

**MINISTRY OF EDUCATION AND SCIENCE OF KYRGYZ REPUBLIC  
OSH STATE UNIVERSITY  
INTERNATIONAL MEDICAL FACULTY  
DEPARTMENT OF ANATOMY, HISTOLOGY AND NORMAL PHYSIOLOGY**

**«APPROVED»**

On the meeting of Dep \_\_\_\_\_  
Prot. № \_\_\_\_ from \_\_\_\_\_ 20 \_\_\_\_ year  
Head of chair \_\_\_\_\_  
c.m.s., Assoc. Prof., Sakibaev K.Sh.

**«AGREED»**

Chairman of EMI IMF  
\_\_\_\_\_  
c.m.s., Assoc. Prof., Sakibaev K.Sh.

**STUDENT EDUCATION PROGRAM  
(Syllabus)  
ON THE DISCIPLINE: histology, cytology and embryology  
for full-time students studying  
on the specialty "560001-General Medicine (GM)"**

form of study: **full-time**  
total: **4 credits**  
year: **1- year**  
semester: **II semester**  
total : **120 hours**  
**Of them:**  
Classrooms: **60 hours (lecture - 24 hours; practical classes- 36 hours)**  
SIW: **60 hours**  
Number of test control (TC) **2.**  
Exam: **II semester**

Information about teacher: **Tashmatova Nazgul Mamatumarovna,  
candidate of biological sciences, acting associate professor  
Department of "Anatomy, Histology and Normal Physiology",  
room No. 409**

Schedule: *daily from 8 a.m. to 4.30 p.m.*  
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**Date: 2019-2020 - academic year**

**1. The purpose of the discipline** "histology, cytology and embryology" is to provide students with knowledge about the microscopic functional morphology and development of human cellular, tissue and organ systems providing a basis for studying clinical disciplines and contributing to the formation of medical thinking

**2. Objectives of the discipline:**

- Study of the general and specific structural and functional properties of cells of all body tissues and the patterns of their embryonic and postembryonic development
- The study of histofunctional characteristics of the basic systems of the body, the laws of their embryonic development, as well as functional, age-related and protective-adaptive changes in organs and their structural elements;
- Study of the main histological international Latin terminology;
- The formation of students' ability to microscope histological preparations, the ability to identify organs, determines the leukocyte formula using a light microscope;
- Formation of students' understanding of methods for analyzing the results of clinical laboratory research, their interpretation;
- Formation of students' skills of independent analytical, research work;

**3. As a result of mastering the discipline, the student must:**

**Know:**

- Safety regulations and work in physical, chemical, biological laboratories with reagents, devices, animals;
- The physicochemical nature of the processes occurring in a living organism at the molecular, cellular, tissue and organ levels;
- The main patterns of development and vital functions of the body based on the structural organization of cells, tissues and organs; histofunctional features of tissue elements; research methods;
- The structure, topography and development of cells, tissues, organs and systems of the body in interaction with their function in normal and pathological conditions, especially the organismic and population levels of life organization;

**Be able to:**

- Use educational, scientific, popular science literature, the net Internet for professional activities;
- Use physical, chemical and biological equipment;
- Work with magnifying equipment (microscopes, optical and simple magnifiers);
- Give a histophysiological assessment of the state of various cellular, tissue and organ structures;
- Explain the nature of deviations during development, which can lead to the formation of variants of anomalies and defects;

**Own:**

- Medical and anatomical conceptual apparatus;
- Skills of microscopy and analysis of histological preparations and electronic microphotographs, drawings;

**4. Prerequisites:** HSE<sup>1</sup>: Latin, MEN: chemistry, biophysics, SPD: molecular biology and medical genetics, medical biology, normal anatomy

**5. Post requisites:** Normal physiology, pathological anatomy, pathological physiology and clinical disciplines.

**6. Technological map of discipline**

modules	total		lectures		Practical cl.		SIW		TC	FC	Points
	Aud	SIW	hour	points	hour	points	hour	points			
<b>I</b>	<b>26</b>	<b>20</b>	<b>12</b>	<b>30</b>	<b>14</b>	<b>30</b>	<b>20</b>	<b>30</b>	<b>30</b>		
<b>II</b>	<b>34</b>	<b>40</b>	<b>12</b>	<b>30</b>	<b>22</b>	<b>30</b>	<b>40</b>	<b>30</b>	<b>30</b>		
<b>total</b>	<b>120</b>		<b>24</b>	<b>30</b>	<b>36</b>	<b>30</b>	<b>60</b>	<b>30</b>	<b>30</b>	<b>40</b>	<b>100</b>

<sup>1</sup> Humanitarian and social- economical disciplines

**7. Map of points accumulation for the subject “Histology, cytology and embryology” in the context of 1 module (2nd semester, 2019-2020 academic year, specialty: 560001-general medicine “GM”)**

№	Name of groups	Average point of current TC	Lecture	SIW	TC	Total
	First name/ last name of stud	30 points	30 points	30 points	30 points	30 points
1.						
2.						
3.						

$$Module = \frac{Average\ point\ of\ pr.cl. + L + SIW + TC}{4}$$

Technological map of the accumulation of points of the group \_\_\_\_\_  
(discipline: “Private histology”, specialty: 560001- general medicine (GM), 3-semester, 2019-2020 academic year)

CLASS №1		Тема №1 Cardiovascular system. General characteristic. Classification. Arteries. Veins. Capillaries.						
№	I-week	Class attendance	Copybook	Album	Activity	Test	total	Date of rework
	First name/last name	4	2	4	10	10	30	
1.								
...								

**7. Calendar and thematic plan of lectures for 1<sup>st</sup> year students the subject: HUMAN HISTOLOGY (2<sup>nd</sup> semester, 2019-2020 academic year)**

Week №	clas s№	Date	Name of the topic	Hours
By semester curriculum	Module 1			24 hours
	1.	17-22.02.20	Introduction. Methods of Histology.	
	2.	17-22.02.20	Cytology. Ultramicroscopic structure of cell.	
	3.	24-29.02.20	The nucleus. Structure of nucleus, nucleolus, chromatin.	
	4.	24-29.02.20	Cell cycle. Cell division. Mitosis. Meiosis. Cell death	
	5.	2-7.03.20	Introduction to the study of tissues. Epithelial tissue. Classification. Lining epithelium.	
	6.	2-7.03.20	Glandular epithelium. Classification. Structure.	
	7.	9-14.03.20	Connective tissue. Classification. Proper connective tissue.	
	8.	9-14.03.20	Connective tissue with special properties	

9.	16-21.03.20	Blood and lymph.	1
10.	16-21.03.20	Hematopoiesis. Formation of blood cells.	1
11.	16-21.03.20	Skeletal connective tissue. Classification. Cartilage.	1
12.	16-21.03.20	Bone. Morphology of bone. Classification. Osteon.	1
Module 2			
13.	16-21.03.20	Muscle tissue. Classification. Sarcomere.	1
14.	16-21.03.20	Cardiac and smooth muscle tissues.	1
15.	23-28.03.20	Nerve tissue. Neuron. Neuroglia.	1
16.	23-28.03.20	Nerve fibers.	1
17.	23-28.03.20	Nervous system. PNS. Ganglion. Nerves.	1
18.	23-28.03.20	Histology of a spinal cord.	1
19.	23-28.03.20	Histology of cerebellum.	1
20.	23-28.03.20	Histology of cerebral cortex.	1
21.	30.03-4.04.20	Sense organs. Organ of vision	1
22.	30.03-4.04.20	Histology of olfactory organ	1
23.	30.03-4.04.20	Histology of ear.	1
24.	30.03-4.04.20	Histology of taste.	1

**8. Calendar and thematic plan of practical classes for 2<sup>nd</sup> year students  
the subject: HUMAN HISTOLOGY 1 (2<sup>nd</sup> semester, 2019-2020 academic year)**

Week №	class №	Name of the topic	Hours
1 week 17-22.02.20	1.	Introduction. The history of the development of histology as a science.	1
	2	Methods of Histological examination.	1
2 week 24-29.02.20	3.	Cytology. Cell structure. Cytoplasm.	1
	4	Organelles. Classification. Ultramicroscopic structure of organelles	1
3 week 2-7.03.20	5	The nucleus. Nuclear envelope, pores, nucleoplasm, chromatin.	1
	6	Cell cycle. Types of cell division. Cell death.	1
4 week 9-14.03.20	7	Epithelial tissue. Morphological characteristics. Classification.	1
	8	Lining epithelium	1
8 week 6-11.04.20	9	Glandular epithelium. Morphological characteristics	1
	10	Classification of glands.	1
	11	Connective tissue. Features of connective tissue. Classification.	1
	12	Proper connective tissue. Connective tissue with special properties	1
9 week 13-18.04.20	13	Blood and lymph. Blood cells	1
	14	Plasma.	1
	15	Hematopoiesis.	1
	16	Postembryonic hematopoiesis	1
10 week 20-25.04.20	1 Module. Human histology 1		
11 week 27.04-2.05.20	17	Cartilage. Morphology. Classification of cartilage	1
	18	Hyaline, elastic and fibro cartilage.	1
	19	Bone. Morphology. Classification of bone.	1
	20	Compact bone. Osteon.	1
	21	Muscle tissue. Morphology. Classification of muscles	1

12 week 4-9.05.20	22	Smooth muscle tissue.	1
	23	Skeletal muscle tissue. Sarcomere.	1
	24	Cardiac muscle tissue.	1
13 week 27.04.-2.05.20	25	Nerve tissue. Structure of neuron cells.	1
	26	Neuroglia. Classification and structure.	1
	27	Nerve fibers. Synapsis.	1
	28	Nerve endings. The reflex act.	1
14 week 11-16.05.20	29	Nervous system. PNS. Spinal ganglion. Peripheral nerves.	1
	30	The spinal cord. Histological structure of spinal cord.	1
	31	Histological structure of cerebellum	1
	32	Histological structure of cerebral cortex.	1
15 week 18-23.05.20	33	Histological structure of eyes	1
	34	Histological structure of smell	1
	35	Histological structure of ear	
	36	Histological structure of taste.	
16 week	2 Module: Human histology 1		
Total	Lectures		24 hours
	Practical classes		36 hours
	Modules		2

## 9. Student individual work (SIW)

№ and name of the topic	competencies	Task for self-work	Hours	Form of control	Points	Lit-re	Deadline
1	2	3	4	5	6	7	8
<b>Module №1</b>							
Introduction The subject and objectives of the course of histology with cytology. The history of the development of histology as a science. Methods of histological examination.	GC-1, SPC-2, PC-5, PC-12, EC-3	1. The history of the discovery of the microscope. 2. Methods of histological techniques	4	Abstract, schematics. picture	30	1,2,3, 45,6	1-2
Cytology. Cell membrane. Cytoplasm and its components	GC-1, SPC-2, PC-5, PC-12, EC-3	1. Cytology. Cell theory. Cell and non-cellular living structures. 2. Organelles and inclusions.	2	Abstract, schematics. picture	30	1,2,3, 45,6	2-3
Cell nucleus. Chromosomes. Cell cycle. Cell division (mitosis, meiosis, etc.).	GC-1, SPC-2, PC-5, PC-12, EC-3	1. The nucleus of the cell. Chromosomes. 2. Cell division (mitosis, amitosis). Cell cycle.	4	Abstract, schematics. Working with microscope	30	1,2,3, 45,6	3-4
Epithelial tissue. Morphological characteristics, classification.	GC-1, SPC-2, PC-5, PC-12, EC-3	1. The development of various types of epithelium. 2. The keratinization process of the stratified squamous epithelium.	4	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	4-5
Glands. Classification. Structure.	GC-1, SPC-2, PC-5, PC-12, EC-3		2	Diagrams, working with microscopy.	30	1,2,3, 4,5,6	8-9
Connective tissue. Proper connective	PC5, PC12, PC	1 The main characteristics of connective	4	Abstract, schematics	30	1,2,3, 4,5,6	8-9

tissue. Connective tissue with special properties.	13	tissue cells and blood in the focus of aseptic inflammation; the participation of neutrophils, lymphocytes, monocytes, macrophages and fibroblasts in trauma or the introduction of a foreign body		cs. picture			
Blood and lymph	PC-5, PC-12, EC-3	1. Age-related blood changes 2. Morpho-functional characteristic of lymph. 3. Types of hemoglobin and forms of red blood cells.	4	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	9-10
Hematopoiesis (hemocytopoiesis). Embryonic and postembryonic hemocytopoiesis	PC-5, PC-12, EC-3	1. The functions of stromal cells of red bone marrow during hematopoiesis 2. The role of specific factors in the regulation of hematopoiesis.	4	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	9-10
<b>Module №2</b>							
Skeletal tissue. Cartilage tissue.	PC-5, PC-12, EC-3	1. The process of internal bone remodeling and age-related changes in bone tissue. 2. The healing mechanism of a simple fracture of the tubular bone.	2	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	11-12
Skeletal tissue. Bone	PC-5, PC-12, EC-3	1. Lamellar bone tissue, a transverse section of the diaphysis of the tubular bone. 2. Development of bone at the site of cartilage - cartilage osteogenesis	2	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	11-12
Muscle tissue. Morph - functional characteristic. Classification. Smooth muscle tissue	PC-5, PC-12, EC-3	1. The mechanism of contraction of smooth muscle tissue. 2. Growth and regeneration of smooth muscle tissue.	2	Abstract, schematics.	30	1,2,3, 4,5,6	12-13
Muscle tissue. Transversely striated muscle tissue skeletal and heart type	PC-5, PC-12, EC-3	1. General characteristics of the evolutionary dynamics of muscle tissue 2. The mechanism of regulation of contraction and relaxation of striated muscle tissue	2	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	12-13
Nerve tissue. The development of nerve tissue. Neuron. Neuroglia.	PC-5, PC-12, EC-3	1. Differentiation of nerve cells and neuroglia. 2. The main provisions of neural theory.	2	Abstract, schematics.	30	1,2,3, 4,5,6	13-14
Nerve fibers: myelin and non-myelinated. Synapses. Nerve endings. Reflex arc.	PC-5, PC-12, EC-3	1. Degeneration and regeneration of nerve fibers	2	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	13-14
Nervous system. Peripheral nervous system. Spinal Node. Spinal cord.	PC-5, PC-12, EC-3	1. The transfer of information from neuron to neuron as the basis of the functional activity of the brain.	4	Abstract, schematics. Working with	30	1,2,3, 4,5,6	14-15

				microscope			
The structure of the cerebellum and cerebral cortex. Autonomic nervous system.	PC-5, PC-12, EC-3	1. The development of the cerebral cortex in mammals and humans. 2. Braking systems of neurons of the cerebellum and cerebral cortex	4	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	14-15
The sensory organs. The organs of vision and smell.	PC-5, PC-12, EC-3	1. The origin of receptor cells. 2. Development and morphofunctional features of photoreceptor cells in mammals and humans.	4	Abstract, schematics.	30	1,2,3, 4,5,6	15-16
The organs of hearing and balance. The organs of taste.	PC-5, PC-12, EC-3	1. Development and morphological and functional features of receptor cells of the organ of taste in mammals and humans. 2. Development and morphological and functional features of the receptor cells of the organ of Corti and the organ of equilibrium in mammals and humans. 3. The origin of receptor cells.	4	Abstract, schematics. Working with microscope	30	1,2,3, 4,5,6	15-16
Total	16		45		30		16

## 10. Educational technology

With a competency-based approach in education, the main factor in educational activity is not so much the component of knowledge acquisition as the component of the acquisition by students of various methods of activity for solving the set educational tasks. Therefore, to achieve the expected learning outcomes of the discipline, it is necessary to use various new technologies and interactive methods.

**Interactive learning** is first of all dialogue learning, during which there is an interaction between the student and the teacher, and between the students themselves. Interactive methods contribute to the formation of competencies and the achievement of certain learning outcomes - the acquisition of knowledge, the formation of skills.

lecture-visualization (LP), problem lecture (PL), mini-lecture (ML), lecture - press conference (LPC), lesson - conference (LC), brainstorming (BS), master class (MC), business and role-playing educational game (BG, REG), the method of small groups (SG), participation in scientific and practical conferences (SPC), student research and development work (SRDW), subject Olympiads (O), preparation and defense of abstracts (R) , Tests (T), situational tasks (ST), interactive whiteboard (IW), handouts (H), videos (V), slides (S), multimedia presentation (MPres ), assignments for independent work, teamwork (TW), research method (RM).

## 12. Educational-methodical and informational support of discipline

### Main:

1. Junqueira's Basic Histology/ Text and Atlas (14<sup>th</sup> ed.) p. 560.
2. Histology/ Color Atlas and textbook/ Leslie P. Gartner, James L. Hiatt (6<sup>th</sup> ed.)
3. Inderbir Singh's textbook of Human Histology/ Neelam Vasudeva, Sabita Mishra/ Color Atlas and practical guide (7<sup>th</sup> ed)

### Extra:

1. Textbook of Histology/ Leslie P. Gartner (4<sup>th</sup> ed.)
2. Histology/ textbook. Eduardo G. Gonzales, M.D. (5<sup>th</sup> ed.)
3. Human histology/ Alan Stevens, James Lowe. (3<sup>rd</sup> ed.)

## 13. The politics of pointing

The student can score points for all types of classes.

Module 1: activity at the lecture –30 b; at 1 practical lesson - 30b.

Milestone control: maximum 30 points: test - 20b; dumb preparation and dumb drawing - 10b. Implementation of the SIW - points separately according to plan. The final control is a maximum of 40b per computer test.

## 14. Questions for modules in histology, cytology and embryology

### History of histology

1. The subject and objectives of histology.
2. The development and formation of histology, cytology and embryology as sciences. Three periods of learning about tissues and the microscopic structure of organs.
3. What theories were in the history of the formation and development of blood cells. What is modern theory? Who is the creator of this theory?
4. The emergence and development of histology as an independent science. Founders of histology in the CIS, far abroad and in the Kyrgyz Republic
5. Automated image processing systems (AIPS) computers. Optical-structural machine analysis (OSMA). Scanning electron microscopy.
6. Special methods of light optical microscopy: comparative, phase contrast, luminescent and ultraviolet microscopy. Cyto- and histochemical methods and radioautography method.
7. Different brands of electron microscopes in the world and in the CIS countries. Transmission and scanning electron microscopes. Electron microscopy, principles of the electron microscope. Microtomes and ultramicrotomes. The thickness of the sections prepared by microtomes and ultramicrotomes.
8. Light microscopy. Magnification, resolution of the microscope. Special types of microscopy: phase contrast, polarization, interference, luminescent.
9. Histochemical and immunocytochemical methods. Cytophotometry, radioautography and stereological research methods.
10. The main stages of preparation of preparations for electron microscopy.
11. Preparation of sections: microtomes, ultramicrotomes, cryostats. Coloring sections, various dyes.
12. Distinctive features and sequence of stages of preparation of the drug for light and electron microscopy. Research methods for living and dead tissues, their chemical composition.
13. Modern methods for the quantitative study of microstructures in histological and cytological preparations. Morphometry, microspectrometry.
14. Histological technique: fixation, filling, preparation of sections, microtomes. Staining slices. Acidic, alkaline and neutral dyes
15. Paints, fixing and dehydrating liquids, battery for painting sections. Paraffins and paraffin blocks, balms. Slides and coverslips. Wiring, pouring, cutting and painting for light and electron microscopy.

### Cytology

1. General cell organization, cell definition. Different types of cells. Plasmolemma and its derivatives, methods of penetration of substances into the cell. Intercellular connections
2. Cells and non-cellular living structures. The concept of the cell as the basis for the shaping of the whole organic world.
3. Cellular theory.
4. The cell. Definition, general plan of the structure.
5. Plasma membrane, its selective permeability. Passive and active transport of lipids, proteins and carbohydrates. Endocytosis and exocytosis.
6. The cell membrane. Structure, chemical composition, functions.
7. Organelles of the cytoplasm. Organelles of general and special significance. Cell inclusion.
8. The cytoplasm. Cytolemma. Structure. Organoids. Inclusions.
9. Intercellular connections. Their structural and functional characteristics.
10. The interaction of cell structures in the process of protein synthesis for the needs of the cell itself and secreted products.
11. The cell cycle. Cell cycle periods. DNA doubling, protein synthesis, ATP accumulation. Cell physiology. Phagocytosis, pinocytosis, endocytosis, exocytosis.
12. The cell nucleus: chromatin, DNA, RNA, gene, chromosome. Nuclear sheath, nucleolus, nucleoplasm. Histo- and ultrastructure of the nuclear envelope.
13. The nucleus of the cell. Cell division, its components: nuclear membrane, chromatin, nuclear juice, nucleolus. The functions of the nucleus, the structure of the nucleus in interphase. Histo- and ultrastructural structure of the nucleus. Euchromatin and heterochromatin. The role of DNA in the period of genetic information and in the formation of RNA.
14. Cell division (mitosis, amitosis, meiosis, endomitosis). Structural elements of chromosomes, chromosome set, sex chromatin.

### General histology

1. General principles of tissue organization. Fabric as a system. The development of tissues in phylogenesis and ontogenesis. Theories of tissue evolution. Varieties of tissues in the body.
2. General patterns and structural features of various types of epithelium: integumentary, stratified keratinized and non-keratinized epithelium and multilayer epithelium. Their distribution in the body. Transitional epithelium.
3. Morphofunctional and histogenetic features of multilayered keratinized and non-keratinized epithelia. The structure of various types of integument epithelium, sources of their development. The ultrastructure of the mesothelium. Edges of a single-layer cylindrical epithelium, cilia of the ciliated epithelium.
4. Sources of development of epithelial tissues. The structure of various types of integument epithelium (histo- and ultrastructure).
5. Epithelial tissue. General characteristics of the epithelium, classification. The structure of various types of epithelium, their physiology, prevalence in the body. Ultrastructural characteristics of epithelial cells.



6. General patterns of the structure of the integument epithelium. Classification of integument epithelium by structure. Multi-row epithelium, spread in the body and cell types.
7. The organization of epithelia, their polar differentiation. Histo and ultrastructure.
8. The organization of the epithelium: layering, row, cell shape. Epithelial functions: transport, endocytosis, pinocytosis, secretion, barrier, protective.
9. Classification of epithelial layers. Layering, row, shape of the epithelium and their histo- and ultrastructure and function.
10. Glands. The structure, function and classification of the glands. Endocrine and exocrine glands. Morphological classification of exocrine glands. The ultrastructure of the cytoplasm of glandular cells. The structure of the glandular epithelium and types of secretion. Secretion phases (4 phases): absorption, synthesis and accumulation, isolation and recovery.
11. Epithelial glands, their exocrine and endocrine groups. Histo- and ultrastructure of glands. The method of secretion.
12. Epithelial glands: endocrine and exocrine. Classification by criteria, types of secretion, methods of secretion. The histological structure of the end section and excretory duct, myoepithelial cells.
13. Connective tissues: their cellular and non-cellular elements. The histological structure of collagen, elastic and reticular fibers. Development and importance in the body.
14. General characteristics and classification of tissues of the internal environment, mesenchyme and its differentiation. Cellular elements of connective tissue, their localization in the body. A variety of connective tissue fibers.
15. Dense fibrous connective tissue, its classification, structure and function. Special types of connective tissue (reticular tissue, reticuloendothelial system, adipose tissue, mucous tissue). Localization in the body of all types of connective tissue, a type of connective tissue fibers, a type of connective tissue fibers.
16. Dense fibrous connective tissue and its classification, structure and function. Special types of connective tissue (reticular tissue, reticulo-endothelial system, adipose tissue, mucous tissue). Localization in the body of all types of connective tissue.
17. Loose fibrous connective tissue, its classification, structure and functions. Localization of loose connective tissue in the body. Cellular elements of loose connective tissue. Own and alien connective tissue cells. Ultrastructure and function of connective tissue.
18. The principles of classification of tissues. Tissue homeostasis. The basics of cell populations. Tissue regeneration. The concept of the macrophagic system of the body. Contribution of I.I. Mechnikov to its study.
19. Morphological and functional characteristics of blood. Structural and functional signs of eosinophils, basophils, neutrophils, lymphocytes and monocytes. The idea of a hemogram.
20. Blood. Plasma and blood cells. Red blood cells, platelets, their development. Histo and ultrastructure.
21. Blood and lymph. The concept of the blood system, a general characteristic of the blood. Features of development, structure and functions. Components of blood: plasma, shaped elements, the concept of a hemogram and a white blood cell formula.
22. Morphological and functional characteristics and functional significance of red blood cells, white blood cells and blood platelets. Their development, form, percentage.
23. White blood cells: granulocytes - neutrophils, eosinophils and basophils. Their histo and ultrastructure. Functional value in inflammatory processes.
24. Granulocytopoiesis: the formation of mature neutrophils, eosinophils and basophils. Their histostructure and functional value.
25. Embryonic hemocytopoiesis. Hematopoiesis in the wall of the yolk sac, in the bone marrow, lymph nodes, in the spleen, in the thymus, in the liver. Intravascular hematopoiesis.
26. Postembryonic hemocytopoiesis. Stages of differentiation of blood cells: morphologically unidentifiable cells. Stem cells are hemocytoblasts.
27. Granulocytopoiesis in the embryonic and postembryonic period. The leukocyte formula is normal. Leukocyte count. Left shift
28. Cartilage and bone tissue, the properties of these tissues (elasticity, elasticity, hardness, etc.).
29. Bone tissue and its general characteristic. Coarse and lamellar bone tissue. Similarities and significant differences between cartilage and bone tissue. Embryo bone development. Histo- and ultrastructural components of compact and tubular bones.
30. Bone histogenesis. Cellular elements of bone tissue. The development of flat bones from mesenchyme. The structure and development of tubular bones at the site of cartilage. Factors affecting bone development and growth.
31. Embryonic and postembryonic osteohistogenesis. Direct osteohistogenesis and its stages. Indirect osteohistogenesis. The histological structure of plate tissue. The structure of osteoblast, osteocyte and osteoclast at the light-optical and submicroscopic level.
32. Muscle tissue. General morphological and functional characteristics and classification of muscle tissue. Sources of muscle tissue development. Features of the location of smooth muscle cells in organs.
33. Smooth muscle tissue of vertebrates. The development of muscle tissue from mesenchyme. Features of the location of smooth muscle cells in organs. Function of the ovarian muscle cells, methods of muscle tissue regeneration. Muscular tissue of epidermal and neural origin.
34. Transverse - striped muscle tissue. Cross - striped skeletal tissue. Red and white muscle fibers, their microscopic and ultramicroscopic structure. Structural and functional units of muscle tissue. Ultrastructures of myofibrils.
35. Structurally functional unit of striated, skeletal, cardiac, smooth muscle tissue. A distinctive feature of the electron microscopic picture of skeletal and cardiac muscle tissue. Insert drives, their structural and functional significance.
36. Histo- and ultrastructural structure and distinctive features of striated and smooth muscle tissue. Their location and importance to the body.

37. Transverse - striped cardiac muscle tissue, especially its structure. Ultrastructural structural features of myocardial myofibrils.
38. Cardiomyocytes: sarcoplasmic reticulum, mitochondria, insertion discs. Their histo and ultrastructure. The development of the heart muscle. Muscle tissue regeneration.
39. Methods of regeneration of muscle tissue. Sarcomere formula. Thick and thin myofilaments and the main proteins in them (ultrastructure of myofibrils).
40. Nerve tissue. General characteristics and histogenesis of nerve tissue. Histophysiology and ultrastructure of the nervous tissue.
41. Morphological and functional characteristics of neurocytes: receptor, associative and effector. The development of the nervous system. Types of nerve cells. Cytoplasm of a neuron, neurofibrils. Secretory neurons. Neuroglia. Microglia, microglia. Ependymocytes, astrocytes and oligodendrocytes.
42. Classification of nerve cells. Morphological and functional distinguishing features of axon and dendritis of nerve cells. Microscopic and ultramicroscopic features of myelin and non-myelin nerve fibers.
43. Nerve fibers, their classification and structure. Nerve trunks. Regeneration and degeneration of nerves. Nerve endings are effector and receptor. Myelin and non-myelin nerve fibers.
44. Interneuronal synapses. Classification of synapses. The principle of structural organization of chemical and electrical synapses. The concept of reflex arcs. Electron microscopy of axon-dendritic synapses.
45. Neuroglia, its classification, structure and functional significance. Ependymocytes, astrocytes, oligodendrocytes.
46. Interneuronal synapses. Classification of synapses. The principle of structural organization of chemical and electrical synapses. The concept of reflex arcs.
47. Bezmyelinovye and myelin nerve fibers. Nerve endings. Interneuronal synapses. The concept of reflex arcs. Regeneration of neurons and nerve fibers.
48. Details of the structure of cells and intercellular substance of the bone. The development of bone from mesenchyme. Histo- and ultrastructure of osteogenic cells. The histological and ultrastructural structure of the tubular bone (osteoblast, osteocyte, osteoclast).
49. The nervous system. General characteristics. Sources and the course of embryonic development.
50. The peripheral nervous system. Nerve. Structure, fabric composition. Sensitive nerve nodes.
51. Central nervous system. The structure of gray and white matter.
52. The spinal cord. General characteristics. The structure of gray matter: types of neurons and types of gliocytes.
53. The brain. Cerebellum. The structure and neural composition of the cerebellar cortex.
54. The brain. General characteristics of the structure, especially the structure and the relationship of gray and white matter. The cerebral cortex. Cytoarchitectonics of the layers (plates) of the cerebral cortex.
55. Autonomic (vegetative) nervous system.
56. Sense organs. Classification. The general principle of cellular organization of the receptor departments.
57. The organ of vision. General characteristics. General plan for the structure of the eyeball.
58. The main functional devices: diopter, accommodation and receptor.
59. The structure and pathophysiology of the rod- and cone-bearing neurons of the retina.
60. Features of the structure of the Central fossa of the optic disc.
61. Retinal pigment epithelium, structure and significance. Especially blood supply to the eyeball. Age-related changes. Auxiliary organs of the eye (eyelids, lacrimal apparatus).
62. The organ of smell. General characteristics. The structure and cellular composition of the olfactory lining: receptor, supporting and basal cells.
63. Histophysiology of the organ of smell.
64. Age-related changes. Vomeronasal organ.
65. The organ of taste. General characteristics. The structure and cellular composition of taste buds: taste, supporting and basal cells. The innervation of taste buds. Histophysiology of the organ of taste. Age-related changes.
66. Organs of hearing and balance. General characteristics. Outer ear: structure of the external auditory canal and eardrum. Middle ear: auditory ossicles, characteristic of the epithelium of the tympanic cavity and auditory tube.
67. Inner ear: bony and membranous labyrinths.
68. The vestibular part of the membranous labyrinth: elliptical and spherical sacs and semicircular canals. Their receptor departments: the structure and cellular composition of the spot and ampullar scallops. Innervation. Histophysiology of the vestibular labyrinth.
69. The cochlear part of the membranous labyrinth: the structure of the cochlear canal, the structure and cellular composition of the spiral organ, its innervation. Histophysiology of sound perception. Age-related changes.