Working program in histology, cytology and embryology
For specialty 8.110101 “Лечебное дело”
Medical faculty
Department of histology

<table>
<thead>
<tr>
<th>Form of education</th>
<th>Course</th>
<th>Semester</th>
<th>Hours</th>
<th>Curricular SOW</th>
<th>Type of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>1, 2</td>
<td>2, 3</td>
<td>270</td>
<td>54</td>
<td>96</td>
</tr>
</tbody>
</table>

The working programme was composed by prof. Tverdokhleb I.V.
The program was considered at the department meeting «___»___________ 20___.
Protocol № _______
Chief of department _________________ professor Tverdokhleb I.V.
The program is approved at a meeting of the cyclic methodical commission on biomedical disciplines «___»___________ 20__ г.
Protocol № _______
1. The purpose and goal of discipline.

Histology, cytology and embryology - the fundamental disciplines of medical and biological profile. They belong to the sciences, which are the basis of higher medical education. The purpose of the study subjects is to help students integrally understand microscopic and ultrastructural organization, patterns of development, regenerative properties of the cells, tissues and organs of the human body. Histology, cytology and embryology provide fundamental disciplines with the possibility of further study of theoretical and clinical pathology. Histology, cytology and embryology are morphological disciplines. The subject of their study is microscopic structure of animals and humans and changes in diversity, different conditions of existence (embryonic development, growth, age-related changes, adaptive and compensatory reactions).

According to different levels of organization of life in the whole organism histology, cytology and embryology are divided into the following sections:

- cytology - the science of the general and specific patterns of morphological and functional organization of the different cells;
- general histology, which considers the principles of various tissues and its common issues of their interaction;
- special histology, which investigates the structure of the various organs in the aspect of the relationship of tissues, which are included in their composition;
- embryology - the science of the development of the embryo. This section considers the general and special patterns of embryonic development of animals on different levels of the organization, as well as the formation of embryonic tissue (histogenesis) and organs (organogenesis).

Due to the fact that the next level of organization includes previous, the selection in the histology, cytology and embryology the above sections is conditional. The sequence of their investigation allows us to go from primitive to more complex, forming a logical system of teaching the subject.

The most important principle in teaching histology, cytology, embryology is structural - the unity of form and function. Subordination to this principle of investigation of cells, tissues and organs, as well as consideration of the morphological aspects of embryogenesis, solves an important problem – to determine the structural organization of the processes of life. This exerts a fostering in formation in students the conviction that not only the assimilation of theoretical positions of discipline, but also the acquisition of skills in working with a microscope and analyzing electronic microphotographs and microspecimens and independent work with atlases and other benefits is a realistic way in assimilation patterns of morphofunctional organization of different parts of the body. The traditional methods in the study of the course histology, cytology and embryology by students are the current control of theoretical preparation, the situational tasks, tests, diagnosis of microspecimens and electron micrographs.

As a result of study of histology, cytology and embryology students must know the microscopic and submicroscopic structure of cells, tissues and organs in different age periods and in terms of physiological and reparative regeneration; must be able to work with microscopic instruments, to investigate under the light microscope histological or embryological specimens, "read" the electron micrograph, to make the protocol of description of the investigating object; to master the practical skills in working with the light microscope; diagnostic of the histological and embryological specimens; investigation of the scientific literature and preparation of abstracts.
2. The structure and content of the discipline.

CYTOLOGY
The concept of the cell as an elementary living system - based on the structure, function, reproduction, development, adaptation and regeneration of eukaryotic organisms. Non-cellular structures as derivatives of the cell.
The purpose and objective of Cytology and its importance for medicine. The main positions of the cell theory at the present stage of scientific development.
The overall plan of the structure of eukaryotic cells. The relationship of form and size of cells and their functional specialization in animals and humans.

STRUCTURAL COMPONENTS OF THE CELL
Cytolemma (plasmalemma, cell membrane)
Cell membrane and epimembrane, submembrane components, their structural, chemical and functional characteristics.
Endo- and exocytosis. Membrane digestion. Cytolemma receptor function. Microvilli, villi, flagellum, basal body. Intercellular contacts, their structure and function, cell-cell interactions.

CYTOPLASM
The main components of the cytoplasm - hyaloplasm, organelles, inclusions.
Hyaloplasm, cytosol and cytomatrix, physico-chemical properties, chemical composition, the value for cell metabolism.
Organelles of special purpose.
Inclusions - definition, classification, value.

Nucleus
The role of the nucleus in cell activity, preservation and transmission of genetic information. The shape, size, number of nuclei and nuclear-cytoplasmic ratio in different cell types. The main components of the nucleus: the nuclear envelope, chromatin, nucleolus, nucleoplasm.
Nuclear envelope, its structure and function. Membrane of the nuclear envelope, perinuclear space, nuclear pores, the inner fibrous layer, the nuclear matrix protein.
Nucleolus as derivative of chromosomes that contain nucleolar organizers. The structure of the nucleolus and its role in the synthesis of ribosomes.
Karyoplasm, physico-chemical properties, chemical composition, the value in the vital activity of the nucleus.

Reproduction of cells
The life and the cell cycle, their characteristics. Cells on different stages of cell cycles. Apoptosis and its biological and medical importance.
Mitosis. Biological significance. The phases of mitosis. The restructuring of the structural components of the cell during the different phases of mitosis. Endomitosis. Polyploidy.
Meiosis, features and biological significance.
Cell reaction on damaging effect. Reversible and irreversible changes in the cells, their morphological characteristic. Adaptation of cells, its importance for the preservation of the life of the cells in the variable environmental conditions.

EMBRYOLOGY
Basis of general embryology
Periodization of the development of animals. Progenesis. Fertilization. The main stages of development of the embryo. Cleavage, gastrulation, histo- and organogenesis. Structural features of the mammalian embryo at different stages of development. The concept of biological processes, which are underlying the development of the embryo: the induction, determination, division, cell migration, growth, differentiation, cell interaction, cell death. Extraembryonic organs, their role and structure. Cloning animals.

Embryology
Sex cells. Structure and function of male and female sex cells, the main stages of their development.
Fertilization, its biological significance, phases. Conditions necessary for normal fertilization, capacitation phenomenon, acrosomal reaction, sperm penetration, male pronucleus formation. Cortical reaction of the oocyte, resume of meiosis, formation of the female pronucleus. The concept of in vitro fertilization, it’s medical and social importance. Zygote as a single-celled organism.
Cleavage of the human embryo, and it’s characteristics. The structure and location of the embryo during cleavage. Types of blastomeres. Morula. Blastocyst formation. Embryo- and trophoblast. Implantation, its mechanisms, phases, timeline, especially in humans.

Gastrulation. The first phase of gastrulation, its chronology. Structures that are formed as a result of the first phase of gastrulation. Presumptive buds of extraembryonic organs, epiblast, hypoblast. The second phase of gastrulation. The formation of the embryonic mesoderm. Neurulation and formation of complex of axial organ.
Differentiation of germ layers and their derivatives.

GENERAL HISTOLOGY
General principles of tissue structure
The concept of the tissue as a system of cells and their derivatives - one of the hierarchical levels of the organization of alive. Cell as the basic element of the tissue.
Formation of tissues on the basis of differentiation of embryonic germ cells. Mechanisms of histogenesis. Regularity of the formation and evolution of the tissues, the theory of parallel and divergent evolution. The concept of the cell populations. Stem cells, their properties.
Determination and differentiation of cells, their molecular and genetic basis. The concept of the histogenetic series (differons).
Classification of tissues. Types of physiological regeneration. The concept of reparative regeneration and metaplasia.
Epithelial tissue and glands
The structure of different types of covering epithelium. Horizontal and vertical anisomorpha epithelial sheets, the polarity of epithelial cells. Cytokeratins as markers of different types of
epithelial tissues. Modern concepts of the structure, origin and function of the basement membrane.


Features of physiological and reparative regeneration of epithelial tissues.

Tissue of the internal environment


**Blood and lymph**

The blood, plasma and cells, functions. Characteristic of plasma. Structure and function of red blood cells, white blood cells and platelets. Classification of leukocytes, their participation in the immune response. Hemogram and wbc, their features in newborns and children of all ages.

Characteristics of lymph. Concept of physiological regeneration of blood and lymph.

**Hematopoiesis and lymphopoiesis**


**Connective tissue**

General characteristics. Classification.

Proper connective tissue. Fibrous connective tissue, its varieties - loose and dense.

Characteristics of loose fibrous connective tissue, its cellular elements (fibroblasts, macrophages, plasma cells, tissue basophils, adipocytes, pigment cells and adventitial), fibrous structures (collagen, reticular and elastic fibers) and ground substance. Macrophageal system. The interaction of blood cells and connective tissue inflammation.

Dense fibrous connective tissue, its variety – regular and irregular, their localization, structure, and function. The structure of the tendon.

Connective tissue with special properties: reticular, fat (white and brown), pigment, mucous, their location, structure and function.

**Skeletal tissues**


Joints. Classification. The structure of the joints, articular cartilage, joint capsule, its structure.

**Muscle tissue**

General morpho-functional characteristics of muscle tissue, the sources of its development and classification.

**Nervous tissue**

**SPECIAL HISTOLOGY**
The concept of organs, the morphological and functional systems. The overall plan of the structure of hollow and parenchymal organ.

**Nervous system**
trunks. Peculiarities of their reaction to injury, processes of reconstruction. Nerve endings (see "Nervous tissue").

**Sensory system**
General characteristics of the sensory organs. The doctrine of the sensory systems. Classification of sensory organs depending on their origin and structure of the receptor cells.

**Circulatory system**
General characteristics. Sources and ways of embryonic development. Classification of vessels. Dependence of the structure of the vascular wall on hemodynamic conditions. Age changes.
Artery. The general plan of the structure of the vascular wall. Types of arteries (elastic, muscular-elastic, muscle). Organ peculiarities of arteries.
Vein, structural features compared with the artery. Classification of veins. The structure of the venous valves. Organ peculiarities of arteries.
The structure of the epicardium and pericardium.
The heart of the newborn. Remodeling, development and age-related changes of the heart after birth.

**The system of the blood and immune defense**
General morphofunctional characteristics and classification.

**The endocrine system**


**Skin**


**Respiratory System**

General morphofunctional characteristic. Airways and respiratory department. The structure of the wall of the airway: mucosa, submucosa, fibro-cartilaginous envelope, external (adventitia) envelope. Departments of airways: nasal cavity, larynx, trachea, bronchi (major, large, medium and small), terminal bronchioles, their structure and function. The concept of bronchi–associated lymphoid tissue, its importance to the body.

**Digestive system**

General morphofunctional characteristic. Embryogenesis. Distribution on the compartments depending on development, structure and function. The structure of the wall of the digestive canal, its envelopes: mucosa, submucosa, muscle, external (adventitia or serosa). The characteristics of the envelope, their tissue composition and characteristics of different parts of the alimentary canal. Innervation and vascularization of the digestive tube. Digestive tract cancer, their localization, structure, and function. The concept of gastroenteropancreatic endocrine system, its importance to the body.


Large salivary glands. Structure, histophysiology, exo- and endocrine function.


Development of teeth. Primary and permanent teeth. Age changes in the teeth.

Pharynx and esophagus. Features of the structure of their mucosa. Glands of the esophagus, localization, histophysiology. Structural features of the esophageal wall at different levels. Age changes.


The structure of the colon wall. Features of relief of the mucosa. Histophysiology of the colon.

Appendix, its structure, function. Rectum, compartments, their morphofunctional characteristics. Age-related changes.


**Urogenital system**

Urinary tracts, renal pelvis structure, calices, bladder, ureter, urethra.
Male reproductive organs. General characteristics. Embryogenesis. Primary gamet cells, the initial localization, migration to the gonadal primordium.
Uterus. The structure of the wall (myometrium endometrium, perimetrium). The menstrual cycle and its phases. The structure of the endometrium in the different phases of the cycle. Correlation between menstrual and ovarian cycle. Effect of pituitary hormones and action of hypothalamic regulatory centers on ovarian cycle. The remodeling of the uterus during pregnancy and after birth. Age changes.
Vagina. The structure of the wall, the changes of the structure in relation to the menstrual cycle.

2.1. Thematic plan of lectures for students of medical faculty (54 hours)

<table>
<thead>
<tr>
<th>Name of lecture</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cytology. Basics of general embryology.</strong></td>
<td></td>
</tr>
<tr>
<td>General embryology. Gamet cells. The initial stages of embryogenesis of chordates, the lower and higher vertebrates. Gastrulation. Patterns of histogenesis.</td>
<td>2</td>
</tr>
<tr>
<td>Together</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General histology.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The doctrine about tissues. Origin and structure of the different types of epithelium. The covering epithelium. The structure of intercellular contacts. Glandular epithelium. Types of secretion.</td>
<td>2</td>
</tr>
<tr>
<td>The concept of the tissues of the internal environment. Structural and functional characteristics of the blood. Hemogram and leukocyte formula.</td>
<td>2</td>
</tr>
<tr>
<td>Cellular elements of the connective tissue. The structural organization of the different types of connective tissue.</td>
<td>2</td>
</tr>
<tr>
<td>Skeletal connective tissue of cartilage and bone. Histogenesis, structure, function and regenerative characteristics of different types of skeletal tissue.</td>
<td>2</td>
</tr>
<tr>
<td>Muscle tissue. Development, structure and functional features. The mechanism of muscle contraction.</td>
<td>2</td>
</tr>
<tr>
<td>Nerve tissue. Classification of neurocytes and glial cells. The structure and functional properties of the nerve fibers. Classification, structure and function of nerves and synapses.</td>
<td>4</td>
</tr>
<tr>
<td>Together</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special histology. Basics of special embryology.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nervous system. Structural and functional characteristics of the spinal cord and peripheral nervous system. Histogenesis, structure and function of the spinal cord, sensory and autonomous ganglia. Development, structure and functional characteristics of the brain and cerebellum.</td>
<td>4</td>
</tr>
</tbody>
</table>
2.2. The thematical plan of practical lessons
for students of medical faculty (126 hours)

<table>
<thead>
<tr>
<th>Content of practical lesson</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods and techniques of cytological, histological and embryological studies. Microscope. Microscopic equipment.</td>
<td>3</td>
</tr>
<tr>
<td>Cytology: cell, acellular structure, cytoplasmic structures.</td>
<td>6</td>
</tr>
<tr>
<td>Cytology: the cell nucleus and proliferative processes.</td>
<td>3</td>
</tr>
<tr>
<td>General Embryology: germ cells, the general scheme of embryogenesis, fertilization, cleavage, blastula.</td>
<td>3</td>
</tr>
<tr>
<td>General Embryology: gastrulation, formation of organ buds and fetal envelopes, histogenesis.</td>
<td>3</td>
</tr>
<tr>
<td>The final lesson. Diagnostic of specimens and electron micrographs.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

**General histology**

<p>| Epithelial tissue and glands. The origin and structure of different types of epithelium. | 3 |
| Mesenchymal derivatives. Structural and functional characterization of | 3 |</p>
<table>
<thead>
<tr>
<th>Topic</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood and lymph. Hemogram and leukocyte formula. Classification, quantity, structure and functional significance of blood cells.</td>
<td>3</td>
</tr>
<tr>
<td>Connective tissue classification, structural composition. Loose and dense fibrous connective tissue. Connective tissue with special properties.</td>
<td>3</td>
</tr>
<tr>
<td>Skeletal connective tissues: cartilage and bone tissue. Patterns of bone formation.</td>
<td>3</td>
</tr>
<tr>
<td>Muscle tissue. Development, structure and functional properties of muscle tissue. The mechanism of muscle contraction. Regeneration of different types of muscle tissue.</td>
<td>3</td>
</tr>
<tr>
<td>Nervous tissue: cells, fibers, nerves, synapses. The classification and structure of neurons and glia. Classification and structure of different types of nerve endings.</td>
<td>6</td>
</tr>
<tr>
<td>Hematopoiesis. The current scheme of hematopoiesis.</td>
<td>3</td>
</tr>
<tr>
<td>Diagnostic of specimens and electron micrographs.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td>30</td>
</tr>
</tbody>
</table>

**Special histology. Basics of special embryology**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forming Organs and immune defense. The study of the central and peripheral organs of blood, their histophysiology and aging. Features of blood in an adult organism.</td>
<td>4</td>
</tr>
<tr>
<td>Cardio-vascular system. Development, the overall structural and functional characteristics, structural features of the heart, blood and lymph vessels. Structure and function of the microvasculature, age changes.</td>
<td>4</td>
</tr>
<tr>
<td>The endocrine system. The study of the development, structure and function of the endocrine glands.</td>
<td>4</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td>General characteristics of the digestive system. The bodies of the oral cavity. Sip. Esophagus, stomach and intestines. Liver and pancreas.</td>
<td>12</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td>Nervous system: brain, spinal cord, nerve ganglia, nerves.</td>
<td>4</td>
</tr>
<tr>
<td>Structural and functional characterization analyzers - visual, olfactory, gustatory, auditory, balance.</td>
<td>4</td>
</tr>
<tr>
<td>Bodies of the respiratory system.</td>
<td>4</td>
</tr>
<tr>
<td>The skin and its derivatives.</td>
<td>4</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td>The structure of the urinary organs.</td>
<td>4</td>
</tr>
<tr>
<td>Male reproductive system.</td>
<td>4</td>
</tr>
<tr>
<td>Female reproductive system.</td>
<td>4</td>
</tr>
<tr>
<td>Human embryogenesis.</td>
<td>4</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td>72</td>
</tr>
</tbody>
</table>

**In total: 126 hours.**

### 2.3. Thematic plan of self extracurricular work for medical students (90 hours)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall structural and functional characteristics of the cardio-vascular system.</td>
<td>4</td>
</tr>
<tr>
<td>The respiratory system.</td>
<td>4</td>
</tr>
<tr>
<td>The skin and its derivatives.</td>
<td>4</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td>The structure of the urinary organs.</td>
<td>4</td>
</tr>
<tr>
<td>Male reproductive system.</td>
<td>4</td>
</tr>
<tr>
<td>Female reproductive system.</td>
<td>4</td>
</tr>
<tr>
<td>Human embryogenesis.</td>
<td>4</td>
</tr>
<tr>
<td>The final lesson. Diagnostic preparations and electron micrographs.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td>72</td>
</tr>
<tr>
<td>Content of lesson</td>
<td>Hours</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Cytology. Basics of general embryology.</strong></td>
<td></td>
</tr>
<tr>
<td>Basic of doctrine about cell. Apoptosis and its biological significance. Morphological changes during the development of apoptosis. Intracellular mechanisms of apoptosis. The role of genes in the induction and blocking of apoptosis. Porter's concept of mitochondrial reticulum cells. Mechanisms and biological role of intracellular regeneration.</td>
<td>6</td>
</tr>
<tr>
<td>General embryology. The role of inductive factors in the process of fertilization. Formation and biological significance of the presumptive areas of blastula. Homeosis genes and their values in the individual development of organisms.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td><strong>General embryology</strong></td>
<td></td>
</tr>
<tr>
<td>The doctrine about the tissues. Mechanisms of basement membranes formation and their role in embryonic histogenesis of epithelial tissues. Evolutionary aspects of the formation of intercellular contacts.</td>
<td>6</td>
</tr>
<tr>
<td>Structural and functional characteristic of blood and lymph. Mechanisms of physiological and reparative regeneration of blood cells. The role of humoral factors in the interaction of blood cells.</td>
<td>6</td>
</tr>
<tr>
<td>The structural composition and age-related changes of loose connective tissue. Structure of proteoglycan of the extracellular matrix of connective tissue and their role in the histogenetic metabolism.</td>
<td>3</td>
</tr>
<tr>
<td>Skeletal connective tissue. Formation, structure and physiological role of lacunary-canalicular system in the adaptation of bone to changing conditions of physical training. Ways and mechanisms of the trophic of cartilage.</td>
<td>6</td>
</tr>
<tr>
<td>Muscle tissue. Ways and mechanisms of regeneration of cardiac muscle tissue. Smooth muscle of tetanic type. Origin, location, structure, and function.</td>
<td>3</td>
</tr>
<tr>
<td>Nervous tissue: embryonic histogenesis of microglia. The ultrastructure of the blood-brain barrier.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Together</strong></td>
<td><strong>30</strong></td>
</tr>
<tr>
<td><strong>Special histology. Basics of special embryology</strong></td>
<td></td>
</tr>
<tr>
<td>The current scheme of hematopoiesis. Ultrastructure, localization, mechanisms of stem cell migration. Tissue characteristics and humoral factors regulating lymphocytopoiesis.</td>
<td>4</td>
</tr>
<tr>
<td>Organs of hematopoiesis and immune defense. Features of antigen-independent lymphocyte maturation in the thymus and lymphoid structures.</td>
<td>4</td>
</tr>
<tr>
<td>Cardio-vascular system. Structural features of the conduction system of the heart. Cellular composition of the walls of blood and lymph vessels.</td>
<td>4</td>
</tr>
<tr>
<td>Central and peripheral endocrine organs. Hypothalamic-hypophyseal system. Function, development, microscopic structure of the epiphysis. Function, development, the microscopic structure of the middle and posterior hypothalamus.</td>
<td>4</td>
</tr>
<tr>
<td>Exocrine and endocrine functions of the liver and pancreas.</td>
<td>4</td>
</tr>
<tr>
<td>Nervous system: conduction pathways in the brain and spinal cord.</td>
<td>4</td>
</tr>
<tr>
<td>Histophysiology proprioceptive, exteroceptive and interoceptive pathways.</td>
<td>4</td>
</tr>
<tr>
<td>Structural and functional characteristic of the analyzers. Microscopic structure of the lens, vitreous, conjunctiva, eyelids. Histophysiology of body equilibrium. Structural features of the receptor elements of the olfactory organ.</td>
<td>4</td>
</tr>
<tr>
<td>The concept of the pulmonary acinus. Comparative and histological characteristics of the respiratory system.</td>
<td>4</td>
</tr>
<tr>
<td>Male reproductive system. Microscopic structure of vas deferens and ejaculatory ducts.</td>
<td>4</td>
</tr>
<tr>
<td>Microscopic structure of the seminal vesicles and penis.</td>
<td>4</td>
</tr>
</tbody>
</table>
3.8. The list of questions submitted to the commission exam for students of medical faculty.

GENERAL INFORMATION
1. Histology. The main stages of historical development.
2. Histology. Determination of the content and purpose of modern histology. Its sections, the value for biology and medicine.

CYTOLOGY
1. Cytology. Definition, task, significance for biology and medicine.
3. Cell as an elementary living system of multicellular organism. Definition. Cytolemma (plasmalemma, cell wall), the structure and function.
15. The methods of reproduction of cells. Their morphological characteristics. Importance to biology and medicine.
18. Mitosis. General characteristics of the different phases. The concept of endoreproduction and polyploidy.
GENERAL EMBRYOLOGY
3. Types of eggs, the nature of their cleavage after fertilization.
5. Gastrulation. Definition of the concept. The biological significance of the first and second phases of the gastrulation. Characteristics of different types of gastrulation.
8. Features of the development of higher vertebrates (for example, birds).
12. Early human embryogenesis. Formation of extraembryonic organs (chorion, the yolk and amniotic vesicles, allantois).
14. Human embryo at the 4th week of development. The formation of the nervous and intestinal tube, somites.
15. The system mother-fetus. Features of placental blood circulation. The structure of the umbilical cord.
17. Connection of the human embryo with the maternal organism. The placenta and umbilical cord.
18. Placenta and its formation, structure and function.
19. The concept of critical periods of development of the human embryo.
20. The main stages of human embryonic development. Embryonic induction as one of the regulatory mechanisms of embryogenesis.

GENERAL HISTOLOGY
TISSUES
2. Tissue as one of the levels of organization of living. Definition. The classification of types. The idea of determination and differentiation of tissues.
3. The concept of differons and stem cells.
4. Tissue as one of the levels of organization of living. Definition. Cell derivatives (syncytium and symplast, intercellular substance).
5. Tissue. Definition. Physiological and reparative regeneration of different types of tissues.

EPITHELIAL TISSUE
1. Epithelial tissue. General characteristics. Morphofunctional and genetic classification of types.
2. Epithelial tissue. Morphofunctional characteristic of different types of covering epithelium.

BLOOD AND HEMATOPOIESIS
1. Embryonic hematopoiesis. The development of a blood as a tissue. Features of the yolk and liver hematopoiesis.
2. Postembryonic hematopoiesis. The current scheme of hematopoiesis.
5. Hemogram and leukocyte formula. Platelets, quantity, function, duration of existence.
7. Leukocyte formula. Leykocytopoiesis in embryonic and postembryonic periods.
8. Leukocytes. Classification, morphofunctional characteristics. Leukocyte formula and its characteristics at different stages of ontogenesis.
10. Leukocyte formula. Morphofunctional characteristics of monocytes, concept of system of mononuclear phagocytes.
11. Macrophages and lymphocytes. Their structure, histochemical characteristic and participation in immune reactions.

CONNECTIVE TISSUE
1. Fibrous connective tissue. Its structure, types and functional value. Formation of extracellular matrix (for example, the synthesis of collagen).
2. Exacellular matrix of connective tissue (fibers, ground substance), the structure, value.
3. Intracellular matrix of connective tissue. Collagen and elastic fibers. Their structure and function.
4. Connective tissue cells. Structure, the functional significance.
5. Loose fibrous connective tissue. Morphofunctional characteristics. Macrophages: structure and sources of development. The concept of the mononuclear phagocyte system.
6. Dense fibrous connective tissue. Morphofunctional characteristics. Structure of dense regular connective tissue (for example, tendon).
7. Macrophages: morphofunctional characteristics, their participation in the congenital and adoptive immunity. The concept of the mononuclear phagocyte system.

SKELETAL TISSUE. CARTILAGE AND BONE TISSUE.
2. Bone. The classification of types. Morphofunctional characteristics.
3. Fibrous bone. Its histogenesis, structure, regeneration and age changes.
4. Lamellar bone tissue. Tubular bone. Structure, development, regeneration.
5. Lamellar bone tissue. General morphofunctional characteristic. Tubular bone regeneration and the factors that affect the structure of the bones.

MUSCLE TISSUE
3. Striated skeletal muscle tissue. The concept of red and white muscle fibers. The structure of the muscles as the organ.

NERVOUS TISSUE
2. Neuroglia. Classification, structure and value of different types of gliocytes.
7. Nerve tissue. Sources of development. Morphofunctional characteristics. The concept of simple and complex reflex arc.

SPECIAL HISTOLOGY AND EMBRYOLOGY

CARDIOVASCULAR SYSTEM
2. Artery. Classification of types and their morphofunctional characteristics. Artery of muscular type.
3. Artery. Classification of types and their morphofunctional characteristics. Artery of elastic and muscular-elastic types. Age-related changes.
4. Vessels of hemomicrocirculatory bed. Morphofunctional characteristics of its parts.
5. Arteriolar-venular anastomoses. Classification, structure of different types of anastomoses. Their function.
8. Lymphatic vessels. Morphofunctional characteristics. Sources of development.

HEMATOPOIETIC ORGANS
1. The concept of the immune system and its tissue components. Classification and characteristics of immune cells and their interaction in the reactions of humoral and cellular immunity.

ENDOCRINE SYSTEM
1. The endocrine system. Classification of the endocrine glands. The concept of the target cells and receptors for hormones.
3. Hypothalamus. Neurosecretory nuclei of the hypothalamus, features of the structure and function of neurosecretory cells. hypothalamic-neurohypophyseal and hypothalamic-adenohypophyseal systems
8. Thyroid. Development, structure, histophysiology, the functional significance. Age-related changes.

DIGESTIVE SYSTEM
2. Oral cavity. Features of the structure of the mucosa of different organs of oral cavity.
9. The development of the tooth. Teething and changing of teeth.
12. Glands of the stomach. Their morphological and functional characteristics in different parts of the organ.
17. Liver. General morphofunctional characteristic. The structure of hepatocytes, perisinusoidal adipocytes and wall of the sinusoids.

SKIN AND ITS DERIVATIVES

RESPIRATORY SYSTEM

URINARY SYSTEM

REPRODUCTIVE SYSTEM
7. The Organs of the female reproductive system. Fallopian tubes and vagina. Changes throughout the ovarian-menstrual cycle, their hormonal regulation.

NERVOUS SYSTEM
3. Sensory ganglia. The structure, functions and relationships.

THE SENSORY SYSTEM (SENSE ORGANS)

7. The organ of hearing. Source of development. The structure of the outer, middle and inner ear.
8. Histophysiology of spiral organ.

3.9. The list of practical skills that students need to master.

As a result of study of histology, cytology and embryology students

**must know:**
- the microscopic and submicroscopic structure of cells, tissues and organs in different age periods and in terms of physiological and reparative regeneration;

**must be able:**
- to work with microscopic instruments;
- to investigate under the light microscope histological or embryological specimens;
- "read" the electron micrograph;
- to make the protocol of description of the investigating object;

**to master:**
- the practical skills in working with the light microscope;
- diagnostic of the histological and embryological specimens;
- investigation of the scientific literature and preparation of abstracts.

**List of examination specimens**

1. Blastula of the frog
2. Early stage chicken gastrula
3. Late stage chicken gastrula
4. The formation of the amniotic envelopes
5. Frog blood
6. Human blood
7. Loose connective tissue
8. Hyaline cartilage
9. Elastic cartilage
10. Lamellar bone
11. Intramembranous bone formation
12. Endochondral bone formation
13. Smooth muscle tissue
14. Striated muscle tissue
15. Cardiac muscle tissue
16. Myelinated fiber
17. Spinal ganglion
18. Spinal cord
19. Brain cortex  
20. Cerebellum  
21. Cornea  
22. Retina  
23. The organ of Corti  
24. Artery of muscular type  
25. Vein  
26. Capillaries in the loose connective tissue  
27. Heart  
28. Lymph node  
29. Spleen  
30. Tonsils  
31. Red bone marrow  
32. Thymus  
33. Hypothalamus  
34. Hypophysis  
35. Thyroid  
36. Parathyroid  
37. Adrenal  
38. Filiform papilla  
39. Foliate papilla  
40. Parotid salivary gland  
41. Esophagus  
42. Fundus of the stomach  
43. Pyloric part of the stomach  
44. Duodenum  
45. Jejunum  
46. Colon  
47. Pancreas  
48. Porcine liver  
49. Human liver  
50. Trachea  
51. Lung  
52. Skin of the finger  
53. Skin with hair  
54. Kidney  
55. Urether  
56. Urinary bladder  
57. Testis  
58. Epididymis  
59. Prostate  
60. Ovary  
61. Uterus  
62. The fetal part of the placenta  
63. Uterine part of the placenta  
64. Mammary gland