

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**Ternopil Volodymyr Hnatiuk National Pedagogical University**

**Faculty of chemistry and biology**



**APPROVED BY**

**Rector**

**Bogdan Buyak**

**April 27<sup>th</sup> 2023**

**PROGRAM**

additional professional entrance test (interviews)  
to university graduate school  
for obtaining the scientific degree of **Doctor of Philosophy**  
in the specialty **091 Biology**

**Ternopil, 2023**

The program was considered and approved at the meeting of the Department of General Biology and Methods of Teaching Natural Sciences on April 14, 2023, protocol № 9.

Head of the Department



\_\_\_\_\_ (Vasyl Hrubinko)

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Guarantor of the program, Head of the Department of General Biology and Methods of Teaching Natural Sciences



\_\_\_\_\_ (Vasyl Hrubinko)

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(first and last name))

## **EXPLANATORY NOTE**

One of the prerequisites for the training of highly qualified specialists of the third educational and scientific level (Doctor of Philosophy) in Ukraine is the implementation of the principles of the single European higher education zone by the higher education system of Ukraine.

The main task of training biology specialists is the formation of the ability to orientate in the educational and scientific information flow, critically interpret it, generalize, systematize and apply it in practical activities and formation of a biological worldview too.

The professional entrance examination involves checking the general theoretical training of entrants in the main biological disciplines. In accordance with this, the compilers determined that it would be appropriate to include in the program the most important general theoretical questions from all biological disciplines provided by the curricula of the specialty 091 "Biology" in combination with other related knowledge that forms the foundation of biological knowledge. At the same time, the specifics of each discipline, interdisciplinary connections and regional peculiarities of the nature of Ukraine are taken into account.

Entrants during the professional examination must show:

- understanding of biology theoretical provisions;
- the ability to combine general and special biological processes, to analyze actual material in English;
- fluency in scientific terminology, knowledge of taxonomic units of all biota kingdoms and factual material to explain the structure and function of an organism or its individual components, biological systems of supraorganismal organization levels.

### **1. CYTOLOGY, MOLECULAR BIOLOGY**

Basic provisions of cell theory. Cell as an elementary structural and functional unit of organisms. Comparative characteristics of prokaryotic and eukaryotic cells. Peculiarities of the cell structure of plant and animal organisms.

Chemical organization of the cell. The role of water and organic compounds (proteins, nucleic acids, carbohydrates and fats) in the cell.

Structure, functions and main properties of biological membranes. Passive transport, active transport and transport in membrane packaging, their biological role. Cytoplasm as a metabolic, working apparatus of the cell. Organelles and inclusions.

The musculoskeletal system of the cell. Protein synthesizing system of the cell. Spatial organization of protein molecules. Proteins - enzymes and their specific properties. Nucleic acids are the most important components of the cell genetic apparatus. Spatial organization levels of nucleic acids. DNA reduplication. RNA structure, types and functions. RNA biosynthesis. Implementation of cell genetic information. Protein biosynthesis, characteristics of its main stages. Structural organization of ribosomes and their role in protein biosynthesis.

Intracellular digestion apparatus. The sequence of intracellular digestion processes and the interaction of cell structures in this process.

The life path of a cell. Cell cycle. Types of cell reproduction and their biological significance. Differentiation, regeneration and cell death. Apoptosis.

### **2. MICROBIOLOGY WITH BASICS OF VIROLOGY**

The role of microorganisms in the substance cycle in nature and the modern life of human society.

Shape and size of bacteria. Structure, chemical composition and functions of prokaryotic cell components. Surface structures: cell wall, capsule, flagella and villi. Protoplast and intracellular structures (cytoplasmic membranes, cytoplasm, inclusions). Reproduction of bacteria.

Genetic apparatus of bacteria. Bacterial plasmids. Genetic map. Phenotypic and genotypic variability.

Nutrition of microorganisms. Mechanisms of nutrient entry into the bacterial cell. Passive,

facilitated, active diffusion. Types of nutrition: autotrophic, chemotrophic (photolithotrophs, chemolithotrophs). Bacterial photosynthesis. Heterotrophy. Photoorganotrophs, chemoorganotrophs. Mixotrophs.

Ecology of microorganisms. Influence of environmental factors on microorganisms. Relationship of microorganisms to oxygen. Obligate aerobes. Microaerophiles, facultative and obligate anaerobes. Alcoholic, lactic acid, butyric acid fermentation, their causes and meaning.

Microorganism participation in ammonification of organic nitrogen-containing compounds, processes of nitrification and denitrification. Biological fixation of molecular nitrogen and its chemistry. Free-living and symbiotic nitrogen-fixing organisms.

Viruses are a non-cellular life forms. Morphology, size and ultrastructure of viruses. Forms of viruses. Chemical composition of viruses and their reproduction and cultivation. Reproduction of viruses. Bacteriophages. Circulation of viruses in nature.

The most common viral and bacterial diseases of plants, animals and humans, prevention and control them measures.

Sars-Cov- 2019. Specificity of the structure, spread and damage. Covid. Disease prevention and treatment. Problems of vaccines and vaccination.

### **3. BOTANY, PLANT PHYSIOLOGY AND BIOLOGICAL BASIS OF AGRICULTURE**

A leaf as a side element of a shoot. Morphology and anatomy of leaves of different ecological plant groups.

The root as the main organ of water absorption and mineral substances. Morphology and anatomy of the root in connection with its functions. Root metamorphosis, their biological role.

A flower as a generative organ of plants. The theory of flower origin. The main directions of flower evolution. Micro- and macro-sporogenesis, double fertilization and its biological role.

Inflorescences, their classification and biological role.

The concept of systematic (taxonomic) units and plant nomenclature. Binary nomenclature of Carl Linnaeus.

Kingdom of Mushrooms. The principles of allocating fungi into a separate kingdom. Peculiarities of mycelium structure, nutrition, structure and types of fruiting bodies, reproduction, importance in nature and human life, principles of classification. The main classes of the Mushrooms department and their representatives.

Department of Lichens. Features of the thalamus structure, anatomical and morphological types of thalamus, reproduction, distribution, significance in nature and human life.

Subkingdom of higher plants: signs of belonging to the subkingdom, divisions and their classification schemes.

Division Ferns: peculiarities of the morphological structure, development cycle, significance and phylogeny on the example of the male fern.

Division Gymnosperms: development cycle, significance and phylogeny on the example of Scots pine.

Department of Angiosperms (Flowering) plants: characteristic features, classification, distinguishing features of Monocyledon and Dicotyledon, characteristics of the main families (Rosaceae, Fabaceae, Cruciferae, Solanaceae, Asteraceae, Liliaceae, Poaceae) and their representatives.

The importance of water in the life of a plant. Mechanisms of water absorption by the root, symplast and apoplast ways of water transport. Root pressure - the work of the lower end motor, its mechanism. "Weeping" and guttation in plants. Paths, driving forces and the mechanism of the ascending path of water through the xylem.

Transpiration - evaporation of water by a plant, biological significance. Characteristics of the main parameters: transpiration intensity, relative transpiration, transpiration productivity, transpiration coefficient. Types of transpiration: respiratory, cuticular and lenticular, their relationship in the ontogenesis of plants.

The significance of photosynthesis in nature, its cosmic role. The main organs of

photosynthesis. Photosynthesis, as a process of combining light and dark reactions. The light stage of photosynthesis. Products of the light stage of photosynthesis and ways of their use. The dark stage of photosynthesis. Dependence of photosynthesis on external and internal factors.

Mineral nutrition is one of the main types of plant nutrition. The content of mineral elements in various plants and their organs. Macro-, micro- and ultra-microelements, their physiological role. Mechanism of absorption of ions by the root and their transport through biological membranes. The role of nitrogen in plant life. Features of nitrogen nutrition of legumes, semi-parasitic, parasitic and insectivorous plants. Mycorrhiza, soil microflora and their role in plant nutrition.

Growth and development of plants. Types of growth of plant organs. Phytohormones: auxins, gibberellins, cytokinins, abscisic acid, ethylene. Growth movements of plants. Development of plants. Stages of ontogenesis of higher plants: embryonic, juvenile, maturity and reproduction, old age and dying. The life cycle of different forms of plants. Phenophases, stages of morphogenesis and organogenesis.

General scheme of soil formation. Weathering of rocks. Factors of soil formation: climatic, biological, temporal, anthropogenic, soil-forming rock, relief. Soil composition and properties. Components of the soil: solid, liquid and gaseous phase. Biological part of the soil. Formation of humus, the role of living organisms in this process. The main groups of humic substances: humic acids, fulvic acids, humins. Fertility is the main property of the soil.

Environmental factors that determine the growth and development of rural and urban areas. plants Basic laws of agriculture. Plant requirements for environmental factors in ontogenesis. Types and systems of tillage. Concept of crop rotation. The need to alternate crops and steam in connection with the peculiarities of their soil nutrition, the physical condition of the soil, biological, economic and other reasons.

The concept of fertilizers and the system of their application. Simple nitrogen, phosphorus and potash fertilizers: their role in plant nutrition, main representatives and features of application to the soil. The role of manure in increasing soil fertility and crop yield. cultures Manure storage methods and features of use. Basic forms and applications of bacterial fertilizers. The concept of pesticides as chemical means of plant protection: main groups and representatives.

Classification of field crops in crop production of Ukraine. Basics of field research methods in crop production. Phases of growth and development of grain crops. Stages of development. Winter and spring forms of plants. Biological features of winter wheat in connection with growing conditions. Technology of growing winter wheat in the forest-steppe of Ukraine. Biology and basics of the technology of growing peas and potatoes in the forest-steppe of Ukraine.

Variety of vegetable plants and different approaches to their classification. Propagation of vegetable plants by seeds, vegetatively, seedlings. Regulation of life factors of vegetable plants in protected soil. Biological features and agrotechnics of growing white cabbage in open ground conditions.

Species composition of fruit crops. Classification of fruits by type of fruit. Seed and vegetative reproduction of fruit and berry crops. Care of fruit trees and soil in gardens. Origin, biology and features of growing the home apple tree.

Biological properties of animals: genetic potential, fertility, exterior, interior, constitution, digestive features, productivity, etc. Inspection of animals. Scientific basis of the organization of feeding of rural and urban areas. animals Economic importance and biological features of pigs. The main breeds of pigs. Pig fattening. The group method of research in animal husbandry, the method of periods, groups-periods and groups-analogues.

## ZOOLOGY

General characteristics of the subkingdom Protozoa - Protozoa.

Type Protozoa, or Sarcomastigophora - Sarcomastigophora. General characteristics of the Protozoa subkingdom. Characteristics of the Sarcomastigophora type - Sarcomastigophora

Subtype Sarcodina - Sarcodina. General characteristics of the Sarkord subtype.

Class True amoebae – Lobosea, class Granuloreticulosea – Granuloreticulosea. Superclass Promenenizhka - Actinopoda. Radiolaria.

Characteristics of the main classes of flagellate animals:

a) class Plant flagellates - Phytomastigophorea;

b) class Animal flagellates - Zoomastigophorea.

Type Apicomplexa - Apicomplexa. General characteristics of the type Apicomplexa.

Characteristics of the class Spores and subclasses Gregarina and Coccidia

Type of Cilia or Infusoria - Ciliophora. General characteristics of the Ciliated type.

Reproduction of ciliates. Characteristics of the main classes of ciliates.

Subkingdom Multicellular - Metazoa. The type of sponge is Spongia

Origin of Multicellular. General characteristics of the multicellular subkingdom.

Characteristics of the Sponge type. Characteristics of the main classes of sponges.

True Multicellular - Eumetazoa. Type Intestinal - Cnidaria, or Coelenterata. Class Hydrozoa - Hydrozoa.

General characteristics of true multicellular. Characteristics of the Intestinal type.

Classification of intestinal cavities. Class Hydrozoa - Hydrozoa.

Class Scyphoid - Scyphozoa. Class Coral polyps - Anthozoa.

Type Flatworms - Plathelminthes. General characteristics of the Flatworm type.

Characteristics of the main classes of flatworms. Class Ciliated worms - Turbellaria. Class Trematoda, or Digenetic mammals - Trematoda, or Digenea. Class Tapeworms - Cestoda.

The type of primary hollow animals is Nematelminthes. General characteristics of the Primary Cavity Type. Characteristics of the class Roundworms, or Nematoda - Nematoda and the main series of nematodes.

Type Annelids - Annelida. General characteristics of the type Ringworms. Characteristics of classes of annelids: polychaete worms - Polychaeta; small bristle worms

– Oligochaeta; leeches – Hirudinea.

Type Arthropoda - Arthropoda. General characteristics of the Arthropoda type.

Characteristics of the subtype Gills, or Crustaceans – Branchiata, or Crustacea.

Systematics of crustaceans. Characteristics of the main classes and subclasses.

Subtype Tracheinodishni - Tracheata. General characteristics of the subtype Tracheinodyshni. Systematics of tracheinos. Characteristics of the class Chilopoda - Chilopoda. Class Amphibians - Diplopoda. The class of Insects is Insecta. General characteristics of the Insect class. Systematics of insects. Series of insects with complete and incomplete transformation.

The Chelicerata subtype is Chelicerata. General characteristics of the Chelicerov subtype. Characteristics of the class Arachnida - Arachnida. Characteristics of the main subclasses and orders of arachnids.

Mollusca type - Mollusca. General characteristics of the Mollusk type. Classification of molluscs, characteristics of the main classes. Class Bivalves - Bivalvia, Gastropods

– Gastropoda, Cephalopoda – Cephalopoda.

Type Echinodermata - Echinodermata. General characteristics of the Echinoderm Type.

Biological organization of invertebrates. Morphoanatomical features and physiological systems.

The main features of the organization of vertebrates.

Anatomical, morphological and biological characteristics of roundmouths.

The superclass of fish is like the primary aquatic jaws. Class Cartilaginous fish. Morphological organization. Physiological systems.

A systematic review of the class Cartilaginous fishes. Class Bony fishes. General characteristics. Superorder Polychaetes and Bony fishes. Peculiarities of morphoanatomy. Ecological features of fish. Biocenotic value of fish. Peculiarities of the morphoanatomy of the cerebral and visceral parts of the skull and the axial skeleton of bony fishes. A systematic review of the class Bony fishes.

General characteristics of the Amphibia class. The main features of morphoanatomy and physiological systems. Evolution of amphibians. Features of the structure of the axial skeleton. Systematics of modern amphibians.

Reptile class. General characteristics of reptiles. Morphoanatomy, physiological systems of the body. Ecology of reptiles. Origin and evolution of reptiles. Protection of reptiles, species listed in the Red Book of Ukraine. Systematics of modern reptiles.

General characteristics of birds, covers and their derivatives. Changes in the covers are related to flying. Respiratory organs, their structure. Mechanism of breathing of birds. Organs of blood circulation. Central nervous system. Excretory organs.

Biology of reproduction of birds. The structure of the digestive organs. Features of the structure of the skeleton of birds. Changes in the skeleton associated with flight. A systematic review of the class Birds.

General characteristics of the class Mammals. Progressive features of the organization. Origin and evolution of mammals. Features of the internal morphoanatomy of mammals. Peculiarities of the morphoanatomy of the digestive system and reproduction of mammals. Dental system. Features of the life cycle. Caring for offspring. A systematic review of the class Mammalia. A subclass of primeval beasts. Sumchasti subclass. Infraclass Higher animals or Placental.

The main periods of the development of biogeography. Connection of biogeography with other sciences. The purpose and tasks of biogeography. The specifics of biogeography research methods. Life forms of organisms. The trophic role of animals in ecosystems. Units and principles of floral zoning. Animal world of Ukraine. Resources of the animal world. Rare and endangered species of plants and animals of Ukraine.

## **MORPHOLOGY, PHYSIOLOGY, HYGIENE, HUMAN DEVELOPMENT AND HEALTH**

Peculiarities of human embryology. General principles of tissue organization.

Classification of fabrics. The concept of regeneration types and levels.

Epithelial tissues. Tissues of the internal environment. Blood and lymph. Hematopoiesis and lymphopoiesis. Characteristics of the body's internal environment. Classification of connective tissues.

Proper connective and skeletal connective tissues. Fibrous connective tissues and their varieties.

Muscle tissues. General morphological and functional characteristics of muscle tissues, their classification. Cardiac muscle tissue. Morphological and functional features of the myocardium.

Nervous tissue. General morphological and functional characteristics of nervous tissue. Histogenesis.

Bioelectric phenomena. Irritable tissues. Biological significance of excitation processes. The concept of irritation and irritants. Classification of irritants. Action potential. Conduction and transmission of excitation.

The role of the nervous system. Features of the structural and functional organization of the nervous system. Physiology of neurons and synapses.

Reticular formation and limbic system. Structural organization and functional significance of the limbic system.

Physiology of the autonomic nervous system. Functional features of the autonomic nervous system, its division into sympathetic and parasympathetic departments.

Cortex of the cerebral hemispheres. Function localization in the cortex of the large hemispheres. Bioelectric activity of the brain. Electroencephalography.

General characteristics of sensor systems. Sensory systems as complex structures that provide analysis of irritants. Classification of receptors. Peripheral and central analysis of irritations. Adaptation. Interaction of analyzers.

Visual analyzer. Hearing analyzer. Peripheral department of auditory and visual analyzers. Functions of the sound-conducting apparatus. Inner ear. Structure of curls. The microstructure of the spiral (Corti) organ. The mechanism of reception of different frequency sounds. Electrical phenomena in the curl. Theories of hearing. Conductive pathways and the cortical part of the auditory analyzer. The structure and functions of the vestibular apparatus.

Skin physiology. Skin analyzer. Classification and structure of skin receptors. Conductive pathways and the cortical end of the skin analyzer. Functional properties of skin receptors.

Mechanoreceptors. Motion analyzer. The structure and functions of the motion analyzer.

General characteristics of the endocrine system and principles of its work. The meaning of hormones, their structure, mechanism of action. Interaction of endocrine glands. Violation of secretory activity. Hypothalamic-pituitary system. Adenohypophysis, neurohypophysis and intermediate lobe of the pituitary gland, their physiological significance.

Physiological significance of thyroid hormones. Hormones of the adrenal cortex: mineralocorticoids and glucocorticoids. The role of mineralocorticoids in the regulation of water-salt balance. Glucocorticoids and their importance in the development of body stress reactions. The concept of general adaptation syndrome, its stages. The value of the medulla of the adrenal gland.

Physiological significance of the thymus gland and pineal gland. The role of the thymus gland as a central organ of the immune system. The phenomenon of thymus gland involution. Endocrine function of the pancreas.

Gonads. Male and female gonads. Sex hormones, their physiological significance in the body, action mechanism.

The concept of lower and higher nervous activity.

The importance I.M. Sechenov and I.P. Pavlov's works in the development of higher nervous activity doctrine. Formation of conditioned reflexes: conditions necessary for the formation of conditioned reflexes and agents that can become conditioned irritants. Conditioned reflexes of various orders.

Formation of conditional connections. Establishing a dominant. Inhibition of conditioned reflexes. Analysis and synthesis of irritations. The phenomenon of generalization, irradiation, concentration and induction. Dynamic stereotypes.

Physiology of body behavioral reactions.

Motivations, emotions and behavioral reactions of the body. The role of the limbic system in their implementation. Concept of abstract activity.

Mechanisms of sleep and wakefulness. Higher nervous activity of a person. The second signal system as a system of information perception, generalized and abstracted from direct activity. Interconnection between the first and second signal systems. Memory, its types. Structural basis and mechanisms of memory.

General characteristics of blood. Leukocyte count.

Characteristics of the body's internal environment. Concept of homeostasis. Blood functions. Physical and chemical characteristics of blood plasma. Buffer properties of blood. Mechanism of blood clotting. Types of leukocytes, their formation and structural features. Functions of different types of leukocytes. Participation of leukocytes in inflammatory reactions and phagocytosis.

Lymph, its formation, composition and properties.

Basics of immune system physiology. The concept of specific and non-specific protection. General characteristics of immunity, its importance for the body. Structural organization of the immune system. Combination and interaction of immune system elements. Types of immunity, mechanisms of their implementation. The concept of immunization. The main hormones and mediators of the immune system. Concept of histone incompatibility. Transplantation and antitumor immunity. Classification of transplants. Characteristics of antigens and antibodies. Structural bases of antigenic specificity.

Characteristics of hemoglobin. Blood groups. Morphological and functional features of erythrocytes. Hemoglobin, its structure, amount and properties. Hemoglobin compounds. Myoglobin. Erythrocyte sedimentation rate (ESR). The nature of the blood division into groups. The concept of Rh-negative and Rh-positive blood.

Physiology of cardiovascular activity. The value of the cardiovascular system. Morphological and functional features of heart muscle. Conductive system of the heart. Cardiac properties muscle Cardiac cycle and its analysis. Conduction of excitation in the heart muscle. Automation of different parts of the heart. The nature and mechanism of automation. Electrocardiography.

Basic laws of hemodynamics. The value of blood pressure in different areas of the blood vessel. Systolic, diastolic and pulse pressure. Peculiarities of blood movement through capillaries, the importance of arterio-venous anastomoses.



Nervous and humoral regulation of the heart work and vascular tone. Physiology of the breathing process.

Mechanism of inhalation and exhalation. Negative pressure in the chest cavity, its meaning. The vital capacity of the lungs. Respiratory volumes. Pulmonary ventilation and its indicators. The respiratory center of the medulla oblongata, its structure. Carbon dioxide as an irritant of the respiratory center. Cortical regulation of breathing. Peculiarities of breathing under different conditions.

Physiological processes of digestion.

The value of digestion. Intracellular and extracellular digestion. Secretarial process. Functional characteristics of digestive organs. Composition, properties and regulation of digestive secretion juices. Wall (membrane) digestion. The role of the colon in the digestion.

Absorption in the digestive tract. Liver functions related to absorption. Motor function of the digestive tract. The value of motor activity of the digestive tract. Physiology of metabolic and excretion processes.

The importance of metabolism, its main stages. The concept of an intermediate body. Protein exchange. The value of proteins in the body. Species and organ specificity of proteins. Protein exchange in the body. Fat exchange. The importance of simple and complex lipids in the body. Fat depots. The importance of carbohydrates and their transformation in the body. Carbohydrate reserves in the body. Blood glucose content. Hyper- and hypoglycemia. Energy metabolism.

Neuro-humoral regulation of protein, fat and carbohydrate metabolism. Vitamins, their general characteristics and importance for the body. The role of vitamins in the synthesis of enzymes and other substances. Hypo- and hypervitaminosis, avitaminosis.

Water-salt exchange. The importance of macro and micro elements in the body.

Dependence of the metabolism intensity on various physiological conditions. Physiological basis of nutrition. The importance of allocation processes. Extrarenal ways of excretion of metabolic products.

The process of urine formation. Morpho-functional characteristics of the nephron. Secretion processes in kidney tubules. Regulation of urine formation and excretion.

## **GENETICS AND BASICS OF BREEDING**

Genetics as a science, the subject of genetics. The concept of heredity and variability, structural and functional continuity between generations. Transmission and realization of signs and properties. Genotype and phenotype. Genotypic and phenotypic variability. Gene allelism and multiple allelism. Methods of genetics. H. Mendel, as the founder of genetic analysis. The main stages of the development of genetics. Development of genetics in Ukraine. The main tasks of genetics and its importance for solving tasks of selection, medicine, biotechnology, nature protection.

The role of the nucleus and cytoplasm in heredity. Nucleic acids as carriers and guarantors of the implementation of genetic information. Primary structure of nucleic acids Macromolecular organization of DNA. Macromolecular structure of RNA. Chromosomes. The role of chromosomes in heredity. Morphology of chromosomes. Karyotype. Giant chromosomes. Artificial chromosomes of eukaryotes. Molecular and supramolecular organization of chromosomes of eukaryotes. Histones. Non-histone proteins of chromatin. Supramolecular organization of chromosomes of eukaryotes. Cell division and reproduction of its organs. Mitotic cycle and phases of mitosis. Genetic control of the mitotic cycle. Meiosis as the basis of splitting and recombination of genes. Phases and stages of meiosis. The difference in the mechanisms of mitosis and meiosis. The formation of germ cells. Sporogenesis. Gametogenesis. General features of the organization and functions of genomes. Genomes of viruses. Structure and function of bacterial genomes. Genes and operons. Plasmids and episomes. Genomes of eukaryotes.

DNA replication as a prerequisite for the transmission of genetic information to offspring. General characteristics of replicative processes. Replication proteins and their genetic determination. Mechanisms of DNA replication in *Escherichia coli*. Features of DNA replication of eukaryotes.

Genetic processes that ensure the relative stability of the genome. DNA modification and restriction systems in bacteria. Replication error correction systems. Mechanisms of DNA repair. Direct reactivation of damaged DNA molecules. DNA excision repair. Post-replicative (recombination) repair. Systems of induced repair. SOS repair.

Mechanisms of implementation of genetic information. Transcription. Transcription promoters and terminators. Transcription. DNA-dependent RNA polymerases. Cycle of DNA-dependent transcription. Processing of primary transcripts. Processing of RNA precursors in bacteria. Processing of proRNA in eukaryotic cells. Mechanisms of splicing and methods of their research. Alternative splicing and transsplicing. The main ways of transcription regulation. Regulation of promoter function. Regulation of transcription at the level of terminators. Broadcasting. Molecular organization of ribosomes. Messenger RNA as a template for protein synthesis. Mechanisms of translation.

Independent (Mendelian) inheritance. Patterns of monogenic inheritance. Method of genetic analysis. Laws of uniformity of hybrids of the first generation and splitting of hybrids of the second generation. Rules of dominance and purity of gametes. Cytological bases of Mendelian laws and conditions ensuring their manifestation. Reciprocal crosses and analytical crosses, their significance. Patterns of di- and polyhybrid crosses. The law of independent combination of genes. Cytological bases of dihybrid crossing. The principle of discreteness of the genotype is the basic principle of genetics.

Sex and sex-linked inheritance. Gender genetics. Types of chromosomal sex determination. Evidence of chromosomal sex determination. Genes that determine and change sex. Gender genetics. Sex-linked inheritance. Biology of sex.

Linked inheritance. Absolute and partial coupling, crossover. Cytological evidence of crossover. Localization of genes in chromosomes, genetic maps. T. Morgan's chromosomal theory of heredity.

Nonchromosomal inheritance. Cytoplasmic heredity. Mitochondria and chloroplasts as carriers of genetic information. Methods of determining the structure and function of a chondrioma. Methods of studying the structure and function of the plastome. Signs controlled by cytoplasmic and chromosomal genes. Infectious agents and extrachromosomal elements. Cytoplasmic predetermination or maternal effect.

Types of variability. Modifications and mutations. Classification of variability. Modification variability or modifications. Mutational variability. Mutations and modifications, their differences. Classification of mutations. General characteristics of some types: spontaneous and induced mutations; recessive and induced mutations; recessive and dominant mutations; direct, reverse and suppressor mutations; nuclear and cytoplasmic mutations; generative and somatic mutations; morphological, physiological and biochemical mutations; conditional lethal mutations. Methods of determining mutations. Study of mutations in microorganisms. Study of mutations in eukaryotes. Gene (point) mutations. Chromosomal mutations. General characteristics and classification. Chromosome rearrangements affecting the number of genes in chromosomes. Deletions. Duplications. Chromosome rearrangements that change the localization of genes. Inversions. Translocations. Transpositions: general characteristics. Migrating genetic elements of prokaryotes. Migrating genetic elements of eukaryotes

## **BIOTECHNOLOGY FUNDAMENTALS**

Genetic engineering. The concept of transgenic organisms: recombinant DNA technology. Natural and artificial physical and chemical systems of genetic material transfer: DNA microinjection; bombardment with parts of heavy metals covered with DNA; electroporation; Ca-phosphate precipitation method; use of polymers, etc. Cloning of genes and their identification, cloned gene expression.

Cell engineering. Eukaryotic cell culture: dedifferentiation and callusogenesis as a basis for creating transplantable cell cultures. Genetic and physiological heterogeneity of cell cultures. Hybridization of somatic and sex embryonic cells. Types of hybrid cells and methods of obtaining

them. Hybridoma technology is a vivid example of the biotechnology introduction into practice. Biotechnology of monoclonal antibodies production.

Cloning as a method of biotechnology. Animal cloning and microclonal reproduction of plants: problems and prospects. Cryopreservation of the gene pool of living organism cells.

Biotechnologies of stem cells. Proliferation. Use in medicine and industry.

Plant and animal cells as objects of biotechnology. Genetically modified microorganisms as producers of new drugs. Biologically active substances and hormones in biotechnological production.

Use of biotechnological processes to solve environmental problems: waste processing, extraction of useful substances from waste, fight against pollution, control of pathogenic microflora, biodegradation of xenobiotics, oil pollution, etc. Preservation of species biodiversity by biotechnological methods.

The main directions of the biotechnological industry development. Use of biotechnology achievements in agricultural production. Development of biotechnology in Ukraine. Prospects and problems of implementing theoretically obtained results into production. International cooperation in the field of biotechnology. Economic and social aspects of the development of biotechnology. Ethical and social problems of biotechnology. Products of transgenic origin: production, significance, risks.

## **5. PROBLEMS OF THE ORGANIC WORLD EVOLUTION. ANTHROPOGENESIS**

Methods of studying evolution. The evolutionary concept of J.B. Lamarck.

Development of the hierarchy principle, formation of ideas about the phylogenetic tree. The development of comparative anatomy and morphology, embryology, the emergence of paleontology and historical geology, the creation of cell theory, the birth of ecology and biogeography.

A general description of the main stages of the evolutionary theory development after Darwin.

Formation of evolutionary biology. Development of evolutionary paleontology. Development of evolutionary morphology and embryology. Biogenetic law, triple parallelism of evolution evidence. Study of passive protective devices from the standpoint of Darwinism. The beginning of experimental studies of the evolution factors (S. Poulton).

Formation of the synthetic evolution theory. Study of the genetic bases of evolution and the origin of population genetics.

Experimental study of ecological evolution factors.

Concepts of the life origin and levels of life organization on the Earth, their characteristics.

Characteristics of the population as an ecological and genetic system. Variability as a general property of the organic world.

Isolation as an elementary evolutionary factor. Forms of isolation. Types of struggle for existence.

Natural selection is the driving and guiding force of the evolutionary process and adaptation.

Species as a form of life existence. General features of the species. Species criteria.

Speciation is a consequence of microevolution and the source of diversity in the organic world. The main ways and methods of speciation.

The ratio of ontogeny and phylogeny. Evolution of ontogenesis. Embryonic adaptation. Genetics data on the connection of onto- and phylogeny and recapitulation.

Evolution of phylogenetic groups, organs and functions. Evolution of organs and functions. The main forms of organ and function transformation and their characteristics. The main phenomena of evolutionary progress. The rate of organs and functions evolution and the reasons for their replacement.

Evolution of phylogeny and ecosystems. Teachings of O.M. Severtsova on filambryogenesis. Ways of organic world diversity: divergence. Forms and ways of phylogeny and criteria.

Stages of anthropogenesis. Man's place in the animal world. Human races, their criteria.

Modeling of evolutionary processes: significance, achievements, risks.

## **6. STRUCTURE AND FUNCTIONS OF ECOSYSTEMS**

Levels of biotic systems organization. Peculiarities of individual and systemic reaction to external influence. Environmental factors, conditions and resources. Basic environments of life. Adaptation: levels, mechanisms, significance (ecological, evolutionary). The role of organisms in the micro- and macroenvironment formation. Biological rhythms. Photoperiodism. Dysynchronosis. Life forms. Biotic relationships.

Population as an ecological, genetic and geographic system. Population strategies in the habitat. The structure and functioning of biocenoses. Biodiversity. Ecosystems as functional ecological structures of nature: production and transfer of matter and energy in trophic chains. Nature protection and conservation work.

Biosphere and its boundaries. V. I. Vernadsky about the biosphere. Living matter and its role in macroevolution. The substance cycles as the main property of the biosphere. The current state and ecological problems of the biosphere. The doctrine of the noosphere.

The place of a man in the organic world system. The main stages and driving forces of anthropogenesis. Evolution of human-nature relations (anthropocentrism, biocentrism and ecocentrism). Human ecology and the human health concept in modern environmental conditions. The influence of weather conditions on human health. Hardening principles. Socio- and technological aspects of human ecological activity. Environmental monitoring. Economics of nature use as a means of regulating the environment state.

## Structure and content of the examination, form of conducting

The exam takes place orally on the basis of the examination papers approved by the head of the admissions committee. The examination paper consists of three questions from different branches of biology.

Preparation time – 30 minutes.

### Criteria for evaluating the entrant's knowledge and skills

The scale for evaluating applicants' answers to questions of theoretical and practical content is placed in the range from 100 to 200 points and is divided into five levels:

- 1) high;
- 2) sufficient;
- 3) satisfactory;
- 4) low,
- 5) very low.

The evaluation criteria are presented in Table 1.

Table 1

Level	Grade Points	Characteristics of the applicant's answers
<b>High</b>	200 – 190 pass	The applicant provides a comprehensive and elaborate answer to the question, demonstrating a strong grasp of conceptual knowledge, fully addressing the essence of the question, and showing a good understanding of interdisciplinary connections. The applicant also provides examples. The applicant demonstrates a high level of proficiency in practical skills and abilities. The applicant provides a comprehensive and elaborate answer to the question, demonstrating a strong grasp of conceptual knowledge, fully addressing the essence of the question, and showing a good understanding of interdisciplinary connections. The applicant also provides examples. The applicant demonstrates a high level of proficiency in practical skills and abilities.
<b>Sufficient</b>	189 – 175 pass	In the answers, minor inaccuracies or insignificant errors may occur, but the applicant demonstrates an understanding of the material and provides logical reasoning for their thoughts. The applicant demonstrates a satisfactory level of proficiency in practical skills and abilities.
<b>Satisfactory</b>	174 – 160 pass	Answers to the questions are fragmentary in nature, predominantly reproducing memorized knowledge. The knowledge of the subject is incomplete, and the applicant gets confused in definitions, loses logic and sequence of presenting the question, and fails to provide examples. The applicant demonstrates a rather low level of practical skills and proficiency.
<b>Low</b>	159 – 145 not pass	The applicant fails to comprehend the content of the question on the ticket, and their answer has no direct relevance to the question posed. They lack proficiency in the fundamental terminology of the discipline and demonstrate an inability to reason and draw conclusions. The applicant exhibits an insufficient level of practical skills and proficiency.

<b>Very low</b>	144 – 100 not pass	The applicant has made serious mistakes and completely failed to address the content of the question; the answer is absent. The applicant demonstrates a lack of practical skills and proficiency.
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## LITERATURE

1. Atlas of Human Anatomy" by Frank H. Netter
2. Biotechnology: An Introduction" by Susan R. Barnum
3. Botany: An Introduction to Plant Biology" by James D. Mauseth
4. Cell Biology and Histology" by Leslie P. Gartner and James L. Hiatt
5. Ecology: Concepts and Applications" by Manuel C. Molles Jr.
6. Ecology: From Individuals to Ecosystems" by Michael Begon, Colin R. Townsend, and John L. Harper
7. Essentials of Human Physiology" by Elaine N. Marieb and Suzanne M. Keller
8. Human Genetics: Concepts and Applications" by Ricki Lewis
9. Human Physiology: From Cells to Systems" by Lauralee Sherwood
10. Gray's Anatomy for Students" by Richard Drake, A. Wayne Vogl, and Adam W. M.
11. Integrated Principles of Zoology" by Cleveland P. Hickman Jr., Larry S. Roberts, and Allan Larson
12. Invertebrates" by Richard C. Brusca, Gary J. Brusca, and Nancy Haver
13. MitchellLangman's Medical Embryology" by T.W. Sadler
14. Microbiology: An Introduction" by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case
15. Molecular Biotechnology: Principles and Applications of Recombinant DNA" by Bernard R. Glick and Jack J. Pasternak
16. Plant Systematics: A Phylogenetic Approach" by Walter S. Judd, Christopher Campbell, Elizabeth A. Kellogg, and Peter F. Stevens
17. Principles of Genetics" by Peter Snustad and Michael Simmons
18. Principles of Virology" by S. Jane Flint, Vincent R. Racaniello, Glenn F. Rall, et al
19. The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design" by Richard Dawkins