**The program of the entrance test in biology**

conducted by the federal state budgetary educational institution of higher education "Dagestan State Medical University" of the Ministry of Health of the Russian Federation independently in the 2024/25 academic year

**Cytology, reproduction and development of organisms**

**A cell** is an elementary living system that underlies the structure and development of organisms. The history of the opening of the cell. The main provisions of the cellular theory.

The main structural components of the eukaryotic cell are the outer cell membrane, the cytoplasm and the nucleus. Structure and functions.

Organelles and inclusions of the cytoplasm. Similarities and differences between plant and animal cells.

Prokaryotic and eukaryotic cells.

**Chemical organization of the cell**

The content of chemical elements in the cell. Water and other inorganic substances and their role in the vital activity of the cell.

Organic substances.

*Carbohydrates.* Mono - and polysaccharides. Functions of carbohydrates in the cell.

*Lipids* (fats and lipids). The functions of fats and lipids in the cell.

*Proteins* as biopolymers. The functions of proteins in the cell. Amino acids, their structure and properties. The primary, secondary, tertiary and quaternary structures of the protein molecule. Enzymes, their role in the processes of vital activity.

Nucleic acids. DNA and RNA as biopolymers.

Nucleotides, their structure and connection during the formation of a polynucleotide chain.

The principle of complementarity.

DNA replication. The DNA code.

RNA. Structure and types of RNA.

ATP. The content of ATP in the cell. Macroergic connections in ATP. The value of ATP in the vital activity of the cell.

NAD, NADP, FAD and their role in the cell.

**Metabolism and energy in the cell**

Energy exchange. Stages of energy exchange in the cell.

Types of fermentation.

Glycolysis. Energy efficiency of fermentation processes.

Mitochondria. The relationship between structure and function.

Cellular respiration. The main features of the Krebs cycle.

Oxidative phosphorylation.

Plastic exchange. Autotrophic and heterotrophic cells.

Features of metabolism and energy in the plant cell.

Photosynthesis. The biological meaning of photosynthesis.

Chloroplasts. The relationship between structure and function.

The light and dark phases of photosynthesis. The role of enzymes.

Ways to increase the productivity of photosynthesis processes in agricultural plants.

Chemosynthesis on the example of bacteria.

Protein biosynthesis. The role of nucleic acids in this process.

The gene and its role in protein biosynthesis.

The DNA code. Matrix synthesis reactions.

The role of enzymes in the implementation of protein biosynthesis.

The value of ATP in protein biosynthesis.

The relationship between the processes of energy and plastic metabolism in the cell. Autoregulation of chemical processes in the cell.

**Non-cellular life forms**

Viruses. Their ultramicroscopic organization, meaning and role in nature. Viral diseases of humans, animals and plants.

**Non-cellular life forms**

Viruses. Their ultramicroscopic organization, meaning and role in nature. Viral diseases of humans, animals and plants.

**Cell division**

The commonality of the process of mitotic cell division in eukaryotes. The mitotic cycle. DNA doubling before mitosis. The biological meaning of mitosis. Phases of mitosis. Species constancy of the number of chromosomes. The individuality of the chromosomes. Their structure. Haploid and diploid sets of chromosomes. The state of the chromosomes in the non-dividing nucleus. Continuity and succession of chromosomes. The constancy of the amount of DNA in the nucleus. Amitosis as a form of division of the interphase nucleus, not accompanied by a uniform distribution of hereditary material.

*Forms of reproduction of organisms*. Asexual and sexual reproduction. Germ cells: ovum and spermatozoa (morphology).

*Meiosis*. The biological meaning of meiosis. Features of the development of ovum and spermatozoa (gametogenesis). Fertilization is the process of restoring a diploid set of chromosomes.

*Individual development of organisms*. The development of a fertilized ovum. Crushing. The blastula stage. Gastrulation. The stage of gastrula. Germ leaves. Homology of germ leaves as evidence of the unity of animal origin. Bookmark organ systems. Postembryonic development. Direct and indirect development.

**The emergence of life on Earth**

Life is a qualitatively new form of the movement of matter. Pre-scientific ideas about the origin of life. The doctrine of self-generation. The works of Redi, Terekhovsky, Pasteur, who proved the impossibility of self-generation of life. Theories of the introduction of life to Earth from other cosmic bodies. Modern theories of the origin of life on Earth from the bodies of inanimate nature (A. I. Oparin and other).

***Genetics***

Genetics is the science of the laws of heredity and variability. The importance of genetics.

**The main patterns of transmission of hereditary traits.** Hybridological method of studying heredity.

Patterns of inheritance established by G. Mendel. Monohybrid crossing.

The first law of G. Mendel. Uniformity of individuals of the first generation. Dominant and recessive signs. Homozygote and heterozygote. Allelic and non-allelic genes. Phenotype and genotype

The third law of G. Mendel. Dihybrid and polyhybrid crossing. Independent combination of hereditary traits in di-and polyhybrid crossing. Statistical nature of splitting phenomena. Cytological foundations of the laws of G. Mendel. Cytoplasmic heredity.

T. Morgan's chromosomal theory of heredity. The phenomenon of concatenated inheritance. Complete coupling. Incomplete coupling. The crossing of chromosomes in meiosis is the process of violation of adhesion. Genotypic sex determination. Sex chromosomes and autosomes. Gender-linked inheritance. The genotype as an integral historically developed system. Interaction of allelic genes. Inheritance of blood groups. Types of interaction of non-allelic genes.

*Patterns of variability*. The role of the genotype and environmental conditions in the formation of the phenotype. Variability and its forms. Variability of traits that is not associated with changes in the genotype. The reaction rate. Statistical patterns of modification variability. The variation series and the variation curve, methods for determining the average value of the variation series.

*Genotypic variability:* mutations and combinations. Gene, genomic and chromosomal mutations. The law of homological series in the hereditary variability of N. I. Vavilov. Mutagenic factors. Experimental production of mutations. Mutations as a material for artificial and natural selection. Environmental pollution by mutagens and its consequences.

Human genetics. Methods of studying human heredity.

*Genetics and the theory of evolution*. Genetics of populations. The reserve of hereditary variability in natural populations. Forms of natural selection, their relationship and correlation with environmental conditions.

**Botany**

Botany is the science of plants. A plant is a complete organism. The plant world as an integral part of nature, its diversity and distribution on Earth. General acquaintance with flowering plants

**The cellular structure of plants**. **The structure of the plant cell**. Tissues of plant organs in connection with the functions performed in the whole organism. The relationship of organs. Vegetative organs of a flowering plant: root, stem, leaf. Generative organs: flower (inflorescences), fruit, seed. The main vital functions of a plant organism: nutrition, respiration, growth and development, reproduction. The movement of plants. Methods of distribution of fruits and seeds in nature. The importance of timely harvesting of fruits and seeds of cultivated plants. Plant living conditions (water, air, light, heat, mineral salts). The influence of various conditions on the growth and development of plants. Seasonal phenomena in the life of angiosperms. Plants in spring. Plant protection and increasing plant wealth. The importance of plants and vegetation cover in nature, human life and in the national economy. The diversity of the plant world. Life forms of flowering plants: tree, semi-shrub, shrub, herbaceous plants — annual and perennial. The plant and the environment. Plant protection.

**Root.** Root functions. The development of the root from the germinal root of the seed. Types of roots (main, lateral, subordinate). Types of root systems (rod, mochkovataya). Root zones. Root growth. The root cover. The structure of the root hair. The external and internal structure of the root of monocotyledons and dicotyledons. Root modifications, their structure, biological and economic significance. Root tissues. Soil as a medium for plant life. Absorption of water and mineral salts by the roots. Water crops. Mineral salts necessary for the plant. The importance of tillage, fertilization, irrigation, loosening for the life of cultivated plants.

**The stem**. Stem functions. Shoots and its parts. Bud. The buds are vegetative, floral, mixed. Their structure and location on the stem. The development of a shoot from the kidney. The growth of the stem in length. Branching of shoots. A variety of shoots: erect, creeping, climbing, creeping, clinging. Stem tissue. Anatomical structure of herbaceous and woody dicotyledonous stems. The stem of monocotyledons. The growth of the stem in thickness. Formation of annual rings. Seasonal differences in wood. The age of the trees. Movement of mineral and organic substances along the stem. Modified shoots: rhizome, stolons, tuber, bulb, their structure, biological and economic significance.

**Leaf.** Sheet functions. The external structure of the leaf (leaf blade, petiole, bases, stipules). Venation of leaves. Simple and complex leaves. Leaf arrangement. Sheet fabrics. Features of the internal structure of the sheet in connection with its functions. Skin and stomata, leaf pulp (columnar and spongy tissues). Chloroplasts. The structure of the leaf veins (conducting bundles). The light and shadow leaves. The movement of the leaves. Leaf mosaic.

Formation of organic substances in leaves in the light. The absorption of carbon dioxide by the leaves and the release of oxygen. Energy storage in the plant.

The breath of the leaves. Evaporation of water by leaves. Plants of wet and arid habitats. Modifications of leaves. The life span of the leaves. Leaf fall. The value of a leaf for plants. The role of green plants in nature and human life.

**Vegetative reproduction of flowering plants**. Propagation of plants by means of shoots, roots and leaves in nature and crop production (modified shoots, stem and root cuttings, layering, bush division, grafting). Biological and economic significance of vegetative reproduction.

**Flower, fruit, seed**. The flower is the organ of seed reproduction. Flower functions. The structure of the flower: pedicel, younger flower, perianth, stamens, pistil. The structure of the stamen and pistil. Double fertilization in flowering plants and its mechanism. The flowers are unisexual and bisexual. Monoecious and dioecious plants. Inflorescences and their biological significance. Cross-pollination by insects and wind.

Self-pollination. Artificial pollination. Pollen germination. Fertilization. Seed and fruit formation.

The seed. Functions of seeds. The structure of seeds (on the example of dicotyledonous and monocotyledonous plants). The composition of the seeds. Conditions of seed germination.

Germination of seeds. The breath of seeds. Nutrition and growth of the seedling. The time of sowing and the depth of seeding.

Fetus. Fetal functions. A variety of fruits: monocarp, apocarp, cenocarp and pseudomonocarp.

The number of fruits and seeds of various plants. The importance of flowers, fruits and seeds in nature and human life.

**Classification of plants.** Elementary concepts of systematic (taxonomic) categories: species, genus, family, class, department. The meaning of international plant names.

**The main groups of plants.** The diversity of the plant world. Systematic review: Bacteria, Algae, Fungi, Lichens, Mossy, Fern-Like, Gymnosperms (Coniferous), Angiosperms.

**Section Bacteria.** General characteristics. The structure of the prokaryotic cell. The structure and vital activity of bacteria. Classification of bacteria by form. Examples. Reproduction of bacteria. The spread of bacteria in the air, soil, water and living organisms. Fermentation bacteria and putrefactive bacteria. Symbiosis of nodule bacteria and legumes. Pathogenic bacteria and the fight against them. The role of bacteria in nature, medicine, agriculture and industry.

**Section** **Green and Brown algae**. General characteristics. Systematics. Unicellular algae - Chlamydomonas, chlorella, pleurococcus. Structure and features of vital activity. Filamentous algae. Structure and features of vital activity. Asexual and sexual reproduction of algae. The spread of algae in water and on land. Examples of seaweed. The importance of algae in nature and agriculture.

**The kingdom of Mushrooms.** These are real mushrooms. General characteristics. Taxonomy. The reasons for the ambiguity of the systematics of fungi and their comparison with plants and animals. Lower and Higher mushrooms.

Cap mushrooms, their structure, nutrition and reproduction. The living conditions of the fungus in the forest. The relationship of fungi with plant roots (mycorrhiza). Edible and poisonous mushrooms.

Mold fungi (mucor and penicillium). Structure, reproduction, features of vital activity.

Yeasts. Structure, reproduction, features of vital activity. Fungi are parasites that cause plant diseases (smut, ergot, tinder). Structure, nutrition, reproduction.

The role of mushrooms in nature and in human life.

**Section Lichens**. Lichens as symbiotic organisms. General characteristics. The structure of the lichen layer. Food. Reproduction. Lichens are scaly, leafy, bushy. The role of lichens in nature and human life.

 **Section Mossy**. General characteristics. Taxonomy. Green mosses. The structure, reproduction and development cycle of cuckoo flax. The concepts of sporophyte and gametophyte. Sphagnum moss. Waterlogging. Peat formation, its significance.

The department is Plan-shaped. General characteristics. The plown is club-shaped. Structure, reproduction, development cycle. The value of the plan-shaped ones.

**Section Horsetail-shaped**. General characteristics. Horsetail field. Structure, reproduction, development cycle. The value of horsetail.

**Section Fern-like.** General characteristics. The plown is club-shaped. Structure, reproduction and development cycle. Fern-like fossils and the formation of coal. The importance of ferns in nature and human life.

**Section Gymnosperms**. General characteristics. Structure, reproduction and development cycle on the example of pine and spruce. Male and female cones. Pollen. Semyapochki. Pollen germination, pollen tube growth and fertilization. Distribution and biology of conifers. Significance in nature and economy

**Angiosperms (Flowering).** The dominance of angiosperms in the modern flora and their advantage in comparison with other plant groups. A variety of wild and cultivated flowering plants. The adaptability of angiosperms to various living conditions on Earth. The development cycle.

Class Dicotyledonous plants. General characteristics. Families: Cruciferous, Rosaceae, Legumes, Nightshade, Compound flowers.

Class Monocotyledonous plants. General characteristics. Families: Lilies, Cereals. Comparative characteristics of the Monocotyledonous and Dicotyledonous classes. Biological features and national economic significance. Typical agricultural, wild-growing and ornamental plants of these families. The influence of human economic activity on the species diversity of flowering plants. The Red Book. Protection of rare plant species.

The development of the plant world on Earth.

The complication of the structure of plants in the process of historical development in connection with the transition from an aquatic to a terrestrial lifestyle. The main stages of plant development on Earth (the time of bacteria, algae, mossy, planoid, horsetail-like, fern-like, gymnosperms and angiosperms).

**Plant communities**. The concept of a plant community. The adaptability of plants to living together: above-ground and underground tiers, different development periods. Changing communities. Plant communities as a part of the landscape. Characteristic features of the structure and biology of plants of the main types of vegetation: tundra, forests, meadows, steppes, deserts, swamps, aquatic vegetation; their connection with the habitat and economic significance. Protection of vegetation.

**Zoology**

Zoology is the science of animals. The importance of animals in nature and human life. The emergence of zoology as a science and the history of its development.

Classification of animals. The concept of a species, genus, family, order, class and type. The significance and success of modern zoology. Similarities and differences between plants and animals.

**The Simplest type. General characteristics of the type. Taxonomy.**

The Sarcodes class. General characteristics of the class. An ordinary amoeba. The habitat. External and internal structure. The cytoplasm. The core. Movement. Food. Breath. Highlighting. Osmoregulation. Reproduction. Inciting. Dysentery amoeba. Building. The habitat. Protection from infection.

Flagellate class. General characteristics of the class. Euglena is green as a single-celled organism that combines the characteristics of animals and plants. Volvox is a colonial organism. The evolutionary significance of Euglen and Volvox species. Free-living and parasitic animals, their meaning.

The class of Infusoria. General characteristics of the class. Infusoria slipper as a more complexly organized unicellular animal. The habitat. Building. Features of the processes of vital activity. Irritability.

The Sporoviki class. General characteristics of the class. Malarial plasmodium as a causative agent of malaria. A method of infecting a person with malaria. The general concept of the change of owners in the development cycle. Elimination of malaria as a mass disease in Russia.

Marine protozoa. Some representatives. Meaning.

**Type of coelenterates**. General characteristics of the type. Taxonomy. The habitat.

Hydroid class. General characteristics of the class. Freshwater hydra. External and internal structure. Ray symmetry. Hydra nutrition. Breath. A reflex. Regeneration. Reproduction is asexual and sexual. The unicellular stage in the development of the hydra. Marine hydroids. Change of phases in the life cycle.

The Scyphoid class. General characteristics of the class. Representatives. Distinguishing features from marine hydroids.

Coral polyps class. General characteristics of the class. Representatives. Signs of complexity in the organization. The value of coelenterates.

**Type flatworms.** General characteristics of the type. Taxonomy.

Class Ciliated worms. General characteristics of the class. White planaria as a representative of free-living worms. The habitat. External and internal structure. Two-sided symmetry. Food. Breath. The nervous system and sensory organs. Reproduction. Regeneration.

**Class of Suckers.** General characteristics of the class. Liver fluke. External and internal structure. Adaptations to parasitism. Protection from infection. Change of owners in the development cycle.

Tapeworms class. General characteristics of the class. Tsepni (pork, bovine), echinococcus. A parasitic lifestyle. Features of the external and internal structure. Development cycles and change of owners. Protection from infection.

**Type Roundworms**. General characteristics of the type. Ascaris. The habitat. External and internal structure. Reproduction and development of ascaris. Measures to protect against infection. Pinworm, whipworm as representatives of roundworms; reproduction, development. Protection from infection.

**Type Annelid worms**. General characteristics of the type. Taxonomy.

Class Maloschetinkovye worms. General characteristics of the class. An earthworm. The habitat. External and internal structure. Digestive, circulatory, and excretory systems. Features of the structure. The nervous system. Reproduction. Regeneration. The importance of earthworms in soil formation.

Class Polychaete worms. Nereid. The main differences from earthworms. The evolutionary significance of polychaete worms, their role in the nutrition of commercial fish.

The Leech class. General characteristics of the class. Representatives.

**The type of Shellfish**. General characteristics of the type. Taxonomy.

Class Gastropods. General characteristics of the class. A large pond. The habitat. External and internal structure. Movement. Features of the processes of vital activity. Reproduction.

Class Bivalves. General characteristics of the class. Toothless (or Perlovitsa). The habitat. External and internal structure. Movement. Reproduction. Marine bivalves. The significance of gastropods and bivalves.

Type Arthropods. General characteristics of the type. Taxonomy.

The Crustacean class. General characteristics of the class. River cancer. The habitat. External structure: chitinous cover, dismemberment of the body, limbs. Internal structure. Features of the processes of vital activity. Reproduction. Other crustaceans. Medical significance. Importance in the nutrition of fish. Commercial crustaceans.

Arachnids class. General characteristics of the class. The habitat. The external and internal structure of the Spider cross. Respiration, nutrition, reproduction. The web and its structure. Ticks. The role of ticks in nature and their medical significance. Measures to protect a person from ticks.

Class Insects. General characteristics of the class. The habitat. The external and internal structure of an insect on the example of a May beetle. Features of vital activity. Reproduction. The medical significance of insects.

**Types of insect development.** The diversity of insects and their significance. The main detachments of insects. Insects with incomplete transformation. The squad Straight-winged. Representatives. Locusts as a dangerous pest of agriculture. The order Hemiptera (bedbugs). Representatives. Meaning. Patronizing coloring. Insects with a complete transformation. The order Lepidoptera. Representatives. Cabbage white. Mulberry silkworm. Sericulture. The order Coleoptera. Harmful and useful beetles. Warning color. The Diptera group. Representatives. Housefly, gadflies. The order Hymenoptera. Representatives. Honey bee, ants. Features of the life of social insects. An instinct. Riders as representatives of parasitic hymenoptera. A biological method of combating harmful insects. Protection of useful insects. Similarities and differences between arthropods and annelids. Aromorphoses of arthropods.

**The Chordal type. General characteristics of the type. Taxonomy**.

The lancet class. Lanceolate as a form close to the ancestors of vertebrates. The habitat. External and internal structure. Reproduction. Lifestyle. The similarity of the lancet with invertebrates and vertebrates.

Fish class. General characteristics of the class. The external and internal structure of fish on the example of a river perch. Reproduction and development. The initial concept of unconditional and conditional reflexes.

A systematic review of fish.

Subclass of Cartilaginous fish: orders-Sharks and Rays. Characteristic. External and internal structure.

The Bone subclass. Superorder Cartilaginous (Sturgeon). Representatives, features of the structure, value and significance. The superorder of bony fish. Detachments - Herring-Like, Carp-Like, Cod-Like. General information about the way of life, adaptations to different conditions of existence. Spawning conditions. Fertility. Fish development, migration. Protection and reproduction of fish resources. Decorative (aquarium) fish.

Amphibians class. General characteristics of the class. Taxonomy.

The external and internal structure of a frog (using the example of any species). Features of the habitat. The importance of the skin in breathing. Reproduction and development of frogs. Tadpoles, their similarity to fish. Wintering grounds. The diversity of amphibians and their significance. The origin of amphibians.

Class Reptiles. General characteristics of the class. Taxonomy.

The external and internal structure of a Nimble lizard. Adaptations to life in a terrestrial environment. Reproduction. Regeneration. Snakes: snakes, vipers. Appearance. Differences between the snake and the viper. Venomous glands, venomous teeth, and viper venom. The effect of snake venom. First aid for a venomous snake bite. Other modern reptiles: Turtles, Crocodiles. A variety of ancient reptiles. The origin of reptiles

The Bird class. General characteristics of the class.

The external and internal structure of the pigeon. Adaptability to flight. Features of the processes of vital activity. Reproduction and development. The origin of birds. The first birds.

The Real Birds subclass. The superorder of Ostrich (Keelless) birds. Distribution. Some features of the structure and life. The Penguins supergroup. Features of the structure and life in the harsh conditions of the Antarctic.

The superorder is Flying (Keel-breasted) birds. Their variety: the Goose-like detachment, the Pigeon detachment, the Daytime predators detachment, the Chicken detachment, the Sparrow detachment. Lifestyle, adaptability to different conditions of existence. Nutrition, reproduction, development. Seasonal phenomena in the life of birds: flights, nesting. Protection and attraction of birds (winter feeding, production and placement of artificial nests). The role of birds in nature and their significance in human life.

Class mammals, general characteristics of the class. Taxonomy. Features of the external and internal structure of mammals on the example of a dog. Reproduction and development. The origin of mammals. The diversity of mammals and their significance.

The subclass is oviparous. Platypus and echidna. Similarity of oviparous and reptile species.

The Real Animals subclass. Placental mammals are the most progressive group of modern vertebrates. Their variety.

An overview of the units. Orders: Insectivores, Bats, Rodents, Carnivores (canids, cats), Pinnipeds, Cetaceans, Artiodactyls, Ungulates, Primates. Higher primates. The families of Marmosets and Great apes. Representatives of the orders of mammals. Features of the structure and vital activity. The importance of mammals in nature and human life.

Protection of useful and rare animals. Distribution of animals on Earth. The reasons for the differences in fauna in different places of the globe.

The development of the animal world on Earth. The main stages of the development of the animal world: from unicellular to multicellular, from the lowest to the highest by eras and periods. Relations between classes of vertebrates. Reflection of kinship relationships in the natural system of the animal world.

**Human anatomy, physiology and hygiene**

Human anatomy, physiology and hygiene are interrelated sciences that study the structure, functions of the human body and the conditions for maintaining its health. The importance of knowledge on human anatomy, physiology and hygiene.

**General overview of the human body**

*The structure and functions of the human body*. Comparison of the structure of the human body and mammalian animals. Structure and division of eukaryotic cells. The main types of tissues (epithelial, muscle, bone, nerve) and their properties. Concepts of nervous and humoral regulation. The processes of excitation and inhibition in nerve cells. Nerve fibers. The receptors. A reflex. The scheme of the reflex arc.

*Musculoskeletal system.*

Functions of the musculoskeletal system. The structure of the human skeleton. Features of its structure in connection with upright walking and labor activity. The structure and composition of bones. Organic and inorganic bone matter. Bone growth in thickness. Bone joints: continuous, semi-movable, joints. First aid for fractures, dislocations and sprains.

Muscles, their structure and functions. The human muscular system. Movement in the joints. Reflex nature of muscle activity. Coordination of movements. The influence of rhythm and load on the performance of muscles. Fatigue. Features of the musculoskeletal system of children and adolescents.

The importance of physical education and sports for the proper formation of the skeleton and muscles. Prevention of curvature of the spine and the development of flat feet. Correct fit, posture and working posture.

The internal environment of the body: blood, tissue fluid and lymph.

The relative constancy of the internal environment of the body. Tissue fluid, its meaning.

Blood. Blood functions. Blood composition: plasma, shaped elements. The role of red blood cells in the transfer of gases. Blood clotting as a protective reaction of the body. Functions of white blood cells. Anemia.

I. I. Mechnikov's teaching about the protective properties of blood. Pathogens of infection: bacteria and viruses. Fighting epidemics. Immunity and its types. Blood groups. Blood transfusion and its significance.

*The circulatory system.*

Functions of the circulatory organs. Large and small circles of blood circulation. Arteries, capillaries and veins. The heart, its structure and work. Heart valves. Properties of the heart muscle. Pulse, its definition. Blood pressure and the speed of blood movement in various parts of the bloodstream. First aid for arterial and venous bleeding. The concept of nervous and humoral regulation of the heart and blood vessels. Heart training. The influence of physical education and sports on the cardiovascular system. Lymph formation. The difference between lymph and plasma. The movement of lymph in the lymphatic vessels.

*The respiratory system*.

Functions of the respiratory organs. Respiratory tract. A voice device. The structure of the lungs. Gas exchange in the lungs and tissues. The mechanism of respiratory movements. Vital capacity of the lungs. The transfer of gases by blood. The importance of respiratory gymnastics. Artificial respiration. Nervous and humoral regulation of respiration. Protective respiratory reflexes. The concept of clinical and biological death. Pre-medical methods of restoring breathing and cardiac activity (mouth-to-mouth breathing, indirect heart massage). Respiratory hygiene. The importance of proper breathing. The struggle for clean air in everyday life, at school and at work. The harm of smoking. Transmission of infectious diseases (influenza, tuberculosis, diphtheria) through the air and their prevention.

*The digestive system.*

Functions of the digestive organs. Food products and nutrients. The meaning of food. The content of proteins, fats and carbohydrates in the main groups of food products. Digestive enzymes. General overview of the digestive organs: oral organs (teeth, tongue, salivary glands), esophagus, stomach, intestines, pancreas, liver. Changes in food in various parts of the digestive tract. Chewing. Experiments of I. P. Pavlov on the study of the activity of the salivary glands. The effect of saliva enzymes on carbohydrates. Swallowing. The secretion of gastric juice. Experiments of I. P. Pavlov on dogs with an isolated ventricle, with a gastric fistula. Imaginary feeding. Digestion of food in the stomach and small intestines. Enzymes. The effect of the composition of food on the activity of the digestive glands. The role of the liver and pancreas in digestion. Absorption of nutrients. Functions of the large intestine. Examples of unconditional and conditional food reflexes. Nervous and humoral regulation of digestion. Hygienic conditions of normal digestion. The concept of prevention of food infections.

*Metabolism*

The assimilation of proteins, fats, carbohydrates in the body. Intracellular metabolism. Assimilation of nutrients in cells (assimilation). The role of ribosomes in protein synthesis. The processes of decay (dissimilation). The role of mitochondria. Assimilation and dissimilation as two sides of a single metabolic process. Self-renewal of the body in the process of metabolism. The role of enzymes. Vitamins. The value of vitamins. Diseases associated with a lack of vitamins in food. The role of the liver in metabolism. The transformation of energy in the body. Body temperature. The value of maintaining a constant body temperature. The body's need for proteins, fats, carbohydrates, water and salts. Nutrition standards. The caloric content of the food ration. Features of nutrition during the growth period. The importance of proper nutrition for the body.

*The system of excretory organs*

Functions of the excretory organs. Allocation of exchange products. Organs of the urinary system. The structure and work of the kidneys. Formation of urine. The importance of the excretory organs in maintaining the constancy of the internal environment of the body.

*Skin*

Skin functions. The structure of the skin. Skin derivatives. The role of the skin in the regulation of heat exchange. First aid for frostbite, burns, heat and sunstroke. The value of hardening the body. Natural hardening factors and the rules for using them. Skin and clothing hygiene.

*The nervous system*

Functions of the nervous system. The central nervous system. The structure and functions of the spinal cord. Components of reflex arcs. The structure and functions of the brain departments: oblong, bridge, cerebellum, middle, intermediate. The highest part of the brain is the cortex of the large hemispheres. The central and autonomic (autonomous) parts of the nervous system. Sympathetic and parasympathetic divisions of the autonomic nervous system.

*Analyzers*

I. P. Pavlov's teaching about analyzers. The value of analyzers for the perception of the surrounding world. Visual analyzer. The structure of the eye. The light-sensitive apparatus of the eye. Building an image on the retina. Nearsightedness, farsightedness and their correction. Visual hygiene

An auditory analyzer. The structure and hygiene of the hearing organ. The mechanism of sound perception.

Touch, smell and taste.

The role of I. M. Sechenov in the development of the doctrine of higher nervous activity. I. P. Pavlov's teaching about conditioned reflexes. Conditional and unconditional reflexes. Formation and inhibition of conditioned reflexes. Distinguishing similar stimuli. Reflexes are the basis of animal behavior. Features of the higher nervous activity of a person. Direct and verbal conditional stimuli. Speech function. The first and second alarm systems. Hygiene of mental work. The mode of the day. The mode of work and rest. Sleep hygiene. The effect of tobacco and alcohol on the nervous system.

*Internal secretion glands*

Functions of the endocrine glands. Hormones and their significance for the body, as opposed to enzymes. The role of humoral regulation in the body. Diseases associated with impaired functions of the endocrine glands.

*Development of the human body-*

The sex glands. Germ cells, their structure and development. Fertilization. The role of chromosomes in the transmission of hereditary properties. The similarity of the early stages of the development of the human embryo and vertebrates. Nutrition of the embryo. Postembryonic human development. Features of the development of children and youth organisms. The importance of physical culture and sports for the normal development and strengthening of the body.

The body is a single whole. Coordination of the activity of all organ systems (humoral and nervous mechanisms of regulation and self-regulation).

**General Biology**

General biology is the science of the basic and common laws of life phenomena for all organisms. The importance of general biology for medicine, agriculture, the forest industry and other branches of the national economy.

**The evolutionary doctrine**

General characteristics of biology in the pre-Darwinian period. The development of zoology and botany. The dominance in science of metaphysical ideas about the immutability of nature and "primordial expediency". The works of Carl Linnaeus on the systematics of plants and animals, their significance. J. B. Lamarck's teaching on the evolution of living nature and its significance. The first Russian evolutionists.

Historical background of the emergence of the teachings of Charles Darwin. Socio-economic prerequisites. Advances in biology in the first half of the XIX century. The success of agriculture in breeding breeds of domestic animals and varieties of cultivated plants. A trip on the ship "Beagle". Works of Ch. Darwin.

The main provisions of the evolutionary doctrine of Ch.Darwin. The importance of teaching for the development of natural science. The driving forces of evolution. Heredity. Variability, types of variability. Natural selection. The leading role of natural selection in evolution. The struggle for existence and its forms. Artificial selection and hereditary variability are the basis for breeding breeds of domestic animals and varieties of cultivated plants. Common and different between artificial and natural selection.

Adaptive nature of evolution. Relative expediency. The divergent nature of evolution. Convergence. Progress and regression. The extinction of species.

Microevolution.

Population as an elementary unit of evolution. The concept of ecological and genetic characteristics of populations. Elementary factors of evolution. Natural selection is the guiding factor of evolution. Forms of natural selection. The creative role of natural selection. Speciation is the result of microevolution. Ways of speciation. Species. Criteria of the type. The structure of the view.

Macroevolution.

The emergence of supraspecific taxa. Forms of phylogeny. The concept of the speed of evolution. The relationship between micro-and macroevolution. The main directions of evolution. Biological progress and biological regression. Ways to achieve biological progress. The results of evolution: organic expediency, adaptability of organisms, diversity of species.

The system of plants and animals is a reflection of evolution. Principles of modern classification of organisms.

**Development of the organic world**

The main evidence for the evolution of the organic world: comparative anatomical, embryological, biogeographic and paleontological. Comparative study of the structure of modern animals and plants in order to prove their historical development. Homology and analogy. Rudiments and atavisms in the structure of modern organisms as proof of their evolution. The similarity of the embryonic development of organisms as proof of the unity of their origin. The biogenetic law of Muller-Haeckel.

The main directions of evolution are the ways of development of the organic world. The division of the Earth's history into eras and periods. The development of the organic world in the Archean, Proterozoic and Paleozoic eras. The emergence of plants and animals is a divergence in the organic world according to the method of nutrition. The cosmic role of green plants. Unicellular. Multicellular. The emergence of plants on land in the Paleozoic era. Psilophytes. Mosses. The reasons for the flowering of ferns. The appearance of gymnosperms.

The output of animals on land. The emergence of vertebrates by increasing the organization, developing adaptations of wide significance and expanding the habitat. Brush-finned as the ancestors of amphibians. The appearance and flourishing of ancient amphibians. Stegocephals are "prefabricated" forms.

The development of the organic world in the Mesozoic era. The dominance of gymnosperms. The appearance and distribution of angiosperms. The flowering of reptiles. The emergence of birds and mammals. The appearance of bony fish. Causes of the extinction of gymnosperms and reptiles in the Mesozoic era.

The development of the organic world in the Cenozoic era. The dominance of angiosperms, insects, birds and mammals. The emergence of numerous adaptations to various habitats in the process of evolution.

The impact of human activity on the diversity of species, natural communities, their protection.

**The origin of man**

Great apes and man. Ch.Darwin on the origin of man from animals. F.Engels on the role of labor in the transformation of ancient monkeys into humans. Driving forces of anthropogenesis: social and biological factors. The leading role of the laws of social life in the social progress of mankind. The role of biological and social factors in human evolution.

Human fossils. Finds in Tanzania. The most ancient people (pithecanthropus, synanthropus, Heidelberg man). Ancient people (Neanderthals). Fossil people of the modern type (Cro-Magnons).

The leading role of the laws of social life in the social progress of mankind. The unity of the origin of the human races. The anti-scientific, reactionary essence of "social Darwinism" and racism.

**Fundamentals of ecology**

Ecology is the science of the laws of the relationship of organisms with the environment. Environmental problems. Environment and environmental factors. The fitness of the organism (species) to abiotic and biotic environmental factors. The complex effect of factors on the body. The main climatic factors (light, temperature, humidity) and their effect on the body. Limiting factors. Human activity as an environmental factor. Adaptation of plants and animals to the seasonal rhythm of external conditions. Seasonality in nature. The state of winter rest. Cold resistance. Factors that control seasonal development. Phenomena of photoperiodism in plants and animals.

*Population.* Factors that cause changes in the population size.

The species, its ecological characteristics. Rational use of species, preservation of their diversity.

*Biogeocenosis*. Examples are a freshwater reservoir, an oak grove. The relationship of populations in the biogeocenosis. Power supply chains. The rules of the ecological pyramid. Self-regulation in the biogeocenosis. Change of biogeocenoses. Creation of artificial biogeocenoses as a result of purposeful human economic activity. Agrocenoses. Increasing the productivity of agrocenoses. Protection of biogeocenoses.

*Fundamentals of the doctrine of the biosphere.*

The biosphere and its boundaries. The noosphere. The density of life. The biomass of the land surface. Soil biomass. The biomass of the World Ocean. Living matter, its gas, concentration, oxidative and reducing functions. The circulation of substances in the biosphere. Biogenic migration of atoms. The role of microorganisms. The role of man in the biosphere. Nature protection and planned reproduction of its riches

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