

**TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV  
ESC 'INSTITUTE OF BIOLOGY AND MEDICINE'**

**INTERVIEW PROGRAM**

**for entrants on I-course (full-time education)  
to gain Master Degree in specialty «Medicine»**

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**Introduction**

The main features of living. Levels of life organization: molecular, cellular, organism, population-species, ecosystems, biosphere. Research methods in biology.

**I. Molecular level of life organization**

**I.1. The elemental chemical composition of organisms.** Classification of chemical elements according to their content in the body (macroelements, including organogenic elements, microelements). The consequences of insufficient or excess intake of human body the chemical elements (I, F, Fe, Ca, K) and the ways to eliminate its deficiency. Notion of endemic diseases.

**I.2. Inorganic compounds in the body.** Role of the water, salts and other inorganic compounds in the body. Hydrophilic compounds. Hydrophobic compounds.

**I.3. Organic compounds in the body.** The structure, properties and functions of organic compounds. Notion of biopolymers and their monomers. Carbohydrates: monosaccharides, oligosaccharides, polysaccharides. Features of the structure, basic features and functions in the bodies of living creatures. Lipids. Peculiarities of structure, general properties and the functions in the body. Proteins: features of a structure. Amino acids, peptides and polypeptides. Levels of structural organization of proteins. The properties of proteins. Denaturation, renaturation, destruction of proteins. The functions of proteins in living creatures. Ferments, their structure, properties and applications in human activities. The nucleic acid. Structure, nucleotides. Structure, properties and functions of DNA, the principle of complementarity. The notion about gene. RNA and their types. ATP, the notion about macroergic connection. Biologically active substances (vitamins, hormones, neurohormones, phytohormones, alkaloids, phytoncides), their biological role.

**II. The cellular level of life organization**

**II.1. The organization of cells.** Modern cell theory. Cell membranes, their structure, properties and basic functions. Plasma membrane. Transport of substances through the cell membranes. Supramembrane complexes (cell wall, glycocalyx). Submembrane complexes. Pelikula cells of unicellular animals. Cytoskeleton, its structure and functions. Cytoplasm and its components. Organelles. Single-membrane organelle, endoplasmic reticulum, Holdzhi apparatus, lysosomes, vacuoles. Two-membrane organelles: mitochondria, plastids and their types (peculiarities of their structure and functions). Mutual plastids transformation. Autonomy of mitochondria and chloroplasts in the cell. Other organelles: ribosomes and polirybosoms, cell center, organelle movement. Cell comprehension. Structure and function of the nucleus. Chromosomes, peculiarities of their structure and chemical composition. Homologous chromosomes. Autosomes and sex chromosomes (heterohromosomy). Chromosome set of the nucleus (haploid, diploid, polyploid). Human karyotype. The types of cells organisation (prokaryotic and eukaryotic).

**II.2. Cell division.** Cell cycle. Interphase. Mitotic cell division and its phases. Meiotic cell division, its phase. Conjugation of homologous chromosomes. Krosingover.

**II.3. Metabolism and energy conversion.** The exchange of substances (metabolism). Plastic (assimilation) and energy (dissimilation) exchanges. Energy sources for organisms. Autotrophic (phototrophic, hemotrophic) and heterotrophic organisms. The stages of energy conversion in the body: preparatory, anaerobic (oxygen-free) and aerobic (oxygen). Aerobic and anaerobic respiration. The biosynthesis of proteins and its stages. The genetic code and its properties. Codon,

anticodon, the start codon, a stop codon. Transcription. Genes (structural and regulatory). Exons, introns. Broadcasting. The reactions of matrix synthesis (replication, transcription, translation). Photosynthesis. The main processes in light and dark phases of photosynthesis. The value of photosynthesis for existence the biosphere.

**III. Non-cellular forms of life: viruses, prions, viroids.** The viruses, their chemical composition, structure and reproduction. The mechanism of penetration the viruses in organism and host cells. The viruses impact on the host organism . Prevention of human viral diseases. The role of viruses in nature and human life. Prion. Viroids.

#### **IV. Organism level of life organization**

**IV.1. Bacteria.** General characteristics of prokaryotes (bacteria, cyanobacteria). Peculiarities of structure and vital processes of prokaryotic (nutrition, respiration, reproduction, sporogonic, incest, exchange of genetic information). Interrelations with other prokaryotic organisms (mutualism, commensalism, parasitism). A variety of prokaryotic and role in nature and human life. Harmful bacteria and diseases which caused by them. Prevention of bacterial diseases.

**IV.2. Plants.** General characteristics of the plant kingdom. Classification of the plants. Life forms of the plants.

**IV.2.1. The structure of the plant body. The processes of life, reproduction and development of plants.** Peculiarities of unicellular and multicellular plants. The lower and higher plants. The fabrics multicellular plants: generating (meristem) coating (epidermis (skin), cork), basic (storing, pneumatic, asymological), mechanical, leading, their structure and function. Xylem. Phloem. Fiber-twisted bundles.

Vegetative plant organs. Root and its functions. The roots types. The root system and its types (rod, fibrous). Root zones and their functions. The structure of the root. Modification of roots (root crops, bulbo roots, breathing, basic, tenacious, air, roots - suckers), their biological significance. The concept about a dive roots. Shoot and functionality. Structure of the shoot. Branching the shoot: the value and type (dichotomous, monopodial, sympodial). Modification of the shoot (underground and aboveground); lengthening and shortening. The stem and its functions. The internal structure of woody stems. The leaf , its structure and functions. Modifying of the leaf. Defoliation. Bud - the germ of shoots. The structure of the bud. The buds variety on location at the shoot (apical and lateral), the structure (vegetative and generative).

Generative organs of angiosperms plant: (flower, seed, fruit). Flower – it is an organ of sexual reproduction of the plants. Structure and functions of flower. Formula of flowers. Inflorescences, their biological significance. Types of inflorescences (tassel, beginning, head, basket, shield (scutum), umbrella, simple spica (colossus), complex spica (colossus), panicle, complex shield(scutum),complex umbrella). Seed and fruit: structure and functions. Seed and fruit development. Types of fruits (beans, bristles, capsule, pod, lunaria annua (siliqua), hemicarp, bruchid, berries, apples, peas). Glome, their biological significance. Rest period and seed germination conditions. Plants nutrition (mineral nutrition, air supply - photosynthesis). Plants breathing. Transpiration. Substances displacement on the plant. Ascending and descending flows substances in the plant. Forms of plant reproduction: sexual and unsexual. Spores. Impregnation. Pollination and its methods. The growth and plant development. Concept about life cycle of the higher plants(alternation of generations, sporophyte, gametophyte). Vulnerability and plant movements. Regulation of vital processes in angiosperms plants. Plants adjustment to the existence conditions.

**IV.2.2. Plants diversification.** Green algae: unicellular (Chlorella, chlamydomonade) and multicellular (spirogyra, ulvi, ulothrix). Stormy algae (laminaria, fucus). Red algae (phyllophora, porphyry, coraline). Diatomic algae (naviculales, pinnularia). Bryophytes(polytrichum, marchantia, sphagnum). Lycopodiophyta (selaginela, huperzia selago, lycopodium clavatum). Equisetophyta (equisetum arvesense, equisetum sylvaticum). Pteridophytes (male pronucleus, ordinary ostrich feather, salvina). Gymnosperm (ginkgo, yew berries tree, white cedar, pine tree, spruce, larch, juniper, cedar, welwichia, cas). Angiosperms. Classification of angiosperms. Classes: monocots and dicotyledons. Cabbage family (cruciferous) (representatives: gritsiks, wild radish, cabbage,

mustard, rape). Pink Family (representatives: strawberries, sweetbrier, Mountain ash, apple, cherry, currants). Bean Family (representatives: peas, beans, soybeans, clover, robinia (white acacia), alfalfa).

Solanaceae (representatives: petunia, pastas, tobacco, potatoes, tomatoes, peppers). Asteraceae (Compositae) (representatives: sunflower, dandelion, thistle, chamomile, cornflower). Onion (Representatives : onions. garlic, wild garlic). Liliaceae (representatives: tulip, snowdrop, hyacinth, lily). Cereals (representatives: corn, rice, wheat, rye, oats, cane, wheat grass). General characteristics and features of the plants distribution of different taxa.

**IV.3. Mushrooms. Lichens.** General characteristics of the Mushroom Kingdom. Environments of existence. Features of the life structure and processes. (Nutrition, reproduction) piliated mushrooms, molds mushrooms, yeast, parasitic mushrooms. Mushroomas variety: piliated mushrooms( butter mushrooms, orange-cap boletus , white mushroom, gaffers, protaiolo, boleti, pleurotus ostreatus, toadstool, amanita).\_Molds mushrooms (Mucor, penicillum, aspergillum); parasitic mushrooms (ustilaginomycetes, rusty mushrooms, erysiphaceae and fomes fomentarius). Mycorrhiza. The value of mushrooms in nature and human life. Lichens - symbiotic organisms. The structure and features of lichens life. Lichens variety (graphis, parmilia, xanthuria, yagel, cetrarium). The lichens value in nature and human life.

**IV.4. Animals.** General characteristics of Animals Kingdom. Principles of animal classification.

**IV.4.1. Animals structure and livelihoods.** Features of organization the single-celled and multicellular animals. Animal webbing. General plan of construction of the animal organism: body symmetry (bilateral, radial); body covering; supporting apparatus (external skeleton, internal skeleton, hydroskeleton); body cavity (primary, secondary, mixed);organs, organs system and their functions. Vulnerability, movement, nutrition, respiration, emission,substances transportation, reproduction, animal growth. Types of animal development: direct and indirect (with complete and incomplete transformation). The regulation of functions in multicellular animals. The features of animal behavior. The concept of reflex and instinctive behavior.

**IV.4.2. Animals variety.** Single-celled animals. General characteristics. Features of the structure and processes of life (nutrition, respiration, emission, osmoregulation, movement, irritability, reproduction, incineration). Limnetic (amoeba proteus, euglena viridis\_ paramecium caudatum) and marine (foraminifera, radiolarians) unicellular, their role in nature and human life. The role of marine single-celled species in the formation of sedimentary rocks and as "fossil fuels". The role of unicellular animals in soil formation. Symbiotic single-celled animals: mutualists, comensals, parasites (dysentery amoeba, trypanosomes, malaria plasmodia). Humans diseases and diseases of domestic animals which caused by parasitic unicellular animals. The role of unicellular animals in nature and human life.

Multicellular animals. Characteristic features of multicellular animals, their difference from unicellular. Sponge type. General type characteristics. The structure features and processes of life. Differentiation of cells. Diversity (Spongilla, Cypridium, Euspongia officinalis). The role in nature and human life. Coelenterata type. General type characteristics. Features of the structure and processes of life. A variety of coelenterates (jellyfish and polyps). The role of Coelenterata in nature and human life. Coral polyps and the formation of coral reefs.The flatworms type. General type characteristics. A variety of flat worms. Classes: Wicker Worms (Milky white planarius), Trematoda (liver and cat's trematoda), Stinging Worms (taenia saginata and taenia solium, echinococcus, diphyllbothrium latum); peculiarities of distribution, structure and processes of life. Development cycles. The suitability of flat worms for a parasitic way of life. Damage which parasitic flatworm causing the host. Type Primogenous, or Round worms (Nematodes). General characteristics. A variety of roundworms and habitat. Free-living round worms, their role in the processes of soil formation. Round worms - plants, animals and humans parasites (ascaris, gastric, trichinella), the diseases caused by them. Harmful effects of helminths on the host's organism. Prevention of diseases caused by helminths. Annelida type. General type characteristics. A variety

of annelid worms, habitat. Polychaeta Worms class (Nereis, Arenicola marina). Oligochaeta (earthworm, Tubifex). Environments, lifestyle. The role of earthworm in soil formation processes. Leeches Class (medical leech). The role of annelida in nature and human life. Protection of annelida.

The type of Mollusks, or Myacons. General type characteristics, variety, habitat and lifestyle. Gastropods class (tentacle, grape snail), Pelecypoda (Anodonta, Oysters, Pinctada margaritifera), Cephalopoda (squid, cuttlefish, octopus). Characteristic features of the structure, processes of life, distribution. The role of mollusks in nature and human life. Protection of mollusks. Type Arthropoda. General type characteristics. Variety of arthropods, their habitat and lifestyle. Shellfish. General characteristics, features of the external and internal structure, processes of life, habitat. Variety of crustaceans (river crayfish, crab, shrimp, woodlice, daphnia, triops, cyclopis, argulus foliaceus). Their role in nature and human life. Crustacean protection. Arachnida. General characteristics, features of the external and internal structure, processes of life, habitat. Variety of arachnida (rows of spiders, ticks). Their role in nature and human life. Insects. General characteristics, habitats. Features of the external and internal structure, processes of life. Types mouthparts. Functions of fat body. Suitability of insects before flight. Behavior features of the insects. Types of development. The pupae phase and its biological significance. Variety of insects. Rows of insects with incomplete (Coleoptera, Lice) and complete (Hymenoptera, or Beetles, Lepidoptera or Butterflies, Two-winged, Fleas) transformation. Characteristics of rows, typical representatives, role in nature and human life. Domestic insects. Use of insects in the biological method of struggle. Insect protection.

Type Chordates. General characteristics, habitats. A variety of chordates. The Cephalochordata subtype. General characteristics. The Cephalochordata class. Features of external and internal structure, processes of vital functions of lanceolate. The Vertebrate, or Craniata subtype. General characteristics. Class Cartilage Fish. Features of the structure, processes of life. A variety of cartilaginous fishes (sharks and rays). Role in nature and human life. Class Bone Fish. Features of the external and internal structure, processes of life. Features of fish behavior. Spawning, caring for descendants. Variety of bone fish: the rows Acipenseriformes, Clupeiformes, Salmonidae, Perciformes, Cypriniformes; subclasses Crossopterygii and Dipneustomorpha. Characteristics and typical representatives. Role in nature and human life. Trade of fish. Rational use of fishery resources.

Artificial fish breeding. Fish protection. Amphibians class. General characteristics. Peculiarities of the structure and processes of life in connection with the access to the land. A variety of amphibians: the rows Anura, Gymnophiona, and Urodela. Features of the organization, representatives, role in nature and human life. Protection of amphibians. Reptilia class. Features of the external and internal structure, processes of life. Seasonal phenomena in reptiles life. Adaptation of reptiles to life on the land. The variety of reptiles: squamata, turtles, crocodiles; peculiarities of organization, representatives, role in nature and human life. Protection of reptiles. Aves class. Features of the external and internal structure, processes of life. Birds - warm-blooded animals. Bird adaptability to flight. Seasonal phenomena in birds life. Settlements, nomadic and migratory birds. Flight of birds and ways of their research. Reproduction and development of birds: marriage behavior, arrangement of nests. The structure of birds egg and its incubation. Multituberculata and Perching birds. Bird diversity: Palaeognathae (ostrich, cassowary, apteryx), Penguins, Neognathae (rows of woodpeckers, Galliformes, Anseriformes, Falconiformes, Strigiformes, Ciconiiformes, Gruiformes, Passeriformes); peculiarities of organization, representatives, role in nature and human life. Poultry breeding. Bird protection. Mammalia class. General characteristics. Environments of existence. Features of external and internal structure. Features of reproduction and development of mammals. Mammalian behavior. Seasonal phenomena in the mammals life. Diversity of mammals. Prototheria- oviposition mammals. Marsupialia. Placentalia mammals: the rows Eulipotyphla, Vespertilioniformes, Rodents, Cops,

Pinnipedia, Cetacea, Artiodactyla, Perissodactyla, Primates; peculiarities of organization, representatives, role in nature and human life. Animal husbandry. Protection of mammals. Lifestyle, especially the external and internal structure, the distribution in nature of representatives of these taxa, their diversity. The value of animals of different taxa in nature and human life.

**IV.5. Human.** Man's position in the organic world. Human body tissues (epithelial, muscular, nervous, tissue of the internal environment: connective, blood, skeletal) their structure and functions. Physiological and functional organ systems. Supporting system. Bone and cartilage tissue. Chemical composition, structure, growth and bone joints. Muscle tissue. Structure and function of skeletal muscles. Mechanism of muscle contraction. Work, tone, strength and muscle fatigue. Hypodynamia.

The internal environment of the human body. Homeostasis. Structure and functions of blood. Structure and functions of erythrocytes, leukocytes and platelets. Blood groups. Blood Transfusion. Blood coagulation. Immunity, its kinds. Phagocytosis. Immune system. Allergic reactions of organism. Haemopoiesis and anemia. Functions and structure of the circulatory and lymphatic systems. Blood circulation. Heart structure. The properties of heart muscle. *Automatos of heart*. Cardiac cycle. The work of heart and its regulation. Heart rate, systolic and minute volumes of blood. Blood vessels, their structure and functions. Circle of blood circulation. The blood movement through the vessels. Tonus of vessels. Blood pressure. Lymphaticum. Lymph, its composition. The lymphatic system, its structure and function. External and cellular respiration. Functions and structure of the respiratory organs. Gas exchange in lungs and tissues. Respiratory movements and their regulation. Larynx. Nutrition and digestion. Structure and functions of digestive organs. Digestive glands. Digestion in the oral cavity, stomach, intestine. Membrane digestion. Absorption. Regulation of digestion. Energy needs of the organism. Standards and nutrition hygiene. Vitamins, their properties. Avitaminosis, hypo and hypervitaminosis. Systems that provide allocation of metabolic products (urinary, respiratory, digestive, skin). Functions and structure of kidneys. Urine formation and removal. Structure and functions of skin. Thermoregulation. Hardening. Regulation functions. Humoral regulation. Endocrine system. Hormones. Functions of internal and mixed secretion Consequences of disorders of endocrine glands function. Nervous regulation. Reflex. Reflex arc. Nervous system: central and peripheral. Structure and functions of the spinal cord and brain. Regulation of motor activity. Vegetative nervous system (sympathetic and parasympathetic). Effect of vegetative system on activity of organism and its functions. Sensory systems and their significance. Functions and structure of sensor systems. General properties of sensor systems. The organs of senses. Receptors. The structure and functions of organs of vision, hearing and balance. Perception of objects, light, color, sound and balance of body. Hygiene of hearing and vision. Higher nervous activity of a person. Unconditional and conditioned reflexes. The formation of conditioned reflexes. Temporary nerve bond. Inhibition of conditioned reflexes. Dynamic stereotype. Physiological basis of speech. First and second signal systems. Thinking and consciousness. Sensation, perception, attention, memory and its kinds, emotions. Personality. Types of temperament. Character. Giftedness, ability. Sleep and its meaning. The effects of alcohol, drugs, toxins and smoking on human body.

**IV.6. Reproduction of organisms. Individual development of organisms.** Forms reproduction of organisms (unsexual, sexual). Methods of unsexual reproduction of unicellular (division, schizogony, budding, spore formation) and multicellular organisms (vegetative reproduction, spore formation). Clone. Cloning of organisms. Parthenogenesis. Polyembryonia. Genetic combinatoric during reproduction - conjugation, copulation. Sexual reproduction. The formation processes of germ cells. Impregnation and its forms. Seedlings and hermaphrodites. Ontogenesis. Periods of individual development of organisms. Embryonic period of development, its stages in animals. Stem cells. Postpartum (post-embryonic) period of development, its types and stages in animals and humans. Sexual maturation of a person. Features of postharvest development in plants. Growth, its

types and regulation. Regeneration. Life cycle. Simple and complex lifecycles. The alternation of different generations in the life cycle. Embryotechnology.

**IV.7. Heredity and variability.** Genetics. Methods of genetic research (including human inheritance). Basic concepts of genetics: genes (structural and regulatory), allele gene, gene locus, dominant and recessive states of signs, homozygotes, heterozygotes, genotype, phenotype, gene pool, heredity, variability, clean lines.

**IV.7.1. Patterns of heredity.** Patterns of heredity, Mendel established by Mendel and their statistical nature. The law of purity of gametes. Methods of checking the genotype of hybrid individuals. Intermediate nature of inheritance. Linked inheritance. Chromosomal theory of heredity. Genetic basis for sex determination in different groups of organisms. The sex ratio in populations. Inheritance coupled with sex. Interaction of genes and their types. Organization of the genome in different groups of organisms. Cytoplasmic heredity.

**IV.7.2. Patterns of variability.** Modification (non-hereditary) variability, its properties and statistical regularities. Rate of reaction. Variation row. Variation curve. Hereditary variability and its types: combinative and mutational. Types of mutations. Mutagenic factors. Spontaneous mutations. The law of homologous series of genetic variability.

**IV.7.3. Selection.** Tasks and methods of selection. Variety, breed, strain. Artificial selection, its shape. systems of crossing organisms: intraspecific hybridization (Related - inbreeding, and unrelated - outbreeding crossing), interspecific (remote) hybridization. Heterosis. Features selection of plants, animals and microorganisms. Polyploidy. Diversity and centers of origin of cultivated plants. Areas of domestication of animals. Biotechnology, genetic and cellular engineering. Genetically modified and bizarre organisms.

**V. Suborganizational levels of organization of life.** Environmental factors: abiotic, biotic, anthropogenic. The notion of a limiting factor. The law of optimum. Ecological valency of species (limits of endurance). Euribiontic and stenobionous organisms. Interaction of environmental factors. Forms of biotic bonds (competition, predation, eating out, mutualism, commensalism, parasitism). Adaptation. Adaptive biological rhythms of organisms. Photoperiodism. Seasonal changes in the life of plants and animals.

**V.1 Environment of existence.** Basic habitats of organisms: ground-air, water, soil. The body of living creatures as a special habitat. Life forms of organisms.

**V.2 Population-species level of life organization.** The concept of a biological species. Criteria of species. Areal. The ecological niche. Structure of species. Population. Characteristics of population. Population structure (age, spatial, sexual). Population waves. Homeostasis of population. The gene pool of population.

**V.3. Ecosystems.** Ecosystems, their composition and diversity. Interrelationships between populations in ecosystems (direct and indirect; antagonistic, neutral, and mutualistic; trophic and topical). Transformation of energy in ecosystems. Producers. Consumer. Reducts. Nutrition chain. The concept of trophic level. Trophic net. The rule of ecological pyramid. Types of environmental pyramids. Ecosystem development. Succession. Self-regulation of ecosystems. Agrocenosis.

**V.4. Biosphere.** Biosphere. Noosphere. The living matter of biosphere, its properties and functions. Circulation of substances and energy flows in biosphere as necessary conditions for its existence. Modern environmental problems: growing population of planet, erosion and soil contamination, the growth of large cities, the destruction of forests, the inefficient use of water and energy resources, possible climate changes, negative impact on biodiversity. The Doctrine of V.I. Vernadsky about the biosphere and the noosphere, its importance for avoiding the global ecological crisis.

**V.5. Protection of species diversity and groupings of organisms.** Red and green books. Protected areas (reserves (biosphere), nature reserves, national and landscape parks). The notion of an ecological network. Environmental protection legislation of Ukraine. Basic documents on human

nature conservation (Red Book, black lists, Green Book). International cooperation in field of nature protection. Role of plants in nature and in human life. Endangered plant species in Ukraine.

## **VI. Historical development of organic world**

**VI.1. Fundamentals of evolutionary theory.** Evolution. Phylogeny. Phylogenetic row. Evolutionary hypothesis of J.-B. Lamarck. The main provisions of C. Darwin's evolutionary theory. Geocell-Muller biogenetic law. Divergence and convergence, similar and homologous organs, rudiments and atavisms, mimicry and its species. Synthetic theory of evolution. Microevolution. Natural selection. Species formation. Macroevolution. Biological progress and regress. Modern evolutionary views (hypotheses of an adaptive compromise, interrupted equilibrium, neo-astrophysy, and salttationism).

**VI.2. Historical development and diversity of organic world.** Modern system of the organic world. Classification principles of organisms. Taxonomic units. The division of the Earth geological history into an era, periods and epochs. The main events that occurred in those or other geological periods of Earth's history.