

Ministry of Education and Science of Ukraine
V. N. Karazin Kharkiv National University

HISTOLOGY, CYTOLOGY AND EMBRYOLOGY

Methodical guidance
for the 1st and 2nd academic years students of the School of Medicine

Electronic resource

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Methodical guidance contains basic recommendations for preparing first and second years medical students for classes and exams in the discipline “Histology, cytology and embryology”. Developed for applicants for higher medical education in higher medical educational institutions of Ukraine III-IV accreditation levels: higher educational level Second (Master of Medicine), field of knowledge “22 Healthcare”, specialty “222 Medicine”, qualification “Doctor”.

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GENERAL DESCRIPTION OF THE «HISTOLOGY, CYTOLOGY AND EMBRYOLOGY» DISCIPLINE

The «Histology, cytology and embryology» discipline occupies a very important place in the educational program of the medical faculty, because it studies the microscopic and ultramicroscopic structure of cells, tissues and organs, as well as the process of human embryogenesis. Mastering this discipline ensures the acquisition of basic knowledge, which is necessary for the successful study of special medical disciplines.

The aim of teaching the discipline «Histology, cytology and embryology» is learning the microscopic and ultramicroscopic structure of the human body structures, their development and changes in various conditions of life. Assimilation of this course provides the basic knowledge necessary for the successful study of special medical disciplines.

Interdisciplinary connections: "Histology, cytology and embryology" as an educational discipline is based on the study of medical biology and anatomy by students of higher education, and is integrated with these disciplines; lays the foundations for the study of pathological anatomy and clinical disciplines, which involves integration with these disciplines and the formation of skills to apply knowledge of histology, cytology and embryology in the process of further education, as well as in professional activities.

According to the Standard of higher education in the specialty 222 Medicine, the study of the discipline "Histology, cytology and embryology", in combination with other components of the educational and professional program, ensures that students of higher education acquire the following competencies:

General:

- Ability to think abstractly, to analyze and synthesize; ability to learn and master modern knowledge. (GC 01).
- Ability to apply knowledge in practical situations (GC 02).

- Knowing and understanding the subject area and understanding the professional activities (GC 03).
- Ability to adapt and to act properly in new situations (GC 04).
- Ability to make an informed decision; work in a team; interpersonal skills (GC 05).
- Skills in using information and communication technologies. (GC 06).
- Skills in the use of information and communication technologies; ability to search, process and analyze information from various sources (GC 07).
- Definiteness and persistence in relation to the tasks that were set and the responsibilities that were taken (GC 08).
- Ability to act socially responsibly and consciously (GC 09).
- Ability to use information and communication technologies (GC 10).
- Ability to search, process and analyze information from various sources (GC 11).
- Determination and persistence in relation to assigned tasks and assumed responsibilities (GC 12).
- Awareness of equal opportunities and gender issues (GC 13).
- The ability to realize one's rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen of Ukraine (GC 14).
- The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle (GC 15).

- The ability to make decisions and act in accordance with the principle of inadmissibility of corruption and any other manifestations of dishonesty (GC 16).

Professional:

- Ability to collect medical information about the patient and analyze clinical data (PC 1).

- Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results (PC 2).

- Ability to determine the principle and nature of treatment and prevention of diseases. (PC 6).

- The ability to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population (PC 17).

- Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results (PC 25).

According to the National Qualifications Framework and the educational and professional program of V. N. Karazin Kharkiv National University School of Medicine, applicants who have completed the educational course "Histology, cytology and embryology", must to:

- To have thorough knowledge of the structure of professional activity. To be able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy (PLO 1).

- Understanding and knowledge of fundamental and clinical biomedical sciences, at a level sufficient for solving professional tasks in the field of health care (PLO 2).

- Specialized conceptual knowledge, which includes scientific achievements in the field of health care and is the basis for conducting research,

critical understanding of the problem in the field of medicine and related interdisciplinary problems, including the system of early intervention (PLO 3).

- To search for the necessary information in the professional literature and databases of other sources, analyze, evaluate and apply this information (PLO 21).

- To apply modern digital technologies, specialized software, statistical methods of data analysis to solve complex healthcare problems. (PLO 22).

- To assess the impact of the environment on the state of human health to assess the state of morbidity of the population (PLO 23).

- To convey one's own knowledge, conclusions and arguments on health care and life issues to specialists and non-specialists clear and unambiguous (PLO 25).

TEACHING METHODS

Several classical and modern pedagogical approaches are used in teaching the discipline:

1. «Teacher-centered approach» or «direct instruction model» — conveying information to higher education students through lectures and instruction on learning.

2. «Student-centered approach» and «personalized learning», namely students'

considerable freedom and independence in choosing topics for individual tasks and expressing their own opinions during its implementation.

3. «High-tech approach», namely the use of Web technologies to support access of students to the materials of the discipline, communication with the teacher and communication with other participants in the educational process.

4. Differentiated approach to methods of memorizing information, for in process of studying the material, students use both passive (reading and taking MCQ tests, viewing the presentations and videos) and active (answering the

provided questions for self-check or control tests with written answers) methods of memorization.

THEMATIC PLAN OF THE DISCIPLINE

Characteristics of the educational discipline	
Obligatory	
Full-time education	
Year	
1st	2nd
Semester	
2nd	3rd
Lectures	
20 hours	20 hours
Practical classes	
88 hours	32 hours
Independent work	
72 hours	38 hours

SECTION I. BASICS OF CYTOLOGY

Topic 1. History of histology, cytology and embryology development. Methods of histological, cytological and embryological research.

Formation of histology, cytology and embryology as independent sciences. The significance of works by R. Hooke, A. Leuenghuka, J. Purkinje, R. Brown, M. Schliden for the cell theory creation. T. Schwann's researches. The cell theory as a fundamental generalization in biology. Clarification of the microscopic structure of tissues and organs, creation of the tissue classification.

Development of histology, cytology and embryology in Ukraine. Organization of independent departments (P.I. Peremezhko, N.L. Khrzhnchevsky). Significance of M.K. Kulchytsky, V.Ya. Rubashkina, V.V. Alyoshina, M.I. Zazibina, M.F. Kashchenko, B.I. Khvatov researches. The contemporary state of histology, cytology and embryology. The relation of histology with other medical and biological sciences.

The major principles of making a preparation for light and electron microscopy, obtaining of the material (biopsy, needle puncture biopsy, autopsy). Fixation, dehydration, paraffin processing, section preparation using microtome and ultramicrotome. The types of preparations –thin slices, smear, stamp, lamina, splits. Staining and contrasting of histological samples. The concept of histological stains. The microscopy technique in light microscopes. Special methods of light microscopy - phase-contrast, dark-field, fluorescent, interferential, laser scanning. Transmission and scanning electron microscopy. The principles of histochemistry, radioavtography, immunocytochemistry. Live cell research methods.

Quantitative methods of research - morphometry, densitometry, cytophotometry, spectrofluorometry.

Topic 2. General structural organization of the eukaryotic cell. Plasma membrane (plazmalemma). Intercellular junctions. Uncellular structures of an organism.

The concept of a cell as an elementary living system. Eukaryotic cell - as a basis for the structure, function, reproduction, development, adaptation and rehabilitation of multicellular organisms. Derivative cells as components of multicellular organisms' tissues.

The aim and tasks of cytology, its significance for medicine. The basic principles of the cellular theory at the contemporary stage of the science development.

The general plan of the eukaryotic cell structure. The interaction of structure and size of the cells and their functional specialization in the organism of animals and human.

Contemporary vision of biological membranes. Fluid mosaic model of the biomembrane structure.

Plasma membrane, epiplasmalemmal and subplasmalemmal components, their structural, chemical and functional characteristics.

Transmembrane transport of substances. Diffusion, passive and active transport. Endo- and exocytosis. Parietal digestion. Receptory functions of plasma

membrane. Micrivilli. cilia, brush border, basal invagination. Intercellular contacts, their types, structure and function, intercellular interactions.

Topic 3. Cytoplasm.

The major components of cytoplasm -hyaloplasm, organelles. inclusions.

Hyaloplasm - definition, cytosol and cytometrics, physical and chemical features, chemical composition, the significance for cellular metabolism.

Organelles - definition, classification. Organelles of general and special purpose. Membranous organelles (granular and agranular endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, mitochondria).

Topic 4. Nonmembranous organelles. Inclusions.

Nonmembranous organelles (ribosomes, centrioles, microtubules, microfilaments and intermediate filaments). Synthetic processes in the cell. Interaction of structural components of the cells during the protein and non-protein substance synthesis.

Inclusion - definition, classification, meaning.

Topic 5. Structural organization of nucleus.

The significance of the nucleus for the vital functions of the eukaryotic cell, preserving and passing of genetic information. Shape, size, quantity of nuclei, nucleo-cytoplasmic ratio in various types of cells. The major components of the nucleus: nuclear envelope, chromatin, nucleolus, karyoplasm.

The nuclear envelope, its structure and functions. The nuclear envelope membranes, perinuclear space, nuclear pores.

Chromatin Structure and chemical composition. Euchromatin and heterochromatin. Sex chromatin. Chromatin as a form of chromosome existence in the interphase nucleus. Composition of chromosomes: DNA, RNA, histone and non-histone proteins. Structure and function of chromosomes during cell division. Karyotype, polyploidy.

Nucleolus is a derivative of chromosomes. Nuclear organizers. The nucleolus structure and its role in the formation of ribosomes.

Karyoplasm, physical and chemical features, chemical composition, significance in the nucleus functions.

Topic 6. Cell reproduction, aging and death.

Life and cell cycle, their characteristics. Cells with different types of the cell cycles.

Mitosis. Biological significance. Phases of mitosis. Reorganization of structural components of the cell during different phases of mitosis. Endomitosis. Polyploidy. Intracellular regeneration. General morphofunctional characteristic, biological significance.

Cell reactions to damaging effects. Reversible and irreversible cell changes. Their morphological manifestations. Adaptation of the cells, its significance for preserving the cells' life in the conditions of changing environment. Apoptosis and its biological and medical significance. Cell aging and death.

SECTION II. BASICS OF EMBRYOLOGY

Topic 1. Human embryonic development. Germ cells. Fertilization.

The aim and tasks of embryology, its significance for medicine. Medical embryology. The ratio of onto- and phylogeny. Periodization of human embryogenesis.

Germ cells. Structure and functions of male and female germ cells, major stages of their development. Meiosis as a mechanism for the formation of germ cell. Its biological meaning. Basic stages of the embryo development. Progenesis. Fertilization.

Fertilization in humans, its biological significance, phases. Conditions necessary for normal fertilization, the phenomenon of capacitation, acrosomal reaction, penetration of sperm, formation of male pronucleus. Cortical reaction of oocyte, the end of meiosis, formation of female pronucleus. The concept of extracorporal fertilization. Its medical and social significance. Zygote as a unicellular organism.

Topic 2. Cleavage. Implantation.

Cleavage of a human embryo, its characteristics. Structure and location of the embryo during the stage of cleavage. Types of blastomeres. Morula. Blastocyst formation. Embryoblast and trophoblast. Implantation, its mechanisms, stages, chronology, features in humans.

Implantation, its mechanism, stages, chronology, particulars of human implantation.

Topic 3. Gastrulation. Histo- and organogenesis.

Gastrulation. Histo- and organogenesis. The features of the mammal embryo structure on various phases of development. Cloning of animals. Conception of biological processes making the basis of the embryo development: induction, determination, division. migration of cells, growth, differentiation, interaction of cells, destruction.

Delamination. Structures formed as a result of delamination. Early stages of the provisory organ formation, epiblast, hypoblast. Gastrulation. Formation of the embryonic mesoderm. Neurulation and appearing of the organs axial complex.

Differentiation of the germ layers and its derivatives.

Topic 4. Provisory organs. Critical periods of human development.

Provisory organs: chorion, amnion, yolk sac, allantois, umbilical cord. their Structure and role of provisory organs. Human placenta, its development, structure and function. Changes of endometrium during pregnancy, fetal membranes. «Mother-embryo» system. The concept of critical periods of embryogenesis and ontogenesis.

SECTION III. GENERAL HISTOLOGY

Topic 1. General principles of tissues organization.

The concept of tissues as a system of cells and their derivatives to be one of the hierarchical levels of the living organism's organization.

Cells and cellular derivatives as tissue elements. Formation of tissues on the basis of differentiation of the cells of the embryo. Mechanisms of histogenesis. Principles of formation and evolution of tissues, the theories of parallelism and

divergent evolution. Concept of cellular populations. Stem cells, their features. Determination and differentiation of cells, their molecular and genetic basis. Concept of histogenetic row (differenton).

Classification of tissue. Types of physiologic regeneration. Concept of reparatory regeneration and metaplasia.

Topic 2. Epithelial tissue.

Epithelial tissues and glands. General morphofunctional characteristics of the epithelium. Structural organization of epithelial layers. Cytokeratins as markers of different types of epithelial tissues. Contemporary conceptions of structure, development and function of the basement membrane. Nourishment of the epithelium. Histogenesis of epithelial tissues. Genetic and morphofunctional classifications. Structure of different types of covering epithelium.

Topic 3. Glandular epithelium. Glands.

Glandular epithelium. Structure and classification of glands. Secretory cycle. Types of secretion. Features of physiological and reparative regeneration of epithelial tissues.

Topic 4. Tissues of the internal environment. Morphology and functions of blood and lymph. Formed elements of blood.

Morphofunctional characteristic. Origin. Mesenchyme. Classification of connective tissue. The system of connective tissue as the internal environment of the organism.

Composition of blood, plasma and formed elements, functions. Characteristics of plasma.

Structure and function of erythrocytes, leukocytes, platelets. Classification of leukocytes, their role in immunological reaction of the organism.

Hemogram and leukocytic formula, their feature in newborns and children of different ages. Characteristics of lymph. Concept of physiological regeneration of blood and lymph.

Topic 5. Hemopoiesis.

Hemopoiesis and lymphopoiesis. Postnatal hemopoiesis as physiological blood regeneration. Myeloid and lymphoid tissues. Contemporary theory of haemopoiesis. Stem cell, its features. Semi-stem cells. Concept of colony forming units. Unipotent cell-precursors.

Morphologically recognizable proliferating cells-precursors, mature blood cells. Separate histogenetic rows, erythropoiesis. granulocytopoiesis. monocytopoiesis, thrombocytopoiesis. lymphopoiesis.

Embryonic hemopoieses (development of blood as a tissue), its stages (mesoblastic, hepatothymolienal, medullothymolymphoid).

Topic 6. Connective tissue proper.

General characteristics. Classification. Fibrous connective tissue, its types – loose and dense.

Characteristics of loose connective tissue. Cellular composition of loose connective tissue (fibroblasts, macrophages, plasmocytes, mast cells, adipocytes, pigment and adventitial cells).

Intercellular matrix of loose connective tissue, fibers (collagen, reticular, elastic fibers) and ground substance.

Macrophages and mononuclear phagocyte system of human organism. Cells interactions during inflammation.

Dense fibrous connective tissue, its types – irregular and regular, its location, structure and function. Structure of tendon.

Topic 7. Connective tissue with special features.

Connective tissue with special features, reticular, adipose (white and brown), pigment and mucous, its location, structure and functions.

Topic 8. Cartilage.

General plan of structure and function. Cellular elements (chondroblasts, chondrocytes). Isogenous groups. Intercellular matrix, its histochemical features. Types of cartilage (hyaline, elastic cartilage and fibrocartilage). Perichondrium, its significance for the cartilage nutrition, growth and regeneration. Histogenesis of cartilage.

Topic 9. Bones.

General structure and function. Types of bone tissue. Primary and secondary bone. Cells of bone tissue: osteoblasts, osteocytes and osteoclasts. Intercellular matrix, its composition (fibers and ground substances), physical and chemical characteristics. Structure of bone as organ. Periosteum, its role in bone nutrition, growth and regeneration.

Topic 10. Growth and formation of bones.

Intramembranous and enchondral bone formation. Bone remodeling during body growth. Influence of different factors on bone growth.

Joints of bones. Classification. Histological structure of joints (articular cartilage, capsule and synovial fluid).

Topic 11. Muscle tissue. Striated muscles.

General morphofunctional characteristics of muscle tissues, genetic and morphological classification.

Skeletal striated muscle tissue (somatic type). Localization, histogenesis, functional features. Muscle fiber as a structural and functional unit of tissue. Structure of myofibril.

Myosatellite cells. Sarcoplasmic reticulum. T-tubules. Types of muscle fibers, the relationship between excitation and contraction of muscle fibers. Muscle as an organ. Mion. Endomysium, perimysium, epimysium. Regeneration of skeletal muscle tissue.

Topic 12. Cardiac muscle tissue. Smooth muscle tissue.

Cardiac muscle tissue (coelomic type). Morphological structure and functions of cardiac muscle tissue. Origin and particularities of histogenesis. Morphofunctional features of typical (contractile), atypical (conducting) and secretory cardiomyocytes. Conducting system of the heart. Opportunities of cardiac muscle regeneration.

Smooth muscle tissue of mesenchymal origin. Histogenesis, structure, morphofunctional and histochemical characteristics.

Myocyte. Organization of contractile apparatus. Regeneration of the smooth muscle tissue. Smooth muscle tissue of the epidermal and neural origin.

Topic 13. Nervous tissue.

General morphofunctional characteristic. Histogenesis. Neurocytes (neurons). Morphological and functional classification. The structure of pericarion, axon, dendrites. Organelles of general and special significance. Transport processes of substances in neuron. Concept of neurotransmitters. Secretory neurons.

Neuroglia. General characteristics, classification. Neuroglia in the central nervous system. Macroglia (ependymocytes, astrocytes, oligodendrocytes). Microglia. Gliocytes in peripheral nervous system.

Topic 14. Nerve fibers. Nerve endings.

Nerve fibers. General characteristics, classification. Myelinated and unmyelinated fibers. Degeneration and regeneration of nerve fibers.

Nerve endings. General morphofunctional characteristics. Receptors and effectors, their classification and structure. Concept of synapse. Interneuronal synapses (classification, structure, mediators). Mechanism of action potential transport via synapses. Morphological substrate of the reflector activity of the nervous system (concept of simple and complicated reflex arcs). Neuronal theory.

SECTION IV. SPECIAL HISTOLOGY

Subsection Special histology of regulatory and sensory systems

Topic 1. Nervous system. Spinal nodes. Nerve.

General morphofunctional characteristics. Embryogenesis. Classification (anatomical and functional). Central nervous system. Gray and white matter. Nervous centers. Meninges. Peripheral nervous system. Sensory ganglia (cranial and spinal nerves). Source of development. Tissue composition. Structure. Location of ganglia in the reflex arc. Structure of the nervous columns. Structure. Location of ganglia in the reflex arc. Structure of the nervous columns. Features of their reactions to injury, processes of regeneration. Nervous endings. Somatic and

autonomic nervous system. General morphological and functional characteristics of autonomic nervous system, division into sympathetic and parasympathetic parts. Concept of metasympathetic nervous system. Nuclei of the central parts of the autonomic nervous system. Structure of the autonomic nervous ganglia. Pre-ganglion and post-ganglion fibers.

Topic 2. Spinal cord. Autonomic nervous system.

Spinal cord. General morphofunctional characteristic. Structure of the gray matter. Neuronal composition. Nuclei. Local apparatus of the reflex activity. Anterior and posterior roots. White matter. Spinal Tracts.

Topic 3. Brain.

Brain. General characteristics, development. Brain stem. Medulla. The most important associative nuclei. Reticular formation. Diencephalons. Thalamus nuclei. Hypothalamus, the main nuclei. Functions of the diencephalons. Cerebral cortex. General morphofunctional characteristic. Cytoarchitecture: neuronal composition, layers of the cerebral cortex, Concepts about brain modules (barrels, columns). Inter-neuronal connections. Myeloarchitectonics. Gliocytes. Blood - brain barrier, structure, functions.

Topic 4. Cerebellum.

Cerebellum. Structure and functions. Gray and white matter. The layers of the cerebellar cortex, their neuronal composition. Inter-neuronal connections. Afferent and efferent fibers. Glial cells.

Topic 5. Sense organs. Visual organ.

General characteristics of sensory organs. Sensory systems doctrine. Classification of sensory organs by origin and structure of receptor cells.

Visual organ. General characteristics. Embryogenesis, general plan of the eyeball structure. Layers of the eye, chambers and derivatives. Main functional apparatuses: dioptric, accommodative, receptor. Photoreceptor cells. Neurons and glia cells of the retina. Structure of the macula lutea and the blind spot. Optic nerve. Hemato-ophthalmic barrier. Auxiliary eye apparatus. Age changes.

Topic 6. Olfactory organ. Organ of taste.

Olfactory organ. General characteristics. Embryogenesis. Localization. Olfactory receptor cells. Supportive and basal cells. Histophysiology of the organ of smell. Vomero-nasal organ.

Organ of taste. General morphofunctional characteristics and embryogenesis. Taste buds, their localization and structure. Taste, support and basal cells. Histophysiology of the organ of taste.

Topic 7. Organ of hearing and equilibrium.

The organ of hearing and equilibrium. General morphofunctional characteristics. External, middle and inner ear. Bone and membranous labyrinths. Vestibular part of the membranous labyrinths: utricle and saccule, semicircular canals, their receptor zones: macula and ampulla. Hair and supporting cells. Otolithic membrane and cupula. Cochlea part of membranous labyrinth. Organ of Corti. Hair and supporting cells. Histophysiology of the vestibular and auditory apparatus. Embryogenesis of the hearing and balance organs. Age changes.

Topic 8. Skin and its derivatives.

Skin. General morphological and functional characteristics. Tissue composition of skin. Regeneration. Epidermis. Epidermal layers, feature of structure of the "thick" and "thin" skin. Keratinocytes. Processes of keratinization in the epidermis. Epidermal differentiation of macrophages and melanocytes. Tactile epitheliocytes. Derma. Papillary and reticular layers. Features of the derma structure in various regions of the skin. Skin glands: sebaceous, sweat and mammary glands (structure, histophysiology). Hair. Development, structure, growth, changes of hair. Nails. Development, structure, growth.

Topic 9. Cardiovascular system. Arteries. Veins. Microcirculatory bed. Lymphatic vessels.

General characteristics. Sources and course of embryonic development. Classification of vessels. Dependence the vessel wall structure on hemodynamics conditions. Age changes. General plan of the structure of vascular wall. Artery. Types of the arteries (elastic, muscular and small). Organ features of arteries. Microcirculatory bed. Hemocapillaries. The structure of the endothelium.

Arteriovenous anastomosis. Vein, its feature comparing to artery. Classification of veins. Structure of venous valves. Organ features of veins. Lymphatic vessels. Classification, structure of the lymphatic vessels of various types. Features of structure of lymphatic capillaries and post-capillaries, participation in microcirculation.

Topic 10. Heart.

Embryogenesis. General structure of the heart wall. Endocardium, heart valves. Myocardium. Features of the structure and functions of cardiac muscle. Source of development, peculiarities of histogenesis. Morphofunctional characteristic of contractile, conductive and secretory cardiomyocytes. Conductive system of heart. Possibility of regeneration of the heart muscle tissue. Structure of epicardium and pericardium. Heart of the newborn. Reconstruction, development and aging changes after birth.

Topic 11. Endocrine system. Hypothalamus. Hypophysis. Epiphysis.

General morphofunctional characteristic. Concept of hormones and their significance for the organism. Cells-targets and receptors of hormones. Mechanism of hormones action. Principles of the feedback regulation. Classification of the endocrine glands. Central and peripheral endocrine glands Neuroendocrine system of regulation of body functions Hypothalamus. Nuclei of the anterior and mediobasal regions of hypothalamus as a central part of the endocrine system. Structure and function of the neurosecretory cells. Hypothalamo-neurohypophysial and hypothalamo-adrenohypophysial systems and their organs (neurohypophysis, medial eminence). Liberines and statins.

Epiphysis. Structure, cellular composition, connection with other endocrine glands. Hormones and their action. Development, age changes. Hypophysis. Embryogenesis of adeno- and neurohypophysis. Structure, cellular composition of adenohypophysis. Morphofunctional characteristic of endocrinocytes, their changes in hormonal imbalance. Hypothalamo-adrenohypophysial vascular system, its role in the hormone transport. Structure and functions of

neurohypophysis, its role in releasing hormones of the anterior hypothalamus into bloodstream. Age changes.

Topic 12. Thyroid gland. Parathyroid gland. Adrenal glands.

Thyroid gland. Development, structure, cellular composition. Follicles. Folliculogenesis. Morphofunctional characteristics of the follicular cells. Structure, hormones and their action. Feature of the secretory cycle. Reconstruction of follicles in response to different functional activity. Parafollicular cells, sources of development, location, hormones and their action.

Parathyroid gland. Development, structure and cellular composition. parathormone, its role in the mineral metabolism regulation.

Adrenal gland. Embryogenesis. Fetal and definitive cortex of the adrenal glands. Zones of cortex, its structure. Morphofunctional characteristic of endocrinocytes. Role of the hormones of adrenal cortex in development of the general adaptation syndrome. Adrenal medulla (structure, cellular composition, hormones and their action).

Single hormonal producing cells of the non-endocrine organs. Classification according to origin. Cells of the APUD-system. location, hormones and their action.

Topic 13. Organs of hemopoiesis and immune defense. Red bone marrow. Thymus.

General morphofunctional characteristics and classification.

Red bone marrow. Localization, structure and functions: stroma, parenchyma, vascularization. Yellow bone marrow. Age changes. Regeneration.

Thymus as the central organ of T-lymphopoiesis. Lobules: cortex and medulla, thymic corpuscles. Features of vascularization. Age- related and accidental evolution, thymico-lymphatic status.

Topic 14. Spleen. Lymph nodes. Mucosa-associated lymphoid tissue.

Structure and functions of the spleen, stroma and parenchyma, white and red pulp. T- and B-zones of white pulp. Features of blood supply. Structure and function of venous sinuses of the spleen. Regeneration possibilities of the spleen.

Lymph nodes. Structure and functions: stroma and parenchyma, cortex and medulla. T- and B-zones. Paracortical zone. System of sinuses. Histophysiology of lymph nodes. Regeneration.

Hemolymph nodes. Features of the structure and function.

Diffuse lymphoid tissue: lymphatic nodules in the walls of respiratory passages, the alimentary canal and other organs.

Subsection Special histology of internal organs system

Topic 15. Digestive system.

General morphological and functional characteristics. Embryogenesis. Division into sections according to development, structure and functions. Structure of the alimentary channel wall.

Characteristics of the layers, their tissue composition and features in various parts of the alimentary channel. Innervations and vascularization of the digestive tract. Glands of the digestive tract, their location, structure and function. Concept of gastro-enteropancreatic endocrine system, its significance for the organism.

Oral cavity. Features of the mucosa in accordance to functions. Lips, cheek, gums, soft and hard palate, tonsils and tongue.

Teeth. Tooth tissue, their division according to anatomic parts. Enamel, dentine, cement – structure, chemical composition and functions. Pulp of tooth, structure, functions. Periodont. Development of teeth. Milk teeth and permanent teeth. Age-dependent changes of teeth. Large salivary glands. Structure, histophysiology, exo- and endocrine functions.

Topic 16. Pharynx. Esophagus. Stomach.

Pharynx and esophagus. Features of mucosa structure. Glands of the esophagus, location and histophysiology. Features of the structure of the esophagus wall on various levels. Age changes.

Stomach. Structure of the wall, its tissue composition. Feature of the mucosa relief and its epithelial pavement, differences in the various parts of the organ. Localization, structure and cellular composition of glands.

Exo- and endocrinocytes of various types. Histophysiology of the secretory cells. Regeneration of the stomach epithelium. Age changes.

Topic 17. Small and large intestine.

Small intestine. General characteristics of different anatomic parts, structure of the wall. Feature of the mucosa relief. Crypt-villus system. Varieties of the epitheliocytes, their structure and functions. Histophysiology of digestion. Significance of microvilli of the columnar epitheliocytes in the parietal digestion. Features of the structure of duodenum, jejunum and ileum. Aggregated lymphatic nodules in the ileum. Regeneration of the intestine epithelium. Age changes.

Large intestine. Structure of the wall. Features of the mucosa relief. Histophysiology of the large intestine. Appendix, its structure and function. Rectum, its parts and morphofunctional features. Age changes.

Topic 18. Liver. Pancreas.

Liver. Morphofunctional characteristic. Feature of the vascularization. Structure of the classic liver lobe. Intra-lobular hemocapillaries. Liver balks. Hepatocytes, its structure and functions. Bile capillaries. Space of Disse space, fat-storing cells, their structure and functions. Concept of the liver acinus and portal lobe. Gall bladder and excretory bile pathways.

Pancreas. General morphofunctional characteristic. Structure of the exocrine and endocrine parts. Acinus as a structure-functional unit of the exocrine part of the pancreas. Features of the morphology and function of the adenocytes. Centro-acinar cells. Structure of the excretory ducts. Types of the cells of the pancreas islets, their morphofunctional characteristics. Acinous-islet cells. Age changes.

Topic 19. Respiratory system.

General morphofunctional characteristic. Conducting and respiratory portions. Structure of the walls of the conducting portion: mucosa, submucosa, fibro-cartilaginous layer, external (adventitia) layer.

Part of conducting portion: nasal cavity, larynx, trachea, bronchi (main, large, middle and small size), terminal bronchi, its structure and function. Concept of bronchi-associated lymphoid tissue, its significance for the organism.

General plan of the lung structure. Concept of the lung lobulus. Acinus as the structure-functional unit of respiratory part of lungs.

Structure of the alveoli, cellular composition of its pavement. Surfactant complex. Blood-air barrier. Pleura. Regeneration potential of the respiratory organs. Age changes.

Topic 20. Urinary system.

Urinary organs. General morphofunctional characteristic. Embryogenesis. Age changes. Kidneys. Cortex and medulla. Nephron as a structure -functional unit of the kidneys. Types of the nephron. Parts of the nephron, its histophysiology. Structure and function of the kidney corpuscle, filtrate barrier. Features of the kidney vascularization- cortical and juxtamedullary system of vascularization. Endocrine apparatus of kidney. Juxtaglomerular complex, its structure and functions. Regeneration potency of kidney.

Excretory urinary pathways, structure of the kidney pelvises, calices. urinary bladder, ureters, urethra.

Topic 21. Male reproductive system.

General characteristics. Embryogenesis. Testis, its structure and function. Seminiferous tubules, structure of its wall. Spermatogenesis. Endocrinocytes of testis, their function. Blood-testis barrier. Age changes.

Excretory ducts. Epididymis. Ductus deference. Seminal vesicles. Ductus ejaculatory. Prostate. Age changes. Penis, its structure, vascularization and innervations.

Topic 22. Female reproductive system.

Ovary, development of its reproductive and endocrine function. Cortex and medulla. Oogenesis, its differences from spermatogenesis. Development and structure of follicles. Ovulation. Development of the corpus luteum, types. Ovarial cycle, its regulation. Atresia of the follicles. Age-dependent features of the ovarian structure.

Uterine tubes. Structure and functions.

Uterus. Structure of the wall (endometrium, myometrium and perimetrium). Menstruation, its phases. Structure of endometrium during different phases of menstruation. Connection of the menstruation and ovarian cycle. Influence of the hypophysis hormones and action of the hypothalamic centers of regulation of the ovarian-menstruation cycle. Reconstruction of the uterus during pregnancy and after childbirth. Age changes. Vagina. Structure of the wall, changes of structure in connection with the menstruation cycle. Mammary gland. Structure and functions.

Independent work

The student's independent work involves the implementation of tasks in the Workbook and the tasks of distance-learning courses.

Typical tasks for independent work in a Workbook are: 1) providing written answers to control questions, 2) drawing diagrams and specimens, 3) labelling diagrams.

Type 1 tasks (written answers to control questions) are usually part of the homework and performed by a student during preparation for practical class. Type 2 - 3 tasks can be a component of homework or performed by a student directly in practical classes (specific type of work is determined by the teacher).

Tasks of distance courses: work with Web-resources on the topic, execution of graphic notes, performance testing tasks of closed and open type, including illustrated tests, which demonstrate the microscopic structure of human body structures.

Completion of distance-learning tasks and Workbook is compulsory. The grade for the topic can be obtained by a student only on condition of correct performance of all tasks in the Workbook and distance-learning tasks.

Name of topic / section

Section I. Basics of Cytology

Microscope. Microscopic equipment. Histological technique. Methods of histological investigation.

General organization of the cell. Plasma membrane (plasmalemma).

Intercellular junctions. Uncellular structures of an organism.

Cell cytoplasm: Hyaloplasm. Membranous organelles.

Non-membranous organelles. Inclusions.

Structural organization of nucleus.

Cell reproduction. Cell aging and death.

Section II. Basics of Embryology

Human embryogenesis. Germ cells. Fertilization.

Cleavage. Implantation.

Gastrulation. Histo- and organogenesis.

Extraembryonic membranes. Critical periods of human development.

Section III. General Histology

General principles of tissues organization.

Epithelial tissues.

Glandular epithelium. Glands.

Tissues of internal environment. Morphology and functions of blood and lymph.
Formed elements of blood.

Hemopoiesis.

Connective tissue proper.

Connective tissue with special features.

Cartilages.

Bone.

Growth and formation of bones. Histological structure of joints.

Muscle tissues. Striated muscle.

Cardiac muscle tissue. Smooth muscle tissue.

Nervous tissue. Neurons. Neuroglia.

Nerve fibers. Nerve endings.

Section IV. Special Histology

Nervous system. Spinal ganglions. Nerve.

Spinal cord. Autonomic nervous system.

Brain.

Cerebellum.

Sense organs. Organ of vision.

Olfactory organ. Organ of taste.

Organ of hearing and equilibrium.

Skin and its derivatives.

Cardiovascular system. Arteries. Veins. Microcirculatory bed. Lymphatic vessels.

Heart.

Endocrine system. Hypothalamus. Hypophysis. Epiphysis.

Thyroid gland. Parathyroid glands. Adrenal glands.

Organs of hemopoiesis and immune defense. Red bone marrow. Thymus.

Spleen. Lymph nodes. Mucosa associated lymphoid tissue.

Digestive system. Development and structure of oral cavity organs. Structure and development of teeth. Large salivary glands.

Pharynx. Esophagus. Stomach.

Small and large intestine.

Liver. Pancreas.

Respiratory system.

Urinary system.

Male reproductive system.

Female reproductive system.

CONTROL METHODS

To determine the level of formation of knowledge and skills in the educational discipline "Histology, cytology and embryology" written and oral control is provided.

Written control is carried out in the form of testing using test tasks of various types (illustrated tests, closed and open type tests, including from the question base of the integrated test exam KROC-1 and banks of test tasks of distance courses in the discipline "Histology, cytology and embryology").

Oral control in the form of an interview is carried out after the student of higher education has completed all educational activities by topic/section.

According to the curriculum for the discipline "Histology, cytology and embryology", the following stages of control are defined: current control (control of mastering the topic and control of the section) and final semester control (differentiated assessment/semester exam).

Current control is carried out during the semester at practical classes in the discipline.

The final semester control (differentiated assessment/semester exam) determines the degree of achievement of higher education students in the planned learning outcomes determined by the work program of the academic discipline.

Differentiated assessment (final assessment work) is carried out after the end of studying the topics of the II semester, before the beginning of the examination session.

The semester exam is held during the exam session (III semester).

Examples of MCQs for the Current control in the discipline "Histology, cytology and embryology"

Cytology

1. Electron microscopic study of a cell revealed roundish bubbles confined by a membrane and containing a lot of various hydrolytic enzymes. It is known

that these organelles provide intracellular digestion and protective functions. These elements are:

- a. Lysosomes
- b. Centrosomes
- c. Endoplasmic reticulum
- d. Ribosomes
- e. Mitochondria

2. A 50-year-old woman had her tooth extracted. The tissue regenerated.

Which of the following organelles are the most active during tissue regeneration?

- a. Ribosomes
- b. Centrosomes
- c. Mitochondria
- d. Agranular endoplasmic reticulum
- e. Lysosomes

3. Formation of ribosome subunits in a cell was disturbed in course of an experiment (by means of activated mutagenic factors). This will have an effect on the following metabolic process:

- a. Protein biosynthesis
- b. Carbohydrate biosynthesis
- c. ATP synthesis
- d. Photosynthesis
- e. Biological oxidation

4. What are the folds on the inner mitochondrial membrane called?

- a. Plasmalemma
- b. Glycocalyx
- c. Protoplasm
- d. Cristae
- e. Ground substance

5. Which organelle is involved in lipid metabolism?

- a. Rough endoplasmic reticulum

- b. Smooth endoplasmic reticulum
 - c. Lysosome
 - d. Golgi apparatus
 - e. Mitochondria
6. Which organelle contains detoxifying enzymes?
- a. Ribosomes
 - b. Peroxisome
 - c. Microfilaments
 - d. Centrioles
 - e. Nucleoli
7. Which of the following is NOT a membranous organelle?
- a. Microtubules
 - b. Lysosomes
 - c. Peroxisomes
 - d. Mitochondria
 - e. Endoplasmic reticulum
8. What is the limiting membrane of a cell?
- a. Plasmalemma
 - b. Glycocalyx
 - c. Protoplasm
 - d. Cristae
 - e. Ground substance
9. What is also called a low resistance junction?
- a. Tight junction
 - b. Gap junction
 - c. Junctional epithelium
 - d. Junctional complex
 - e. None of the above
10. Which of the following is an organelle?
- a. Pigment

- b. Glycogen
- c. Lipid
- d. Secretory granules
- e. Mitochondria

Embryology

1. While examining the amniotic fluid collected with the help of amniocentesis (puncture of amniotic membrane) cells with sex chromatin containing nuclei (Barr's bodies) were detected. What does this fact indicate?

- a. Development of a female fetus
- b. Development of a male fetus
- c. Genetic disorders in embryonic development
- d. Trisomy
- e. Polyploidy

2. Blue asphyxia of a newborn child has been diagnosed. What vessel carrying oxygenated maternal blood to the fetus has been pinched during delivery?

- a. Chorionic artery
- b. Umbilical artery
- c. Chorionic vein
- d. Umbilical vein
- e. Uterine artery

3. Two sacs contacting with each other (amniotic and yolk) can be seen in a 10-day embryo specimen. What is the structure in the place of their contact called?

- a. Amniotic crus
- b. Bottom of the amniotic sac
- c. Roof of the yolk sac
- d. Embryonic plate
- e. Extraembryonic mesoderm

4. In a histological specimen is observed an extraembryonic organ that represents a bladder connected with intestinal tube. Its wall is covered with epithelium on the inside, on the outside it is formed of embryonic connective

tissue. At early stages of embryogenesis, it functions as a hematopoietic organ.

What organ is this?

- a. Amnion
- b. Allantois
- c. Yolk sac
- d. Umbilical cord
- e. Uterine artery

5. At early stages of human embryogenesis there arises a digitiform outgrowth of the ventral wall of the primitive gut rooting itself in the amniotic crus. What is the name of this extraembryonic organ?

- a. Yolk sac
- b. Allantois
- c. Amnion
- d. Placenta
- e. Umbilical cord

6. In the histological specimen of a human fetus there can be seen one of extraembryonic organs – a bladder linked with intestinal tube. In its wall there are primary germ cells and primary erythrocytes (megaloblasts). Define what this organ is.

- a. Yolk sac
- b. Allantois
- c. Placenta
- d. Umbilical cord
- e. Amnion

7. In the course of the experiment D a frog embryo the external embryonic layer – ectoderm – has been destroyed. Which of the following morphological structures has not developed henceforth?

- a. Epidermis
- b. Somites- mesoderm
- c. Nephrotome – intermediate mesoderm

d. Splanchnotome – lateral plate mesoderm

e. Myotome - somite

8. In a histological specimen there is a hen embryo in the stage of mesoderm differentiation to somites, nephrotomes, and splanchnotome. Of which material will the axial skeleton develop?

a. Myotome – muscle: trunk and limb

b. Dermatome - dermis

c. Nephrotomee – the kidney

d. Splanchnotome – nephrotome and gonadotome

e. Sclerotome – vertebra and ribs

9. Zygote cell-division finishes after blastula formation. What type of blastula is specific of a human being?

a. Discoblastula.

b. Celoblastula.

c. Blastocyst.

d. Amphiblastula.

e. Morula.

10. During the third week of embryo-genesis the central part of epiblast cells (ectoderm) sags and neurulation process begins. In which direction will the remaining ectodermal cells differentiate?

a. Gut

b. Skin

c. Somites – myo ; dermo ; sclero

d. Choroid

e. Yolk sac

Epithelial tissue and glands

1. Which one of the following statements about the desmosome is true?

a. It is sometimes called a nexus

b. It permits the passage of large proteins from one cell to an adjacent cell

c. It has a plaque made up of many connexons

- d. It facilitates metabolic coupling between adjacent cells
- e. It is a disk-shaped adhesion site between epithelial cells

2. A medical student who has chronic lower respiratory infections seeks the advice of an ear,

nose, and throat specialist. A biopsy of the student's respiratory epithelium reveals alteration in certain epithelial structures. This patient is most likely to have abnormal:

- a. microvilli
- b. desmosomes
- c. cilia
- d. hemidesmosomes
- e. basal plasmalemma infoldings

3. Which one of the following statements about the gap junction is true?

- a. It extends as a zone around the apical perimeter of adjacent cells
- b. It possesses dense plaques composed in part of desmoplakins
- c. It permits the passage of ions from one cell to an adjacent cell
- d. Its adhesion is dependent upon calcium ions
- e. It possesses transmembrane linker glycoproteins

4. Which one of the following statements about glands is true?

- a. Exocrine glands lack ducts
- b. Simple glands have ducts that branch
- c. Endocrine glands secrete into ducts
- d. Serous secretions are watery
- e. Holocrine glands release their contents by exocytosis

5. Which one of the following statements about epithelia is true?

- a. They are polarized
- b. They are vascular
- c. They are completely surrounded by a basal lamina
- d. They contain wide intercellular spaces
- e. They are not part of the wall of blood vessels

Connective tissue

1. Which one of the following statements regarding collagen is true?
 - a. It is composed of tropocollagen
 - b. Reticular fibers are composed of type II collagen
 - c. It is synthesized mostly by mast cells
 - d. Elastic fibers are composed of type I collagen
 - e. Type II collagen is most common in connective tissue proper
2. Dense regular connective tissue is present in
 - a. Capsules of organs
 - b. Basement membrane
 - c. Tendons
 - d. Skin
 - e. Dermis
3. Of the following cell types found in connective tissue, which is most often present along capillaries and resembles fibroblasts?
 - a. Plasma cell
 - b. Lymphocyte
 - c. Macrophage
 - d. Mast cell
 - e. Pericyte
4. Synovial fluids of normal joints are usually devoid of collagen. Patients with rheumatoid diseases have various types of collagen in their synovial fluid, depending on the tissue being damaged. If a patient has type II collagen in the synovial joint, which of the following tissues is being eroded?
 - a. Vascular endothelium
 - b. Compact bone
 - c. Vascular smooth muscle
 - d. Articular cartilage
 - e. Synovial membrane

5. Which one of the following cell types arises from monocytes?

- a. Plasma cells
- b. Fibroblasts
- c. Lymphocytes
- d. Macrophages
- e. Mast cells

Blood

1. Examination of a normal peripheral blood smear reveals a cell more than twice the diameter of an erythrocyte with a kidney-shaped nucleus. These cells are < 10% of the total leukocytes. Which of the following cell types is being described?

- a. Monocyte
- b. Basophil
- c. Eosinophil
- d. Neutrophil
- e. Lymphocyte

2. Which of the following is an immunocompetent cell?

- a. Red blood cell
- b. Lymphocyte
- c. Platelet
- d. Neutrophil
- e. Basophil

3. Which of the following is derived from myeloblasts?

- a. Red blood cell
- b. Lymphocyte
- c. Platelet
- d. Monocyte
- e. Basophil

4. Which one of the following cells is associated with antibody production?

- a. Red blood cell

- b. Lymphocyte
- c. Monocyte
- d. Neutrophil
- e. Basophil

5. Which of the following possesses specific and azurophilic granules?

- a. Red blood cell
- b. Lymphocyte
- c. Platelet
- d. Neutrophil
- e. Monocyte

Cartilage

4. Which one of the following statements concerning hyaline cartilage is correct?

- a. It is vascular
- b. It contains type IV collagen
- c. It undergoes appositional growth only
- d. It is located at the articular ends of long bones
- e. Its chondrocytes are aligned in rows

2. Which type of cartilage is found in the larynx?

- a. Hyaline cartilage
- b. Elastic cartilage
- c. Fibrocartilage
- d. Both a and b
- e. All of the above

3. Which of the following is NOT a glycosaminoglycan in cartilage?

- a. Chondroitin sulfate
- b. Proteoglycans
- c. Keratan sulfate
- d. Hyaluronic acid
- e. All of the above are glycosaminoglycans in cartilage

4. Which type of cartilage is characterized by a glassy matrix?
- a. Hyaline cartilage
 - b. Elastic cartilage
 - c. Fibrocartilage
 - d. All of the above
 - e. None of the above
5. Which type of cartilage is characterized by the presence of chondrocytes sitting in lacunae?
- a. Hyaline cartilage
 - b. Elastic cartilage
 - c. Fibrocartilage
 - d. All of the above
 - e. None of the above

Bone

1. Which of the following statements characterizes osteoclasts?
- a. They are enucleated cells
 - b. They produce collagen
 - c. They secrete osteoid
 - d. They are derived from osteoprogenitor cells
 - e. They occupy Howship lacunae
2. Which one of the following statements is correct concerning the periosteum?
- a. It is devoid of a blood supply
 - b. It produces osteoclasts
 - c. It is responsible for interstitial bone growth.
 - d. Its inner layer contains osteoprogenitor cells
 - e. Its outer layer is devoid of fibers
3. Which one of the following statements is characteristic of osteocytes?
- a. They communicate via gap junctions between their processes
 - b. They contain large amounts of RER

- c. They are immature bone cells
 - d. They are housed as isogenous groups in lacunae
 - e. They give rise to osteoclasts
4. Which of the following statements is characteristic of bone?
- a. Bone matrix contains primarily type II collagen
 - b. About 65% of the dry weight of bone is organic
 - c. Haversian canals are interconnected via Volkmann canals
 - d. Bone growth occurs via interstitial growth only
 - e. Bone growth occurs via appositional growth only
5. Which component of bone impedes the distribution of nutrients and oxygen to osteocytes?
- a. Extracellular matrix
 - b. Canaliculi
 - c. Periosteum
 - d. Cell processes
 - e. Haversian canals

Muscle

1. Which of the following is true for mammalian skeletal muscle?
- a. T tubules are located at the Z disk
 - b. T tubules are absent
 - c. Troponin is absent
 - d. It possesses triads
 - e. It possesses caveolae
2. Which of the following is true for cardiac muscle?
- a. T tubules are located at the Z disk
 - b. T tubules have a smaller diameter than those of skeletal muscle
 - c. Troponin is absent
 - d. It possesses triads
 - e. Oxytocin triggers contraction
3. Which of the following is true for smooth muscle?

- a. T tubules are located at the Z disk
 - b. It possesses dyads
 - c. Caveolae store and release calcium ions
 - d. It possesses triads
 - e. T tubules are located at the A-I interface
4. Contraction in all types of muscle requires calcium ions. Which of the following muscle components can bind or sequester calcium ions?
- a. Rough endoplasmic reticulum
 - b. Tropomyosin
 - c. Troponin
 - d. Active sites on actin
 - e. Titin
5. Each smooth muscle cell
- a. Has triads associated with its contraction
 - b. Has dyads associated with its contraction
 - c. Possesses a single central nucleus
 - d. Is characterized by the absence of sarcolemmal vesicles
 - e. Contains troponin

Nervous Tissue

1. Nissl bodies are composed of
- a. synaptic vesicles and acetylcholine
 - b. polyribosomes and rough endoplasmic reticulum
 - c. lipoprotein and melanin
 - d. neurofilaments and microtubules
 - e. SER and mitochondria
2. The axon hillock contains
- a. rough endoplasmic reticulum
 - b. ribosomes
 - c. microtubules
 - d. Golgi complex

- e. synaptic vesicles
3. Synaptic vesicles possess which of the following characteristics?
- a. Manufacture neurotransmitter
 - b. Enter the synaptic clef
 - c. Become incorporated into the presynaptic membrane
 - d. Become incorporated into the postsynaptic membrane
 - e. Release neurotransmitter via endocytosis
4. Myelination of peripheral nerves is accomplished by
- a. astrocytes.
 - b. oligodendrocytes.
 - c. Schwann cells.
 - d. neural crest cells.
 - e. basket cells
5. Which of the following is characteristic of the chromatophilic material called Nissl substance in neural tissue?
- a. Found throughout neurons
 - b. Site of mRNA translation for proteins of the axolemma
 - c. Most abundant in unipolar neurons
 - d. Becomes more abundant as an individual gets older
 - e. An example of intermediate filament proteins

Nervous System

1. Which of the following is an element of the peripheral nervous system?
- a. Receptors
 - b. Brachial plexus
 - c. Ganglia
 - d. Sciatic nerve
 - e. All of the above
2. What are the conglomerations of gray matter deep within the cerebrum and cerebellum called?
- a. Tracts

- b. Islets
 - c. Soma
 - d. Cortex
 - e. Nuclei
3. Where is the cerebrospinal fluid?
- a. Between the dura mater and bone
 - b. Subdural space
 - c. Subarachnoid space
 - d. Between the pia mater and brain
 - e. None of the above
4. Which of the following are considered to be part of the meninges?
- a. Dura mater
 - b. Arachnoid
 - c. Pia mater
 - d. Both a and c
 - e. All of the above
5. What is the outer gray matter of the brain called?
- a. Tracts
 - b. Islets
 - c. Soma
 - d. Cortex
 - e. Nuclei

Sense Organs

1. What are neurons in the retina?
- a. Unipolar
 - b. Pseudounipolar
 - c. Bipolar
 - d. Multipolar
 - e. Both a and b
2. Which structure is transparent?

- a. Choroid
 - b. Ciliary body
 - c. Iris
 - d. Ora serrata
 - e. Cornea
3. Which of the following is the receptor for color?
- a. Rods
 - b. Cones
 - c. Bipolar cells
 - d. Ganglion cells
 - e. Horizontal cells
4. What is responsible for adjusting the lens?
- a. Choroid
 - b. Ciliary muscle
 - c. Iris
 - d. Ora serrata
 - e. Sclera
5. Which of the following is a type of neuron?
- a. Rods
 - b. Ganglion cells
 - c. Cones
 - d. Pigmented epithelium
 - e. Supporting cells

Integumentary System

1. In the histological specimen you can see a skin. Which layers does this organ include? Which layers compose this organ?
- a. Epidermis, dermis and hypoderma
 - b. Simple columnar epithelium and derma
 - c. Mucosa, submucosa and muscularis externa
 - d. Tunica intima, tunica media and tunica adventitia

- e. Mucosa, muscularis externa and serosa
2. An organ presented in the histological specimen consists of epidermis and derma. Which organ is found in the specimen?
- a. Liver
 - b. Esophagus
 - c. Skin
 - d. Tongue
 - e. Stomach
3. In the histological specimen of skin you can see epidermis. Which tissue forms this layer of the organ?
- a. Stratified squamous nonkeratinized
 - b. Simple columnar
 - c. Simple ciliated
 - d. Stratified squamous keratinized
 - e. Transitional epithelium
4. In the histological specimen of skin you can see dermis. Which tissues form this layer of the organ?
- a. Stratified squamous epithelium and loose connective tissue
 - b. Smooth muscles and connective tissue
 - c. Loose connective tissue and cartilage
 - d. Loose connective and adipose tissue
 - e. Loose and dense connective tissues
5. In the histological specimen of skin you can see a layer which includes four types of cells. They are: keratinocytes, melanocytes, Langerhans cells and Mercel`s cells. In which layer are they found?
- a. Epidermis
 - b. Dermis
 - c. Hypodermis
 - d. Tunica inima
 - e. Mucosa

Circulatory System

1. Which layer of the heart is composed of cardiac muscle?
 - a. Epicardium
 - b. Pericardium
 - c. Myocardium
 - d. Endocardium
 - e. Endomysium
2. Where is the myocardium the thickest?
 - a. Right atria
 - b. Left atria
 - c. Right ventricle
 - d. Left ventricle
 - e. Both right and left ventricle
3. What is the connective tissue sac surrounding the heart?
 - a. Epicardium
 - b. Pericardium
 - c. Myocardium
 - d. Endocardium
 - e. Endomysium
4. What is the connective tissue called which surrounds an individual cardiac muscle fiber?
 - a. Epicardium
 - b. Pericardium
 - c. Myocardium
 - d. Endocardium
 - e. Endomysium
5. What is the pacemaker of the heart?
 - a. Sinoatrial node
 - b. Atrioventricular node
 - c. Bundle of His

- d. Right bundle branch
- e. Purkinje fiber

Lymphoid System

1. In the specimen you can see an organ of the immune system. Which tissues can form the parenchyma of this organ?

- a. Epithelial
- b. Epithelial and/or nervous
- c. Myeloid or lymphoid
- d. Loose connective
- e. Bone or/and cartilage

2. In the specimen you can see the red bone marrow. Which tissue forms this organ?

- a. Myeloid
- b. Epithelial
- c. Lymphoid
- d. Loose connective
- e. Adipose

3. In the specimen you can see the thymus. Which tissue forms the parenchyma of this organ?

- a. Myeloid
- b. Epithelial
- c. Lymphoid
- d. Loose connective
- e. Adipose

4. In the specimen you can see the parenchymatous lobulated organ. Each lobule has a peripheral dark cortex and a central light medulla. Which organ is in the specimen?

- a. Spleen
- b. Lymph node
- c. Red bone marrow

d. Yellow bone marrow

e. Thymus

5. In the specimen you can see the thymus. Which cells does this organ produce?

a. Erythrocytes

b. T-lymphocytes

c. T- and B-lymphocytes

d. B-lymphocytes

e. Granulocytes

Endocrine System

1. Which of the following is NOT a characteristic of the endocrine system?

a. Products secreted into blood

b. Glands with ducts

c. Secretes hormones

d. Non localized response

e. All of the following are characteristics of the endocrine system

2. What type of hormone is testosterone?

a. Protein

b. Amino acid chain

c. Steroid

d. Catecholamine

e. None of the above

3. What organ is nicknamed the "master gland"?

a. Adrenal medulla

b. Adrenal cortex

c. Brain

d. Pituitary

e. Heart

4. What cell type secretes ACTH?

a. Lactotropic cells

- b. Thyrotropic cells
 - c. Somatotropic cells
 - d. Corticotropic cells
 - e. Gonadotropic cells
5. Where is corpora arenaceous found?
- a. Pituitary
 - b. Pineal gland
 - c. Adrenal gland
 - d. Pancreas
 - e. Thyroid

Digestive System

1. In the histological specimen you can see a muscular organ covered by mucosa on the dorsal surface, which forms numerous papillae. What type of epithelium lines the mucosa of ventral surface of this organ?

- a. Stratified squamous
- b. Simple columnar
- c. Simple ciliated
- d. Stratified cuboidal
- e. Transitional

2. In the histological specimen you can see a muscular organ covered by mucosa on the dorsal surface and mucosa with submucosa on the ventral surface. Mucosa on the dorsal surface forms numerous papillae. Which organ is this?

- a. Stomach
- b. Esophagus
- c. Small intestine
- d. Large intestine
- e. Tongue

3. In the histological specimen of tongue you can see the most numerous papillae. They have conical elongated shape and are covered with stratified squamous keratinized epithelium. Which type of papillae is described?

- a. Foliate
- b. Primary
- c. Fungiform
- d. Filiform
- e. Circumvallate

4. In the histological specimen of tongue the filiform papillae are found.

Which type of epithelium lines these papillae?

- a. Stratified squamous keratinized
- b. Stratified squamous nonkeratinized
- c. Simple columnar
- d. Stratified cuboidal
- e. Transitional

5. In the histological specimen of tongue you can see papillae. They are located between filiform papillae, have mushroom shape and their covering epithelium has taste buds. Which type of papillae is described?

- a. Foliate
- b. Primary
- c. Fungiform
- d. Filiform
- e. Circumvallate

Respiratory System

1. Which cell is also called a septal cell?

- a. Clara cell
- b. Type I pneumocyte
- c. Type II pneumocyte
- d. Dust cell
- e. Brush cell

2. Which cell is a respiratory macrophage?

- a. Kupffer cells
- b. Histiocyte

- c. Dust cell
 - d. Langerhans cell
 - e. Microglia
3. Which cell is a type of neuron?
- a. Basal cells
 - b. Brush cells
 - c. Olfactory cells
 - d. Sustentacular cells
 - e. All of the above
4. What cell types are found in the respiratory mucosa?
- a. Ciliated cells
 - b. Goblet cells
 - c. Basal cells
 - d. Brush cells
 - e. All of the above
5. What type of tissue makes up the epiglottis?
- a. Compact bone
 - b. Spongy bone
 - c. Hyaline cartilage
 - d. Fibrocartilage
 - e. Elastic cartilage

Urinary System

1. What is the glomerulus?
- a. Afferent arteriole
 - b. Efferent arteriole
 - c. Capillary tuft
 - d. Peritubular capillaries
 - e. Vasa recta
2. What is a renal pyramid and its associated cortex referred to?
- a. Medulla

- b. Lobe
 - c. Renal columns
 - d. Nephron
 - e. Medullary ray
3. What are the foot processes on podocytes?
- a. Visceral layer of Bowman's capsule
 - b. Parietal layer of Bowman's capsule
 - c. Pedicels
 - d. Juxtaglomerular cells
 - e. Macula densa
4. What is the Malpighian corpuscle?
- a. Glomerulus
 - b. Bowman's capsule
 - c. Renal corpuscle
 - d. Loop of Henle
 - e. Distal convoluted tubule
5. What type of tissue lines the bladder?
- a. Simple squamous epithelium
 - b. Simple cuboidal epithelium
 - c. Simple columnar epithelium
 - d. Stratified squamous epithelium
 - e. Transitional epithelium

Male reproductive System

1. What is the capsule that surrounds the testes?
- a. Tunica adventitia
 - b. Tunica externa
 - c. Tunica media
 - d. Tunica intima
 - e. Tunica albuginea
2. Which one of the following are the earliest cells of spermatogenesis?

- a. Primary spermatocytes
 - b. Secondary spermatocytes
 - c. Spermatids
 - d. Spermatozoa
 - e. Spermatogonia
3. Which cells are also called "nurse cells"?
- a. Interstitial cells
 - b. Leydig cells
 - c. Sertoli cells
 - d. Sustentacular cells
 - e. Both c and d
4. When do the testes descend into the scrotum?
- a. Fetal development
 - b. Infancy
 - c. Puberty
 - d. Adulthood
 - e. During arousal
5. Which is the largest accessory structure of the male reproductive system?
- a. Epididymis
 - b. Prostate
 - c. Seminal vesicle
 - d. Bulbourethral gland
 - e. Cowper's gland

Female reproductive System

1. What are developing gametes called?
- a. Oogenesis
 - b. Ovary
 - c. Ovulation
 - d. Oocyte
 - e. Ova

2. What is the inner part of the ovary?
 - a. Follicle
 - b. Germinal epithelium
 - c. Medulla
 - d. Tunica albuginea
 - e. Cortex
3. Which stage of the follicle is arrested in prophase?
 - a. Primordial follicle
 - b. Primary follicle
 - c. Secondary follicle
 - d. Mature follicle
 - e. Graffian follicle
4. What is the cavity within a secondary follicle?
 - a. Graffian follicle
 - b. Theca folliculi
 - c. Granulosa cells
 - d. Zona pellucida
 - e. Antrum
5. During the first week to 10 days, what is the main hormone which stimulates the growth of the follicles?
 - a. FSH
 - b. LH
 - c. HCG
 - d. Estrogen
 - e. Progesterone

**Approximate list of questions for differentiated credit
in the discipline "Histology, cytology and embryology"**

Basics of Cytology

1. Microscope. Microscopic devices. Histological technique. Methods of histological studies.
2. General organization of the cell. Cytolemma (plasmalemma). Morphofunctional characteristics of intercellular contacts.
3. Morphofunctional characteristics of non-cellular structures.
4. Morphofunctional characteristics of hyaloplasm and membrane organelles.
5. Morphofunctional characteristics of non-membrane organelles and inclusions.
6. Morphofunctional characteristics of the cell nucleus.
7. Characteristics of mitosis as a process of cell proliferation.
8. Characteristics of meiosis as a process of cell proliferation.
9. Aging and cell death. Necrosis and apoptosis.

Basics of Embryology

1. Morphofunctional characteristics of the male gamete.
2. Morphofunctional characteristics of the female gamete.
3. Embryonic human development. Characteristics of the fertilization process.
4. Human embryonic development. Characteristics of cleavage and implantation processes.
5. Characteristics of the gastrulation process. Histo- and organogenesis.
6. Morphofunctional characteristics of extraembryonic organs.
7. Morphofunctional characteristics of the placenta.

General histology

1. Morphofunctional characteristics of epithelial tissues.
2. Morphofunctional characteristics of glandular epithelium. Glands.
3. Morphofunctional characteristics of erythrocytes.
4. Classification of leukocytes. Morphofunctional characteristics of neutrophilic granulocytes.

5. Classification of leukocytes. Morphofunctional characteristics of blood granulocytes.
6. Classification of leukocytes. Morphofunctional characteristics of basophilic granulocytes.
7. Classification of leukocytes. Morphofunctional characteristics of eosinophilic granulocytes.
8. Classification of leukocytes. Morphofunctional characteristics of blood agranulocytes.
9. Morphofunctional characteristics of platelets.
10. Characteristics of embryonic hematopoiesis.
11. Characteristics of postembryonic hematopoiesis.
12. Morphofunctional characteristics of connective tissues proper.
13. Morphofunctional characteristics of connective tissues with special properties.
14. Morphofunctional characteristics of cartilage.
15. Morphofunctional characteristics of bone.
16. Histological structure of joints. Bone growth and development.
17. Embryonic development and general characteristics of muscle tissue.
Morphofunctional characteristics of striated muscle tissue.
18. Embryonic development and general characteristics of muscle tissue.
Morphofunctional characteristics of cardiac muscle tissue.
19. Embryonic development and general characteristics of muscle tissue.
Morphofunctional characteristics of unstriated muscle tissue.
20. General characteristics of nervous tissue. Morphofunctional characteristics of neurons.
21. General characteristics of nervous tissue. Morphofunctional characteristics of neuroglia.
22. General characteristics of nervous tissue. Morphofunctional characteristics of nerve fibers.

23. General characteristics of nervous tissue. Morphofunctional characteristics of nerve endings.

**Approximate list of exam questions
in the discipline "Histology, cytology and embryology"**

Nervous system

1. Histological structure of the spinal cord.
2. The structure of sensitive nerve ganglions.
3. The structure of the intramural ganglia.
4. The structure of the peripheral nerve.
5. Cerebrum. General morphofunctional characteristics. Cyto- and myeloarchitectonics of the brain cortex.
6. Histological structure of the meninges.
7. Cerebellum. Structure and functional characteristic. Neuronal composition and glial cells of cerebellum cortex.

Sense organs

1. Histological structure of the eye's dioptric (light-refractive) apparatus.
2. Histological structure of the eye's accommodation apparatus.
3. The structure of the retina. Hystophysiological characteristics of the photoreceptor cells.
4. Histological structure of the vestibular organ.
5. Histological structure of the organ of hearing (spiral organ).
6. Histological structure of the organ of taste.
7. Histological structure of the olfactory organ.

Circulatory system

1. Blood vessels classification. Structure of the elastic and mixed arteries.
2. Classification and morphofunctional characteristics of the veins.
3. Blood capillaries. Structure. Main types of capillaries.
4. Heart. General plan of the layer's structure. Myocardium. Morphofunctional characteristics of the cardiomyocytes.

5. Morphofunctional characteristic of the endocardium.
6. Classification of the vessels. The relationship of hemodynamic conditions with vessels' structure.
7. Classification of the vessels. Morphofunctional characteristic of the muscular arteries.
8. Histological structure of the blood and lymphatic capillaries.
9. Morphofunctional characteristics of the microcirculatory bed.
10. Veins. Classification, histological structure, functions. Dependence of the veins structure from hemodynamic conditions.

Skin and it's appendages

1. Histological structure of the skin. The structural features of "thin" skin. The structural features of "thick" skin.
2. Structure and functions of the skin. Physiological regeneration of the epidermis.
3. Morphofunctional characteristics of cellular composition of the epidermis.
4. Structure and functions of the skin glands. Types glands secretion.
5. The structure of the hair.
6. The structure of the nail.

Formed elements of the blood

1. Morphofunctional characteristics of erythrocytes.
2. Classification of leukocytes. Morphofunctional characteristic of neutrophilic granulocytes.
3. Morphofunctional characteristics of the agranulocytes.
4. Morphofunctional characteristics of the granulocytes.
5. Morphofunctional characteristics of the thrombocytes.
6. Morphofunctional characteristics of leukocytes. Basophil granulocytes.
7. Morphofunctional characteristic of the eosinophilic granulocytes.

Endocrine system

1. Endocrine glands classification.

2. Hypothalamus. Neurosecretory nuclei of the hypothalamus. Hypothalamic-pituitary system.

3. Pituitary. Development. General structure. Adenohypophysis, its connection with the hypothalamus, the functional significance.

4. Pineal gland. Structure. Secretory functions.

5. Adrenal glands. Histological structure of the cortex and medulla.

6. Thyroid gland. The structure and functional significance.

7. Parathyroid glands. The structure and functional significance.

Organs of hematopoiesis and immune system

1. Organs of immune system and hematopoiesis classification. Structure of the red bone marrow. Features of embryonic and postembryonic hematopoiesis.

2. Red bone marrow. The structure and functions. Characteristics of postembryonic hematopoiesis in the red bone marrow. Interaction of stromal and hematopoietic elements of the red bone marrow.

3. Classification of organs of immune protection and hematopoiesis. Sources of embryonic development and morphofunctional characteristics of the thymus gland. Age-related and accidental involution of the thymus.

4. Classification of organs of immune protection and hematopoiesis. Spleen. Sources of embryonic development, histological structure and functional significance.

5. Classification of organs of immune protection and hematopoiesis. Lymph nodes. Sources of embryonic development, histological structure and functional significance.

6. Classification of organs of immune protection and hematopoiesis. Lymphoid system of mucous membranes, histological structure and functional significance.

Digestive system

1. Oral cavity. The structure of the tooth. Histological structure of the esophagus.

2. Histological structure of the small intestine. The system "crypt-villus"

3. Histological structure and functions of the pancreas.
4. Liver structure. Characteristics of the cellular composition of the liver.
5. Histological structure of the stomach. Cellular composition of the gastric glands.
6. The structure of the gastric glands.
7. Histological structure of the pancreas.
8. Histological structure of the large intestine.
9. Peculiarities of the liver's blood supply.

9. Respiratory system

1. Histological structure of the respiratory portion of the respiratory tract.
2. Respiratory tract wall general structure and cellular composition of the airway epithelium.
3. General plan of the histological structure of the respiratory passages.
4. Structure of the tracheal wall.
5. The structure of the blood-air barrier.

10. Urinary system

1. General plan of the kidney structure. The structure of the nephron.
2. Structure of the renal corpuscles.
3. The structure of the kidney filter.
4. Histological structure of the juxtaglomerular apparatus of the kidney.
5. Histological structure of the ureter.
6. Histological structure of the urinary bladder.

11. Reproductive system (male and female)

1. Histological structure of the ovary.
2. The structure of the testis.
3. The structure of the uterus.
4. The structure of the fallopian tube.
5. The structure of the prostate.

The list of histological specimens that student must be able to diagnose.

1. Mitosis of cells.
2. Human blood (smear).
3. Adipose tissue.
4. Loose fibrous connective tissue.
5. Tendons.
6. Hyaline cartilage.
7. Elastic cartilage.
8. Fibrous cartilage.
9. Transverse section of a tubular bone.
10. Development of bone in place of cartilage.
11. Development of bone in place of mesenchyme.
12. Mesothelium.
13. Cuboid and cylindrical epithelium.
14. Smooth muscle tissue.
15. Cardiac muscle tissue.
16. Striated skeletal muscle tissue
17. Tigroid of nerve cells.
18. Astrocytic neuroglia.
19. Myelin nerve fibers.
20. Transverse section of a nerve.
21. Vessels of the microcirculatory bed.
22. Artery of muscular type.
23. Vein of the muscular type.
24. Artery of elastic type.
25. Heart wall.
26. Lymph node.
41. Stomach.
42. Small intestine.
43. Colon.
44. Appendix.
45. Parotid salivary gland.
46. Sublingual salivary gland.
48. Human liver.
49. Pancreas.
50. The skin of a human finger.
51. Skin with hair.
52. Trachea.
53. Lung.
54. Kidney.
55. Ureter.
56. Urinary bladder.
57. Testicle.
58. Epididymis.
59. Prostate gland.
60. Ovary.
61. Uterine tube.
62. Uterus.
63. Vagina.
64. Mammary gland.
65. Human placenta.
66. Umbilical cord.
67. Cortex of the large hemispheres of the brain.
68. Cerebellar cortex.
69. Transverse section of the spinal cord.

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| 27. Spleen. | 71. Sensitive ganglion. |
| 28. Tonsil. | 72. Vegetative ganglion. |
| 29. Red bone marrow. | 73. Eyelid. |
| 30. Pituitary gland. | 74. Meridional section of the front part of the eye. |
| 31. Thyroid gland. | 75. Cornea. |
| 32. Parathyroid gland. | 76. Back wall of the eye. |
| 33. Thymus. | 77. Spiral (Corti's) organ. |
| 34. Adrenal gland. | |
| 35. Tongue papillae. | |
| 36. The lip. | |
| 37. Tooth grind. | |
| 38. Histogenesis of tooth tissues. | |
| 39. Esophagus. | |
| 40. Transition of the esophagus into the stomach. | |

SCORING SCHEME

Final semester control

II semester ends with a differentiated credit.

The grade for the second semester is calculated as the sum of the points of current performance (CAP) and the result of differentiated credit:

Grade for the II semester= CAP+ result of the differentiated credit

The calculation of current performance points for the II semester is carried out by the teacher in the last practical class.

The average arithmetic mean of the current performance is calculated on a traditional scale with a rounding up to two decimal places. The result is transferred into a 120-point scale (Table transfer is given in paragraph 2 of the Training discipline program). The maximum sum of the CAP points for the II semester is 120, minimum – 70.

The minimum amount of points for the differentiated credit is 50. The maximum amount of points for the differentiated credit is 80.

Example of the differentiated credit card

1. Characteristics of mitosis as a process of cell proliferation. (0-10 points)
2. Morphofunctional characteristics of the female gamete. (0-10 points)
3. Classification of leukocytes. Morphofunctional characteristics of neutrophilic granulocytes. (0-10 points)
4. Histological specimen. Name the specimen. Indicate the name of the structures marked on the specimen with numbers and describe them. (0-25 points)
5. Histological specimen. Name the specimen. Indicate the name of the structures marked on the specimen with numbers and describe them. (0-25 points)

The maximum number of points for the II semester is 200, minimum – 120.

The third semester ends with a semester exam.

The grade for the III semester is calculated as the sum of the points of current performance (CAP) and the exam result:

Grade for the III semester= CAP + examination

The calculation of current performance points for the III semester is carried out by the teacher in the last practical class.

The average arithmetic mean of the current performance is calculated on a traditional scale with a rounding up to two decimal places. The result is transferred into a 120-point scale (Table transfer is shown in Paragraph 2 of the Training discipline program). The maximum sum of the CAP points for the III semester is 120, minimum is – 70.

The minimum number of points that a student can receive for the exam is 50.

The maximum number of points that a student can receive for the exam is 80.

Example of the exam card

1. Cerebellum. Structure and functional characteristic. Neuronal composition and glial cells of cerebellum cortex. (0-10 points)

2. Classification of the vessels. The relationship of hemodynamic conditions with vessels' structure. (0-10 points)

3. Histological structure of the stomach. Cellular composition of the gastric glands. (0-10 points)

4. Histological specimen. Name the specimen, name the structures marked on the specimen with numbers, give a morphofunctional characteristic of the organ tissue components represented in the specimen. (0-25 points)

5. Histological specimen. Name the specimen, name the structures marked on the specimen with numbers, give a morphofunctional characteristic of the organ tissue components represented in the specimen. (0-25 points)

The maximum amount of points for the III semester is 200, minimum – 120.

The final grade for the discipline «Histology, Cytology and Embryology» is equal to the total amount of points obtained by a student in the CAP III semester and a result of the exam (maximum 200 points, minimum – 120).

Criteria for assessing knowledge and skills of the current students' academic performance

Grades of the current academic performance of higher education students are calculated according to the traditional (four-point) scale.

Control of mastering the topic.

The grade "5" (excellent) is given to a student, who:

1. Completed homework (answered the questions in the Workbook concerning the topic).

2. During the testing, correctly answered 14-15 questions from 15.

3. Finished the practical class record (drawn specimens and diagrams in the Workbook on the topic).

4. Correctly answered 95-100% of the teacher's questions, using specimens and electron micrographs which are discussed at the practical class.

5. Demonstrated a high level of practical skills.

The grade "4" (good) is given to a student, who:

1. Completed homework (answered the questions in the Workbook concerning the topic).

2. During the testing, correctly answered 12-13 questions from 15.

3. Finished the practical class record (drawn specimens and diagrams in the Workbook on the topic).

4. Correctly answered 80-90% of the teacher's questions, using specimens and electron micrographs which are discussed at the practical class.

5. Demonstrated a sufficient level of practical skills.

The grade "3" (satisfactory) is given to a student, who:

1. Completed homework (answered the questions in the Workbook concerning the topic).

2. During the testing, correctly answered 10-11 questions from 15.

3. Finished the practical class record (drawn specimens and diagrams in the Workbook on the topic).

4. Correctly answered 70-80% of the teacher's questions, using specimens and electron micrographs which are discussed at the practical class.

5. Demonstrated a satisfactory level of practical skills.

The grade "2" (unsatisfactory) is given to a student, who:

1. Did NOT do his homework (did NOT answer the questions in the Workbook concerning the topic).

2. During the test correctly answered LESS, than 10 questions from 15

3. Did NOT finish the record of the practical class (did NOT draw specimens and diagrams in the Workbook on the topic).

4. Did NOT answer more than 70% of the teacher's questions.

5. Demonstrated a low level of practical skills.

SUMMARY SECTION CONTROL

The final section control is taken in the end of Section learning at the practical class.

Must be verified:

1.The level of knowledge formation of Section theoretical content, acquired during the face-to-face training and independent students' work (control test).

The test result is 50% of the Section total score.

2.Level of compulsory skills and abilities formation (interview, practical skills).

The interview result is 50% of the Section total score.

Testing on the Section topics is conducted in the final class at the rate of 1 minute for one question and consists of 45 questions of the closed type on the Section topics from the base of the state licensing examination KROK-1.

After the test, the teacher conducts an interview with the student.

Grade "5" (excellent):

Correct answers to 43 - 45 questions from 45 of the test tasks

Correct answers to 95-100% of questions and demonstration of practical skills during the interview.

Grade "4" (good):

Correct answers to 38 - 42 questions from 45 of the test tasks

Correct answers to 85-90% of questions and demonstration of practical skills during the interview.

Grade "3" (satisfactory):

Correct answers to 32 - 37 questions from 45 of the test tasks

Correct answers to 70-80% of questions and demonstration of practical skills during the interview.

Grade "2" (unsatisfactory):

Correct answers less than 32 questions from 45 of the test tasks

Correct answers are less than 70% of the questions and lack of practical skills during the interview.

The practical skills control is based on the assessment of student's ability to work with a microscope, to analyze diagrams, histological specimens and electron micrographs, as well as illustrated tests which reflect the structure of cells, tissues and organs of a human body.

Practical skills in working with a microscope: correctly set the light, bring the specimen into focus, set the microscope to provide the desired magnification.

Criteria for assessing practical skills

High Level

1. The type of the specimens and the name of the microscopic specimens are correctly indicated.
2. The answer regarding the localization of the structures presented in the specimen, is correct.
3. The answer regarding the characteristics of the microscopic and ultramicroscopic structure of the structures represented in the specimen is correct, complete and exhaustive.
4. The answer regarding the function of the structures represented in the specimen is correct, complete and exhaustive.

Sufficient level

1. The type of the specimen and the name of the microscopic specimen are correctly indicated.
2. The answer regarding the localization of the structures represented in the specimen in the cells and tissues is correct.
3. The answer regarding the characteristics of the microscopic and ultramicroscopic structure of the structures represented in the specimen is correct, but incomplete and/or contains inaccuracies.
4. The answer regarding the function of the structures represented in the specimen is correct, but incomplete and/or contains inaccuracies.

Satisfactory (Medium) Level

1. The type of the specimen and the name of the microscopic specimen are correctly indicated.
2. The answer regarding the localization of the structures represented in the specimen in the cells and tissues is correct.
3. The answer regarding the characteristics of the microscopic and ultramicroscopic structure of the structures represented in the specimen is correct, but incomplete, contains errors.
4. The answer regarding the function of the structures represented in the specimen is correct, but incomplete, contains errors.

Insufficient (Low) Level

1. The type of the specimen and the name of the microscopic specimen are not specified/indicated incorrectly.
2. It is not specified/indicated incorrectly, where exactly in the human body the localized structures presented in the specimen.
3. Characteristics of microscopic and ultramicroscopic structure of structures represented in the specimen are not provided/provided incorrect.
4. The functions of the structures presented in the preparation are not specified/indicated incorrectly.

In the last semester of the practical lesson, the teacher calculates the arithmetic mean of the points of the current educational activity with rounding to two decimal places. The result is translated into a 120 - point scale.

Criteria for evaluating knowledge and skills of the final semester control student's educational activities

Differentiated credit in the discipline "Histology, cytology and embryology"

Differentiated assessment is carried out after the end of the semester according to the schedule by the teacher of the academic group in order to check the level of knowledge and skills formed by students of higher education in the

process of studying sections I, II, III of the discipline "Histology, cytology and embryology", namely

- 1) from the theoretical content of sections I, II, III of the discipline;
- 2) on the diagnosis and analysis of microscopic preparations.

Criteria for differentiated credit in the discipline "Histology, cytology and embryology":

Score "excellent": from 70 to 80 points inclusively - the student of higher medical education has deeply and steadily mastered the program material; explains it comprehensively, consistently, competently and logically. The answer closely links theory with practice; provides a correct and well-reasoned answer regarding the definition of the microscopic preparation, provides a correct, complete and comprehensive answer regarding the localization, microscopic structure and functions of the structures presented in the preparation.

Score "good": from 60 to 69 points inclusively – the student of higher medical education firmly knows the program material, teaches it competently and to the point; does not allow significant inaccuracies in answering questions; correctly applies theoretical provisions when solving practical questions and tasks; is able to show logical thinking on the basis of the specific content of the answer, provides a correct and reasoned answer regarding the definition of the microscopic preparation, the answer regarding the localization, microscopic structure and functions of the structures presented in the preparation contains minor inaccuracies.

Score "satisfactory": from 50 to 59 points inclusively – the student of higher medical education knows only the basic material, but has not mastered it in detail, admits inaccuracies, insufficiently correct formulations, violations of the sequence in the coverage of the program material, correctly determines the type and name of the microscopic preparation, but the answer regarding the localization, microscopic structure and functions of the structures presented in the preparation, is incomplete and contains inaccuracies and errors.

Score "unsatisfactory": below 50 points - the student of higher medical education does not know a significant part of the program material, makes significant mistakes, does not provide or provides incorrect answers regarding the definition of the microscopic preparation and the microscopic structure and function of the structures presented in the preparation.

A student who received a differentiated credit score **less than 50 points** is considered to **have failed** the differentiated credit.

Refusal of a student of higher education to perform the task of differentiated credit is certified as an unsatisfactory answer.

Exam in discipline "Histology, Cytology and Embryology"

Histology, Cytology and Embryology exam includes verification the level of knowledge and skills formation acquired during the learning of the discipline "Histology, cytology and embryology" content, namely

- 1) from the theoretical course I, II, III, IV discipline sections;
- 2) from diagnostics of histological specimens.

Criteria for exam assessment in the discipline "Histology, cytology and embryology":

Score "excellent": from 70 to 80 points inclusively - the student of higher medical education has deeply and steadily mastered the program material; explains it comprehensively, consistently, competently and logically. The answer closely links theory with practice; provides a correct and well-reasoned answer regarding the definition of the microscopic preparation, provides a correct, complete and comprehensive answer regarding the localization, microscopic structure and functions of the structures presented in the preparation.

Score "good": from 60 to 69 points inclusively – the student of higher medical education firmly knows the program material, teaches it competently and to the point; does not allow significant inaccuracies in answering questions; correctly applies theoretical provisions when solving practical questions and tasks; is able to show logical thinking on the basis of the specific content of the answer,

provides a correct and reasoned answer regarding the definition of the microscopic preparation, the answer regarding the localization, microscopic structure and functions of the structures presented in the preparation contains minor inaccuracies.

Score "satisfactory": from 50 to 59 points inclusively – the student of higher medical education knows only the basic material, but has not mastered it in detail, admits inaccuracies, insufficiently correct formulations, violations of the sequence in the coverage of the program material, correctly determines the type and name of the microscopic preparation, but the answer regarding the localization, microscopic structure and functions of the structures presented in the preparation , is incomplete and contains inaccuracies and errors.

Score "unsatisfactory": below 50 points - the student of higher medical education does not know a significant part of the program material, makes significant mistakes, does not provide or provides incorrect answers regarding the definition of the microscopic preparation and the microscopic structure and function of the structures presented in the preparation.

Evaluation scale

(According to the number of received points on the university scales assigned in accordance with such system):

Received points	Four-level evaluation scale	Two-level evaluation scale
0-119	Unsatisfactory	failed
120-149	Satisfactory	graded
150-179	Good	
180-200	Excellent	

Recommended literature

Basic literature

1. Mescher A.L.: Junqueira's Basic Histology: Text and Atlas, 14th ed. 2018.
2. Histology: a text and atlas: with correlated cell and molecular biology / Michael H. Ross, Wojciech Pawlina, 7th ed., 2016.

Additional literature

1. Essential cell biology / Bruce Alberts et al. 4th ed. 2014.
2. Cell and Molecular Biology. Concepts and Experiments / Gerald Karp, 2010.
3. GRAY'S Anatomy The Anatomical Basis of Clinical Practice / Susan Standring et al. 44th ed. 2016.
4. Molecular cell biology / Harvey Looish et al. 7th ed. 2013
5. Human physiology / Stuart Ira Fox, Pierce College. 4th ed. 2016.
6. Leslie P. Gartner and James L. Hiatt, Color Textbook of Histology, 5th Edition: Elsevier Saunders: 2007, - p.573.
7. Ovalle, William K. Netter's essential histology. — 2nd ed. 2013
8. Atlas of histology: with functional and clinical correlations / Dongmei Cui [et al.]. – 1st ed. 2011
9. Inderbir Singh's Textbook of Human Histology. – 7th ed. 2015
10. Textbook of Histology and a Practical Guide, 2nd ed. JP Gunasegaran, 2010
11. Histology and cell biology: an introduction to pathology / Abraham L. Kierszenbaum, Laura L. Tres. 4th ed. 2015.
12. Eroschenko, Victor P. Di Fiore's atlas of histology with functional correlations. 11th ed. 2017.
13. Cell biology and histology / Leslie P. Gartner, James L. Hiatt. 7th ed. 2017.).

14. Wheater's Functional Histology: A Text and Colour Atlas, 5th Edition/ Barbara Young, J.S. Lowe, A. Stevens, J.W. Heath: Elsevier Churchill Livingstone: 2006, - p.437.

Links to the Internet information resources, video lectures, and other methodological support

1. Training materials of distance-learning courses "Basics of cytology", "Histology, cytology and embryology", "Histology, cytology and embryology_2", "Special histology" (<https://moodle.karazin.ua>).

2. Histology Guide virtual histology laboratory / T. Clark Breje, Robert L. Sorenson. 2005-2019. <http://www.histologyguide.com>

3. Biolucida MBF Bioscience MicroBrightField. 2019. <https://www.biolucida.net/viewer>

4. Index of Anatomy and human Biology. Anatomy Textbooks and Anatomy Atlases. 1995-2019. <http://www.anatomyatlases.org/MicroscopicAnatomy>

6. Department of Anatomy and Integrated Anatomy. Histology website resources. University of Wisconsin School of medicine and public health. 2015. <http://histologyatlas.wisc.edu>

7. Electron Microscopic Atlas of Mammalian Tissues, extensive image collection from the Universität Mainz, some available only with German-language labels.

8. Using the microscope <https://www.micrographia.com/tutoria/micbasic/micbpt01/micb0100.htm>

9. Molecular Expressions website Molecular Expressions: Exploring the world of optics and microscopy. <https://micro.magnet.fsu.edu/>

10. Microscopy.info is a premier web destination for information on microscopes and microscopy techniques. <http://www.microscopy.info/>

11. <http://histology-world.com/microscope/microscope2.htm>

12. Normative documents regulating the educational process (Web-site of the medical faculty of V.N. Karazin KhNU, section "For students"). [Electronic resource]. - Access mode: <http://medicine.karazin.ua>

ONLINE STUDYING

Preparation for classes. Preparation for classes is carried out by students independently on the basis of textbooks of Histology, cytology and embryology, Lectures (video lectures), Krok-1 questions book and training videos.

Classes. The classes and knowledge monitoring are carried out by your teacher in the Google Meet video chat according to your official Timetable (see The rules of conduct for online Classes, Credit and Final Exam below).

Rework of the classes. You have to rework your classes to your teacher in the Google Meet video chat according to the Rework Timetable (every teacher has his/her own Timetable of reworks, so they will announce it to you separately).

Academic honesty. Students found cheating in any form, will receive an automatic failing grade for the course and their names will be sent to the Dean of the Medical School for further disciplinary action.

Communication with teachers. For communication with teachers, email or a convenient messenger can be used by agreement.

RULES OF ONLINE CONDUCT

General rules:

1. The class, module and final exam will be video recorded.
2. The student taking a video proctored online class, module and final exam must prove their identity prior to the examination by showing their ID card, passport and credit book.
3. The student is obliged to show their room by making a 360° film of the room with the webcam.
4. The student must be dressed and behave decently at all times.

5. The student's room must be quiet and tranquil. There may not be sounds from music, television or any other sounds.

6. The webcam and microphone required for the class, module and final exam must be enabled and running.

7. The webcam must be focused on the student taking the class, module and final exam at all times.

8. The student's face must be positioned in the center of the webcam view and must be visible throughout the duration of the class, module and final exam.

9. Nothing may cover the lens of the webcam at any time during the class, module and final exam.

10. The student must face the webcam during the class, module and final exam constantly.

11. Wearing ear plugs or headphones is not allowed.

12. There may not be any other people in the student's room.

13. There may not be other computers or similar devices running in the student's room.

14. Lighting must be "daylight" quality and overhead. If overhead lighting is not possible, the source of light should not be behind the student.

15. On the desk or other workplace, there may not be anything except a computer/tablet/cell phone and, in case the computer/tablet/cell phone does not have an internal webcam, an external web camera. All other materials have to be removed, unless explicitly permitted (ID card, passport and credit book).

Credit and Final Exam rules:

16. The teacher doesn't have to interpret given questions for the student as class, module and final exam questions require the student to make his/ her own interpretations or assumptions.

17. The question review is not allowed, providing no opportunity to change student answers.

18. The student doesn't have to receive assistance from the teacher, or anyone else, during the class, module and final exam.

19. The student doesn't have to repeat questions of the teacher out loud.

20. The student cannot access any resources during the class, module and final exam. This means no resources of any kind are allowed, including external websites, other software applications, or any other hardcopy resources. All other web browser tabs must be closed during the class, module and final exam. Cell phones and all other electronic devices must be turned off for the class, module and final exam.

21. The student may not leave the room after starting the class, module and final exam. Everything must be completed in one sitting. Restroom or other breaks aren't allowed.

22. The class, module and final exam has a specific amount of time allotted (max 15 minutes for each student) and a specific number of questions (2 questions for class and 3 questions for module and final exam).

23. Questions must be answered orally. No keyboard is required and typing is not allowed.

24. The student has to answer the teacher's questions immediately without any hesitation.

Cheating:

25. Cheating is a serious offence and subject to disciplinary action under Code of Ethics. Any evidence of cheating that occurs during the class, module and final exam would be noted in detail by the teacher. The teacher, who becomes aware that the student may have cheated or have failed to follow the rules in any way, is obligated to notify the Head of Department and Dean Office.

Examples of the cheating are:

- Any recording of the screens, including taking screenshots, pictures, or video.
- Copying the questions or answers.
- Leaving mobile devices/smart phones, other web browsers, software applications, or other computers on during the class, module and final exam.

Having access to or consulting notes or books during the class, module and final exam.

Allowing other individuals to be present, to come in and out of the room during the class, module and final exam.

Talking or otherwise communicating with another person during the class, module and final exam.

Arranging to have another person take a class, module and final exam for the student.

Breaking the class, credit and final exam rules:

26. If the student breaks the Rules, the student can be excluded from participating or continuing the class, module and final exam. The teacher may also decide to nullify, not assess and/or not establish a result for the (partially) completed class, module and final exam.

Електронне навчальне видання комбінованого використання
Можна використовувати в локальному та мережному режимі

Проценко Олена Сергіївна
Чумак Любов Ігорівна

ГІСТОЛОГІЯ, ЦИТОЛОГІЯ ТА ЕМБРІОЛОГІЯ

Методичні рекомендації
для студентів I та II курсів медичного факультету

В авторській редакції

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