

Detailed program of Histology & Cell Biology for the English language students' group attending the Advance MD program of medical studies

CELL BIOLOGY

Organization of a model cell: cell membrane, cytoplasm: membrane system of the cell (cell membrane, ribosomes, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes), semiautonomic structures (mitochondria, centrioles), cytoskeleton (microtubules, microfilaments, intermediate filaments), basic cytoplasm (cytosol), proteasomes and their role in the cell, cytoplasmic deposits, nucleus: nuclear envelope structure, nuclear pore complexes, nuclear localization signal, nuclear lamina, nuclear matrix, chromatin (nucleosome, solenoid, euchromatin, heterochromatin, sex chromatin), role of chromatin and nucleolus in the cell.

Genes – the flow of genetic information: structure of eukaryotic gene, transcription factors, gene control region, alternative splicing, epigenetic control of gene expression.

Life of the cell: (1) In the cycle (definition and phases of the cycle [G_1 , S, G_2], cell function in particular phases, cell division, cell cycle regulation). (2) Out of the life cycle (phase G_0).

Cell death: apoptosis (apoptotic pathways, regulation), autophagy, pyroptosis, oncosis, necrosis, necroptosis.

Cell membrane; principles of cell transport and cell signalling: (1) structure: phospholipids, cholesterol, membrane fluidity, glycocalyx, membrane proteins, lipid rafts. (2) Membrane transport (diffusion, facilitated diffusion, active transport), vesicular transport: endocytosis and exocytosis and their modifications). (3) Types of signalling (auto-, para-, endo- and juxtacrine), cell receptors (types, mode of action, regulation of receptors function), ligands.

HISTOLOGY

Epithelial tissue: (1) Classification of epithelial tissue. (2) Covering epithelia: classification, structure and function, surface specialisation (intercellular junction, microvilli and stereocilia, basement membrane, cilia and flagella, polarity of epithelial cells). (3) Glands: criteria of classification, structure, function, types of excretion.

Connective tissue: (1) Cells and extracellular components: classification of cells, identification, ultrastructure and function of particular types of connective tissue cells, collagen and elastic fibers (characteristics and production), ground substance. (2) Classification, structure, existence and function of particular types of proper connective tissue. (3) Adipose tissue. (4) Cartilages.

Bone: Classification (^[1] primary or woven and secondary or lamellar, and ^[2] compact or cortical and trabecular or cancellous), lamella as mature bone structural unit (composition of

the unit), osteon as cortical bone structural unit, trabecular packets as the cancellous bone structural unit, classification and function of the bone cells, periosteum; histogenesis of the bone (intramembranous ossification, development of long bone: mechanism and effect of endochondral ossification, production of cortical bone - mechanism and effect, epiphyseal-metaphyseal complex or growth plate - time and place of existence, role, type of the bone it produces), mineralization; role of the bone in calcium homeostasis.

Muscular tissue: (1) Definition and classification from the morphological and physiological point of view. (2) General structure of skeletal, cardiac and smooth muscles. (3) Ultrastructure of skeletal fibers (myofilaments - contraction system, sarcoplasmic membrane system, heterogeneity of skeletal fibers, neuromuscular junction). (4) Ultrastructure of cardiac muscle (intercellular junctions). (5) Ultrastructural and molecular basis of contraction. (6) Smooth muscle.

Nervous tissue: (1) Classification of nerve cells according to several criteria. (2) Ultrastructure and function of nerve cell (nucleus, perikaryon, dendrites, axon, terminations of axons - synapses: ultrastructure, types, distribution). (3) Neuroglia and other supporting cells. (4) Nerve fibers (sheaths, myelin-forming in central and peripheral nervous system, classification). (5) Regeneration and degeneration in nervous tissue. (6) Blood-brain barrier. (7) Peripheral termination of nerve fibers.

Cardiovascular system: (1) Heart: anatomical and histological organization (endocardium, myocardium and epicardium); valves, heart vessels, conducting system and nerves, endocrine cells. (2) Blood vessels: general remarks, capillaries (types, types of endothelium, function of endothelium), arteries, veins, arteriovenous anastomoses. Lymphatic vessels.

Blood: Composition, blood cells (classification, number and percentage, ultrastructure, function, origin and life cycle).

Bone marrow: Occuring and histological organization of the red bone marrow; hematopoiesis, factors controlling hematopoiesis; bone marrow-blood barrier.

Lymphatic (immune) system: Definition of immunity and immune reactions; cells involved in immune reactions (lymphocytes B and T, memory cells, antigen-presenting cells, macrophages, NK [natural killer] cells), humoral immunity (immunoglobulins), cellular immunity (lymphokines); organs involved in immune reactions: central (bone marrow and thymus), peripheral (lymph nodes, spleen, tonsils); thymus-dependent zone (PALS, paracortex) and thymus-independent zone (lymphatic nodules); recirculation of lymphocytes; function of the spleen (function of red pulp - monitoring of erythrocytes and other).

Endocrine system: (1) Definitions and terms concerning endocrine and target cells; intercellular communication: endocrine, paracrine, autocrine, synaptic; mode of action of extracellular messengers on target cells. (2) Histological organization, cytostructure, function and hormones (including the effects of the hormone action) of hypothalamus, hypophysis, thyroid gland, parathyroid gland, adrenal gland, pineal gland and the dispersed

(neuro)endocrine cell system (APUD series cells, paraneurons). (3) Control of hormone secretion.

Skin: (1) Epidermis: cells (keratinocytes, melanocytes, Langerhans cells, Merkel cells), histological organization, ultrastructural details, mechanism of keratinization, epidermal-melanin unit and the mechanism of pigmentation, dermal-epidermal junction. (2) Dermis. (3) Hair, glands and nerve endings of the skin.

Respiratory system: (1) Nasal cavity and sinuses (respiratory mucosa and olfactory mucosa, vomeronasal organs and paranasal sinuses). (2) Nasopharynx. (3) Larynx. (4) Trachea. (5) The lungs (bronchiopulmonary segments, structure of wall of bronchi and bronchioles, respiratory bronchioles and subdivisions, functional respiratory units, structure and function of the alveolar wall, respiratory epithelium, surfactant, alveolar macrophages, pulmonary circulation and nerves).

Digestive system:

Oral cavity: Lips, vestibular mucosa, proper oral cavity (alveolar bone processes, gingiva, hard and soft palates), tongue (papillae - filiform, fungiform, foliate, circumvalate; taste buds, glands of tongue mucosa), teeth (dentin, enamel, cementum, pulp, periodontal tissue), tooth development, salivary glands.

Gastrointestinal tract: General organization of wall; esophagus; stomach (gastric and pyloric glands); small intestine (regional differences, structure and function of intestinal villi); large intestine (including cecum, vermiform appendix and rectum); mechanism of the epithelial renewal; immune defense mechanism; gastrointestinal endocrine cell system.

Liver: General histological organization, hepatocyte as a glandular cell, ultrastructure and function of hepatocyte, blood supply of the liver, ultrastructure of sinusoid wall (blood - hepatocyte "barrier", space of Disse), morphological and functional units (classic lobule, liver acinus), bile excretory ducts, function of liver. Gallbladder.

Pancreas: Exocrine pancreas (histological organization, the acinar cell ultrastructure, mechanism of secretion, control of secretory process); the pancreatic (Langerhans) islets (histological organization and ultrastructure, and secretory function of the cells, control of the hormone secretion).

Urinary system: (1) Kidney: topography area (cortex lobules, renal columns, medullary pyramids, medullary rays, outer and inner zones of medulla, papilla, renal pelvis, major and minor calyces), nephron as functional unit (definition and classification, organization of renal corpuscle and other parts of nephron, function of nephron (filtration - blood-urine barrier, resorption, concentration of urine, control of urine production), nephron topography, collecting ducts, papillary ducts, juxtaglomerular apparatus. (2) Ureters. (3) Bladder. (4) Urethra.

Male reproductive system: (1) Testis: histological organization, compartments of seminiferous epithelium, spermatogenesis (definition and phases), cycle of seminiferous epithelium, interstitial gland (androgen secretion and its control), hormonal and local mechanism controlling spermatogenesis (paracrine interaction of Sertoli cells with Leydig cells and germinal cells). (2) Excurrent duct system. (3) Male accessory organs.

Female reproductive system: (1) Ovary: histological organization, classification of ovarian follicles, development and function of the ovarian follicles in dependence on menstrual cycle (recruitment, selection, domination), estrogen secretion mechanism and its hormonal control and consequence, ovulation, oogenesis and fertilization, corpus luteum (organization, hormones, function). (2) Oviducts (Fallopian tubes), uterus, vagina: histological organization, menstrual cycle dependent changes and its hormonal control.

Central nervous system: Some aspects of histological organization and functioning (white and gray matter; cerebrum, cerebellum and spinal cord morphology; cerebrospinal fluid; choroid plexus, meninges). Blood - brain barrier.

Sense organs: Eye: (1) Histological organization (parts of the eye, protective tissues, refractive tissues, chambers of the eye and their contents, nutritional tissues, retina, photoreceptors, optic nerve). (2) Function of the eye.