

**Federal State Budgetary Educational Institution of Higher Education  
«Pavlov First Saint Petersburg State Medical University»  
(FSBEI of HI «PFSPbSMU»)  
of the Ministry of Health of the Russian Federation**

Rector of FSBEI of HI PFSPbSMU  
of the Ministry of Health of Russia  
Academician of RAS

\_\_\_\_\_ Bagnenko S.F.

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**Entrance Tests Program in Biology  
for Applicants Entering Undergraduate Training  
(School of Medicine, EMD)**

**General Biology**

Basics of cytology

Cell Theory: history and current status. Chemical structure of the cell: chemical elements (carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur) inorganic and organic substances.

Inorganic molecules of the cell (biogenic chemical elements: carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur, and oxygen, carbon dioxide, ammonia, potassium ions, sodium, calcium, chlorine, phosphate and carbonic acids) and their functions.

Lipids (simple - fats and waxes, complex - phospholipids and glycolipids, cholesterol and steroid hormones, fat-soluble vitamins): their structure and main biological functions (structural, energetic, regulatory).

Sugars (monosaccharides: ribose, deoxyribose, glucose, fructose, galactose; disaccharides: maltose, sucrose, lactose; polysaccharides: amylose, amylopectin, glycogen, cellulose, chitin): basic structure and biological functions (energetic, protective).

Proteins: structure (amino acids, peptide bonds), organization levels (primary, secondary, tertiary and quaternary structure) and main biological functions (enzyme, transport, receptor, structural, regulatory).

Enzymes and their role in the cell.

Nucleic acids (DNA and RNA): structure (deoxyribonucleotides and ribonucleotides, phosphodiester linkage, intermolecular and intra-molecular hydrogen bonds), synthesis

(replication and transcription) and biological function (storage of genetic information, participation of m-RNA, r-RNA and t-RNA in protein biosynthesis).

Prokaryotic and eukaryotic cells: comparative analysis of their structure (membrane, cytoplasm, genetic material) and types of division.

The surface unit cell: structure (plasma membrane, glycocalyx) and basic functions (insolation, transport, receptor, contact).

Organelles movement: pseudopodia, cilia, flagella - structure and function.

Cytoplasmic: hyaloplasm and organelles. Endoplasmic reticulum: membrane structure and basic functions (distribution of protein, synthesis of lipids, cholesterol and steroid hormones, the formation of glucose from glycogen).

Golgi complex: the membrane structure and basic functions (distribution of proteins, received from the ER, the synthesis of specific polysaccharides, participate in the formation of lysosomes).

Lysosomes: structure (membrane, hydrolytic enzymes) and main functions (splitting cell molecules - participation in intracellular regeneration, splitting extracellular molecules – intracellular digestion, immune defense).

Mitochondria: structure (outer membrane and inner membrane, ribosomes, circular DNA molecule, genes) and main function - the oxygen stage energy metabolism: Krebs cycle, oxidative phosphorylation.

Plastids: structure (outer and inner membrane, stroma, ribosomes, circular DNA molecule, genes), types (leucoplasts, chromoplasts and chloroplasts) and functions: stocking (leucoplasts) attracting (chromoplasts), photosynthetic (chloroplasts).

Photosynthesis in plants (light and dark phases, electron transport, water photolysis and its value, creating a proton gradient for ATP synthesis, incorporation of hydrogen and carbon dioxide in the synthesis of carbohydrates), factors affecting the rate of photosynthesis.

Ribosomes: structure (r-RNA and ribosomal proteins, large and small subunits), localization (hyaloplasm, ER and nuclear membrane, mitochondria, plastids) and function (protein synthesis).

Genetic code and its properties: triplet, continuity, linearity, degeneracy (redundancy), specificity, universality.

Cell center: components (centrosome and centrosphere) and their functions (synthesis of microtubules during interphase, the formation of cell poles and spindle microtubules during cell division).

Nucleus: structure (nuclear membrane with pores, karyoplasma - nuclear sap, genetic material (chromosomes) Chromosomes, their structure (linear DNA molecule in a complex with proteins) and classification (size, position of centromere; autosomes and sex chromosomes), human

karyotype. Nuclear functions: storage of genetic information, copying of genetic information (DNA synthesis), the first step of realization of genetic information (RNA synthesis).

Matrix synthesis: replication (DNA synthesis), transcription (RNA synthesis), translation (polypeptide synthesis).

Gene and its role in the biosynthesis - the flow of information in the cell: DNA + transcriptional proteins - transcription - m-RNA, r-RNA + ribosomal proteins, tRNA, translational protein - translation - replication, transcription, ribosomal and translational proteins + proteins of non-matrix processes.

Energy cycle in the cell. Anti-oxygen (anaerobic) phase – glucose biosynthesis (glucose phosphorylation and its cleavage products, ATP synthesis during dephosphorylation of intermediate products with pyruvic acid formation). Fermentation, its species (malolactic, acetate, alcohol) and its value in the industry. Oxygen (aerobic) phase: an intermediate stage (oxidative decarboxylation of pyruvic acid (formation of activated acid form - acetyl coenzyme A, restored carriers of protons – NADP-H and carbon dioxide), Krebs cycle (oxidative decarboxylation dehydrogenation of intermediate products of the cycle with formation of restored carriers of protons, carbon dioxide and ATP molecule synthesis) and oxidative phosphorylation (splitting proton atoms into protons and electrons, creating a proton gradient in the electron transport, the use of its energy to ATP synthesis, the use of oxygen as the terminal electron acceptor and the formation of water). Role of fatty acids (splitting up to molecules of activated acetic acid with formation of recovered hydrogen vectors), amino acids (deamination with conversion into an activated form of acetic acid), ethanol (oxidation into activated form of acetic acid with formation of recovered hydrogen vectors) in the energy exchange.

Cell division: simple binary division of prokaryotes, mitosis, meiosis, amitosis - comparative review.

Mitosis: phases (interphase, prophase, metaphase, anaphase, telophase), their characteristics (DNA doubling, condensation of chromosomes, breakdown of nuclear membrane, spindle formation, chromosome centromere interaction with the spindle, arrangement of chromosomes, discrepancy each sister chromatids to different poles of the cell, de-condensation of chromosomes, disruption of mitotic spindle, formation of two cores by forming nuclear envelopes, division of cytoplasm) and biological value (keeping the number of chromosomes and cell genotype, unicellular eukaryotes reproduction way, the way of multicellular structures and organisms forming).

Reproduction and ontogenesis (individual development) of different organisms.

Sexual and asexual reproduction: sexual reproduction (conjugation in Infuzoria), reproduction with fertilization based on the process of meiosis, sexual reproduction without fertilization (parthenogenesis in Hymenoptera), simple binary division (bacteria), mitosis (unicellular eukaryotes), budding (yeast), spore reproduction (plants, sporozoans), vegetative reproduction in plants (modified shoots - rhizomes, tubers, mustache stem - cuttings, roots) and animals (fragmentation in worms, identical twins).

Meiosis: stages (interphase, the first and second division), the phases (prophase I, metaphase I, anaphase I, telophase I, prophase II, metaphase II, anaphase II, telophase II), their characteristics. Specificity of prophase and anaphase during first meiotic division (conjugation and divergence of homologous chromosomes, resulting in the formation of haploid cells), no DNA synthesis before the second division, a second meiotic division running like mitosis (the difference of sister chromatids at anaphase II while maintaining the number of chromosomes). The biological significance of meiosis (the formation of haploid fission products - spores and gametes, combinative variability resulting from crossover and discrepancies of homologous and non-homologous chromosomes during the first division).

Gametogenesis: development and structure of gametes (sexual cells) in animals: reproduction, growth, maturation (meiosis) and the formation of gametes. Differences between oogenesis and spermatogenesis: the size of oocytes and sperm cells, degeneration of the three meiotic products in oogenesis. The structure of oocytes (nucleus, large volume of cytoplasm, membrane) and sperm cells (with small-sized head containing the nucleus and cytoplasm, a neck with mitochondria and centrioles and a tail, forming from nine peripheral pairs of microtubules and central microtubule pair). The development of germ cells of flowering plants (the formation of haploid spores by meiosis, degeneration of the three meiotic products, formation of pollen grains by mitoses, forming co-contents of the embryo sac - egg cells with satellite cells, diploid central cell).

Animal embryo development: fertilization, formation of diploid zygote, zygote crushing, formation of blastula (monolayer embryo), gastrula (multilayer embryo) forming of embryonic layers (ecto-, ento- and mesoderm) during gastrulation, histogenesis and organogenesis (formation of tissues and organs). Postembryonic development in animals: direct way - without metamorphosis (conversion) and the indirect way - with metamorphosis (complete and incomplete conversion). Fertilization in flowering plants (double fertilization), parthenogenesis (development without fertilization).

## **Fundamentals of genetics**

Mono- and di-hybrid cross (sex-linked and autosomal inheritance, non-linked and linked inheritance), test cross.

Mendel's laws (laws of autosomal inheritance): The first law is the law of dominance (complete dominance, incomplete dominance, co-dominance); second law - law of segregation of hybrids of the second generation (of the genotype: 1AA: 2Aa: 1AA; and of the phenotype: complete and incomplete dominance, co-dominance); third law - the law of independent assortment of characters between hybrids of the second generation [9A-B-: 3A-bb: 3aaB-: laabb = (3A-: laa) x (3B-: lbb)].

Cytological foundations of Mendel's laws (behavioral patterns of homologous chromosomes in the first meiotic division, non-dependent behavior of non-homologous chromosomes during the first meiotic division) and statistical character (probability of three products of meiosis death during oogenesis, probability of non-homologous chromosomes combination in meiosis and probability of fertilization).

Sex Genetics (in mammals).

Sex-linked inheritance: sex chromosome (X and Y), the inheritance of the genes located on X chromosome, the role of these genes, Y-specific genes, significant in sex determination.

Genetic linkage and crossing-over (experiments of T. Morgan).

Chromosomal theory of inheritance: the role of Mendel experiments (Mendel laws) and T. Morgan experiments (sex-linked inheritance, genetic linkage and crossing-over) and the main points of the theory (localization of genes in chromosomes, their linear arrangement, the frequency of crossing-over as a distance between genes). Cytoplasmic inheritance (mitochondria and plastid genomes).

Phenotype and genotype: phenotype (a set of characters of a given organism), genotype (a set of alleles of genes of the organism), alleles (different structural states of a single gene), homo- and heterozygotes (carriers of a two identical or two different alleles of some genes), interaction of alleles of one gene (complete dominance, incomplete dominance, co-dominance), and interaction of alleles of various genes (polygenic control of determining in one character).

Genotype as a complete system: interaction of alleles of one and various genes.

Phenotype and the environment: modifications as phenotypical changes, appearing under environmental factors, their reversibility and non-inheritance, statistics of modification variations (variation curve and its parameters).

Mutations – qualitative or quantitative changes of genetic material: gene mutations (changes in gene structure - substitution, insertion and deletion of nucleotides), chromosome mutations (changes in chromosome structure: deletion, duplication, inversion and translocation), genomic mutations (changes in chromosomal number, multiple and non-multiple of haploid set of chromosomes); nuclear mutations (in DNA or chromosomes) and cytoplasmic (in plastids and mitochondrial DNA); autosomal (in autosomes) and sex-linked mutations (in sex chromosomes); dominant and recessive mutations (with and without manifestation at a state of heterozygote); somatic (in somatic cells) and generative mutations (in gametes); spontaneous and induced (caused by environmental factors), the effects of mutations on the phenotype. Mutagens (physical, chemical) and the effects of pollution of the environment (increase in mutation frequency).

Methods of Human Genetics. Human as an object of genetics (fertility, genealogical method (pedigrees method), its symbols (male and female, marriage, brothers and sisters, di- and monozygotic twins, carriers of studied trait) and its opportunities (definition of hereditary character trait, its dominant or recessive character, autosomal or sex-linked character). Twins method: mechanism of di- and monozygotic twins developing, comparison of the degree of variability in di- and monozygotic twins (to determine the relative role of genotype in character development. Molecular genetic method: analysis of the variability of its causes at the molecular level (detection of changes in marker metabolite levels, appearing of new metabolites, structural and functional changes of some specific proteins, changes in nucleotide sequence of specific genes). Cytogenetic method: analysis of number and structure of chromosomes. Comparative-genetic method: analysis of molecular-genetic control of traits in animals.

Genetics and Medicine: hereditary diseases as a chronic non-contagious diseases caused by changes in the genotype. Gene diseases: their causes (genetic mutations); chromosomal diseases: their causes (chromosomal and genomic mutations). Diagnostics (molecular genetic method), the opportunity of treatment (administration of the missing substances, stimulation of accumulating substances excretion, elimination from the diet accumulating substances, the introduction into the diet counterparts of accumulating substances, enzymes activation by introducing appropriate chemical substances) and prophylactics (possibility of child birth avoidance in families with a high genetic risk to have a baby with severe congenital malformation, improvement of diagnose of severe hereditary disease at different stages of human developing: a fetal stage, when "in vitro" fertilization, using cultivated blastomere cells at a pre-implantation stage) of hereditary diseases.

Variability - the property of existence of living systems in several structural and functional conditions, its classification: genotypic (combinative based on the behavior of chromosomes during meiosis, crossing-over and fertilization, mutation), modification, developmental (WPP-genomic) - and its role in evolution.

The type and query: morphological and anatomical (similarly and different signs and the internal structure), biochemical (similarity and differences in primary structure of proteins and DNA, features of metabolism), behavioral (similarity, different behavior including mating), ecological (converging-occupied area difference and ecological niche - complex of links in other species and environmental factors), genetic (skew bridge-crosslink, fertility-sterile offspring) - their advantages and disadvantages. You must use a set of criteria.

Proof of macroevolution: taxonomy (systematics organisms), paleontological (fossils, transitional forms), comparative anatomical (homology and organs analogy), embryological (ontogeny and phylogeny, the biogenetic law of Haeckel-Müller, rudiments, atavisms), biogeographical (comparison of plant in different geographical areas). The main provisions of evolutionary theory of Charles Darwin.

Route and directions of macroevolution: aromorphoses (morpho-physiological progress, increasing the overall level of organization) and total degeneration (simplification of organization), their ratio in macroevolution; biological progress and regres, their criteria (outcome variables, the number of individuals, the values range, diversity of genus).

The emergence of life on Earth: the definition of life as a form-existence of organic matter in the form of systems capable of self-presentation, self-regulation and self-reproduction; chemical deposits of step occurrence of life (part of solar radiation, the temperature of the Earth, gases and water occurrence, small organic molecules and polymers), protozoan appearance, biological systems (the role of nucleic acids, proteins, complicated lipids and carbohydrates) and cells.

A brief history of the organic development of the world (geo-bio-chronology): Archean, Proterozoic, Paleozoic (Cambrian, Ordovician, Silurian, Devonian, Carbon and Permian), Mesozoic (Triassic, Jurassic and Cretaceous periods), Cenozoic (Paleogene, Neogene and Anthropogenic periods), periodization occurrence of major groups of living organisms (super-kingdom, kingdoms, subkingdoms, types).

Basic aromorphoses in evolution: of photosynthesis and aerobic chemosynthesis (Prokaryotes super-kingdom); intracellular organelles, membrane, nuclear membrane, dividing spindle and sexual process (Eukaryotes super-kingdom); multicellularity (colonial animals and plants); double layer, intestinal cavity and the nervous system (type Coelenterates); triple layer, smooth muscles, gonads, excretory system (Phylum Plathelminthes); primary body cavity and hindgut (Phylum Nemathelminthes); secondary body cavity, circulatory and respiratory systems (Phylum Annelida); external chitinous skeleton, striated muscles, jointed limbs (Phylum Arthropods); the outer horny skeleton (Phylum Shellfish); an internal axial skeleton and the neural tube (Phylum Hordates).

The forms of natural selection: driving, decreasing (increasing) of the frequency of one allele and one type homozygotes; stabilizing, alignment of the frequency of different alleles leads to high proportion of homozygotes; disruptive, lead to the formation of two subpopulations with down frequency of different alleles (homozygous in each of them).

Factors of evolution and populations dynamics of genotypic structure (genotype frequency changes under the influence of evolutionary factors). Evolution results: occurrence devices of the formation of species, the complexity of organization - their mechanisms (genotypic variableness, isolation and natural selection). Relativity adjustments in changes of external conditions.

Human evolution (origin and evolution of man). Status of the temporary persons in fauna system (Subkingdom of Metazoan, Phylum Chordates, Subphylum Vertebrates, Class Mammals, Order Primates, Genus Homo, Species Homo sapiens). Driving forces of anthropogenesis: biological (variability, isolation, migrations, mutations, natural selection) and social (public pattern of life, labor and speech activity). Stages of anthropogenesis: Driopithecus, Australopithecus, Archanthropines (ancient people), Neanthropines (fossil and living humans from time-type), - their characteristics. The human race (Negroid, Mongoloid, Caucasian), their origin and unity.

### **Basis of selection.**

The notion of animal and plant varieties. Variability and its selection. The selection methods: domestication, hybridization, the induction of mutations, artificial selection and breeding.

Plant breeding: pollination, vegetative propagation, heterosis, distant hybridization, polyploidy, massive selection. Course of plant selection, the role of modification variability.

Breeding of animals: assessment manufacturers on a genotype, relative marriage, cross-breeding, heterosis, distant hybridization, individual selection.

Biotechnology and its main directions: cultivation of microorganisms, somatic cells and tissues; cell engineering - hybridization of somatic cells, transplantation of fertilized oocytes, somatic cell nuclear transplantation into eggs (cloning), regeneration and vegetative propagation of plants; Genetic engineering (transgenic organisms, gene therapy).

### **Fundamentals of Ecology.**

Ecological systems, their classification: biosphere, types of biomes - continents and oceans, biomes - desert, steppe, tundra, etc., sea, lake, river, etc.), the system (grove, meadow, pond, etc.), microecosystem (ant, stump, puddle, etc.) and components (biotic and abiotic) and the

spatial characteristics of the species. Characteristic ecosystems: autotrophic (photosynthetic and chemosynthetic parameter) and heterotrophic. The concept of biomass and productivity of ecosystems.

Chain and supply network (trophic ecosystem characteristics): Producers (producers of organic - photosynthetic and chemo-synthetic), consumers (in consumer of organics - herbivores, carnivores, omnivores), decomposers (destroyers mineralizers dead organic matter).

Environmental pyramid (energy, biomass, number), circulation of substances in ecosystems.

Environmental species characterization: area (distribution area its value), the density (number per unit area value), age supply return-structure (fractions pre-reproductive, reproductive and post-reproductive groups) and sex structure (ratio of male and female reproduction group characters). Changes in population size and ways of its regulation.

Habitat and ecological niche types: collection of all environmental factors ecosystem, acting on the form; aggregation and characterization the species due to environmental factors in the ecosystem.

Abiotic environmental factors (light, moisture, temperature), its complex action. The principle of ecological optimum, limited (limiting) factors.

Biotic environmental factors. Relationship populations in ecosystems: neutral, negative (competition, predation, parasitism), positive (unilateral - cohabitation; bilateral - mutual usefulness), their effect on populations.

Man-made environmental factors, their impact on the natural eco-system. Anthropogenic ecosystems (villages) and agro-ecosystems (agricultural land, nurseries, farms), their characteristics, problems of self-regulation and species diversity. Environmental protection.

Development and ecosystem change - ecological succession. Reasons of its assignment: internal (endogenous succession, self-development) and outside (exogenous succession, the action of powerful external influences); - predictability bridge endogenous succession. Primary (on previously uninhabited space) and secondary (on post-catastrophic space) succession. Equal Spring (climax) ecosystem.

Biosphere, its borders and characterization as pan-ecosystems. The concept noosphere (sphere of reason) as the qualitatively new state and development of the bio-sphere under the influence of human activity.

Living matter and its functions (redox, concentration).

Circulation of matter and energy flow in the biosphere: maximum lock cycles circuit nutrients (carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur), solar radiation is the main source energy for biosphere, the transformation of solar energy into the biosphere, circulation of substances due to the transformed energy thermal energy as a last link of energy flow in the biosphere.

## **Human health**

Major tissues, organs and organ systems of the human. Neuro-humoral regulation of activity of an organism.

### Nervous system.

The central nervous system - the general overview of the building (a brain, a spinal cord) and functions (integrative and regulatory). Nervous tissue, its building (neurons and auxiliary cells) and properties (excitability, conductivity). The structure of neurons (a body and shoots), nervous impulse (an electric wave), its carrying out on shoots. Transfer of nervous impulses on other cells (specific contacts) and its value (carrying out impulses on nervous chains, regulation of activity of neurons and other cells). Excitement and braking of neurons. Types of neurons: sensitive (information transfer from bodies), inserted (momentum transfer between neurons) and motor (momentum transfer to bodies).

Peripheral nervous system: organization (somatic and autonomous parts) and functions (neural regulation of skeletal muscles - somatic part, neural regulation of internals - autonomous part).

Spinal cord. Structure of a spinal cord: covers, longitudinal furrows, gray and white substance, their relative positioning ("butterfly"), the spinal channel with liquid, departments (cervical, chest, lumbar, sacral, coccygeal), segments, spinal knots, roots and nerves. Functions of a spinal cord (reflex and conduction), spinal reflexes and their arches. Reflex arc of a knee jerk. Injuries of a spinal cord, their consequence (paralyzes, disturbances of sensitivity).

Brain. Structure of a brain: covers, departments (met encephalon: medulla, bridge and cerebellum; mesencephalon; neon cephalon: intermediate and final). Functions of departments of a brain: communication with a spinal cord, nerve centers of regulation of breath, digestion, work of a cardiovascular system, protective reflexes of cough, sneezing and vomiting, innervation of language, throat, thyroid gland, large blood vessels, internals (myelencephalon); communication between oblong and other departments of a brain, facial and acoustical nerves (bridge); maintenance of balance and pose, coordination of movements (cerebellum); communication between back and a neon cephalon, the visual and acoustical centers (mesencephalon); centers of thermal control, thirst, hunger and saturation, hypothalamus its hormones (diencephalon). Big hemispheres of a neon cephalon, their bark: furrows, crinkles, shares (frontal, parietal, occipital, temporal), zones (motive, space orientation, visual, acoustical, olfactory), their localization and functions (analysis and control of the corresponding types of activity and feelings, forming of programs of behavior and management of work). Specialization of the left and right hemispheres: acoustical and motive word centers, implementation of abstract thinking (the left hemisphere), acoustical and visual recognition of images, musical and art creativity - figurative thinking (the right hemisphere). Cerebrocranial nerves, their number (12), examples (olfactory, visual, oculomotor, trigeminal, front, acoustical, glossopalatine, wandering, etc.) and functions (an innervation and neural regulation of activity of appropriate authorities). Injuries of a brain, their consequence.

Autonomous (vegetative) nervous system - sympathetic, parasympathetic and met sympathetic departments. Sympathetic department: arrangement of vegetative nerve knots (a boundary sympathetic trunk near a spinal column), arches of sympathetic reflexes (kernels of side horns of

all chest and first three lumbar segments of a spinal cord - nervous ganglia in a sympathetic trunk - nerve terminations in the innervated bodies). Parasympathetic department: arrangement of vegetative nerve knots (near the innervated body or in its wall), arches of parasympathetic reflexes (kernels of a segment of a mesencephalon, apex of segments of a myelencephalon, three segments of sacral department of a spinal cord - nerve knots of bodies - nerve terminations in the innervated bodies). Antagonism of vegetative regulation of internals, its mechanism (various neurotransmitters). Met sympathetic department: arrangement of reflex arcs (a wall of the innervated body), autonomy of regulation of cardiac performance and a digestive tract.

Analyzers (sensor systems), their building: the receptor which is carrying out a way, the lowest centers (back, oblong and a diencephalon) and the highest center (the site of a cerebral cortex), functions (perception and information processing). The highest centers of analyzers: visual (parietal zone), flavoring (frontotemporal zone), acoustical and vestibular (temporal zone), olfactory (neon cephalon subcortex), skin and tactile (parietal zone). Associative zones of bark (frontal, parietal and temporal zones), their functions (integration of analyzers, perception of difficult images).

Reflexes (conditional and unconditional) - response of an organism to irritants by means of a nervous system. Reflex arcs and their building: sensitive, internuncial and motor (executive) neurons, braking of reflexes (external and internal). A role of associative zones of bark of big par encephalon in formation of conditioned reflexes (forming of temporary bonds). Higher nervous activity.

Dream - the physiological condition of a brain and all organism which is characterized by an immobility, sharp decrease in reactions to external irritants and the special organization of activity of a cerebral cortex. Dream stages: backfilling (somnia), superficial dream, deep sleep. Periods of a deep sleep: slow (slow wave on the electroencephalogram) and fast, or paradoxical (fast wave on the electroencephalogram), their characteristics (decrease in a metabolism and frequency of heartbeat, rare and shallow breathing, fall of temperature of a body - a slow dream; strengthening of a metabolism and frequency of heartbeat, increase in blood pressure, breath increase, the movement of the closed eyes - a REM sleep). Regularity of change of the periods of a deep sleep. Value of a dream: rest and restoration of normal activity of an organism (a slow dream), processing of information obtained during wakefulness (REM sleep). Dreams as the difficult mental phenomena based on the impressions endured earlier which can independently be combined during a REM sleep. Sleep disorders: snore, gnashing by teeth, lunacy (sleep-walking), bed wetting (enuresis), nightmares at children and nightmares at adults, insomnia.

Organs of sense - the general overview of the building and functions.

Organ of sight. Structure of an eye globe: white (sclera) and cornea, choroid, retina and optic nerve, iris of the eye and pupil, anterior chamber, crystalline lens, vitreous. Oculomotor muscles, the lacrimal gland and the plaintive channel, eyelids with eyelashes. Structure of a retina: a pigmented layer, photoreceptor cells (sticks and flasks), layers of neurons and fiber of an optic nerve, a macula lutea (the site of a retina containing only flasks) and a blind spot (the place of an exit from a retina of an optic nerve). Mechanisms of visual perception: a crystalline lens role (focusing of the image on a retina due to change of the curvature), sticks (light perception) and

flasks (color perception). Vision disorders: short-sightedness (the extended form of an eye globe or the increased curvature of a crystalline lens), far-sightedness (the flattened form of an eye globe or a crystalline lens), daltonism (color-blindness because of defects of flasks), a twilight (chicken) blindness because of defects of sticks, turbidity of a cornea (cataract), - and possibilities of their treatment. A hygiene of sight.

Acoustic organ. Structure of an acoustic organ: an external ear (an auricle and acoustical pass with glands), a middle ear (a tympanic membrane, a hammer, an anvil and a stirrup, an acoustical pipe) and an internal ear snail (oval and round windows, liquid of a snail, a webby partition, a membrane, hairpin cells - acoustical receptors, an acoustical nerve). Acoustical perception and its mechanisms: air fluctuations - an external ear - fluctuations of a tympanic membrane - fluctuations of acoustical stones - fluctuations of a membrane of an oval window - fluctuations of liquid of a snail - irritation of hair cells - emergence and carrying out nervous impulses. Acoustic organ diseases: accumulation of an earwax, elasticity of a tympanic membrane, inflammation of a middle ear (otitis), hereditary deafness (defects of acoustical stones, hair cells, acoustical nerve). Hygiene of an acoustic organ.

Organ of equilibrium (vestibular mechanism). Structure of an organ of equilibrium: semicircular channels, sacks with limy crystals, jellylike liquid, hairpin cells receptors and nerve fibrils; communication with an inner ear. Functions of an organ of equilibrium: perception of information on position of the head (body), beginning and completion of the rectilinear movement, its acceleration or delay, change of gravity; their mechanisms (role of jellylike liquid, limy crystals, hair cells). Motion disease (sea sickness) and its reasons. Hygiene of a vestibular mechanism.

Olfactory organs and taste. Olfactory receptors, their arrangement (a mucous epithelium of a nasal cavity), the building (club-shaped cells with cilia) and functions (interaction of cilia with molecules of odorous substances and forming of nervous impulses). Flavoring receptors, their arrangement (flavoring nipples on a language surface), flavoring zones (sweet - a language tip, salty - a lobby and side parts of language, acid - side edges of a middle part of language, bitter - a back part of language).

Bodies of muscle and skin sense. Muscle receptors, their arrangement (muscles) and functions (the excitement at reduction or a muscle strain providing coordination of movements). Skin receptors, their location (skin), a variety of the building in connection with a variety of functions (the receptors perceiving touch, pressure, cold, heat, pain)

### Endocrine system.

A thyroid gland, its arrangement (middle area of a neck under a throat), the building (two segments connected by a crossing point, consisting of follicles), and functions (the ability to absorb iodine, to synthesize and secretion of thyroid hormones which enhance intensity of oxygen absorption and energy balance of the substances stimulating growth of an organism is activated by excitability of the central nervous system, memory and emotions). Disturbances of functions thyroid gland: a myxedema (deficiency of thyroid hormones and its influence on body temperature, puffiness, a xeroderma and a partial hair loss), cretinism (the deficiency of thyroid hormones at newborns leading to a dwarfism and strong mental retardation), thyroidism (the

excess of thyroid hormones which is followed by a hypermetabolism of substances, excitabilities, weight loss against the background of the increased appetite).

Pancreas, its localization (to the left of a body axis, under big curvature of a stomach), endocrine function (synthesis and secretion by special groups of cells of the hormones regulating carbohydrate metabolism). Insulin as one of pancreas hormones reducing concentration of glucose in blood by strengthening of its absorption by cells (muscles, a liver, lipoblasts); the diabetes mellitus caused by deficiency of insulin, its symptoms (the increased concentration of glucose in blood, availability of glucose in secondary urine, frequent and plentiful releases of urine, thirst). Consequences of excess of insulin in an organism (low concentration of glucose in blood, disturbances of work of neurons of a brain, the general weakness with a loss of consciousness and spasms).

Adrenal glands, their localization (pair organ on the top pole of kidneys), the structure (superficial layer and marrow) and functions (synthesis and secretion of the hormones regulating a water salt metabolism - corticosteroids of a superficial layer, carbohydrate protein metabolism - corticosteroids of a superficial layer, puberty at men - androgens of a superficial layer, activity of all types of muscles of an organism, a carbohydrate metabolism of lipids - adrenaline and noradrenaline of marrow).

Gonads (ovaries and seed plants). Ovaries: their arrangement (a pelvic cavity on uterine sheaves), the building (bodies of connecting fabric with follicles), endocrine function (synthesis and secretion of estrogen - female sex hormones). Functions of female sex hormones (maturing of ova and an ovulation, an adiposity on female type, female type of behavior), consequences of their deficiency (infertility, development of signs in men's type) and surplus (premature puberty). Seed plants: their arrangement (scrotum), the building (a difficult cover, segments with seed tubules), endocrine function (synthesis and secretion of androgens - male sex hormones special cells of seed tubules). Functions of male sex hormones: development of male sexual characters and behavior, control of a spermatogenesis, stimulation of ossification of cartilages, strengthening of protein synthesis in muscles and a liver. Consequences of deficiency of male sex hormones (infertility, development in female type) and their surplus (premature puberty and low-tallness).

Hypophysis: its arrangement (an outgrowth of a bottom side of a diencephalon), the building (front and back shares) and functions (synthesis and secretion of a growth hormone and hormones tracks is also new, other glands and bodies regulating work: sexual, milk, thyroid, adrenal glands, kidneys, uterus).

Hormones: their structure (peptide - insulin, steroid - sexual and corticosteroid, derivative amino acids - thyroxine) and the mechanism of their action (interaction with specific receptors with the subsequent activation or synthesis of certain cellular proteins) Hormones of a hypophysis, adrenal glands, a pancreas, thyroid and gonads: functions and consequences of their disturbance (see above).

Neural and humoral regulation of activity of an organism. Hypothalamus: its localization (diencephalon) and function (synthesis and secretion of the neurohormones regulating work of a hypophysis on the principle "stimulation - suppression"). Hypothalamus-to-hypophysis system and scheme of its work: level of hormones in blood - a hypothalamus - secretion of

neurohormones - a hypophysis - secretion of hormones of a hypophysis - secretion of hormones of glands - bodies and fabrics, a hypothalamus; the principle of feedback in work of a hypothalamus-to-hypophysis system.

### Reproductive system.

Reproductive organs: gonads (gonads - ovaries and seed plants), internal generative organs (oviducts - uterine tubes, a uterus and a vagina; semen tubes, ejaculatory duct and prostate), external genitals (small and big vulvar lips, clitoris; scrotum and penis), their building and functions. Sex hormones and puberty. Diseases of a reproductive system, prevention of venereal diseases.

Formation of sex cells (ovum and spermatozoa): zones (periods) of reproduction (an oogonium and a spermatogonium), growth, maturing (the oocytes which are formed by meiosis I with polar little bodies and spermatocytes with spermatids), formations (ovum and spermatozoa).

Embryo and fetus development. Fertilization of an ovum and its crushing (a germ from 30-32 cells) in uterine tubes, pre-natal development in a uterus with formation of a placenta and an umbilical cord, the building and a role of these temporary bodies (gas exchange and a metabolism between blood of mother and a germ - a fruit). Development of a germ (1-6 weeks of pregnancy): emergence and development of rudiments of bodies and extremities, heartbeat): development and further growth of a body and bodies. Pregnancy: its features (strengthening of release of hormones ovaries, increase in the sizes of chest glands and uterus, increase in arterial blood pressure and water salt metabolism, need for vitamins) and hygiene (personal hygiene, correct diet and dream, intake of medicines only on doctor's orders, inadmissibility of smoking of alcohol intake). Child's birth, his growth and development: the mechanism of childbirth (joint reduction of muscles of a uterus and an abdominal wall) and the beginnings of breath after binding and cutting of an umbilical cord (accumulation of carbon dioxide in an organism of the newborn and excitement of a respiratory center), the development periods after the delivery: newborns (the first year of life), the early childhood (age 1-3 years), the preschool period (from 3 to 7 years), the school period (7-17 years), the teenage period (11-17 years) - physiological, psychological and social maturity.

### Circulatory and lymphatic systems.

Organs of blood circulation: heart, an aorta, arteries, capillaries, veins, - the general overview of the building and functions.

Heart, its structure (pericardial bag, cardiac muscle, auricles and ventricles, folding valves) and work (the movement of blood in heart from hollow and pulmonary veins auricles, from auricles in ventricles, from ventricles in an aorta and a pulmonary artery). Cardiac cycle: reduction of auricles (0.1 sec.) - reduction of ventricles (0.3 sec.) - the general relaxation (0.4 sec.), - a role of semi-lunar and folding valves. Automatism of cardiac performance (ability to spontaneous rhythmic reductions) and its mechanism (existence of special self-excited muscle cells with the highest concentration in the right auricle. The electrocardiogram - reflection of action of the heart on the basis of registration of the bioelectric signals generated by heart. Neuro and humoral regulation of cardiac performance: the receptors in walls of cardiac cavities perceiving changes of pressure of blood; role sympathetic (weakening of frequency of reductions) and

parasympathetic (strengthening of frequency of reductions) departments of an autonomous nervous system, pain stimulations and emotional state; strengthening of cardiac performance under the influence of adrenaline and salts of calcium, weakening of cardiac performance at action of acetylcholine and salts of potassium.

Big and small circles of blood circulation: blood vessels, their building (epithelial, smooth muscle and connecting fabrics, semi-lunar valves). Big circle of blood circulation: the movement of blood in vessels from a left ventricle to the right auricle (a left ventricle - an aorta - arteries - capillaries with an arterial blood to a brain, internals, muscles and skin; veins with a venous blood from the head, a neck and the upper extremities - the top vena cava - the right auricle, veins with a venous blood from a trunk, the lower extremities and abdominal organs - the lower vena cava - the right auricle). Small circle of blood circulation: the movement of blood from a right ventricle to the left auricle (a right ventricle with a venous blood - a pulmonary artery - pulmonary capillaries - pulmonary veins with an arterial blood - the left auricle). A role of semi-lunar valves in blood circulation (providing the unidirectional blood-groove), blood pressure (the maximum arterial - in an aorta at reduction of ventricles and minimum arterial - in an aorta during relaxation of ventricles) and its regulation (receptors in walls of vessels - nervous impulses in the centers of a myelencephalon - muscles of vessels and a cardiac muscle; increase in pressure - expansion of gleams of vessels and weakening of cardiac performance, pressure drop - narrowing of a gleam of vessels and strengthening of cardiac performance), measuring of blood pressure by means of a tonometer, pulse. Negative influence of nicotine and alcohol (increases in adrenaline in blood) on a cardiovascular system. Cardiovascular diseases (hypertension, atherosclerosis, myocardial infarction), their prevention. First aid at bleedings.

Blood. Composition of blood: plasma, erythrocytes, leukocytes (neutrophils, eosinophils, monocytes, macrophages, lymphocytes), thrombocytes, their building, functions, concentration in blood. Blood groups (the ABO systems and the Rhesus factor), their value for blood transfusion. Blood diseases (anemias, hemophilia), their reasons and prevention.

Organs of lymph circulation (vessels, knots), communication with the blood circulatory system.

Internal environment of an organism (blood, lymph, intercellular lymph), its unity.

### Immune system.

Organs of the immune system: red marrow, thymic jelly - for (thymus gland), a spleen, lymph nodes. Immunity: cellular and humoral, active and passive, natural and artificial. A role of phagocytes and lymphocytes in an immune response. Immunological prevention of infectious diseases (vaccines and serums). Diseases of the immune system (immunodeficiencies, allergy), their reasons. AIDS and its prevention.

### Urinary system.

Organs of urination (kidneys, ureters, bladder, urethra), their building and functions. Formation of primary and secondary urine: filtration of a blood plasma in renal balls; a reabsorption of water, glucose and amino acids in renal tubules. Neural and humoral regulation of an urinary system. Diseases of urinary bodies, their prevention.

### Respiratory system.

Respiratory organs: a nasopharynx, lungs (a trachea, bronchial tubes, pulmonary bubbles alveolus), a pulmonary bag (pleura), - their building and functions. Respiratory movements, role of intercostal muscles and diaphragm. Gas exchange in lungs. its mechanisms (free diffusion of oxygen and carbon dioxide). Neuro and humoral regulation of breath. Artificial respiration. Diseases of a respiratory organs, their prevention. Voice device.

### Digestive system.

Digestive organs: teeth, an oral cavity, language, a gullet, a stomach, intestines (thin, thick, blind and direct guts), - their building and functions.

Digestion in various departments of a digestive tract, digestion enzymes. Absorption of products of digestion and water in intestines. A role of a liver, salivary and pancreatic glands in digestion. Bacteria and digestion. Neuro and humoral regulation of digestion. Diseases of digestive organs, their prevention. Hygiene of food.

### Skin.

Skin: the building (epidermis, a derma - actually skin, a hypodermic fatty tissue, hair, nails, sweat and sebaceous glands, nervous receptors, blood vessels), and functions. A skin role in thermal control (thickness of hypodermic cellulose, diameter and number of open capillaries, activity of sweat glands) and touch (types of nervous receptors of skin). Hygiene of skin, first aid at thermal, electric, heatstroke. Diseases of a cover system, their prevention.

### Musculoskeletal system.

Skeleton: a skull (frontal, parietal, occipital, temporal, malar, nasal, plaintive, upper and mandibular bones), a backbone (cervical, chest, lumbar, sacral and coccygeal departments, vertebrae), a thorax (vertebras, edges, a breast), a belt of the upper extremity and the upper extremities (a shovel, a clavicle, humeral, elbow and beam bones, a wrist, a shank, fingers), a girdle of lower extremity and the lower extremities (pelvic, femoral, big and small tibial bones, a patella, a tarsus with a calcaneus, an instep, fingers). Bones: structure (organic and inorganic components), the building (round and flat, tubular and spongy), growth and types of connections (motionless - a seam, semi mobile and mobile - joints) bones.

Skeletal muscles: building (connective tissue cover, sinews, muscle bundles, multinuclear muscle fibers, blood vessels, nerve terminations), properties (excitability and contractility), main groups, functions. Mimic muscles. First aid at sprains, bruises, dislocations and bone fractures. Diseases of a musculoskeletal system, their prevention.

### Metabolism and energy.

Metabolism (metabolism): plastic and energy balance (anabolism and catabolism). Metabolism of proteins, fats, carbohydrates, mineral salts and water, its value.

Vitamins (water-soluble - V of B6, Bi2, With and fat-soluble - And, D), their role in a metabolism. Diseases of a metabolism, hyper - hypo - and avitaminose, their prevention.

## Zoology

Systematization of live organisms: empires, domain, kingdoms, subkingdoms, phylums, subphylums, superclasses, classes, groups, families, order, species.

Empire Noncellular, kingdom viruses: the structure (RNA and DNA viruses, fibrous and membrane casings), a life cycle (interaction with a cell, penetration into a cell, release from covers, replication, a transcription, broadcast of virus proteins, assembly of virus particles, an exit from a cell), ecological, industrial and medical value. Viral diseases of the person. HIV (human immunodeficiency virus), ways of infection, prevention of AIDS.

Empire Cellular, domain Prokaryotes, kingdom Eubacteria: the building (a cell wall, a cellular membrane, flagellums, cytoplasm with ribosomes, the nuclear device - nucleoid), food and a metabolism (autotrophic: photo- and hemosynthetic, heterotrophs - saprophytes and parasites), life cycles (simple binary division, sporogenesis), ecological (producers, consumers and reducers), industrial (lactobacilli) and medical (intestinal microflora, causative agents of infections) value. Prevention of bacterial diseases.

Domain Eukaryotes, kingdom Animals, subkingdom Protozoa (Simplest) animals: origin, systematization, building, metabolism, life cycles, evolutionary, ecological, industrial and medical value.

Sarcomastigophore type: general characteristic. Class Sarcodic: subclasses Rhizopoda, Radiolaria and Sunfish. Sarcodic - parasites of the person (a dysenteric amoeba).

Class Flagellar (Flagellates): subclasses Animal and Vegetable flagellates. Flagellates - parasites of the person (lamblia).

Type Ciliary (Infusoria): general characteristic. Infusoria - parasites of the person (balanthidium).

Type Sporozoa: general characteristic. Sporozoa - parasites of the person (a malarial plasmodium, coccidia).

Subkingdom Metazoans: origin, systematization, building, metabolism, life cycles, evolutionary, ecological, industrial and medical value.

Phylum Coelenterates: general characteristic. Classes Hydrozoa (hydra), Scyphozoa (jellyfishes) and Coral polyps (actinium, corals). Jellyfishes, dangerous to the person.

Phylum Flat worms: general characteristic. Class Ciliary hearts (planaria). Class Flukes. Flukes - parasites of the person (liver fluke). Class Tape-worms. Tape-worms - parasites of the person (a wide tape-worm, bull and pork tapeworms, an echinococcus). Type Roundworms: general characteristic. Roundworms - parasites of the person (an ascarid, a pinworm).

Phylum Annelids: general characteristic. Classes Polychaeta (nereid), Oligochaeta (earthworm, tubifex), Bloodsuckers.

Phylum Arthropods: general characteristic.

Subphylum Gillbreathing, class Crustacea. Crustacea (a Cyclops, crayfish, crabs) - intermediate owners of parasites of the person (a wide tape-worm, a pulmonary fluke).

Subphylum Helicerata, class Arachnoid. Arachnoid - parasites of the person and carriers of infectious diseases (scabby and taiga mites). Poisonous arachnoid (scorpions, spiders: tarantula and каракурт).

Subphylum Tracheata, class Insects (groups of the Dragonfly, Coleopterous, Lepidoptera, Hymenoptera, Flies, Semi-coleoptera, Louses, Fleas). Insects - parasites of the person and carriers of diseases (louses, fleas, bugs, gadflies, mosquitoes, mosquitoes, flies, a gadfly). Poisonous insects (wasps, bees, bumblebees, hornets).

Phylum Molluscs: general characteristic. Classes Two-fold (swan mussel, pearl shell, oyster, mussel), Castropoda (pond snail, coil, grape snail, slug), Cephalopods (octopus, squid, cuttlefish). Castropoda - intermediate owners of flukes.

Phylum Chordates: general characteristic. Subphylum Acranial, class Lancelets.

Subphylum Cranial (Vertebrata).

Superclass Fish, class Cartilaginous fishes (groups of the Shark and Slopes).

Class Bony fishes, subclass Lobe-finned (groups Crossopterygians and Amphypneustic), subclass of Actinopterygians (Sturgeons, Salmonids, Sardines, Carp-like, Solf-find, Flatfishes, Perciformes groups, Eel). Bony fishes - intermediate owners of flukes (cat's and Chinese flukes) and a wide tape-worm. Poisonous and dangerous fishes (blowfishes - fish the fugue, moray eels, piranhas, slopes, sharks).

Class Amphibious (Amphibians): groups having a tail (triton, salamander), Tailless (frog, toad), Legless (limbless amphibians). Poisonous Amphibia (frog, toad, salamander).

Class Kowtowing (Reptiles): groups Scaly (lizards, snakes). Turtles, Crocodiles. Fossil reptiles. Venomous snakes (viper, adder, carpet viper, cobra, blunt-nosed viper), dangerous reptiles (crocodiles, boas).

Class Mammals (Animals): subclasses Singleparous or Oviparous (echidna, duck-bill), Marsupials (kangaroo, koala bear, etc.), Placental (groups Insectivorous, Wing-handed animals, Rodents, Harelike, Cetacea, Artiodactyl, One-hooted, Hemipterous, Predatory, Primacies). Mammals - owners of parasites of the person.

Class Birds: Apterai (Strutioniformes, Apterygiformes groups), Keeled (Sphenisciformes, Galliformes, Anseriformes, Piciformes, Colibris, Psittaciformes, Strigiformes, Gruidae, Guter-bird groups).