ENTRANCE BIOLOGY TEST SYLLABUS

Introduction

The biological knowledge of the younger generation is basic for understanding the laws of nature, formation of a healthy lifestyle, ensuring genetic literacy, hygienic education and preparation for work in the field of medicine, biotechnology, agriculture and many others.

Applicants to higher medical educational institutions are to show at biology exam the following necessary for continuing education in high school

knowledge:

- of evolutionary development of living nature, as well as the main concepts, patterns and laws relating to the structure, life activity and development of plant, animal and human organisms;

- of classification and main taxonomic groups of plants and animals;

- of morphology and physiology of plants, animals and humans;

skills:

- to justify the conclusions, to use biological terms and concepts to explain the phenomena of nature using examples from healthcare, pharmacy, agricultural and industrial production practice;

knowledge and skills:

- defining value orientations towards environment, one's own health and health of others;

- that are important for expressing a scientific worldview and for culture of behavior upbringing.

CYTOLOGY BASES

The concepts of living systems organization levels. Cellular level of organization.

Cell is a living elementary system underlying the structure and development of organisms. The history of cell discovery. The main postulates of cell theory. Modern cell research methods.

Chemical organization of the cell. Classification of chemical elements. The content of chemical elements in living systems. Water and other inorganic substances and their role in the vital functions of living systems.

Organic substances.

Carbohydrates. Monosaccharides and polysaccharides of 1 and 11 order. Functions of carbohydrates in a cell.

Lipids (fats and lipids). Functions of fats and lipoids in a cell.

Proteins as biopolymers. Amino acids, their structure and properties. Primary, secondary, tertiary and quaternary structures of protein molecule. Examples of simple and complex proteins. Functions of proteins in a cell. Enzymes, their role in the processes of cell activity.

Nucleic acids. RNA and DNA as biopolymers. Functions. Nucleotides, their structure and connection in the formation of polynucleotide chain. Complementarity principle. DNA replication as a reaction of matrix synthesis. RNA structure and types. DNA (RNA) code.

ATC. ATC content in a cell. High energy bonds in ATC. ATC role in cell activity. NAD^+, $NADP^+$, FAD^+ and their role in a cell.

Cell structure. Main structural components of eukaryotic cell: outer cell membrane, the cytoplasm and the nucleus. Structure and function. Organelles and cytoplasm inclusions. Structure and function. Similarities and differences between plant and animal cells. Structure of prokaryotic cell. Prokaryotic and eukaryotic cells. Similarities and differences.

Non-cellular life forms. Viruses. Ultramicroscopic organization of viruses and bacteriophages, their significance and role in nature. Viral diseases in humans, animals and plants. Examples.

Metabolism and energy exchange in a cell. Plastic and energy metabolism are the basis of cell activity.

Plastic metabolism. Autotrophic, mixotrophic and heterotrophic cells.

Photosynthesis. Features of metabolism and energy exchange in plant cell. Biological meaning of photosynthesis. Chloroplasts. Relationship between structure and function. *Light phase of photosynthesis.* Oxidative photophosphorylation (cyclic and non-cyclic). I and II photosystems. *Dark phase of photosynthesis*. Enzymes role. The biological meaning Calvin's cycle. Ways to increase photosynthesis productivity in agricultural plants.

Chemosynthesis by the example of iron-, nitro- and sulfur-bacteria.

Protein biosynthesis. Role of nucleic acids in the process of protein biosynthesis. Gene and its role in protein biosynthesis. DNA code. Reactions of matrix protein synthesis – transcription and translation. Role of enzymes in the implementation of protein biosynthesis. Value of ATC and $NADP^+$ in the process.

Energy exchange. Three stages of energy exchange in a cell. Preparatory stage. Polymers and monomers of organic compounds.

Anaerobic respiration. Glycolysis. Types of fermentation. Energy efficiency of glycolysis and fermentation processes.

Aerobic breathing.

Mitochondria. Relationship between structure and function. Oxidative phosphorylation. Relationship between energy and plastic metabolism in a cell. Autoregulation of chemical processes in a cell.

Cell division. Division is a biological process that underlies the reproduction and individual development of organisms. State of hereditary material in non-fissile nucleus. Constancy of DNA amount in the nucleus. Mitotic cycle. DNA doubling before mitosis. Individuality and chromosomes structure. Haploid and diploid chromosomes set. Chromosomes continuity and succession. Species constancy of chromosomes number.

Mitosis. Common process of mitotic cell division in eukaryotes. Mitosis phases. Behavior of chromosomes in mitosis. Mitosis biological role.

Meiosis. I and II meiosis divisions. Chromosomes behavior in meiosis. Meiosis biological role.

Amitosis as a form of interphase nucleus division, not accompanied by a uniform distribution of hereditary material. Amitosis role.

Individual organisms' development.

Gametogenesis is a process of germ cells formation. Features of ovum and sperm development. Structure of germ cells. Fertilization is a process of diploid chromosomes set reconstitution.

Ontogenesis is organism individual development. Embryonic development. Development of a fertilized ovum by the example of lancelet. Cleavage process. Morula. Blastula stage. Gastrulation process. Gastrula stage. Germinal layers. Germinal layers homology as evidence of animal origin. Tissues and organ systems anlage. *Postembryonic development.* Direct and indirect development. Examples.

Organisms reproduction. The forms of organism's reproduction – asexual and sexual. Types of asexual and sexual reproduction. Examples.

GENETICS

Genetics is the science about heredity and variability laws. Role of genetics for medicine. Basic concepts of genetics: gene, allelic and nonallelic genes; dominant and recessive features; homozygote and heterozygote; phenotype, genotype, genome, karyotype, linkage group.

Basic patterns of hereditary traits transmission.

Patterns of characters inheritance established by G. Mendel. Hybridological method of heredity studying. Monohybrid crossing.

The first law of G. Mendel. Uniformity of first-generation hybrids. Tasks on Genetics. *The second law of G. Mendel*. Splitting in genotype and phenotype of second-generation hybrids.

Statistical nature of splitting. Intermediate type of inheritance. Analyzing crossing. Statistical nature of the splitting. Tasks on Genetics. *The third law of G. Mendel.* Dihybrid and polyhybrid crossing. Independent combination of hereditary traits in di-and polyhybrid crossing. Statistical nature of independent inheritance of features. Cytological basis of G. Mendel's laws. Hypothesis of 'purity of gametes'. Meiosis as material basis for patterns of features inheritance and hypothesis of 'purity of gametes'. Tasks on Genetics. Nuclear and cytoplasmic heredity. Examples.

Chromosomal theory of heredity by T. Morgan. Phenomenon of linked inheritance. Complete and incomplete linkage. Chromosomes crossing in meiosis - process linkage disruption. Chromosomal mechanism for sex determination. Sex chromosomes and autosomes. Sex-linked inheritance. Tasks on Genetics.

Gene interaction. Allelic genes interaction. Inheritance of blood groups as an example of multiple allelism and codominance. Dominance, incomplete dominance, overdominance. *Interaction of nonallelic genes.* Genotype as holistic historical system. Epistasis, complementarity, polymers. Pleiotropic effect of genes. Tasks on Genetics.

Variability patterns. The role of genotype and environmental conditions in phenotype formation. Variability and its forms. *Modification variability*. Reaction norm. Statistical patterns of modification variability. Variational series and variation curve, methods for average value of variational series determination. *Genotypic variability:* combinations and mutations. Ways of combinational variability. Mutations: genomic, chromosomal and gene. Mutagenic factors. Experimental mutation organization. Mutations as a material for artificial and natural selection. The law of homologous series in hereditary variability by N.I. Vavilov. Contamination of the natural environment by mutagens and its consequences.

Human genetics. Methods of human heredity studying. Cytogenetic, twin, genealogical, population-specific. Prevention and treatment of certain hereditary diseases.

BOTANY

Botany is the science about plants. A plant is an entire organism. Flora as an integral part of nature, its diversity and distribution around the Earth.

General knowledge of seed plants. Cell plant structure. Plant cell structure (repetition from the course of Cytology). Tissues of plant organs in connection with the performed functions in the whole organism. The relationship of organs. Vegetative organs of a seed plant: root, stem, leaf. Generative organs: flower (inflorescence), fruit, seed. The main vital functions of a plant organism: nutrition, respiration, growth and development, reproduction. The movement of plants. Methods of fruits and seeds distribution in nature. The role of timely

harvesting of fruits and seeds of cultivated plants. Plant life conditions (water, air, light, heat, mineral salts). The influence of various conditions on plant's growth and development. Seasonal phenomena in the life of angiosperms. Plants in spring. Plant protection and increase of plant's wealth. The role of plants and vegetation in nature, human's life and in national economy. Variety of plant world. The life forms of seed plants: tree, subshrub, shrub, herbaceous plants – annual and perennial ones. Plant and environment. Plant protection.

Root. Root functions. Development of the root from germinal seed rootlet. Types of roots (main, lateral, accessory). Types of root systems (rod, branched and fibrous). Root zones. Root growth. Root cap. Root tissue. External and internal structure of the root in monocotyledonous and dicotyledonous plants. Root modifications, their structure, biological and economic role. Absorption of water and mineral salts by roots. Root hair. Mineral salts necessary for a plant. Soil as a medium for plant life. Role of tillageб such as fertilization, irrigation and loosening for the life of cultivated plants. Aquatic cultures.

Stem. Stem functions. Spear and its parts. Spear branching. Variety of spears: up-straight, creeping, climbing, trailing, clinging. Bud. Vegetative, floral, mixed buds. Their structure and location on the stem. Spear development from a bud. The growth of a stem in length. Stem tissues. The anatomical structure of monocot, herbaceous and woody stems of dicotyledons. Stem growth in thickness. The formation of annual rings. Seasonal differences in wood. Age of trees. Movement of mineral and organic substances along a stem. Modified spears: rhizome, stolons, tuber, bulb, their structure, biological and economic role.

Leaf. Leaf functions. External leaf structure (lamina, leafstalk, butt, stipules). Leaf nervation. Simple and complex leaves. Leaf arrangement. Leaf tissues. Features of internal leaf structure in connection with its functions. Peel and stoma, leaf pulp (columnar and spongy tissue). The structure of leaf veins (conductive beams). Light and shadow leaves. Leaves movement. Leave mosaic. Formation of organic substances in the leaves in light (revision of the theme "Photosynthesis" from the section "Cytology"). Carbon dioxide absorption by leaves and oxygen release. Energy accumulation in plants. Leaves breathing. Evaporation of water by leaves. Plants of wet and dry inhabitation. Leaves modifications. Leaf life span. Falling of leaves. Leaf's role for plants. Role of green plants in nature and human life and their protection.

Vegetative reproduction of seed plants. Plants reproduction by means of spears, roots and leaves in nature and in plant growing (modified spears, stem and root cuttings, offsets, bush dividing, grafting). Biological and economic role of vegetative reproduction.

Flower, fruit, seed.

Flower is an organ of seed reproduction. Flower functions. Flower structure: pedicel, receptacle, perianth (calyx and corolla), stamens, pistil (pistils). Stamen and pistil structure.

Diclinous and monoclinous flowers. Monoecious and dioecious plants. Inflorescences and their biological role. Cross-pollination by insects and wind. Self-pollination. Artificial pollination. Double fertilization in seed plants and its mechanism. Pollen germination. Fertilization. Seed and fruit formation.

Seed. Seed functions. The structure of the seeds (by the example of dicotyledonous and monocotyledonous plants). The composition of seeds. Seed germination conditions. Seed germination. Seed breathing. Nutrition and sprout growth. Agrotechnology of seeds sowing and plants growing.

Fruit. Functions of fruit. Variety of fruits: monocarpous, apocarpous, coenocarpous and false monoccarpous (pseudomonocarpous). Number of fruits and seeds in various plants. Role of flowers, fruits and seeds in nature and in human life.

Classification of plants. Elementary knowledge about systematic (taxonomic) categories (species, genus, family, order, class, division). The meaning of international names of plants.
The main groups of plants. Variety of plant world. Systematic review: Bacteria, Algae, Fungi, Lichens, Mossy, Ferns, Gymnosperms (Conifers), Angiosperms.

Division bacteria. *(Pre-nuclear super-kingdom, Schizophyte kingdom, True bacteria subkingdom).* General characteristics. The structure of prokaryotic cell (revision of the information from the course of Cytology). Bacteria structure and their activity. Form classification of bacteria. Examples. Bacteria reproduction. Bacteria spread in the air, soil, water and among living organisms. Fermentation and putrefactive bacteria. Symbiotic bacteria. Pathogenic bacteria and fight against them. The role of bacteria in nature, medicine, agriculture and industry. Use of bacteria by humans.

Divisions - Green and Brown algae. *(nuclear super-kingdom, plants kingdom, lower plants subkingdom).* General characteristics of green algae. Classification. *Unicellular green algae* (Chlamydomonas, Chlorella, Pleurococcus). The structure and life characteristics. *Multicellular green algae*. Filamentous algae. Spirogyra. The structure and life characteristics. *Sea algae* (laminaria, fucus). The structure and life characteristics. Asexual and sexual algae reproduction. Algae spread in water and on land. Role of algae in nature and in human life.

Kingdom Fungi, Division True Fungi. General characteristics. Classification. Lower and Higher Fungi. Reasons for ambiguity of the classification of fungi and their comparison with plants and animals. *Mold fungi* (mucor and penicillin). Structure, life and reproduction characteristics. Role of mold fungi. *Yeast*. Structure, life and reproduction characteristics. *Parasitic fungi* causing plants' diseases (smut, ergot, tinder). Structure, nutrition, reproduction. Role of fungi in nature and in human life. Selection of bacteria, fungi, its importance for microbiological industry (production of antibiotics, enzyme preparations, fodder yeast, etc.). The

main directions of biotechnology (microbiological industry, cell and genetic engineering). *Pileate fungi*. Structure, life and reproduction characteristics. Connection of fungi with plant roots (mycorrhiza). Living conditions of fungus in a forest. Edible and poisonous mushrooms. Rules for collecting mushrooms. Prevention of poisoning with mushrooms.

Division Lichens. Lichens as symbiotic organisms. General characteristics. Structure of blastema. Crustose, foliose, fruticose lichens. Lichens nutrition and reproduction. Role of lichens in nature and in human life.

Division Mossy. General characteristics. Classification. *Green mosses*. The structure, reproduction and development cycle of common hair moss. The concepts of sporophyte and gametophyte. Sphagnum moss. Structure, reproduction and development cycle of sphagnum. Swamping. Peat formation, its role.

Division Mountain Mossy. General characteristics. Toothed Clubmoss. Structure, reproduction, development cycle. Role of mountain mosses.

Division Horsetail. General characteristics. Common Horsetail. Structure, reproduction, development cycle. Role of horsetail.

Division Fern. General characteristics. Brake Fern. Structure, reproduction and development cycle. Fossil ferns and coal formation. Role of fern in nature and in human life.

Division Gymnosperms. General characteristics. Structure, reproduction and development cycle by the example of pine and spruce. Male and female cones. Pollen. Ovules. Pollen germination, pollen tube growth and fertilization. Distribution and biology of conifers. Role of gymnosperms in nature and in the economy.

Angiosperms (Flowering). Dominance of angiosperms in the modern flora and their advantage in comparison with other groups of plants. Adaptability of angiosperms to various conditions of life on the Earth. Development cycle. Sporophyte and gametophyte in their development cycle. Variety of wild and cultivated flowering plants.

Class Dicotyledons. General characteristics. Families: Cruciferous, Rosaceae, Legumes, Solanaceae, Compositae. Characteristics of families and their role in nature and inhuman life.

Class Monocot plants. General characteristics. Families: Lily, Cereals. Characteristics of families and their role in nature and in human life.

Comparative characteristics of monocots and dicots families. Biological features. Typical agricultural, wild and ornamental plants of these families. Impact of human activities on the species diversity of flowering plants. Red Book. Protection of rare plant species.

The development of flora on the Earth. Complication of plants structure in the process of historical development in connection with the transition from aquatic to terrestrial lifestyle.

Main stages of plants development on the Earth (time of bacteria, algae, moss-like, pyropod-shaped, horsetail, fern, gymnosperms and angiosperms).

Plant communities. The concept of plant community. The adaptability of plants to living together: aboveground and underground stratification, different periods of development. Change of communities. Plant communities as part of landscape. Characteristic features of plants structure and biology of the main types of vegetation: tundra, forests, meadows, steppes, deserts, swamps, aquatic vegetation; their relationship with the environment and economic value. Vegetation protection.

ZOOLOGY

Zoology is the science about animals. Role of animals in nature and in human life. Appearance of zoology as a science and history of its development.

The classification of animals. The concept of type, genus, family, order, class and phylum. Role and success of modern zoology. Similarities and differences among plants and animals.

Phylum Protozoa. Classification. General phylum characteristics.

Class Rhizopods. General class characteristics. Amoeba Common. Habitat. External and internal structure. Motion. Nutrition. Breathing. Excretion. Osmoregulation. Reproduction. Encystation. Dysenteric amoeba. Structure. Habitat. Medical value. Protection against infection.

Class Flagellates. General class characteristics. Euglena Viridis as a single-celled organism combining animal and plant features. Volvox is a colonial organism. Evolutionary significance of Euglena and Volvox.

Class Infusorias. General class characteristics. Slipper Animalcule as a more complex unicellular animal. Habitat. Structure, life activity and reproduction features. Irritability.

Class Sporozoa. General class characteristics. Plasmodium malaria as causative agent of malaria. Way of infecting a person with malaria. General concept of changing owners in development cycle. Elimination of malaria as a mass disease in the Russian Federation.

Marine protozoa. Representatives. Role.

Phylum Coelenterates. Classification. General phylum characteristics. Habitat.

Class Hydrozoa. General class characteristics. Freshwater hydra. External and internal structure. Hydra nutrition. Breathing. Reflex. Regeneration. Asexual and sexual reproduction. Unicellular stage in hydra development. Marine hydrozoas by the example of the medusa obelia. Phases change in obelia life cycle.

Class Scyphozoa. General class characteristics by the example of aurelia. Structure and development cycle. Distinguishing features from marine hydroids.

Class Coral polyps. General class characteristics. Representatives. Features of organization complexity.

Role of Coelenterates.

Phylum Flatworms. Classification. General phylum characteristics.

Class turbellarian worms. General class characteristics. White Planarium as a representative of free-living worms. Habitat. External and internal structure. Bilateral symmetry. Nervous system and sense organs. Nutrition. Breathing. Reproduction. Regeneration.

Class Trematoda. General class characteristics. Liver fluke. External and internal structure. Adaptations to parasitism. Protection against infection. Change of owners in development cycle.

Class Tapeworms. General class characteristics. Tenia (pig and beef). Parasitic lifestyle. Features of the external and internal structure. Development cycles and change of owners. Protection against infection.

Phylum Roundworms. General phylum characteristics. *Ascaris*. Habitat. External and internal structure. Roundworm reproduction and development. Measures of protection from infection. *Seat worm* as a representative of roundworms. Protection against infection.

Phylum Annelid Worms. Classification. General phylum characteristics.

Class Oligochaetes. General class characteristics. Earthworm. Habitat. External and internal structure. Systems of digestive organs, blood circulation, excretion. Nervous system. Reproduction. Regeneration. Role of earthworms in soil formation.

Class Polychaete worms. Nereid. Main differences from earthworms. Evolutionary significance of polychaete worms, their role in feeding commercial fish.

Phylum Mollusks. Classification. General phylum characteristics.

Class Gastropods. General class characteristics. Pond snails. Grape snail. Habitat. External and internal structure. Moving. Lifestyle features. Reproduction.

Class Mussels. General class characteristics. Swan mussel and pearl mussel. Habitat. External and internal structure. Moving. Reproduction. Marine mussels.

Role of gastropods and mussels.

Phylum Arthropods. Classification. General phylum characteristics.

Class Copepods. General class characteristics. Crayfish. Habitat. External structure: chitinous covering, body dismemberment, limbs. Internal structure. Features of life style. Reproduction. Other Copepods. Medical value. Fish nutrition Importance. Commercial Copepods.

Class Arachnoids. General class characteristics. Habitat. External and internal structure of garden spider. Respiration, nutrition, excretion, reproduction. Cobweb and its structure. Ticks. Ticks' role in nature and their medical value. Measures to protect people from ticks.

Class Insects. General class characteristics. Habitat. External and internal structure of insect by the example of May beetle. Features of life. Reproduction.

Types of insect development. Variety of insects and their role. Main order of insects. *Insects with incomplete transformation*. Order **Orthopteras**. Representatives. Locust as dangerous vermin in agriculture. Order **Hemipteras** (bugs). Representatives. Role. Protective coloration. *Insects with complete transformation*. Order **Lepidopteras**. Representatives. Cabbage whitefish. Silkworm. Sericulture. Order **Coleopteras**. Harmful and helpful bugs. Cautionary coloring. Order **Dipteras**. Representatives. Housefly, gadfly. Medical value. Order **Hymenopteras**. Representatives. Honeybees, ants. Life Features of social insects. Instinct. Ichneumons as representatives of parasitic Hymenoptera.

Biological method of combating harmful insects. Protection of beneficial insects. Arthropod Arthropods. Similarities and differences between arthropods and annelids.

Phylum Chordates. Classification. General phylum characteristics.

Class Lancelet. Lancelet is a form close to ancestors of vertebrates. Habitat. External and internal structure. Reproduction. Lifestyle. Similarity of lancelet with invertebrates and vertebrates.

Superclass (class) Fish. General characteristics. External and internal structure of fish by the example of river perch. Reproduction and development. Primary concept of conditioning and unconditioning.

Systematic fish review.

Class (subclass) Cartilaginous Fish Order – Sharks and Skates. Characteristic features. External and internal structure.

Class (subclass) Osseous Fish. *Super-Order* **Sturgeon** (cartilaginous). Representatives, features, value and role. *Super-Order* **Lungfish**. Representatives of lungfish. *Super-Order* Crossopterygii. Representatives of Crossopterygii. *Super-Order* **Bony fish**: orders – Herrings, Salmonids, Carps, Flatfishs, Cods. General information about lifestyle, adaptations to different life conditions. Egg-laying conditions. Fertility. Development of fish migration. Protection and reproduction of fish resources.

Class Amphibians. Classification. General characteristics of the class.

External and internal structure of a frog (by the example of any species). Features of the habitat. Role of skin in breathing. Reproduction and development of frogs (frog larvas, their

similarity with the fish). Nutrition. Wintering. Diversity of amphibians and their role. Oorigin of amphibians.

Class Reptiles. General characteristics of the class.

External and internal structure of sand lizard. Adaptations to life in the terraneous environment. Reproduction. Regeneration. *Snakes*: colubrid snakes, vipers. Appearance. Differences between colubrid snake and viper. Poisonous glands, poisonous teeth and viper poison. Action of snake poison. First aid for the bite of a poisonous snake. Other modern reptiles: *turtles, crocodiles*. Origin of reptiles. Variety of ancient reptiles.

Class Birds. Classification. General characteristics of the class.

External and internal structure of pigeon. Adaptability to flight. Features of lifestyle. Reproduction and development. Origin of birds. Pioneer birds.

Subclass True Birds. Super-Order Ostrich (Lophosteon free) birds. Spread. Some features of structure and life. Super-Order Penguins. Features of structure and life in the harsh conditions of the Antarctic. Super-Order Flying (Lophosteon) birds. Most important Orders: Sparrows, Shorebirds, Geese, Day-time predators, Chickens, Storks, Pigeons, Woodpeckers, Swifts, Cuckoos. Variety of flying birds - birds of the forest; birds of steppes and deserts; open air birds; birds of swamps, freshwater and coasts birds. Lifestyle, adaptability to different conditions of existence. Nutrition, reproduction, development. Seasonal phenomena in birds' life: migration, nesting. Protection and attraction of birds (winter feeding, production and placement of artificial nesting). Role of birds in nature and their importance in human life.

Class Mammals. Classification. General characteristics of the class. Features of external and internal structure of mammals by the example of a dog. Reproduction and development. Origin of mammals. Variety of mammals and their significance.

*Subclass Egg-laying*s. General characteristics. Platypus and echidna. The similarity of egg-layings and reptiles.

Subclass True Animals. Placental mammals are the most progressive group of modern vertebrates. Their variety.

Overview of mammals by their order: Entomophage, Chiropterans, Rodents, Hares, Predatories (Canines, Felines), Pinnipeds, Cetaceans, Artiodactyls, Odd-toeds, Proboscidians, Primates. Higher primates. Families - Guenons and Sub-human Primates. Representatives of mammals: forest, digging, semi-aquatic, aquatic, flying animals and animals of open spaces. Features of structure and lifestyle. Role of mammals in nature and in human life.

The role of mammals in nature and in human life. Protection of useful and rare animals. Spread of animals on the Earth. Causes of fauna differences in different parts of the globe.

The development of wildlife on the Earth. Main stages of animal world development: from unicellular to multicellular, from lower to higher in eras and periods. Relations between classes of vertebrates. Reflection of filiations in natural fauna system.

HUMAN ANATOMY, PHYSIOLOGY AND HYGIENE

Anatomy, physiology, and human hygiene are interrelated sciences that study human body structure, functions, and conditions for health maintaining. Role of knowledge of anatomy, physiology and human hygiene.

General overview of human body.

The structure and function of human body. Comparison of human body and mammals' structure. Main types of tissue (epithelial, connective, muscular, nervous) and their properties.

Nervous system. Functions of nervous system. Concepts of nervous regulation. Processes of irritation and suppression in nerve cells. Concepts – nerve, nerve fiber. Types of nerve fibers. Receptors. Reflex. The scheme of reflex arc.

Central nervous system. Structure and function of spinal cord. Composition of the reflex arcs. Structure and function of brain: medulla, cerebellum, middle, intermediate, end brain. Highest part of the brain – cortex of cerebellum. *Peripheral nervous system*. Somatic and autonomic (autonomic) nervous systems. The sympathetic and parasympathetic divisions of the autonomic nervous system.

Endocrine glands. Functions of endocrine glands. Hormones and their role in the body, unlike enzymes. Concept of humoral regulation. Role of humoral regulation in the body. Diseases associated with dysfunction of endocrine glands.

Skeletal-muscular system. Functions of skeletal-muscular system. Structure of human skeleton. Features of skeleton structure in connection with upright walking and human labor. Structure and composition of bones. Organic and inorganic bone matter. Bone growth in thickness. Connections of bones: continuous, joints, half-joints. First aid for fractures, dislocations and sprains.

Human muscular system. Muscles, their structure and function. Movements in joints. Reflex nature of muscle activity. Coordination of movements. Influence of rhythm and load on muscles working capacity. Fatigue. Features of the skeletal-muscular system in children and in adolescents. Role of physical education and sports in proper formation of skeleton and muscles. Prevention of spinal curvature and development of flatfoot. Proper fit, posture and working posture.

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

Blood. Blood functions. Blood composites: plasma, blood corpuscle. Role of red blood cells in gases transportation. Blood coagulation as a body protective reaction. Leukocyte function. Anemia. Teachings of I. I. Mechnikova on protective properties of blood. Infectious agents: bacteria and viruses. Fight against epidemics. Immunity and its types. Blood groups. Blood transfusion and its value.

Lymph. Lymph formation. Movement of lymph in lymphatic vessels. Difference between lymph and plasma. Tissue fluid, its role.

Circulatory system. Functions of circulatory system. Systemic and pulmonary circles of blood circulation. Arteries, capillaries and veins. Heart, its structure and work. Valves of the heart. Features of cardiac muscle. Pulse, its definition. Blood pressure and blood velocity in different parts of bloodstream. First aid for arterial and venous bleeding. Concept of nervous and humoral regulation of heart and blood vessels. Heart training. Influence of physical culture and sports on cardiovascular system.

Respiratory system. Functions of respiratory system. Airways. Glottis. Structure of lungs. Gas exchange in lungs and tissues. Mechanism of respiratory movements. Vital capacity of lungs. Gas transportation by blood. Role of breathing exercises. Artificial respiration. Nervous and humoral regulation of respiration. Protective respiratory reflexes. Concept of clinical and biological death. Pre-medical methods of respiratory recovery and cardiac activity (breath from mouth to mouth, indirect heart massage). Breath hygiene. Role of proper breathing. Struggle for clean air in everyday life, at school and at work. Harm of smoking. Transmission of infectious diseases (influenza, tuberculosis, diphtheria) through the air and their prevention.

Digestive system. Functions of digestive system. Food and nutrients. Role of food. Content of proteins, fats and carbohydrates in main food groups. Digestive enzymes. Overview of digestive organs: oral organs (teeth, tongue, salivary glands), esophagus, stomach, intestines, pancreas, liver. Changing food in different parts of digestive tract. Chewing. Experiments of I. P. Pavlov on the study of salivary glands activity. Action of enzymes in saliva carbohydrates. Swallowing. Gastric juice discharge. Works I. P. Pavlova on digestion. Fictitious feeding. Experiments on dogs with a fistula of stomach, with isolated ventricle. Digestion of food in stomach and small intestine. Enzymes. Influence food composition on digestive glands activity. Role of liver and pancreas in digestion. Nutrient absorption. Functions of large intestine. Examples of unconditioned and conditioned food reflexes. Nervous and humoral regulation of digestion. Hygienic conditions of normal digestion. Concept of food infections prevention.

Metabolism. Assimilation of proteins, fats, carbohydrates in the body. Intracellular metabolism. Nutrient absorption (assimilation). Decay processes (dissimilation). Assimilation

and dissimilation as two ways of single metabolic process. Body self-renewal in process of metabolism.

The role of liver in metabolism. Transformation of energy in the body. Body temperature. Role of constant body temperature maintaining. Body need in proteins, fats, carbohydrates, water and salts. Nutrition norms. Calorie diet. Vitamins. Role of vitamins. Diseases connected with lack of vitamins in food. Nutritional features in growth period. Role of proper nutrition for body.

Excretory system. Functions of excretory system organs. Isolation of exchange products. Organs of urinary system. Structure and work of kidneys. Role excretory system organs in maintaining constancy internal body environment.

Skin. Functions of skin. structure of skin. Derivatives of skin. Role of skin in thermoexchange regulation. First aid for congelation, burn, heat and sunstroke. Role of body hardening. Natural hardening factors and rules for their use. Skin and clothing Hygiene.

Analyzers. Teachings of I. P. Pavlov on analyzers. Role of analyzers in surrounding world perception. *Visual analyzer*. Eye structure. Photosensitive eye apparatus. Building images on retina. Myopia, hyperopia and their correction. Eyesight hygiene. *Auditory analyzer*. Structure and hygiene of hearing organs. Mechanism of sounds perception. Otolithic apparatus and semicircular canals. Taction. Mechanisms of touch, cold, heat perception. *Osmesis*. Mechanism of odors perception. Taste. Mechanism of food perception.

Higher nervous activity. The role of I. M. Sechenov in development of higher nervous activity teaching. Teachings of I. P.Pavlov on conditioned reflexes. Conditioned and unconditioned reflexes. Formation and inhibition of conditioned reflexes. Reflexes are the basis of animal behavior. Features of human higher nervous activity. Immediate and verbal stimuli. Speech function. First and second signal systems. Mental labor hygiene. Day regime. Work and rest regime. Sleep hygiene Effect of alcohol, tobacco and drugs on nervous system.

Human body development. Male and female reproductive systems. Sex cells. Fertilization. Role of chromosomes in hereditary features transmission. Similarity of human embryo early development stages and the ones of vertebrates. Nutrition of human embryo. Human postembryonic development. Features of children’s and adolescent organisms’ development. Role of physical culture and sports for normal development and strengthening of body. Influence of alcohol, tobacco and drugs on cells, organs and systems of human body during embryonic and postembryonic periods.

Body as a whole unit. Coordination of all organs (humoral and neural regulatory mechanisms).

EVOLUTIONARY DOCTRINE

General characteristics of biology in pre-Darwinian period. Zoology and botany development. Dominance of metaphysical ideas about constanc of nature and "initial expediency" in science. Works of Karl Linnaeus on systematics of plants and animals, their role. of J. B. Lamarck teachings on wildlife evolution and its significance. First Russian evolutionists.

Historical background of Charles Darwin teachings. Socio-economic background. Advances in biology in the first half of the XIX century. Success of agriculture in breeding domestic animal breeds and varieties of cultivated plants. Journey by "Beagle" ship. Ch. Darwin's works.

Main ideas of Charles Darwin evolutionary teachings. Role of his teachings for science development. **Evolution driving forces**. Heredity. Variability. Types of variability. Natural selection. Leading role of natural selection in evolution. Struggle for existence. Forms of struggle for existence.

Artificial selection and hereditary variability are the basis for breeding domestic animals and cultivars. Common and different between artificial and natural selection.

The concept of evolutionary transformations levels.

Microevolution. Genetics and theory of evolution. Population as elementary evolutionary unit. Genetics of populations. Ideal and real populations. Hardy-Weinberg equilibrium formula. Fund of hereditary variability in natural populations. Genetic processes in populations. Concept of ecological and genetic characteristics of populations. Elementary factors of microevolution. Natural selection is evolution guiding factor. Creative role of natural selection. Forms of natural selection, their relationship and correlation to environmental conditions. Speciation is a result of microevolution. Ways of speciation. Species. Species criteria. Structure of the species (semi-species, subspecies, ecotypes, populations).

Macroevolution. Origin of superspecific taxa. Forms of phylogenesis: phyletic evolution, divergent evolution, parallelism, convergence. Concept of evolution rate. Correlation of micro and macroevolution. Adaptive nature of evolution. Relative expediency.

Main directions of evolution (aromorphosis, idioadaptation, degeneration). Biological regress and biological progress (A.N. Severtsev). Species extinction as a result of biological regress. Ways to achieve biological progress. Results of evolution: organic expediency, adaptability of organisms, diversity of species, gradual organization complication.

System of plants and animals is an evolution display. Principles of modern organisms' classification. Taxonomic units.

ORGANIC WORLD DEVELOPMENT

Origin of life on the Earth. Life is a qualitatively new form of matter motion. Pre-scientific ideas about origin of life. Teachings on aseity. Works of Redy and Pasteur that proved

impossibility of aseity ideas. Theories of bringing life to the Earth from other cosmic bodies. Modern theories of life origin on the Earth from bodies of inanimate nature (A.I. Oparin and others).

Main evidence of organic world evolution: comparative anatomical, embryological, biogeographical and paleontological. Comparative study of modern animals and plants structure in order to prove their historical development. Homology and analogy. Rudiments and atavisms in modern organisms' structure as evolution evidence. Similarity of embryonic development of organisms as evidence general origin. Muller- Haeckel biogenetic law.

Main directions of evolution are organic world development paths. Earth history division into eras and periods. Development of organic world in the *Archean*, *Proterozoic* and *Paleozoic* eras. Origin of plants and animals –divergence in organic world due to the way of nutrition. Space role of green plants. Unicellular and multicellular organisms. Origin of plants on land in the Paleozoic era. Psilophytes. Mosses. Reasons for ferns flourish. Appearance of gymnosperms.

Outlet of animals on land. Origin of vertebrates by increasing organization, development of adaptations of wide significance and expansion of habitat. Crossopterigiis as ancestors of amphibians. Origin and flourish of ancient amphibians. Labyrinthodontias is a joint group of ancient amphibians.

Development of organic world in Mesozoic era. Dominance of gymnosperms. Angymnosperms' origin and spread. Reptiles flourish. Origin of birds and mammals. Origin of bony fish. Reasons for gymnosperms and reptile's extinction in Mesozoic era.

Development of organic world in Cenozoic era. Dominance of angymnosperms, insects, birds and mammals. Origin of numerous adaptive ways to a variety of habitats in the process of evolution.

Impact of human activity on diversity of species, natural communities and their protection.

HUMAN ORIGIN

Subhuman primate and human. Ch. Darwin on the origin of a human from animals. F. Engels on the role of labor in the transformation of ancient monkeys into man. Driving forces of anthropogenesis: social and biological factors. Leading role of social life laws in social mankind progress. Role of biological and social factors in human evolution.

Fossil human remains. Findings in Tanzania. The most ancient people (Pithecanthropus, Synanthropus, Heidelberg man). Ancient people (Neanderthals). Fossil humans of the modern type (Cro-Magnon).

Leading role of the social life laws in social mankind progress of. Unity human races origin. The antiscientific, reactionary essence of 'social Darwinism' and racism.

ORGANISM AND ENVIRONMENT

Ecology is the science about the laws of relationship among organisms and environment. Ecology tasks. Environment and environmental factors. Adaptability of organism (species) to abiotic and biotic environmental factors. Complex factors effect on the body. 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 seasonal rhythm of external conditions. Seasons in nature. State of winter dormancy. Cold resistance. Factors governing seasonal development. Phenomena of photoperiodism in plants and animals.

Population. Factors causing changes in population size.

Species, ecological characteristics. Rational use of species, preservation of their diversity.

Biogeocenosis. Examples: freshwater pond, oak forest. Relationship of populations in biogeocenosis. Food chain Rules of ecological pyramid. Self-regulation in biogeocenosis. Change of biogeocenoses. Creation of artificial biogeocenoses as a result of purposeful human economic activity. Agrocenoses. Increased productivity of agrocenoses. Protection of biogeocenoses.

Biosphere. Basis of biosphere teachings. Biosphere boundaries. Teachings of V. I. Vernadskiy about biosphere as the Earth blanket, inhabited by living beings. Noosphere. Density of life. Biomass of land surface. Soil biomass. Biomass of World Ocean. Living being, its gas, concentration, oxidizing and reducing functions. Circulation of substances in biosphere. Biogenic migration of atoms. Role of microorganisms. Role of man in biosphere. Conservation of nature and planned reproduction of its wealth.