

## **Explanatory note**

The curriculum guide in Biology for foreign citizens aims to:

- 1) Teach foreign students biological terminology in English by revising the material, already familiar to them;
- 2) Fill knowledge gaps of foreign students, caused by a mismatch in the national and Ukrainian curriculum guides in biology;
- 3) Prepare students for listening to and summarizing lectures during the first year of studies of biological disciplines in English at higher educational institutions;
- 4) Prepare students for exams in biology in English.

This curriculum guide is based on a systematic approach to teaching, which reveals the integrity of organic nature, multitude and variety of its components and a close interrelation between them.

The succession of studying the questions, within the curriculum sections, may be varied by a teacher under the specific conditions.

The curriculum guide envisages simple, manageable lab work that help to extend the theoretical material, to master practical skills, to observe biological objects and to conduct experiments.

### **The Content of the program**

#### **Section 1. General Biology. Molecular biology.**

1.1. Biology as a science. Significance of biology in physician training.

1.2. The fundamental properties of living beings. The chemical composition of cells: inorganic and organic substances.

1.3. Inorganic substances: water, mineral salts and chemical elements. Chemical composition of living systems. Inorganic substances and their role in the vital activity of organisms. Organic compounds. Structure, properties, significance of lipids, carbohydrates, proteins, nucleic acids (Deoxyribonucleic acid (DNA), ribonucleic acid (RNA), adenosine triphosphate (ATP). Chemical stability of organisms.

1.4. DNA and RNA structure and functions. Gene – the basic unit of heredity. Gene classification. The genetic code. The general concept of protein synthesis: transcription, translation.

1.5. Cell as the basic structural and functional unit of nature. Characteristic features of cells - prokaryotes and eukaryotes. Structure and functions organoids of the cells. Cell as a complete system. Metabolism and energy exchange in a cell. Fundamentals of the cell theory.

1.6. Chromosomes in interphase and metaphase of mitosis. Hetero- and euchromatine. The structure of mitotic chromosomes. Karyotype. Human karyotype. Classification of human chromosomes.

1.7. The life cycle of a cell. The division of somatic cells by mitosis. The phases of mitosis. Meiosis. Reduction of the number of chromosomes to one half during the formation of gametes.

## **Section 2. Essentials of Genetics.**

2.1. Subject and basic tasks in genetics. Main concepts of genetics: heredity, variation, genetic material and its properties (conservation, variation, realization of genetic information). Allele genes. Dominant and recessive genes. Homo- and heterozygous organisms. Genotype, genome, phenotype.

2.2. Monohybrid crossing, 1st and 2nd Mendel's laws. Dihybrid crossing. Polyhybrid crossing, 3rd Mendel's law. Interactions between genes. Multiple alleles. Blood groups determination on ABO system.

2.3. Sex determination. Inheritance of sex-linked characters of man.

2.4. Variation types: modifications, combinations, mutations. Their significance in ontogenesis and evolution. Modifications. Norm of reaction. Combinative variation. Mutation types. Its classification. Genetics Practice Problems. Hereditary diseases caused by mutations.

## **Section 3. General biology.**

3.1. Ontogenesis and its periods. Embryonic development and its stages. Postembryonic ontogenesis. Man's growth and development.

3.2. The basic principles of Darwin's theory. Modern concept of evolution. Micro- and macroevolution.

3.3. Ecology. Environment as an ecological concept. Environmental factors. Ecosystems Ecology of man. Adaptation of people to life conditions on cellular, organism, population and biosphere levels. Man as an ecological factor. Main directions and results of anthropogenic influence in environment. Environment protection..

3.4. Biosphere, main conception. Links of biosphere's components. Biosphere as place. Biosphere as process. A model of chemical cycling.

3.5. Poisons' organisms

## **Section 4. Human anatomy and physiology. Human hygiene and health.**

1. Human and animal tissues

A human body as a single whole. The union of cells in the tissue. Types of tissues: epithelial, connective, muscular, nervous.

The concept of bone, cartilage and loose connective tissue. Blood- fluid connective tissue.

Smooth muscles and their functions. Striated muscles and their functions. Peculiarities of heart muscle.

Neuron as a structural and functional unit of the nervous system. Reflex arc.

The concept of an organ, the system of organs. Physiological systems of human organs.

## 2. Skeletal system. Skeleton

Overview of the structure of the human skeleton. Classification and connections of bones. The composition, structure and properties of a bone. The main functions of a skeleton: support, protection, its role in metabolism, hematopoietic function.

The skeleton of a human body, a spine, a skull, limbs. Bones of different parts of the skeleton.

Peculiarities of the structure of a human skeleton, caused by bipedal locomotion.

## 3. Muscular system of a human

The major groups of human muscles. Head and neck muscles, trunk muscles and limbs muscles. The mechanism of muscular contraction.

The regulation of muscles functioning. The prevention of spinal curvature and flat feet.

## 4. The cardiovascular system of a human

Transport of materials in a human body. The composition of blood. The composition of plasma. Red blood cells, their structure and functions. White blood cells, their structure and functions. The concept of immunity. Platelets. Coagulation.

Heart. Its structure and functioning. Neurohumoral regulation of heart. Pulse.

Large and small circles of blood. The flow of blood through blood vessels. Vessels: arteries, capillaries and veins. Blood pressure. Bad habits and their influence on blood circulation.

## 5. The lymphatic system

Lymphomas. Tissue fluid. Structure and functions of the lymphatic system. The movement of fluids in body. The maintenance of homeostasis of the organism.

## 6. Human respiratory system

Airways and lungs. Upper respiratory tract, nasal function. Larynx, its structure and functions. Vocal apparatus, its structure, the formation of sound. The trachea, bronchi, bronchioles, alveoli. The mechanism of inhalation and exhalation. Transport of oxygen and carbon dioxide.

Cellular respiration.

Nervous and humoral regulation of breathing.

The influence of carbon monoxide. The influence of smoking and air pollutants on the respiratory system.

## 7. Digestive system

Nutrients and foods.

Mechanical processing of food and chemical breakdown of food.

The structure and functions of the digestive system of a human.

Teeth. The structure of teeth, depending on the function performed.

The enzymes in saliva, gastric juice, and pancreas. The mechanism of functioning of enzymes. The role of bile.

Digestion in the small intestine. Absorption in the small intestine. The function of the colon.

The importance of biomedical quality and safety requirements for food.

Possible causes of indigestion.

## 8. Urinary system

The overview of the urinary system structure.

Macro- and microscopic structure of a kidney. Nephron. The formation of primary and secondary urine.

Bladder and the reflex output of urine.

Homeostatic indices of the chemical composition of urine.

## 9. Skin

Structure and functions of skin. Sweat glands. The mechanism of thermoregulation. Mechanical and thermal skin damage. Skin hygiene. Skin derivatives.

## 10. The nervous system

Nervous regulation. Neuron as a structural and functional unit of the nervous system. Central and peripheral nervous system. The somatic nervous system. The autonomic nervous system (sympathetic and parasympathetic). Reflex arc.

The structure of the spinal cord and its functions. The structure of the brain and its functions. Cerebral cortex. The notion of the higher nervous activity of a human. Unconditioned and conditioned reflexes. Language - the second signaling system of a human.

The influence of alcohol, drugs and toxins on the nervous system and behavior.

11. The concept of sensory systems and analyzers

12. Endocrine System

Hormones and their effects.

Glands of inner secretion: pituitary, pineal gland, thyroid, parathyroid, adrenal gland.

Mixed gland secretion: pancreas, gender.

Glands of external secretion.

Hypothalamus as a higher center, regulating the maintenance of homeostasis.

Unity and complementarity of neurohumoral regulation.

13. Metabolism and energy exchange

Exchange of organic and non-organic substances. Assimilation and dissimilation - two sides of the same process of metabolism. Regulation of metabolism.

Liver and its role in metabolism.

Types of metabolism.

Balanced nutrition.

14. Reproduction and individual human development

Sexual reproduction. The structure of the male and female reproductive systems.

The embryonic period of human development. Germ layers. The formation of the fetus.

Postembryonal period of development. Life stages (infancy, toddlerhood, early childhood, adolescence, early adulthood, middle adulthood, old age).

Hormone regulation of puberty.

## **Section 5. Zoology – the scientific study of animals.**

5.1. The similarities and differences between animals and plants.

5.2. Tax in the taxonomy of animals. The major systematic groups of animals. The concept of species. Parasitology and medicine. The concept of parasitism.

5.3. Single-celled animals

The cell of protozoa as an entire organism. General characteristics of the single-celled. The peculiarities of external and internal structure of the single-celled.

Single - celled parasitic organisms: dysenteric amoeba, trypanosoma, Trichomonas, Giardia lamblia, Leishmania, malaria plasmodium.

5.4. Metazoans

The difference between the cells of unicellular and multicellular organisms. General characteristics of multicellular organisms (describing hydra as an example).

5.4.1. Flat type worms

General description of the type (three-layer structure, bilateral symmetry, skin- muscular bag). The peculiarities of structure. Life cycles of parasitic flat worms.

The intermediate and final hosts of parasites. Liver flukes, beef tapeworm, pork tapeworm, diphylobothriumlatum, echinococcus.

Prophylaxis (prevention) of infection.

5.4.2. Nematodes Phylum

General description of the type (the three layer structure, bilateral symmetry, body cavity).

The peculiarities of structure, the habitat of parasites.

The life cycle of round worms. Ascaris, Pinworm, Filarias. Tropic worms

Prophylaxis (preventing) of invasions.

Helminthology - the scientific study of parasitic worms.

5.4.3. Arthropods Phylum

General description of the type (segmentation, cavity of the body, integuments).

Classes: crustaceans, arachnids, insects.

The habitat, structure and vital activity of spiders and mites. A variety of spiders and mites, their significance to nature, the life of animals and humans (tarantula, karakurt, spider mites, gall mites, itch mite, taiga tick (mite), dog tick (mite)).

The structure of insects. Types of insects. The peculiarities of behavior of insects.

Practical significance of insects, as the pollinators of plants, forest nurses, herbivorous, the dangerous pests of agricultural crops, the causative agents and disease vectors in humans, animals and plants.

5.4.4.Chordates Phylum. General description of the type. Classification(taxonomy) of chordates. Variety. The significance of chordates in human life.

Cephalochordates.

Lancelet, as the example of chordate animals, and the peculiarities of its structure.

5.4.5.Craniates

Fish. Structure (internal and external) and development. A variety of fish.

Amphibians. The peculiarities of structure (external and internal) and vital functions, caused by semi-aquatic lifestyle. The diversity of amphibians.

Reptile. The features of structure and vital functions. A variety of reptiles. Practical significance.

Birds. The features of structure and vital functions of birds. A variety of birds and their adaptation to the living conditions.

Mammal. General description of type.A variety of mammals.Domestic animals.Protection of mammals.

## **Section 6. Viruses. Microorganisms. Fungi.**

6.1. Viruses – the living organisms of pre-cell structure. The peculiarities of structure. Prophylaxis (prevention) of viral diseases.

6.2. Bacteria. The structure of the bacterial cell. Forms of bacteria, nutrition and reproduction. The significance of bacteria in nature and human life. Nitrogen-fixing bacteria. Cyanobacteria.

6.3. Fungi. The concept of higher and lower fungi, their diversity. Parasitic fungi. The practical significance of fungi.

## List of recommended practical tasks

1. Polydactyly (having extra fingers or toes) determines by dominant gene (A). The parents have polydactyly and they are heterozygote. How many and what types of gametes these parents can form? What is the possibility of the healthy child birth?
2. In human Haemophilia is a sex-linked recessive disorder ( $X^h$ — allele of the haemophilia,  $X^H$ —allele of the normal blood clotting). Healthy woman marries a healthy man. What is the probability that their child will have haemophilia?
3. The parents have brown eyes (B—brown eyes; b—blue eyes). They are heterozygote by this trait. How many and what types of gametes this parentsform? What is the possibility of birth of the child with blue eyes?
4. Human's is recessive sign (a), curly hair dominant sign (A), is recessive disorder (d— allele of the albinism, D—allele of the normal color skin). Parents have curly hair and they are healthy heterozygote by this trait. What is the possibility of birth of a child with albinism and straight hair?
5. Write the sequence of the m-RNA strand from the following parental DNA bases sequences: ACC – ATT - CGG - CCT - ATA – GCT – CAA – GGA.