical substance, brain substance, filtration, reabsorption, renal pelvis, kidney gate, renal pyramid, antidiuretic hormone / vasopressin /.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize: organs of the urinary system; element and structure of the kidney, nephron. To compare composition of primary urine, secondary urine, blood plasma. Justify measures to prevent diseases of the urinary system. Prove the importance of removing the end products of metabolism from the human body.

4.11 Leather. Thermoregulation

The structure and function of the skin. The role of the skin in the secretion of metabolic products. Thermoregulation and the role of the skin in this process.

KNOW AND UNDERSTAND

Skin functions. Components of leather, features of their structure. Derived derivatives, skin glands, their functions. The role of the skin in the release of metabolic products and regulation of body temperature. Causes of sunstroke and heat stroke. The importance of skin in the body's adaptation to environmental conditions. Negative effects of alcohol and smoking on the skin. The meaning of concepts and terms: epidermis, dermis, subcutaneous tissue, melanin, thermoregulation.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize the structural elements of the skin. Establish the relationship between the structure and functions of the skin. Recognize the signs of sunstroke and heat stroke and choose how to provide home care. Justify: rules of care for own skin; measures to prevent skin diseases.

4.12 The musculoskeletal system of man

Values, functions, structure of the musculoskeletal system. Chemical composition, structure, bone growth. Types of bone connections. Skeleton structure. Features of the human skeleton due to upright walking.

Muscle tissue. Structure and functions of skeletal muscles. The main groups of skeletal muscles. The mechanism of muscle contraction. Work, tone, strength and muscle fatigue.Regulation of motor activity.

KNOW AND UNDERSTAND

Components and functions of the musculoskeletal system. Conditions for motor function. Features of growth and age-related changes in bone chemical composition. Functions of the main groups of skeletal muscles. The value of exercise for the proper formation of the skeleton and muscles. The mechanism of contraction and relaxation of skeletal muscles. Causes of muscle fatigue. Nervous regulation of motor activity. The role of the cerebral cortex in the regulation of arbitrary human movements. Meaning of concepts and terms: periosteum, compact bone substance, spongy bone substance, bone plate, osteocytes, osteon, red bone marrow, yellow bone marrow, joint, ligaments, tendons, fascia, myofibrils, actin, myosin, muscle strength, muscle tone, fatigue, posture, hypodynamy.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize: the parts of the skeleton and bones that form them; types of bone connections (fixed, semi-mobile, mobile); elements of the structure of the tubular bone; bone, cartilage, muscle tissue; elements of skeletal muscle structure. Distinguish: active and passive parts of the musculoskeletal system; types of bones (long, short, flat, mixed, air-bearing); contractile and non-contractile part of the skeletal muscle; static and dynamic work. Compare: the structure of flat and tubular cysts; physiological features of striated and unstriated muscles. Classify muscle by function. Recognize injuries of the musculoskeletal system and choose the method of providing home care. Justify the role of physical activity for good health.

4.13 Human sensory systems.

General characteristics of sensor systems. The role of sensory systems in ensuring the connection of the organism with the external environment. Sensory systems of sight, hearing, balance, smell, taste, touch, temperature, pain.

Receptors, their types. Sense organs as peripheral parts of sensory systems. Structure and functions of the organs of sight, hearing and balance.

KNOW AND UNDERSTAND

The structure and general principle of operation of sensor systems. Features of the structure and function of the main sensor systems. Perception processes: images of objects; light;colors; sounds; body balance; taste; odors; touch; pain. The meaning of concepts and terms: sensory systems, sensory adaptation, sense organs, receptors, accommodation, myopia, hyperopia, astigmatism, color blindness, optical system of the eye.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize the elements of the structure of the organs of sight, hearing, balance. Establish the relationship between the structure and functions of the organs of sight, hearing, balance. Justify: rules of hygiene of the organs of sight and hearing; measures to prevent visual and hearing impairments.

4.14 Higher human nervous activity

Nervous processes, their indicators. Unconditional and conditioned reflexes, instincts. Formation of conditioned reflexes. Formation of temporary neural connections, their significance for the formation of conditioned reflexes. Inhibition of conditioned reflexes. Physiological bases of speech. The first and second signaling systems. Teaching. Memory. Higher human nervous activity and its main types.

Types of temperament.

Sleep as a functional state of the body, its significance

KNOW AND UNDERSTAND

Nervous processes: excitation, inhibition. Indicators of nervous processes: strength, mobility, balance. Mechanisms of reflex formation. The value of the second signal system. Features of higher nervous activity of the person. The value of sleep. See the dream. The role of the cerebral cortex in thinking. Causes of individual characteristics. Negative effects of alcohol and smoking on higher human nervous activity. The meaning of concepts and terms: excitation,

inhibition, instinct, unconditional reflexes, conditioned reflexes, temporal neural connection, memory.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Compare: conditioned and unconditioned reflexes; the first and second signaling systems; types of higher human nervous activity. Classify unconditional reflexes. Recognize: instinctive and acquired human behavior; temperament type; conditioned and unconditioned reflexes. Distinguish: types of training; types of memory; types of higher nervous activity and temperament properties. Justify the rules of mental activity.

4.15 Reproduction and human development

The structure of the human reproductive system. Functions of the human gonads. The structure of human germ cells. Gametogenesis. Primary and secondary sexual characteristics. Periods of human ontogenesis. Development of embryo and fetus, placental function. Child development after birth.

KNOW AND UNDERSTAND

The structure of the human reproductive system. Functions of the gonads, placenta. Stages of gametogenesis. Differences in the structure and processes of formation of male and female gametes. Periods of human ontogenesis. Stages of embryonic and post-embryonic human development. Primary and secondary sexual characteristics. The role of the endocrinesystem in the regulation of gametogenesis, ovulation, pregnancy, and human puberty. Negative effects of alcohol and smoking on the reproductive system. The meaning of concepts and terms: pregnancy, placenta, puberty.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Visually recognize and characterize: human germ cells; stages of human gametogenesis. Compare the structure and development of male and female gametes. Establish the relationship between the structure and functions of male and female gametes.

Section 5. Fundamentals of ecology and evolutionary theory

5.1 Environmental factors. Population

Environmental factors and their classification. The concept of the optimal range of environmental factors. Regularities of influence of ecological factors on living organisms.Adaptation of living organisms to the action of environmental factors. Ecological valence. Ecological niche as a result of adaptation of organisms to existence in the ecosystem. The concept of population. Structure and characteristics of populations. Population parameters. Population waves. The concept of a minimum viable population. Ecological strategies of populations.

KNOW AND UNDERSTAND

Ecological factors: abiotic, biotic, anthropogenic / anthropic /. Regularities of influence of ecological factors on living organisms (laws of limiting factor, tolerance, cumulative action of factors). Ecological niche parameters. The rule of mandatory filling of the ecological niche. Population parameters: number, density, age, sex and genetic structure, growth, fertility, mortality. The meaning of concepts and terms: ecology, ecological valence, ecological niche, ecological factors, limiting factors, optimal and pessimistic conditions, habitat, tolerance, population, population structure, population waves, minimum viable population, population homeostasis.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Classify environmental factors. Distinguish: wall and euribiont species, static and dynamic parameters of the population, ecological strategies of populations. Characterize the parameters of the population. Analyze tabular data and graphs that reflect the magnitude or change in population parameters. Model the consequences of significant overlap of ecological niches of competing species.

5.2 Ecosystems

Components, properties and characteristics of the ecosystem. Biocenosis and biotope. Types of relationships between populations of different species in ecosystems. Energy conversion in ecosystems. The concept of producers, consumers and reducers. Trophic structure of the biocenosis. Ecological pyramids. Spatial heterogeneity of the biocenosis. Structural diversity of the biocenosis. Temporal heterogeneity of ecosystems (phenological changes, succession).

KNOW AND UNDERSTAND

Components, properties and characteristics of ecosystems. Ways of assimilation, transmission and scattering of energy in ecosystems. The main biomes of the Earth. Examples: primary and secondary successions; trophic chains and trophic grids; phenological changes. Meaning of concepts and terms: biotope, biotic connections, biocenosis, agrocenosis, ecological pyramid, mosaic biocenosis, productivity of ecosystems, producers, consumers, reducers, succession, trophic chain, trophic pi ven, trophic grid, stratification of biocenosis, species biocenosis species diversity of the biocenosis.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish: types of biotic and x bonds in biocenosis; primary and secondary successions; pasture / eating / and detrital / decomposition / trophic chains. Identify types of population interactions in ecosystems. Draw up schemes for the transfer of substances and energy in ecosystems. Analyze the structural diversity of the biocenosis and predict its stability. Compare the features of the organization and functioning of agrocenoses and natural ecosystems.

5.3 The biosphere as a global ecosystem

The structure and boundaries of the biosphere. Biogeochemical cycles / cycle of substances / as a necessary condition for the existence of the biosphere. V.I. Vernadsky doctrine of the biosphere and noosphere and its significance for avoiding the global ecological crisis. Basic ideas about anthropogenic / anthropic / impact on the biosphere. Types of pollution, their consequences for ecosystems and humans. The concept of environmental quality. Modern global ecological problems of the world, ecological problems in Ukraine. Anthropogenic / anthropic / impact on biological diversity (extinction of species, universal species). Conservation of biodiversity as a necessary condition for the stability of the biosphere. Modern directions of nature protection and environmental protection in Ukraine and the world.

Basic provisions of nature management. The concept of sustainable development.

KNOW AND UNDERSTAND

The structure and boundaries of the biosphere. Key biogeochemical cycles. The essence and meaning of the concept of sustainable development. The role of the basic laws of nature management in the formation of the principles of sustainable nature management in the context of sustainable development. Modern directions of nature protection in Ukraine and the world. The impact of environmental factors and indicators of its quality on human health and safety. Meaning of concepts and terms: anthropogenic / anthropic / impact, biosphere, biogeochemical cycle, alien species, ecological network, ecological policy, living matter of the biosphere, biogenic matter, inert / inanimate / matter, biomaterial, pollution, noosphere, protection nature management, ecological thinking, sustainable development.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish: types of biosphere substances; types of environmental pollution; sources of environmental pollution. Analyze: schemes of biogeochemical cycles, anthropogenic changes in the biosphere, the state of the environment. Predict the consequences of environmental pollution for living organisms and humans in particular.

5.4 Adaptation as a general property of biological systems

General patterns of formation of adaptations. The concept of preadaptation and postadaptation. Properties of adaptations. Formation of adaptations at the molecular and cellular

levels of the organization. The principle of unity of organisms and their habitat. Strategies of adaptation of organisms. The concept of ecologically plastic and ecologically non-plastic species. The concept of adaptive radiation. Life forms of animals and plants as adaptations to the habitat. The concept of conjugate evolution / coevolution / and coadaptation.

The main habitats and adaptations of organisms to them. Methods of thermoregulation of organisms. Symbiosis and its forms. The body as a habitat. The spread of parasitism among different groups of organisms. Adaptation of parasites to live in the host. The response of the host organism to the settlement of parasites. Adaptive biological rhythms of biological systems of different levels of organization. Types of adaptive biological rhythms of organisms. Photoperiodism and its adaptive significance.

KNOW AND UNDERSTAND

General patterns of formation of adaptations. The importance of preadaptations and postadaptations in the evolution of the organic world. Basic properties of adaptations. Formation of adaptations at the molecular and cellular levels of the organization. The principle of unity of organisms and their habitat. Methods of thermoregulation of organisms. The main forms of symbiosis. Examples: adaptations of organisms to the action of environmental factors, to different habitats; adaptive biological rhythms. The essence and significance of photo periodicity. Adaptive value of photoperiodism. Features of the main habitats of organisms. Meaning of concepts and terms: adaptation, preadaptation, postadaptation, adaptive potential, ecological niche, adaptive radiation, coevolution, coadaptation, life form, adaptive biological rhythms, photoperiodism.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Distinguish: types of adaptive biological rhythms of organisms (external, internal, daily, monthly, tidal, seasonal, annual, perennial); forms of symbiosis; representatives of different ecological groups of plants. Correlate: adaptation of organisms with the habitat; human adaptation to living conditions. Determine: signs of adaptation of organisms to the environment; adaptive nature of animal behavioral reactions. Compare: features of thermoregulation of poikilothermic and homoiothermic animals; adaptation of different groups of organisms to a certain habitat. To make schemes of complexes of adaptations which characterize this or that life form of organisms.

5.5 Fundamentals of evolutionary theory

The concept of evolution. The evolutionary hypothesis of J.-B. Lamarck. The main provisions of Darwin's evolutionary theory. The combination of Darwin's theory and genetics: a synthetic theory of evolution. Population of organisms as a unit of evolution. The concept of microevolution. Factors changing the genetic structure of the population: mutations, isolation, migration, gene drift, natural selection. Regularities of allele distribution in populations.

Methods of speciation. The concepts of divergence, convergence and parallelism, similar and homologous organs, rudiments and atavisms, biological progress and regress.

Views on the origin of life on Earth (creationism, panspermia, abiogenesis). Modern views on the initial stages of the evolution of life: the RNA world. Key stages in the evolution of life on Earth.

KNOW AND UNDERSTAND

The value of evolution. The essence: the evolutionary hypothesis of J.-B. Lamarck; the main provisions of Darwin's evolutionary theory; the main provisions of modern synthetic theory of evolution; different views on the origin of life. Causes and consequences of gene drift. Regularities of allele distribution in populations. The role of natural selection in adaptations to changes in the natural environment. Key stages in the evolution of life on Earth (the emergence of photosynthesis, the emergence of eukaryotic cells through the symbiosis of prokaryotes, the emergence of multicellular organisms). The meaning of concepts and terms: evolution, microevolution, isolation, gene drift, migration, divergence, convergence, parallelism,

natural selection, parallelism, biological progress, biological regression, genetic structure of the population, gene pool of the population.

BE ABLE TO

Determine the correctness of the application of these concepts and terms. Characterize the population as a unit of evolution. Distinguish: similar and homologous organs, rudiments and atavisms, methods of speciation (geographical and ecological isolation of populations, reproductive isolation, random genetic changes). Compare the progress of biological and biological regression. To substantiate the role of heredity in the evolution of organisms.

EXAMINATION STRUCTURE AND EVALUATION CRITERIA

The admission exam is carried out in writing (by completing test questions).

The test contains 30 questions (24 multiple-choice, 4 matching, and 2 with three possible answers) for a maximum total of 46 points.

24 questions (Nos. 1–24): 1 point for a correct answer (0 points if incorrect or multiple answers selected).

4 questions (Nos. 25–28): 1 point for each correct logical pair (max. 4 points per question).

2 questions (Nos. 29–30): 1 point for each correct answer from the groups (max. 3 points per question).

All points earned by the applicant are added together.

The total test score is converted to a ranking score according to the following table:

Test points	Points according to 100–200 scale
7	100
8	107
9	114
10	119
11	124
12	128
13	131
14	134
15	136
16	138
17	140
18	142
19	144
20	145
21	146
22	147
23	148
24	149
25	150
26	151
27	152
28	154
29	156
30	158
31	160
32	162
33	164
34	166
35	168
36	170
37	172
38	175
39	177
40	179
41	182
42	185
43	188
44	192
45	196
46	200

The total duration of the exam may not exceed 120 minutes. Applicants who receive less than 100 points on the admission exam are not allowed to participate in the competitive selection process.

Evaluation criteria

When assessing the level of academic achievement in biology takes into account:

- the level of mastery of biological ideas that are an important component of human culture: levels of organization of living nature, the relationship of structure and functions of organisms, the historical development of the organic world, diversity of organisms, integrity and self-regulation of living systems, human and nature;
- the level of skills to use theoretical knowledge in practice, when solving problems of various types, the ability to draw conclusions and generalizations based on practice.

Levels of academic achievements of entrants	Points	Criteria for assessing the academic achievements of applicants
I. Initial	**100-119**	The entrant (entrant) recognizes and names individual biological objects.
	120-129	The entrant tries to reproduce some facts, gives elementary examples of biological objects and their individual features.
	130-139	The entrant (entrant) reproduces some facts, fragmentarily characterizes some features of biological objects; answers questions that require a one-word answer.
II. Average	**140-144**	The entrant (entrant) reproduces a small part of the educational material, gives a definition of individual biological concepts, gives an incomplete description of the general features of biological objects; may make mistakes in the answers.
	145-149	The entrant (entrant) reproduces the main content of the study material, answering questions; characterizes the general features of biological objects; gives definitions of individual biological concepts; gives examples based on the material of the textbook; may make mistakes in the answers.
	150-154	The entrant (entrant) incompletely reproduces the educational material, partially adheres to the logic of its presentation; answers some questions; generally uses biological terms correctly; characterizes the structure and functions of individual biological objects according to the plan; makes mistakes in the answers; solves simple typical biological exercises and problems.
III. Sufficient	**155-159**	The entrant reproduces most of the study material, using the necessary terminology; reveals the essence of biological concepts; characterizes the basic provisions of biological science, admitting inaccuracies in the answers; solves simple typical biological exercises and problems.
	160-169	The entrant (entrant) reproduces the study material; answers the questions, admitting inaccuracies in the answers; compares biological objects, phenomena and processes of living nature, establishes differences between them; corrects mistakes; solves typical biological exercises and problems using the algorithm.
	170-179	The entrant (entrant) freely reproduces the study material and answers the questions; establishes causal links; gives a comparative description of biological objects, phenomena and processes of living nature; solves standard cognitive tasks; corrects own mistakes; independently solves typical biological exercises and problems.
IV. High	**180-187**	The entrant systematically reproduces the study material within the

		program; gives complete, meaningful answers to questions; reveals the essence of biological phenomena, processes; analyzes, systematizes, generalizes, establishes causal relationships; uses knowledge in non-standard situations; independently solves biological exercises and problems within the program.
	188-194	The entrant (entrant) logically and consciously reproduces the educational material within the program; reasonably answers questions; independently analyzes and reveals the laws of wildlife; gives examples based on own observations; evaluates biological phenomena, laws; identifies and substantiates causal relationships; uses knowledge in non-standard situations; independently solves biological exercises and problems.
	195-200	The entrant (entrant) shows strong and deep knowledge of biology; freely answers difficult questions, using interdisciplinary links; characterizes biological phenomena and processes, reveals a personal position on them; is able to identify the problem and identify ways to solve it; freely solves biological exercises and problems of different levels of complexity in accordance with the curriculum.

Chairman of the subject examination commission and interview commissions
School of Biology
_____ Natalia VOLKOVA

APPROVED at the meeting of the admission committee of V. N. Karazin Kharkiv National University, protocol 3, April 17 2026.

Executive Secretary
of the admissions committee

_____ Hanna ZUBENKO