

**Private Institution of Higher Education
“Kharkiv International Medical University”**

APPROVED by
Rector`s order
From 05.01.2022 №10

**ENTRY PROGRAM IN BIOLOGY
FOR FOREIGN CITIZENS AND STATELESS PERSONS**

Kharkiv

PROGRAM ON BIOLOGY FOR FOREIGN ENTRANTS

Explanatory note

The program of entrance examinations in Biology is carried out according to the programs and curriculum approved by the Ministry of Education and Science of Ukraine and it has been developed on the basis of the program of external independent evaluation in Biology for persons who wish to obtain higher education on the basis of complete general secondary education, approved by the Order of the Ministry of Education and Science No. 77 dated 02.03.2016, and current educational programs.

The goals of entrance examinations in Biology are:

- to check basis theoretical knowledge of the discipline that a high school graduate should have;
- to check the compliance of practical skills according to the program requirements;
- to evaluate the general qualification of secondary schools graduates for study at the PIHE «KhIMU».

The current entrance examinations program is subdivided by the principal levels of life organization and consists of issues included in sections “Introduction”, ‘Molecular level’, ‘Cellular level’, ‘Uncellular forms of life’, ‘Organism level’, ‘Population-species, Ecosystem, ‘Biosphere’, ‘Human and his role in the organic world’, ‘Theory of evolution’, ‘Supraorganismal levels of life organization’ sections, which are subdivided by topics. The requirements for participants’ knowledge and practical skills on biology of external independent evaluation are determined for each theme.

The purpose of the entrance examinations is to evaluate the students’ level of knowledge and practical skills on school subject “Biology”, on the basis of which the entrant can:

- identify and discover basic features of the life and living organisms;
- recognize the scientific difference between living and nonliving things;
- describe and identify the levels of biological organization from molecules to the biosphere, noting the interrelationships between levels;
- characterize the basic unifying scientific principles through the provision of relevant facts, concepts, and theories;
- know the features of the main processes of life (metabolism, growth, reproduction etc.);
- Explain the relationship between structure and function in biology.
- Compare and contrast the main characteristics of prokaryotic and eukaryotic cells;
- demonstrate a working knowledge of DNA and genetics;
- list examples of different sub disciplines in biology
- establish functional, structural relationships and patterns in wildlife and classify the living objects;
- to understand the danger posed to health by bad habits;

- apply knowledge on biology for analysis of situational tasks;
- analysis of biological information presented in various forms (presentations, video content, graphics, diagrams, slides);
- State the modern theory of biological evolution, emphasizing the long history of life on Earth, common ancestry, and natural selection.
- the ability to draw conclusions, summarizing the material.

DESCRIPTION OF VERIFICATION AND EVALUATION CRITERIA of enrolee's answer at entrance examination in biology in 2021

General provisions

Kharkiv International Medical University puts a great emphasis on selecting outstanding applicants for enrollment and training. Therefore, we persist on undertaking written examination tests followed by personal interviews, which allows us to reliably estimate the knowledge, skills, motivation and personality of the applicants. During the entrance examination, the candidate must demonstrate the basic theoretical and practical skills in biology obtained in school.

The examination card includes three complex questions from the various sections of the program for entrance examination in biology, and enrollee has 60 minutes for answering the questions. The answers can be submitted when all the questions have been answered, and the answers are automatically submitted when the time of the test is over. The secretary of the selection committee encodes the work of the applicant and submits it for its assessment.

The examination is scored as the sum of points of all answers. The first 2 questions of the exam ticket are for Level 1 questions. Level 1 questions are rated at 50 points each. Question number 3 refers to the question of the 2nd level and is estimated at 100 points.

MAIN DISCIPLINE UNITS.

INTRODUCTION. GENERAL BIOLOGY

Biology is the natural science that studies life and living organisms. Diversity of the living world. Levels of life organization: molecular, cellular, organism, population-specific, ecosystem, biosphere.

1. MOLECULAR LEVEL OF LIFE ORGANIZATION.

Biological levels of organization of living things. Characteristics of life
General chemical composition of organisms. Classification of chemical elements.

Identification of the organic and inorganic molecules.

Organic compounds of organisms. Structure, properties and functions of organic compounds.

Inorganic compounds of organisms. The role of water, salts and other inorganic compounds in the body. Osmosis and tonicity.

Carbohydrates: monosaccharides, oligosaccharides, polysaccharides.

Saturated and unsaturated lipids. Features of the structure, basic properties and functions in organisms.

Proteins: structural features. Amino acids. Chemical changes during peptide bond formation.

Introduction to metabolism: anabolism, catabolism.

Enzymes, their structure and properties. Effect of the environment on the activity of enzymes.

Nucleic acids. Structure, properties and functions of DNA. The concept of the gene. RNA and their types.

Biosynthesis of proteins and its stages. Genetic code and its properties. Transcription. Genes (structural and regulatory). Exons and introns.

Cell cycle (G1, S, G2 and G0 phases and their characteristics). Types of the cell division. Characteristic of the mitosis, stages. Division of the sex cells. Stages of the meiosis.

Photosynthesis. The main processes occurring in the light and dark phases of photosynthesis.

2. CELLULAR LEVEL OF LIFE ORGANIZATION.

General structure of the cell. The basic principles of the Cell Theory.

Comparison of the animal and plant cells.

Structure of the plasmolemma (fluid-mosaic model). Fluidity as an essential property of biological membranes. Functions of the plasmolemma. Properties of the phospholipids. Types and functions of the membrane proteins.

Types of the transport across membrane (passive, active, their differences). Characteristic of simple diffusion, facilitated diffusion, osmosis, pumps, exocytosis and endocytosis.

Cellular responses to hypertonic, hypotonic, and isotonic solutions.

Chemical composition of the cytoplasm. Organelles and inclusions.

Functional and structural classification of the organelles.

Nucleus, its structure and functions.

Chromatin; types, function.

Chromosomes, their structure and chemical composition. Structure of the chromosome and chromatin in different stages of the cell cycle.

Human karyotype. Types of the cell division. Stages of the mitosis and meiosis. The differences of the mitosis and meiosis.

Metabolism and energy conversion. Comparison of photosynthesis, cellular respiration, and fermentation.

Comparison of catabolic and anabolic pathways. Energy transformation. ATP and ADP.

Assimilation and dissimilation.

Synthetic apparatus of the cell. Stages of the protein synthesis.

Genetic code and its properties. Transcription. Genes. Exons and introns.

Photosynthesis. The main processes occurring in the light and dark phases of photosynthesis. The value of photosynthesis. Inputs and outputs for cellular respiration.

3. UNCELLULAR FORMS OF LIFE.

Prions, viruses. Common features of the viruses. The chemical composition, structure and reproduction of the viruses. The mechanism of viruses penetration into the organism. Role of viruses in nature and human life.

4. ORGANISMIC LEVEL OF LIFE ORGANIZATION.

General characteristics of prokaryotes (bacteria, cyanobacteria).

Non-pathogenic bacteria, their role in the human organism. Prevention of bacterial diseases. Pathogenic bacteria and diseases caused by them.

General characteristics of Plant kingdom. Classification of plants.

The structure of plant organism. Features of unicellular and multicellular plants organization. Tissues of multicellular plants.

Vegetative organs of plants. Structure of the root. Features of the roots components.

Types of the root. The root system and its types (rod, blubber).

Sprout and its functions. Structure of sprout.

Stem and its functions. Inner structure of a stem.

Leaf, its structure and functions.

The bud is the germ of the stem. The structure of the bud.

Generative organs of Angiospermae: (flower, seed, fruit).

The structure and functions of the flower. Inflorescences, their biological significance. Flower is an organ of sexual reproduction of plants.

Seed and fruit development. Seed and Fruit. Structure and function.

Development of plants. The principles of the plants reproduction. Nutrition of plants (mineral nutrition, photosynthesis). Breathing of plants. Transpiration.

Types of reproduction of plants: sexual and asexual. Spores. Fertilization.

Variety of plants.

Green algae: unicellular (chlorella, chlamydomonade) and multicellular (spirogira, chara, ulva, ulotrix).

Red algae (phyllophora, porphyry, coral).

Diatomaceous algae (navicula, pinnularia).

Brown algae (laminaria, fucus).

Vascular spore plants (Lycopodiales, Equisetales, Pteropsida)

Phylum Gymnospermae (ginkgo, berry thistle, thuja, pine, spruce, larch, juniper, cedar, velichia, stalk).

Angiospermae. Classification of angiospermae. Monocotyledones and Dicotyledones Classes.

Fungi. General characteristics of the Fungi kingdom. A variety of fungi.

Lichenes. Lichenes - symbiotic organisms. A variety of Lichenes.

5. GENERAL CHARACTERISTICS OF ANIMAL KINGDOM. PRINCIPLES OF ANIMAL CLASSIFICATION. ANIMAL TISSUES.

Unicellular animals. General characteristics.

Symbiotic unicellular animals: parasites (dysentery amoeba, trypanosomes, malaria plasmodiae).

Freshwater (amoeba proteus, euglena green, infuzoria-shoe) their role in nature and human life.

Multicellular animals. Characteristic features of multicellular animals, their difference from unicellular.

Phylum Coelenterata or Cnidaria. General characteristics of the type.

Phylum Flatworms. General characteristics of the type. Class Fluck (liver fluck), features, distribution, structure and processes of life. Class Cestodeae (Taenia solium and Taenia saginata), peculiarities of distribution, structure and processes of life.

Phylum Roundworms (nematodes). General characteristics of the type. Round worms - parasites of plants, animals and humans (Ascaris, Enterobius, Trichinella), diseases that they are caused.

Phylum Carnivorous worms. General characteristics of the type.

Phylum Mollusca. General characteristics and variety of the type.

Phylum Arthropoda. General characteristics of the type. Variety of arthropods.

Class Crustaceae. General characteristics, features of external and internal structure.

Class Arachnida. General characteristics, features of external and internal structure.

Class Insecta. General characteristics. Variety of insects.

Phylum Chordata. General characteristics, habitats. A variety of Chordatae.

The subphylum Vertebrata. General characteristics. Class Cartilage Fish (Chondrichthyes). Features of the structure, processes of life. A variety of cartilaginous fishes (sharks and tinker).

Class Amphibia. General characteristics. Features of the structure and processes of life in connection with the exit to land.

Class Bone Fish. Features of external and internal structure, processes of life.

Class Reptilia. Features of external and internal structure, processes of life.

Class Birds. Features of external and internal structure, processes of life.

Class Mammalia. General characteristics. Features of external and internal structure. Diversity of mammals.

6. HUMAN AND HIS ROLE IN THE ORGANIC WORLD.

Types of tissues in the human body. General and special tissues. Main structural features and functions of each tissue.

Epithelial tissue. Types of the glands.

Types of the connective tissues.

Composition of the blood. Structure and functions of the formed elements. Chemical composition of the plasma.

Blood groups. Immunity, types of immunity.

Types of the muscles. Structural organization of the muscle tissue.

Composition of the bone tissue and cartilages.

Functions and structure of the circulatory and lymphatic systems. Types of the blood vessels. The structure of the heart.

Functions and structure of the respiratory organs.

Nutrition and digestion. Structure, functions and components of the digestive system.

Major digestive glands. Structure and functions of the liver, pancreas and salivary glands.

Organs of the urinary system. Functions and structure of the kidneys. Urinary tract.

Structure and functions of the skin.

Nervous regulation. Types of the reflex arcs.

Nervous system: central and peripheral organs. Structure and functions of the spinal cord and brain.

Sensory systems of their significance.

Structure and functions of the organ of vision. The structure and functions of the organ of hearing.

External, middle and inner ear. The structure and functions of the equilibrium system.

Reproduction of organisms. Forms of reproduction of organisms (asexual, sexual). Methods of asexual type of reproduction of unicellular organisms (division, schizogony, budding, spore formation) and multicellular organisms (vegetative reproduction, spore formation).

Sexual reproduction. Processes of formation of germ cells. Fertility and its forms.

Individual development of organisms. Ontogenesis. Periods of individual development of organisms.

Heredity and variability. Genetics. Methods of genetic research.

Basic concepts of genetics: genes (structural and regulatory), gene allele, gene locus, dominant and recessive states of signs, homozygotes, heterozygotes, genotype, phenotype, gene pool, heredity, variability, pure line.

Patterns of heredity. Patterns of heredity, established by G. Mendel and their statistical nature. Autosomal linkage. Chromosomal theory of heredity. Sex linked inheritance. Interaction of genes and their types.

Modification variability. Patterns of variability.

Hereditary variability and its types: combinative and mutational. Types of mutations. Mutagenic factors.

Selection. Tasks and methods of selection.

Biotechnology, genetic and cellular engineering. Genetically modified and bizarre organisms.

7. THEORY OF EVOLUTION. Darwin's Theory of Evolution. Darwin's Evidence. Inventing the Theory of Natural Selection, sexual selection, and artificial selection.

Adaptive trait and adaptation.

Modern theory of biological evolution. Species formation.

Macroevolution. Allopatric and sympatric speciation.

Principles of microevolution in modern medicine. Mutation, genetic drift, and gene flow.

8. SUPRAORGANISMAL LEVELS OF LIFE ORGANIZATION.

Environmental factors: abiotic, biotic, anthropogenic. Population-specific level of organization of life.

Kind. Population. Principles of population ecology to practical problems including pest control, endangered species conservation, and fisheries management. Logistic population growth and carrying capacity.

Ecosystems, their composition and diversity. Living (biotic) and nonliving (abiotic) components of an ecosystem. Comparison of water, carbon, nitrogen, and phosphorus cycles in terms of their major driving processes and abiotic reservoirs. Trophic levels in an ecosystem. Producers, consumers, reducers. .

Biosphere. Noosphere. Circulation of substances and energy flows in the biosphere as the necessary conditions for its existence.

Recommended books:

1. Campbell biology / J.B. Reece, L.A. Urry, M.L. Cain et al. — 10th edition. — Boston: Pearson, 2014. — 1488 p.
2. Biology / Brooker R.J., Widmaier E.P., Graham L.E., Stiling P.D. (eds.) - 5th edition. — McGraw-Hill Education, 2020. — 1442 p.
3. Human Biology / S.S. Mader, M. Windelspecht. — 14th edition. — NY: McGraw-Hill Education, 2015. — 672 p.
4. Barron's AP Biology / D.T. Goldberg. — 5th edition. — NY: Barrons Educational Series, Inc., 2015. — 504 p.
5. About Life: Concepts in Modern Biology / Agutter P.S., Wheatley D.N. - Springer, 2007. — 244 p.
6. An Introduction to Systems Biology: Design Principles of Biological Circuits / Alon U. – 2nd edition. - Boca Raton: CRC Press, 2020. — 343 p.
7. Biology / Carter-Edwards T., Gerards S., Gibbons K. et al. - Toronto, Canada: McGraw-Hill Ryerson, 2011. — 649 p.