

Ministry of Health Service of Ukraine
Zaporizhzhia State Medical University



«Confirmed»

Rector of Zaporizhzhia State Medical University

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SYLLABUS

of the BIOLOGY

for foreign students and persons without citizenship
who enter on the basis of comprehensive secondary education
according to section XIV Admission regulations to SHEE
«Zaporizhzhia State Medical University»

Zaporizhzhia 2019

The content of the program in Biology consists of the sections: "Introduction" "Molecular level of life," "Cellular level of life", "Non-cellular form of life", "Organism level of life", "The development of the organic world", which in turn are is divided into topics.

Each topic is defined volume of claims to knowledge and subject skills. The program aim is to identify the level of knowledge and skills formation of school subject "Biology" on which entrance test will be:

- Characterize basic biological concepts, laws and theories, biological phenomena and processes ;
- Explain the processes and phenomena of nature, given examples from the life and activity of human health ;
- Compare life processes at different levels of organization (molecular, cellular, organism, population, species, ecosystem, and biosphere) and detect relationships between them.
- Establish causes, functions, structures relations and patterns in wild life ;
- Detect effects of bad habits on the body;
- Apply biological knowledge to analyze situations that arise in different areas of life;
- Perform calculations using mathematical tools ;
- Apply the acquired knowledge in the analysis of biological information presented in different forms (graphical, presentation, etc.);
- Justify conclusions.

INTRODUCTION

The main features of living things. Levels of life: molecular, cellular, Organism, population- species, ecosystem, biosphere.

Know the basic features of living things, the level of life and their structure. Evaluate the importance of biological knowledge in life and society. Different levels of life organization

MOLECULAR LEVEL OF LIFE

Inorganic compounds in the body.

The role of water, salts and other inorganic compounds in the body. Hydrophilic compounds. Hydrophobic compounds.

To characterize the biological role of water, oxygen, ions Na^+ , K^+ , Cl^- , Ca^{2+} , Mg^{2+}

To establish the relationship between physicochemical properties and biological role of water.

Organic compounds in organisms.

Structure, properties and functions of organic compounds. The concept of biopolymers and their monomers.

Carbohydrates: monosaccharide, oligosaccharides, polysaccharides. Structure and functions in organisms.

Lipids. Structure and functions in organisms.

Proteins: levels of structural organization amino acids, peptides and polypeptides.

The properties of proteins: denaturation, renaturation, degradation. The functions of proteins in living things. Enzymes, their structure, properties and applications of human activities.

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

Biologically active substances (vitamins, hormones, plant hormones, alkaloids,volatile), their biological role.

To know the functions and features of organic compounds (lipids,carbohydrates, proteins, nucleic acids, ATP).

To determine the role of chemical bonds in the structural organization of macromolecules.

To compare DNA and RNA composition and levels of structural organization.

To evaluate the importance of biologically active substances in securing the vital processes of organisms.

CELLULAR LEVEL OF LIFE

Cell structure.

Modern cell theory. Membranes, their structure, properties and functions.
Plasma membrane. Transport of substances across membranes.

Cell wall. Cytoskeleton and its functions.

Cytoplasm and its components. Organelles. Membranous organelles: endoplasmic reticulum, Golgi apparatus, lysosomes, vacuoles, mitochondria, plastids and their types (especially their structure and functions). Reciprocal transformation of plastids. Autonomy of mitochondria and chloroplasts in the cell. Other organelles: ribosomes. The cell center, organelle movement. Cellular inclusions.

Structure and function of the nucleus. Chromosomes: structure and chemical composition. Homologous chromosomes. Autosomes and sex chromosomes (heterochromosomes). Human karyotype. Chromosome sets in the nucleus (haploid, diploid,polyploid).

Types of cells (prokaryotic and eukaryotic).

To know the modern cell theory.

To recognize the mechanisms of transport of substances through the membrane.

To compare structure and function of animals, plants, fungi and bacteria.

To evaluate the role of membranes in the cell interaction.

To characterize the structure and function of cell components.

To establish the relationships between the structure and functions of cell components.

To recognize cells and their components on schematic drawings and photomicrographs.

To explain: the role of the nucleus in the storage, transmission and realization of genetic information ; karyotype stability value for the species.

To compare prokaryotic and eukaryotic cells.

To identify the causes of differences in the structure of prokaryotic and eukaryotic cells (plants, animals, fungi).

Cell division.

Cell cycle. Interphase. Mitotic cell division in eukaryotes, its phases. Meiotic cell division, its phases. Conjugation of homologous chromosomes. Crossing over.

To explain the nature and biological significance of mitosis, meiosis, crossing-over.

To recognize (in the scheme or schematic drawing) cells at different phases of mitotic division.

Metabolism and energy conversion.

Metabolism. Autotrophic and heterotrophic organisms. Aerobic and anaerobic respiration.

The biosynthesis of proteins and its stages. The genetic code and its properties. Codon, anticodon, start codon, stop codons. Transcription. Genes (structural and regulatory). Exons, introns. Photosynthesis. Importance of photosynthesis.

To recognize autotrophic (photo- and chemo -) and heterotrophic organisms.

To explain the nature and importance: assimilation and dissimilation, biosynthesis of proteins and nucleic acids, glycolysis, fermentation, aerobic respiration, photosynthesis, the impact of environmental conditions on the intensity of the

process of photosynthesis, the role of ATP in energy metabolism, the role of enzymes in providing metabolic processes.

To record the total equation of photosynthesis and respiration.

To compare photosynthesis in pro-and eukaryotes, respiration and glycolysis, transcription and replication.

To analyze the process of photosynthesis, the stages of catabolism and anabolism.

To use the table "genetic code."

NONCELLULAR LIFE FORMS

Viruses, prions, viroids.

Viruses, their chemical composition, structure and reproduction.

Effect of viruses on the host.

Prevention of viral diseases.

The role of viruses in nature and human life. Prions. Viroids.

To know the structural features of viruses, activities of viruses in the cells of humans, animals, plants, bacteria and human diseases caused by viruses (polio, influenza, AIDS, hepatitis, encephalitis, measles) and prions (spongiform encephalopathy); the paths ways of viruses and prions infection.

To evaluate the impact of viruses on the host, the role of viruses in nature and human life, the prospects of viruses in biotechnology.

To recognize the figures and schemes of viruses (bacteriophages, tobacco mosaic virus, influenza).

To apply knowledge of the features of viruses and prions for the prevention of diseases.

To compare properties of viruses, viroids and prions.

ORGANISM LEVEL OF LIFE

Bacteria.

General characteristics of prokaryotes (bacteria, cyanobacteria: structure and life processes (nutrition, respiration, reproduction, sporulation). Relations with other prokaryotic organisms (mutualism, commensalism, parasitism). Diversity and role of prokaryotes in nature and human life. Bacteria and diseases caused by them. Prevention of bacterial diseases.

To know examples of human diseases that caused by bacteria (tonsillitis, diphtheria, tuberculosis, cholera, typhoid, scarlet fever, botulism, salmonella).

To recognize bacteria, cyanobacteria in the schemes, drawings, micrographs.

To highlight the essential features of bacteria, cyanobacteria.

To compare structure and vital activity of bacteria and cyanobacteria.

To identify relationships with other prokaryotic organisms.

To evaluate the role of prokaryotic organisms in nature and human life, the possibility of using bacteria in biotechnology.

To use knowledge of the features of bacteria for the prevention of bacterial diseases.

Plant Kingdom.

General characteristics of the plant kingdom. Classification of plants. Life forms of plants.

To highlight the essential features of the Plant Kingdom;

To know the basic unit of classification of plants (phylum, class, family, genus, species).

To recognize the morphology plants.

To evaluate the role of plants in the nature and in human life.

The structure of the plants.

Features of unicellular and multicellular plants. The lower and higher plants. Vegetative plant organs.

Root: structure and functions. The root systems and their types. Modifications of the roots, their biological significance.

The stem and its features. The internal structure of wood stems, their biological significance.

Leaf structure and its function. Bud, its structure.

Generative organs of angiosperms (flower, seed, fruit). Flower - organ of sexual reproduction of plants. Structure and function of the flower. Cones, their biological significance. Types of inflorescence.

Seeds and fruits: structure and function. The formation of the seed and the fruit. Types of fruits (beans, berry, capsule, pod, struchochok, achene, grains, berries, apples, walnuts).

To recognize tissues, organs of plants in charts and in figures.

To compare higher and lower plants according their organization.

To analyze the structural features of the plant as a result of their adaptation to the new environmental conditions.

To recognizes types of roots, and root`s systems, modifications of roots, roots zones, elements of the internal structure of a root in cross section.

To determine the relationship between the structure and function of the root.

To establish the relationship between the internal structure and function of the stem.

To recognize the diagrams and drawings elements of external and internal structure of leaf venation types, simple and compound leaves.

To establish the relationship between the internal structure and functions of the leaf.

To recognize types of buds.

To compare generative and vegetative buds in structure and function.

To recognize the elements of the structure of the flower, inflorescence types.

To establish the relationship between the structure and functions of the parts of the flower.

To determine the way of the flower pollination.

To know the features of the structure: seed monocot and dicot plants, different types of fruit.

To recognize and figures on the types of fruit. Identify way of spread the fruits of their structure.

To estimate the value of seed dormancy.

The processes of life, reproduction and development of plants.

Nutrition, respiration transpiration.

Sexual and asexual reproduction. Fertilization. Pollination and its types.

The growth and development of plants. Irritability and movements of plants.

Adaptations of plants to environment.

To know the features of the mineral nutrition of plants, photosynthesis, respiration, growth, movement of substances in plant.

Methods of vegetative propagation (cuttings, grafting, layering, root sprouts, and modified shoots), ascending and descending flow of substances in plants.

To identify the patterns of life processes of plants, especially the adaptations of plants to land, water and a parasitic lifestyle.

To explain the significance of double fertilization in angiosperms, the biological significance of vegetative propagation, pollination, photosynthesis, respiration, transpiration.

To evaluate the impact of fertilizer on the plant growth and development, the role of phytohormones in the regulation of life functions of multicellular plants.

Diversity of plants.

Green algae: unicellular (Chlorella, Chlamydomonas) and multicellular (Spirogyra, Hara, Ulva, Ulva).

Kelp :(Laminaria, Fucus).

Red algae :(Phyllophora, purple, Coraline).

Diatoms :(navikula, pinulyariya).

Bryophytes :(polistryh, marshantsiya, sphagnum).

Lycopsids :(selahinela, ordinary sheep, moss clavate).

Horsetail :(horsetail, horsetail forest).

Pteridophytes :(Ferns, Salvini).

Gymnosperms :(Ginkgo, pine, spruce, larch, juniper, cedar, Welwitschia, cycads).

Angiosperms. Classification of angiosperms. Classes : monocotyledons and dicotyledons.

General characteristics and features of the distribution of plants of different taxa.

To know the essential features of the plants, reproductive organs of higher plants.

To identify the features of the structure and life processes of algae and higher spore plants, gymnosperms and angiosperms, distribution of plants of different taxa in the world.

To recognize the figures and diagrams of different parts of the plants.

To distinguish: the representatives of different taxonomic groups of the plants

To compare plants of different taxonomic groups.

To evaluate the importance of plants in nature and human life.

Mushrooms. Lichens

General description of the kingdom Fungi. Habitat. Features of the structure and processes of life. The diversity of fungi: Caps, mold fungi parasites. Significance of fungi in nature and human life.

Lichens - symbiotic organisms: structure and peculiarities of lichens. The diversity of lichens and their value in nature and human life.

To know the features of growth and reproduction of fungi and lichens.

To recognize the figures of major groups of fungi and lichens.

To determine the relationship of fungi and higher plants, the reasons that cause the persistence of lichens.

To compare the principles of organization, structural features, and life processes of plants and fungi.

Animal kingdom.

General characteristics of the animal kingdom. Principles of classification of animals.

To know the essential features of the animal kingdom, the main units of classification of animals (phylum, class, order, family, genus, species).

To evaluate the role of animals in ecosystems.

To compare the features of the structure and life processes of animals, plants and fungi.

The structure and activity of animals.

Features of unicellular and multicellular animals. Tissues. The overall body plan of animals: the symmetry of the body (bilateral, radial), covering the body, the organ systems and their functions.

Irritability, movement, nutrition, respiration, excretion, transport of substances, reproduction, growth of animals. Regulation of functions in multicellular animals.

Features of the animal behavior.

To know the ways of nutrition and respiration of animals, types of movement of animals, animal response to stimulation; behaviors (conditioned, unconditioned reflexes and instincts).

To estimate the direct and indirect value of animals.

To compare the features of unicellular and multicellular animals, tissues of animals and plants, the regulation of body functions of plants and animals.

A variety of animals.

Phylum Sarcomastigophora. Subphylum Sarcodina. Class Lobosea: Amoeba proteus, Entamoeba histolytica. General characteristics and the role of these animals in nature and human life.

Class Zoomastigophora: the main features.

Phylum Apicomplexa. Class Sporozoa: the main features, the life-cycle of Plasmodium.

Phylum Ciliophora: general characteristics.

Phylum Platyhelminthes. Class Turbellaria. Planaria (morphology, life-cycle, the role in the nature).

Class Trematoda: structure, life cycle and pathogenicity of parasites. *Fasciola hepatica*, *Opistorchis felinus*, *Schistosoma*.

Class Cestoda: the main feature; Cestodes as parasites of human being.

Phylum Nematoda. General characteristics of free-living round-worms, their role in the soil. Nematodes as parasites of plants, animals and humans. *Ascaris*, Pinworm, *Trichinella*. Prevention of diseases caused by helminthes.

Phylum Coelenterata – general features. *Hydra*: structure, nutrition, respiration, locomotion, growth, excretion, reproduction. Colonial forms of coelenterates..

Phylum Annelida: General characteristics. The members of the classes: Polychaeta (*Nereis*), Oligochaeta (earthworms), Hirudinea (leeches).

Phylum Mollusca. General characteristics. Habitats and life styles, members of mollusks.

Phylum Artropoda. General characteristics. The diversity of arthropods, their habitats and life-styles. Classes: Crustacea, Arachnida, Insecta. General characteristics, structure, life processes, habitats. A variety of crustaceans, arachnids, insects. Their role in nature and human life.

Coelomate animals. Phylum Chordata. General characteristics. A primitive chordate: *Amphioxus*.

An Aquatic Craniate. Class Chondrichthyes. Features of the structure and processes of life. A variety of cartilaginous fish (sharks and rays). The role in nature and human life.

Class Osteichthyes (bony fishes). General characteristics and typical representatives. The role in the nature and human life. Artificial breeding of fish.

Class Amphibia. Habitats, structure, the processes of life. A variety of amphibians. General features.

Class Reptilia. Class Aves. Structure, the life processes, habitats, reproduction and development. The role in nature and human life.

Class Mammalia. General characteristics. Habitats. External and internal structure, reproduction, the behavior of mammals. Seasonal events in the life of mammals. The main orders.

To know the features of the external and internal structure of the animals;

To identify features of animals adaptations to living conditions, the relationship between an animal and other organisms.

To explain the patterns of distribution of species in nature, meaning behavioral responses of animals.

To distinguish characteristics of features of animals listed taxa.

To compare the features of the structure of animals of different taxonomic groups.

To analyze changes in the structure, in the life of animals resulting from adaptations to their habitats.

Human body. Organs and systems.

Skeleton bone and cartilage tissue. The chemical composition, structure, growth and bone connections. Muscles. Structure and function of skeletal muscles. The mechanism of muscle contraction.

Blood. Structure and function of red blood cells, white blood cells and platelets. Coagulation. Immunity and its types. Phagocytosis. The immune system. Allergic reactions. Hematopoiesis and anemia.

The functions and structure of the circulatory and lymphatic systems. Circulation. The structure of the heart. The properties of the heart muscle. Automaticity of the heart. Cardiac cycle. The work of the heart and its regulation. Heart rate, systolic and minute volume of blood. Blood vessels, their structure and function. The movement of blood through the vessels. Vascular tone. Blood pressure.

Lymph. Lymph its composition. The lymphatic system, its structure and function.

Respiration. The functions and structure of the respiratory system. Gas exchange in lungs and tissues. Respiratory movements and their regulation. Vocal apparatus.

Nutrition and digestion. Structure and function of the digestive system. Digestive glands. Digestion in the mouth, stomach, and intestines. Wall digestion. Absorption. Regulation of digestion. Standards of hygiene and nutrition. Vitamins, their properties. Vitamin deficiency, hypo-and hypervitaminosis.

The functions and structure of the kidneys. The formation and excretion of urine.

Structure and function of the skin. Thermoregulation. Tempering.

The endocrine system. Hormones. The functions of the endocrine glands. The consequences of dysfunction of the endocrine glands.

Nervous regulation. Reflex. Reflex arc. Nervous system: central and peripheral. Structure and function of the spinal cord and brain. Regulation of motor activity. The autonomic nervous system (sympathetic and parasympathetic). Effect of autonomic nervous system activity in the body and its functions.

Sensory systems. The functions and structure of the sensory systems. General properties of sensory systems. Senses. Receptors. Structure and function of vision, hearing and balance. Perception of image objects, light, color, sound, and balance the body. Occupational hearing and vision.

Higher nervous activity of man. Unconditional and conditional reflexes. The formation of conditioned reflexes. Temporary nerve cords. Inhibition of conditioned reflexes. The dynamic stereotype. Physiological basis of speech. The first and second signal systems. Thought and consciousness. Sensation, perception, attention, memory and its types and emotions. Personality. Types of temperament. Character. Talent, ability. Sleep and its importance.

The effects of alcohol, drugs, toxins and smoking on the human body. Reproduction and its types.

To know the structural features of the glands.

To characterize the types of tissue, the internal environment of the human body, principles of the nervous and endocrine systems, mechanisms of the heart, blood flow through the vessels, mechanisms of muscle contraction, breathing movements, protective reaction of the body (immune, allergic, blood clotting, stress, sustained

fever etc.), digestion, absorption, gas exchange in cells and tissues, urine formation, thermal regulation, the role of vitamins, bacterial flora of the gastrointestinal tract in human life, the physiological nature of sleep.

To explain the role of the components of the internal environment of the human body and functional systems, the value of signaling systems in the perception of the environment, the biological significance of sleep.

To compare the structure of the skeleton of human and animals, nervous and hormonal regulation functions, types of temperament.

Reproduction. Ontogenesis.

Types of reproduction. Gametogenesis. Structure of gametes. Fertilization. Periods of ontogenesis.

To compare sexual reproduction and asexual, the structure of male and female gametes, and process of their formation.

To characterize the stages of embryonic development in animals (fragmentation, formation of morula, blastula, gastrula, cell differentiation, histogenesis, organogenesis, the phenomenon of embryonic induction), mechanisms of growth.

Heredity and variation.

Genetics. Methods of genetics. Basic concepts of genetics: genes (structural and regulatory), alleles of the gene locus, homozygote, heterozygote, genotype.

To know the basic techniques of genetic research, gene structure, the basic concepts of genetics.

To recognize allelic and nonallelic genes; homozygotes and heterozygotes, dominant and recessive genes, types of interactions between genes.

Patterns of inheritance.

Mendel's laws of heredity. Linked inheritance. Chromosome theory. Genetic bases of sex determination in different groups of organisms. The interaction of genes and their types.

Modification (non-hereditary) variability, its statistical properties and patterns. Rate of reaction. Variation range. The variation curve.

Genetic variation and its types. Mutations. Types of mutations. Mutagenic factors. Spontaneous mutation.

To explain the role of interaction between genotype and environmental conditions in the phenotype, the adaptive nature of the modification changes, the role of mutagenic factors.

To identify the sources of variability.

To compare modification and mutation.

To analyze the variation range and variation curve.

To justify the value of mutations in nature and human life, measures of defense against the influence of mutagenic factors, the role of mutations in the evolution of organisms.

Selection.

Objectives and methods of selection. Artificial selection and its form.

Heterosis. Selection of plants, animals and microorganisms. Polyploidy. Biotechnology, genetic and cellular engineering. Genetically modified organisms.

To characterize the achievements of modern biotechnology, principles of development and use of genetically modified organisms.

To compare classical and modern methods of biotechnology.

To explain the biological significance of the phenomenon of heterosis, importance of polyploidy in plant breeding, the role of modern biotechnology achievements in life and human activities.

To determine the effects of various genetic crosses of organisms causes heterosis, ways to overcome the sterility of interspecific hybrids, the effects of the application of modern biotechnology.

ECOLOGY. ECOSYSTEMS. BIOSPHERE.

Environmental factors. Environmental factors: abiotic, biotic, anthropogenic. The concept of the limiting factor. The interaction of environmental factors. Adaptation. Adaptive biological rhythms of organisms. Photoperiodism. Seasonal changes in the lives of plants and animals.

To know environmental factors, biological rhythms.

To classify environmental factors, forms of biotic relationships; adaptive biological rhythms of the organisms.

To explain the role of the limiting factors in the expression biological rhythms.

To analyze the effect of environmental factors on organisms, their impact on the dynamics and fluctuations in population size.

Ecosystems.

Ecosystems, their composition and diversity. Linkages between populations in ecosystems. Characteristics of the population. The structure of the population (age, space and gender). Population wave. Homeostasis of the population. The gene pool of the population (direct and indirect, antagonistic, neutral, trophic and typical). The transformation of energy in ecosystems. Producers. Consumers. Decomposers. Food chain. Trophic level. Trophic net. The rule of ecological pyramid. The types of ecological pyramids. The development of ecosystems. Succession. Self-regulation of ecosystems. Agroecosystems.

To establish the relationship between populations in ecosystems, communities change in one location.

To identify the organisms that are producers, consumers, decomposers.

To explain the mechanisms of self-regulation of populations and ecosystems, especially the functioning agroecosystems, ways to improve their performance.

To compare natural and artificial ecosystems.

To justify the need for the protection of the gene pool of populations, the role of organisms: producers, consumers, decomposers and humans in artificial and natural ecosystems.

To solve problems in ecology (structure, performance, and stability of various ecosystems).

Biosphere.

Biosphere. Living matter biosphere its properties and functions. Cycling of matter and flow of energy in the biosphere as a necessary condition of its existence. Current environmental issues: the growth of the world population, erosion and soil contamination, growth of large cities, deforestation, unsustainable use of water and energy resources, climate change may have a negative impact on biodiversity.

To characterize the properties and functions of living matter of the biosphere, forms of pollutions.

ORGANIC EOLUTION

Evidences of evolution. The Lamarckian Theory. Darwin's theory of natural selection. Neo-Darwinism.

To know analogous and homologous organs, the rudiments and atavisms.

To compare the evolutionary hypothesis of Lamarck and Darwin, various forms of the struggle for existence.

To analyze the diversity of adaptations of organisms as a result of an evolutionary process, a form of natural selection.

To justify the relative fitness of organisms to life in a particular environment.

To analyze the complexity of the flora and fauna in the process of evolution.

SUGGESTED READING

1. Starr L., Starr C., Kaggart R. Biology: The Unity and Diversity of life. International Edition. Brool Cole, 13 edition: 2012, 360p
2. Sharma S., Baneriee S. Exploring Biology (vol. 1,2) Arihant Publications, 2014.

3. Bhatia K.N.. Objective Biology (vol. 1,2,3) Dinesh Publications 2015.
4. Complete NEET Cuide: Biology Paperback -2016 by MTC, Editorial Board.
5. Tripathy A. Biology for AIPMT (All India Pre-Medical Test) Vol.1. Paperback, 2015.
6. Board Objective Toology for AIPMT/AIIMS/JIPMER/AMU other PMT Entrance Exams, 2016, Paperback, 325p.
7. Objective NCERT at Your Fingertips for NEET-AIIMS-Biology Paperback, 2016 by MTH Edition.
8. Audesirk Y., Audesirk T. Biology: Life on Earth. Pearson 11 Edition, 2016.
9. Gareth Williams, Richaed Fosbery Essential Biology for Cambrige IGCSE 2nd Edition, OUP Oxford, 2015, 320p.
10. Mamta R., Solanki and Talita Yhotik Medical Entrances Biology (vol. 1,2,3)- Target Publications, 2017.
11. Srivastava S.K. Biology for Medical Entrance ISBN, S. Chand Publishing, 2018.401 p.

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