

## 5-year DDS program

### Lectures (e-learning)

Lectures (e-learning) will be successively available on the Pegaz platform.

#### 1st SEMESTER

- 1. The cell – Part 1.** The biological membranes: membrane lipids and proteins, their properties and functional significance. Transport across the membranes: transporters, vesicular transport, membrane trafficking. The cell membrane, glycocalyx, adhesion molecules. The cell nucleus: spatial organization of the chromatin, eu- and heterochromatin. The nucleolus. The nuclear envelope and communication between the nucleus and the cytoplasm. Structure and function of ribosomes, the translation process. The endoplasmic reticulum (smooth and rough), characteristics of the membranes, enzymes associated with ER, functions of ER. The Golgi apparatus: polarity of the dictyosome, the role in protein glycosylation and sorting, membrane remodeling and modification of the secretory material.
- 2. The cell – Part 2.** Exo- and endocytosis, including receptor-mediated endocytosis. Lysosomes: types and their morphological characteristics, lysosomal enzymes, involvement in intra- and extracellular digestion processes. Proteasomes. Mitochondria: morphology, characteristics of mitochondrial compartments, distribution of the main enzymatic complexes and mechanisms of their action. Genetic apparatus and biogenesis of mitochondria. Peroxisomes: morphology, enzymes, functional significance. The cytoskeleton (microtubules, actin filaments, intermediate filaments) and its involvement in the motility of cells. Cell death: necrosis and apoptosis.
- 3. The epithelial tissue.** Definition and components of a tissue. General characteristics and functions of epithelia. Classification and characteristics of different types of epithelia. Epithelial cell polarity. Free surface of the epithelial cells and its structures: microvilli and cilia, mechanism of ciliary movement. The basolateral surface: cell-cell and cell-matrix junctions, their structure and functions. Basal lamina. Glands: morphological and functional classification.
- 4. The connective tissue proper.** Chemical and structural characteristics of the extracellular substance: matrix and fibers. Stages of collagen fiber production. Origin, structure and function of the connective tissue cells: fibroblasts, plasma cells, mast cells and macrophage family. General classification of connective tissue. Characteristics of connective tissue proper types. The comparative characteristics of white and brown adipose tissue.
- 5. Cartilage and bone.** Cartilage: characteristics of the extracellular substance, chondral territories, nourishment of cartilage. Types of cartilage and their mechanical properties. Bone: organic and inorganic components of the extracellular substance. Bone cells: osteoprogenitor cells, osteoblasts, osteocytes, osteoclasts. The bone lamella, organization of

cancellous and compact (Haversian) bone. Intramembraneous and endochondral ossification. Growth and remodelling of the bone. Basic mechanisms of biomineralization.

- 6. Blood and hematopoiesis.** Blood plasma. Blood cells, their counts, characteristics and functional adaptations. Erythrocyte and its cell membrane. Comparative characteristics of granulocytes and agranulocytes. The role of granulocytes in the defense mechanisms: neutrophils and bacteria-killing system, eosinophils, basophils. Lymphocytes – general characteristics. Monocytes and their functions. Blood platelets. The structure of hematopoietic bone marrow and principles of hematopoiesis.
- 7. The muscle tissue.** The contractile apparatus. Classification of the muscle tissue. Characteristics of smooth, skeletal and cardiac muscle cells/fibres. Structural and biochemical basis of smooth and striated muscle contraction. Sarcomere, its structure, contractile, regulatory and accessory proteins. The role of T-tubules and sarcoplasmic reticulum in excitation-contraction coupling. Motor end plate. The organization of smooth muscle layer, skeletal muscle, and cardiac muscle including the conduction system. The nonmuscle contractile cells.
- 8. The nerve tissue.** Definition of the neuron and its structural characteristics. Classification of neurons. Types of nerve fibers. Structural and chemical basis of neural conduction: resting and action potentials, the role of ion channels and myelin sheath. Structure and types of synaptic junctions, neurotransmitters, the synaptic transmission. Paracrine transmission. Types and functions of neuroglial cells. Organization of the nervous tissue: the peripheral nerve, the dorsal root ganglion, white and grey matter of the central nervous system.
- 9. The vascular system.** Components of the vascular wall. Endothelium – structural characteristics and functions. Mechanisms of transendothelial transport of substances and migration of leukocytes. The structure and types of capillaries. Precapillaries and postcapillaries. Regulation of blood flow in capillary bed. Layers of the vascular wall, comparative characteristics of arteries and veins. Arterioles and arteries (muscular and elastic). The veins and their structural variability. Arteriovenous anastomoses. The heart wall layers.
- 10. The lymphatic system.** The innate immunity: pattern recognition receptors, NK cells. The adaptive immunity: cells involved in the immune reactions - antigen presenting cells, T- and B-lymphocytes and their subpopulations, characteristics and cooperation. Humoral and cell-mediated immune response. The lymphoid tissue and its organization. The lymphoid nodule. Structure and function of the lymph node. Spleen - organization and functions of white and red pulp, the splenic circulation. Thymus: general organization, epithelioreticular cell system and its role in the differentiation and maturation of T lymphocytes.
- 11. The integument.** Layers of the integument. Epidermis: keratinocytes and the keratinization process, melanocytes, Langerhans and Merkel cells and their functions. Organization of dermis and hypodermis. Eccrine and apocrine sweat glands and sebaceous glands: structure, function and mode of secretion. The hair follicle. Vascularization and innervation of the skin, types of encapsulated mechanoreceptors and their function. Comparative characteristics of thick and thin skin.

## 2nd SEMESTER

- 12. The oral cavity.** Definition and general characteristics of mucosa. The lip. The mucosa of different regions of the oral cavity. The tongue: lingual papillae and glands. Structure and function of taste buds, mechanisms of taste perception. The pharynx. The tonsils. Oral exfoliative cytology.
- 13. Salivary glands and temporomandibular joint.** General histology of the salivary glands. The secretory portions: serous acinus and mucous tubule. The excretory ducts, their morphological and functional characteristics. Composition of saliva. Histological differences between parotid, sublingual and submandibular glands. Minor salivary glands. General histology of the joint, specific structure of the temporomandibular joint.
- 14. The dental organ, part 1. Structure and function of mineralized tissues.** General architecture and components of the dental organ. Composition, structure and function of mineralized tissues of the tooth: enamel, dentin and cementum (primary and secondary). Dental plaque and dental calculus.
- 15. The dental organ, part 2. Structure and function of nonmineralized tissues.** Tooth pulp: its components, areas, vascularization and innervation. Characteristics of pulp cells – odontoblasts, fibroblasts, dendritic cells and stem cells. The periodontal ligament: general structure, classification of principal fibers and their functions, cells present in the ligament, its vascularization and innervation. Gingiva and dentogingival junction..
- 16. Development of the dental organ.** Stages of tooth development. Mechanisms of induction of tooth tissues. Formation of primary epithelial band and dental lamina. Development and functions of enamel organ, dental papilla and dental follicle. Formation and mineralization of enamel and dentin, structural and functional characteristics of the involved cells: ameloblasts and odontoblasts. Development of cementum and periodontal ligament. Tooth eruption and shedding.
- 17. The alimentary canal.** General organization of the alimentary canal, characteristics of the wall layers. The esophagus. The wall of stomach: surface lining epithelium and its protective function, characteristics of the gastric glands and their cellular composition. The intestines and their adaptations to function (intestinal epithelium, villi and crypts), segmental differences in the wall structure. The gut-associated lymphoid tissue. Innervation of the alimentary canal.
- 18. Large glands of the alimentary system: pancreas and liver.** The pancreas - organization of the exocrine part, characteristics of the secretory pancreatic cell, acini and ducts. General organization of the liver, types of hepatic lobules. Structural and functional characteristics of the hepatocyte and its polarity. The hepatic sinusoids and associated cells. The hepatic circulation. Intra- and extrahepatic bile ducts.

- 19. The endocrine system.** General characteristics of endocrine glands. The pituitary gland: adeno- and neurohypophysis. The functional interrelations between hypothalamus and the pituitary. Morphological and functional classification of cells in adenohypophysis, structure and function of pars nervosa. General organization of thyroid gland. The thyroid follicle: its cells and stages of thyroid hormone production. The C-cells. The parathyroid glands – its histological structure and cell types. The pancreatic islets: ultrastructural and functional characteristics of their cells. The adrenal cortex, its layers and hormones. The ultrastructural features of steroidogenic cells. Adrenal medulla, chromaffin cells. The system of disseminated neuroendocrine cells (DNES).
- 20. The respiratory system.** The airways - characteristics of the mucosa, the airway epithelium and its cell types, the mucociliary cleaning mechanism. Nasal mucosa: the respiratory and the olfactory regions. Olfactory epithelium: cell types and functions. The paranasal sinuses and Eustachian tube. The middle ear. Pharynx and larynx. The structure of trachea, bronchi and bronchioles. General organization of the lungs. The pulmonary alveoli: types and functions of pneumocytes, air-blood barrier, the surfactant and its role.
- 21. The reproductive systems.** The testis: seminiferous tubules, spermatogenesis and spermiogenesis. Sertoli cells and their functions. Endocrine function of testis: Leydig cells. Excretory ducts: efferent tubules and ductus epididymis. Vas deferens. Basic characteristics of prostate gland, seminal vesicles and Cowper glands. The ovary: developmental stages of ovarian follicles. Corpus luteum. Endocrine function of the ovary. The oviduct. The uterus – endometrial alterations during the menstrual cycle. The vagina.
- 22. The urinary system.** The kidney: cortex and medulla. Nephron and the localization of its segments in the renal parenchyma. The renal corpuscle and filtration barrier, mechanism of ultrafiltration. Structural and functional characteristics of the successive segments of the nephron. The collecting tubule and its role in urine condensation. The juxtaglomerular apparatus: its components and their function. Renal blood vessels. The excretory passages: urether and urinary bladder.
- 23. The organ of vision.** General organization of the eyebulb and its layers. The sclera and cornea. The choroid and structures responsible for accommodation and adaptation: ciliary body and iris. Production and circulation of the aqueous humor. The lens. The retina: layers, characteristics of cones and rods, molecular basis of photoreception. Macula lutea and optic disk. The eyelid: conjunctiva, tarsal plate, glands. The lacrimal gland.
- 24. Review of slides.** Practical clues how to identify histological slides (aid in preparation for the lab exam) – **part 1.**
- 25. Review of slides.** Practical clues how to identify histological slides (aid in preparation for the lab exam) – **part 2.**