

Semmelweis University
Department of Anatomy, Histology and Embryology

Faculty of Medicine
2nd year / 2nd semester

ANATOMY HANDBOOK



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Anatomy, Histology and Embryology for EM students

TEACHING DEPARTMENT:

SEMMELWEIS UNIVERSITY

Department of Anatomy, Histology and Embryology

Budapest, Tűzoltó utca 58.

H-1094 Budapest

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LEARNING OBJECTIVES

Aims of the lectures in anatomy: Presentation of the important and/or complicated chapters such as introductory chapters, thorax, pelvis, hand, foot, skull, heart, chapters of the visceral organs, central nervous system, **organs of special senses, topographical anatomy.**

Aims of the lectures in cell biology and histology: Presentation of the cell, basic principles in cell biology (mitosis, cytoskeleton, cellular motility), detailed presentation of the basic tissues (epithelial, connective, muscle and nervous). Completing the gross anatomy with the detailed presentation of the fine structure of the organs, including the ultrastructural details as well as the molecular arrangement. Important chapters: basic tissues, viscera, central nervous system.

Aims of the lectures in embryology: Presentation of the early development from the differentiation of the germ cells to the formation of the human embryo (general embryology). Presentation of the development of the organs and functional systems parallel with the gross anatomical and histological lectures including the frequently occurring malformations.

Aims of the practical sessions in the dissecting room: Based on the weekly programs the students study the preparations (bones, joints, muscles, viscera, brain) and dissect (parts of or an entire cadaver). They are aided by the lab instructors. Bones, joints, muscles and peripheral nervous system will be taught primarily in the dissecting room.

Aims of the practical sessions in the histology room: Facilitate the understanding of the basic tissues (epithelial, connective, muscle and nervous) and the fine structure of the organs through the observation and interpretation of histological specimens.

Discussion of the more complicated chapters of the embryology is presented on small group discussions connected to the practical sessions in the dissecting room.

The knowledge of the students will be checked by mid-term tests.

Lectures: first semester: 3x 45 min; second semester: 3x 45 min; third semester: 3x 45 min; fourth semester: 1x 45 min.

Topics of the lectures:

First semester: Gross anatomy of the bones, joints and muscles, basic cytology, basic histology, basic embryology, development of the skull, spine and limbs.

Second semester: Heart and vessels, lymphatic organs, viscera and body cavities; integrated gross anatomy, cytology, histology and embryology.

Third semester: Central and peripheral nervous system, organs of special senses, endocrine organs; integrated gross anatomy, cytology, histology and embryology.

Fourth semester: Topographical anatomy of the head, neck and body cavities (thorax, abdomen, pelvis), cross sectional anatomy.

Practical course

: 6x 45 min; second semester: 6x 45 min; third semester: 4x 45 min; fourth semester: 2x 45 min;

First semester: Gross anatomy of the bones, joints and muscles, basic cytology, basic histology, basic embryology, development of the skull, spine and limbs.

Second semester: Heart and vessels, lymphatic organs, viscera, topography of body cavities; integrated gross anatomy, cytology, histology and embryology. Topographical anatomy of the ventral regions of limbs and the trunk.

Third semester: Central and peripheral nervous system, organs of special senses, endocrine organs; integrated gross anatomy, cytology, histology and embryology. Topographical anatomy of the dorsal regions of limbs and the trunk, including spinal cord.

Fourth semester: Topographical anatomy of the head, neck and body cavities (thorax, abdomen, pelvis), cross sectional anatomy. Review of the subjects taught and studied during the four semesters.

Type of exams: first semester: semifinal; second semester: semifinal; third semester: semifinal; fourth semester: final exam from the subjects of the four semesters..

ECTS credits: four semesters together: 28 (first semester: 9; second semester: 9; third semester: 7; fourth semester: 3)

EM II

2nd year 2nd (4th) semester announcements

Signing of the lecture book: active participation in lectures and dissection room classes is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in **25%**. Presence will be recorded.

Midterm examinations: During the 4th semester, both practical and theoretical knowledge will be regularly evaluated. The **anatomy** mid-terms include both identification of several structures on the specimen and theoretical questions related to the subject.

Evaluation is made using a five-grade scale (1-5)

In the 4th semester, at least one of the midterms will have to be completed with at least a pass (2) for the acceptance of the semester. The date of the tests is always set previously.

In case neither of the tests were successful, due to being absent from, or failing both of the midterm tests, one **dissection room** test will have to be **repeated** in the final weeks of the semester (TBA). The results of all tests will appear on the personal achievement cards.

Students will be asked to present their histology notebooks, containing the drawings, during the final exam.

*N.B. – In case, neither the first nor the repeated takes of the final exam have been successful during the summer examination period, the students may register for **a CV final course** for the following semester, or, they may **reregister for ANA4** and repeat the semester in the next academic year.*

EM II.

Subject matter of the 4th semester

I. Topographical anatomy in regions and sections

- a) upper and lower limbs
- b) thoracic and abdominal wall
- c) organs of the thoracic cavity
- d) organs of the abdominal cavity
- e) organs of the pelvis
- f) perineum
- g) regions of the head and the neck
- h) nasal and oral cavities, orbit
- i) cranium

II. Review of the histological specimens

Dates of the revision (consultations) TBA

III. Preparation for the final examination

Test I.

Topic: Ventral regions of the limbs and the body wall, organs of the thorax and abdomen
(topographical aspects)

Date: 6th week Monday, Tuesday and Thursday

Test II.

Topic: Organs of the head and neck (topographical aspects)

Date: 11th week Monday, Tuesday and Thursday

Final examination

Topics: Chapters of the four semesters in anatomy, histology, cell biology and embryology.

The final exam consists of three parts:

1. Macroscopical anatomy
2. Histology (2 specimens)
3. Theoretical part (6 topics + Cell biology)

Academic Year 2015/2016
Faculty of Medicine, Second Year, Second Semester
EM II. Groups 1 - 8

Week	Lecture Monday 9.00 - 9.45	Dissection room Monday (or Thursday for Group 2)
Week 1 Febr 1- 5	The topographical anatomy of the thorax, clinical relevances.	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 2 Febr 8 - 12	The sectional anatomy of the thorax	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 3 Febr 15 - 19	The topographical anatomy of the abdomen clinical relevances.	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 4 Febr 22 - 26	The sectional anatomy of the abdomen	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 5 Febr 29 – March 4	The topographical anatomy of the limbs, gait mechanism	Dissection of ventral regions. Body cavities, internal organs and limbs
----- ----- March 5 Monday classes on Saturday	----- ----- The topographical and sectional anatomy of the head, clinical relevances	Dissection of ventral regions. Body cavities, internal organs and limbs (Saturday dissection class for groups 1,3-8, 10-12)
Week 6 March 7 - 11	The topographical anatomy of the neurocranium, clinical relevances	1. Midterm : Topographical anatomy of the ventral regions, internal organs and ventral regions of the limbs
Week 7 March 14 - 18	March 15th National Holiday	Dissection of the head and neck regions
March 21 – 25	Easter Break	
Week 8 March 29 – April 1	Easter Monday	Dissection of the head and neck regions
Week 9 April 4 - 8	The topographical anatomy of the viscerocranium, clinical relevances	Dissection of the head and neck regions
Week 10 April 11 - 15	The topographical anatomy of the neck, clinical relevances	Dissection of of the head and neck regions
Week 11 April 18 - 22	The sectional anatomy of the neck	2. Midterm: Topographical anatomy of the head and neck regions
Week 12 April 25 – 29 <i>Competition 1st round</i>	The topographical and sectional anatomy of the male pelvis and perineum, clinical relevances	Dissection of the pelvis and perineum. Presentation of prosected specimens of the final examination
Week 13 May 2 - 6 <i>Competition 2nd round</i>	The topographical and sectional anatomy of the female pelvis and perineum, clinical relevances	Dissection of the pelvis and the perineum, Brain. Presentation of prosected specimens of the final examination
Week 14 May 9 - 13	Histology of ground tissues and organs <i>Announcement of the competition results</i>	Brain dissection. Presentation of the placenta and the fetus

Academic Year 2015/2016
Faculty of Medicine, Second Year, Second Semester
EM II. Groups 9 - 16

Week	Lecture Monday 14.00 - 14.45	Dissection room Monday (10,11,12) or Tuesday (13,14,15) or Thursday (9,16)
Week 1 Febr 1- 5	The topographical anatomy of the thorax, clinical relevances.	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 2 Febr 8 - 12	The sectional anatomy of the thorax	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 3 Febr 15 - 19	The topographical anatomy of the abdomen clinical relevances.	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 4 Febr 22 - 26	The sectional anatomy of the abdomen	Dissection of ventral regions. Body cavities, internal organs and limbs
Week 5 Febr 29 – March 4 ----- March 5 Monday classes on Saturday	The topographical anatomy of the limbs, gait mechanism ----- The topographical and sectional anatomy of the head, clinical relevances	Dissection of ventral regions. Body cavities, internal organs and limbs Dissection of ventral regions. Body cavities, internal organs and limbs (Saturday dissection class for groups 1,3-8, 10-12)
Week 6 March 7 - 11	The topographical anatomy of the neurocranium, clinical relevances	1. Midterm : Topographical anatomy of the ventral regions, internal organs and ventral regions of the limbs
Week 7 March 14 - 18	March 15th National Holiday	Dissection of the head and neck regions
March 21 – 25	Easter Break	
Week 8 March 29 – April 1	Easter Monday	Dissection of the head and neck regions
Week 9 April 4 - 8	The topographical anatomy of the viscerocranium, clinical relevances	Dissection of the head and neck regions
Week 10 April 11 - 15	The topographical anatomy of the neck, clinical relevances	Dissection of of the head and neck regions
Week 11 April 18 - 22	The sectional anatomy of the neck	2. Midterm: Topographical anatomy of the head and neck regions
Week 12 April 25 – 29 <i>Competition 1st round</i>	The topographical and sectional anatomy of the male pelvis and perineum, clinical relevances	Dissection of the pelvis and perineum. Presentation of prosected specimens of the final examination
Week 13 May 2 - 6 <i>Competition 2nd round</i>	The topographical and sectional anatomy of the female pelvis and perineum, clinical relevances	Dissection of the pelvis and the perineum, Brain. Presentation of prosected specimens of the final examination
Week 14 May 9 - 13	Histology of ground tissues and organs <i>Announcement of the competition results</i>	Brain dissection. Presentation of the placenta and the fetus

RULES AND REGULATIONS IN THE DISSECTING ROOM

IT IS STRICTLY FORBIDDEN to eat, drink, smoke, to chew gums, or to use music devices or phones.

Bags and coats should be left in the lockers before entering the dissecting room.

The lockers will have to be locked using your padlocks.

Please, remember to keep your valuables always on you, or lock them in the lockers since the department takes no responsibility for lost items.

Everybody is supposed to behave in the dissecting room conforming to the spirit of the site. Loud speech, out-of-place jokes and any kind of behaviour, disregarding the dignity of human corpses, should strictly be avoided.

Students are expected to be prepared for the practical work.

Students should take care of the furniture and equipment of the dissecting room. Do not sit on the dissection tables or stand on the tripod stools to avoid accidents. **Fire and work safety regulations** should be maintained. The dissection room is a hazard area. **Cleanliness and order** should be kept.

Working in the dissection room involves the use of **sharp and pointed tools**, injuries should be reported to the lab instructor. The technical personnel will provide first aid when necessary.

The white lab coats should be worn while in the dissection room, but should be removed before leaving the dissection room area. The purpose of wearing the lab coats is to protect one's clothing from contacting the cadaver specimen. Furthermore we advise you to wear closed toed shoes and clothing covering the legs. In the end of the class, lab coats should be emptied and left in order on the coat hangers. The department is not responsible for valuables left in the dissecting room.

Only the members of the study group can participate in the sessions, visitors may be present only with prior permission by the lab instructor. Students can leave the sessions only with the approval of the lab instructor.

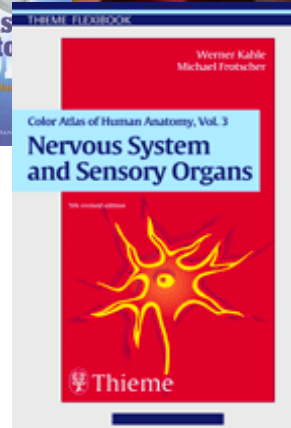
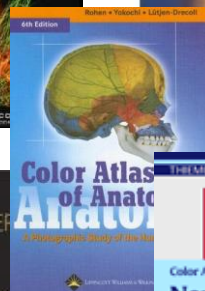
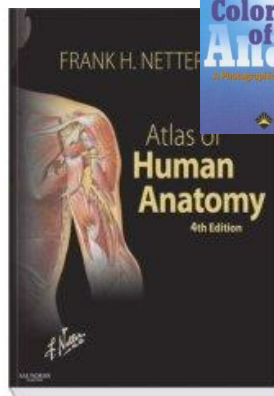
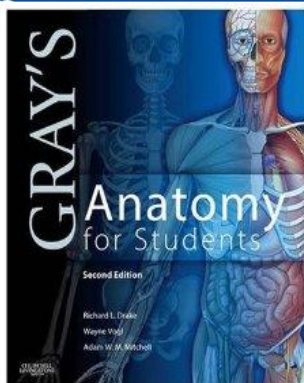
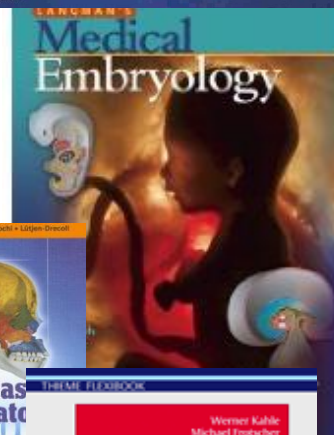
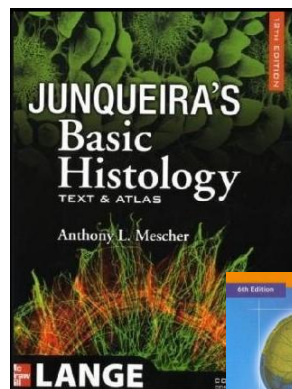
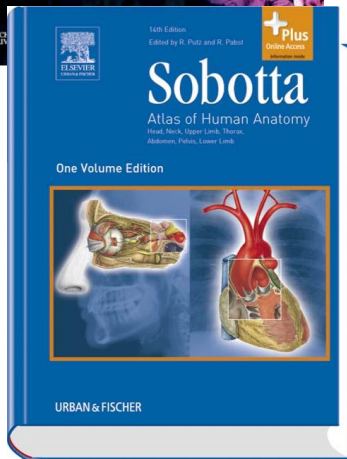
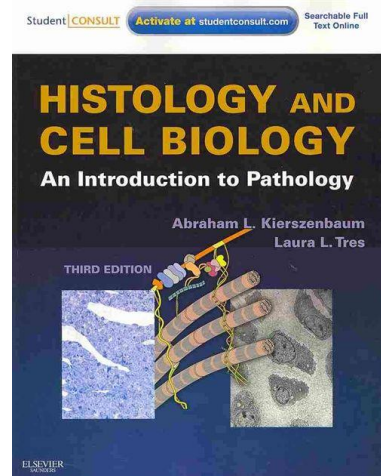
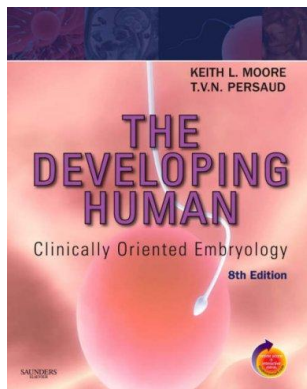
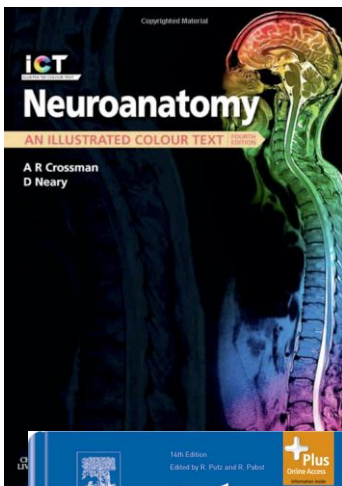
Photos, or videos can only be made with the agreement and in the presence of the lab instructor.

Specimen preparations should be wrapped and labeled. Dissection materials of other groups or individuals should not be handled. Dissected cadaver pieces should be discarded in a designated container and discarded blades have to be collected separately.

Dissecting rooms are closed between 6:00 PM to 8:00 AM and over the weekends Students may not stay in the dissecting room without the supervision of one of the assistants of the department. In the absence of an instructor, the technical personnel should ask the students to leave the dissecting room.

SMOKING IS STRICTLY FORBIDDEN ON THE DEPARTMENTAL PREMISES, INCLUDING THE GARDEN AND THE YARD!

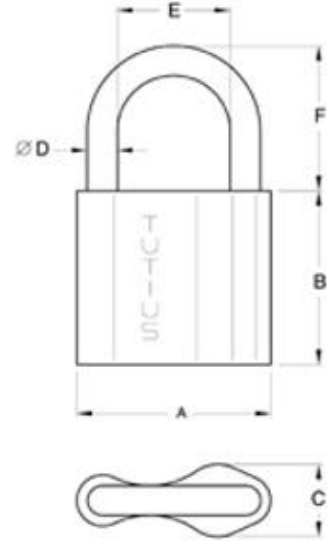
RECOMMENDED BOOKS



During dissection classes keep your belongings in the lockers and lock them with your padlock!

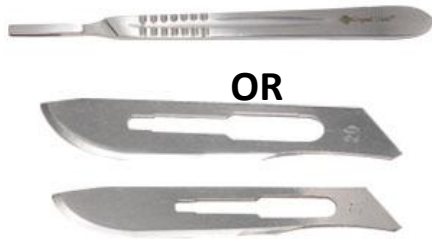
PADLOCK SIZE: 6 mm

Please, remember to keep your valuables always on you, or lock them in the lockers since the department takes no responsibility for lost items.



DISSECTION ROOM TOOLS

SCALPEL



OR



A PAIR OF ANATOMICAL FORCEPS



RUBBER GLOVES



PROTECTIVE CLOTHING (LABCOAT)

GOGGLES



TOPICS OF THE FINAL EXAMINATION IN ANATOMY, HISTOLOGY AND EMBRYOLOGY

- 1.: Embryology**
- 2.: Histology**
- 3.: Locomotor system**
- 4.: Circulatory system or organs of special senses**
- 5.: Splanchnology (viscera)**
- 6.: Nervous system**

EMBRYOLOGY

Spermatogenesis
Oogenesis, Female reproductive cycles
Fertilization, cleavage of the zygote
Blastocyst formation. The bilaminar embryonic disc
Implantation
Gastrulation, The notochord
Neurulation
Development and differentiation of the neural tube
Derivatives of the ectoderm
Derivatives of the endoderm
Differentiation of the mesoderm. Formation and derivatives of the somites
Derivatives of the mesoderm
Lateral mesoderm and its derivatives
Folding of the embryo
Development of the primitive cardiovascular system and the placental circulation
The structure of the placenta
Fetal membranes. Umbilical cord
The embryonic and fetal periods. Parturition, multiple birth
Stages of human prenatal development
Development of the limbs
Development of the skull
Development of the muscular system
Early development of the heart. Folding of the heart tube.
Development and partitioning of the primitive atrium
Development and partitioning of the primitive ventricle.
The aorticopulmonary septum.
Development of the great arteries. Derivatives of the aortic arches.
Development of the inferior vena cava and the portal vein.
Development of the superior vena cava, the azygos and hemiazygos veins.

The fetal and neonatal circulation
Development of the face and palate
Development of nasal cavity and paranasal sinuses
Development of the teeth and the tongue
Development of the branchial arches and their derivatives
Development of laryngo-tracheal tube, bronchi and the lung
Development of branchial grooves, the pharyngeal pouches and their derivatives
The formation and differentiation of the foregut
Formation and development of the midgut
Development of liver and pancreas
The formation and differentiation of hindgut
Development of the kidneys
Development of the urinary passages
Development of the gonads
Development of the male genital ducts and auxiliary glands
Development of the female genital ducts and auxiliary glands
Development of the male and female external genitalia
Formation and division of the body cavities
Development of the peritoneum
Development and differentiation of the spinal cord
Development of the forebrain
Development of the peripheral nervous system
Development of the eye and optic nerve
Development of the organs of hearing and equilibration.

HISTOLOGY

Concept of basic tissues .
Definition and classification of epithelial tissue
Simple epithelia
Stratified epithelia
Membrane specialisations of epithelia
Glandular epithelia
Pigment epithelium and sensory epithelium
Cells of connective tissue
Ground substance and fibres of connective tissue
Types of connective tissue
Blood and the formed elements of blood
Bone marrow maturation of erythrocytes and platelets
Maturation of granulocytes, lymphocytes and monocytes.
Histology of cartilage
Histology of the bone
Intramembranous ossification
Endochondral ossification
Growth and remodeling of bone
Smooth muscle and myoepithelial cells

Histology skeletal muscle
Cardiac muscle
Sarcoplasmic reticulum and transverse tubule system
Histology of the neuron
Microscopic structure of neurons in the CNS
Neuroglia
Nervous and supporting cells in the CNS
Neurons and supporting cells of the neural crest
Nerve fibres, Myelin sheath
Receptors. Effectors. Motor end-plate
Interneuronal synapses
Gross anatomy of pituitary gland. Histology and development of neurohypophysis
Blood supply of pituitary. Histology of adenohypophysis
Gross anatomy and histology of pineal body
Gross anatomy, histology and development of the thyroid gland
Gross anatomy, histology and development of the parathyroid glands
Microscopic anatomy and development of adrenal cortex
Gross anatomy of adrenal glands, Histology and development of adrenal medulla
Histology of pancreas and the islets of Langerhans
Microscopic anatomy of lymph nodes
Gross and microscopic anatomy of the spleen
Microscopic anatomy of thymus
Microscopic anatomy of tonsils
Microscopic anatomy of arteries and arterioles
Microscopic anatomy of capillaries and veins
Microscopic anatomy of skin
Microscopic anatomy of epidermal appendages of skin and mammary glands
Microscopic structure of the wall in the gastrointestinal tract
Microscopic structure of exocrine glands
Microscopic structure of intestinal villi

LOCOMOTOR SYSTEM

Architecture and classification of bones
Fibrous and cartilaginous joints
Components of synovial joints
Classification of synovial joints. Movements and mechanisms
Structure and actions of somatic muscles
Structure of the vertebral column and the muscles responsible for its movements
Movements of the head and the muscles participating in them
Osteofibrous structure of the thoracic cage
Joints of the shoulder girdle and the muscles acting on them
The shoulder joint and the muscles acting on it
The axilla, the quadrangular and triangular spaces
The elbow joint, movements and muscles acting on it
The cubital fossa

Muscles and cross section of the arm
Muscles and cross section of forearm
Structure and movements at the wrist joint and the muscles acting on it
Osteofibrous spaces and muscle compartments of the hand
Joints of fingers and muscles concerned in their movements
Joints of the thumb and the muscles concerned in their movements
Structure of the osteofibrous pelvis
Muscles of the buttock, the posterior abdominal wall and the pelvis (external and internal muscles of the hip).
The hip joint and muscles concerned in its movements
Osteofibrous compartments, muscles and cross section of the thigh
The knee joint and muscles concerned in its movements
Popliteal fossa
Femoral sheath, vascular and muscular compartments. Adductor canal
Osteofibrous compartments, muscles and the cross section of the leg
Ankle joint and muscles concerned in its movements
Subtalar and talocalcaneonavicular joints and muscles acting on them
Structure of the foot. Arches of the foot
Osteofibrous compartments of the foot
Mechanism of walking
Anterior cranial fossa (composition, boundaries, connections)
Middle cranial fossa (composition, boundaries, connections)
Posterior cranial fossa (composition, boundaries, connections)
Walls and connections of the orbit
Walls and connection of the nasal cavity
Inferior surface and connections of the base of the skull
Bony walls of the oral cavity, the temporal and infratemporal fossa
Walls and connections of the pterygopalatine fossa
Temporomandibular joint and the muscles concerned in its movements
Diaphragm
Lateral superficial abdominal muscles and fasciae
Rectus abdominis muscle and its sheath
Inguinal canal
Femoral canal
Muscles of the pelvic floor
Superficial muscles of the neck and the muscle triangles
Deep muscles of the neck and the laminae of the cervical fascia
Muscles of facial expression

CIRCULATION

Shape and surfaces of the heart
Skeletone of the heart
Structure of the myocardium
Chambers of the heart
Endocardium and the valves of the heart

Conducting system of the heart
Blood supply of the heart
Pericardium
Surface anatomy of the heart. Heart sounds
Position and radiology of the heart.
The pulmonary circulation
Subdivisions and topography of the aorta
Arch of the aorta and its branches
Subclavian artery and its branches
Axillary artery and its branches
Arteries and veins of the arm and forearm
Vessels of the hand
External carotid artery and its branches
Maxillary artery and its branches
Course and distribution of the internal carotid artery
Venous drainage of the head
Course and branches of the thoracic aorta
Course and branches of the abdominal aorta
Coeliac trunk and its branches
Superior mesenteric artery and its branches
Inferior mesenteric artery and its branches
Branches of the internal and external iliac arteries
Vessels of the thigh and leg
Vessels of the foot
Course and tributaries of superior vena cava
Course and tributaries of inferior vena cava
Portal system of veins. Communication between portal and systemic veins
Venous and lymphatic drainage of the body wall including the breast
Lymph nodes and lymphatic drainage of head and neck
Lymphatic drainage of upper limb
Lymphatic drainage of lower limb
Thoracic and the right lymphatic ducts.

ORGANS OF SPECIAL SENSES

Fibrous coat of the eyeball
Vascular coat of the eyeball
Retina
Visual pathways
Optic lens and the convergence-accomodation reaction
Chambers of eye and vitreous body
Extrinsic muscles of the eyeball
Eyelids, conjunctiva, fascial sheath of eyeball. Lacrimal apparatus
External ear and tympanic membrane
Walls of the tympanic cavity. Auditory tube
Shape, joints and muscles of auditory ossicles.

Bony and membranous labyrinth
Bony cochlea and cochlear duct
Auditory pathways
Organs of taste and olfaction

INTERNAL ORGANS

Oral cavity
Gross anatomy and histology of tongue
Morphology of the permanent teeth, blood and nerve supply
Fine structure of dentin and enamel
Histology of cementum and periodontium
Development of teeth. Dentition
Gross anatomy, histology and topography of salivary glands
Isthmus of fauces
Gross anatomy and muscles of pharynx
Microscopic anatomy, blood and nerve supply of pharynx
Topography of pharynx. Para and retropharyngeal spaces
Gross anatomy, histology and topography of oesophagus
Gross anatomy and peritoneal relations of stomach
Microscopic anatomy of stomach
Gross anatomy of duodenum
Gross anatomy of jejunum and ileum
Microscopic anatomy of small intestines
Microscopic structure of intestinal villi
Gross anatomy of large intestines and vermiform appendix
Microscopic anatomy of large intestines
Gross anatomy and histology of rectum and anal canal
Gross anatomy and peritoneal relations of liver
Microscopic structure of liver
Gross and microscopic anatomy of gall bladder and bile ducts
Gross anatomy and topography of pancreas
Structure of nasal cavity and paranasal sinuses
Skeleton of larynx. Joints and fibroelastic membranes
Cavity of larynx. Mucous membrane and muscles
Gross anatomy and histology of trachea
Bronchial tree. Histology of the lung
Gross anatomy of the lung
Pleura
Subdivision and contents of mediastinum
Gross anatomy of the kidney
Microscopic anatomy of the kidney
Gross anatomy and histology of renal pelvis and ureter
Gross and microscopic anatomy of urinary bladder
Gross anatomy and histology of male and female urethra
Gross anatomy of the testis

Histology of the testis
Gross and microscopic anatomy of epididymis and ductus deferens
Spermatic cord, scrotum and coverings of testis
Gross anatomy and histology of seminal vesicle and prostate
Gross anatomy and histology of penis. Mechanism of erection
Gross anatomy of the ovary
Histology of the ovary
Gross and microscopic anatomy of the uterine tube
Gross anatomy and fixation of the uterus
Histology of the uterus. Menstrual cycle
Gross anatomy and histology of vagina and female external genitalia
Topography of female genital organs in the pelvis. Connective tissue spaces, peritoneal relations
Topography of male genital organs in the pelvis. Connective tissue spaces, peritoneal relations
Anatomy of peritoneum . Lesser and greater omentum. Omental bursa, mesentery.

NERVOUS SYSTEM

Gross anatomy of spinal cord. Spinal segment. Spinal nerve. Blood supply and meninges of the spinal cord
Microscopic structure of spinal cord
Spinal proprioceptive reflex arc
Spinal flexor (withdrawal) reflex arc
Spinal autonomic reflexes
Fourth ventricle
Gross and microscopic anatomy of medulla oblongata
Gross and microscopic anatomy of pons
Gross and microscopic anatomy of midbrain
Cranial nerve nuclei
Tracts of the brainstem
Reticular formation and monoaminergic brainstem systems
Gross and microscopic anatomy of cerebellum
Afferent and efferent connections of cerebellum
Anatomy, blood supply and development of the diencephalon
Third ventricle
Gross and microscopic anatomy of thalamus
Hypothalamo-hypophyseal systems
Gross anatomy of hemispheres
Gross and microscopic anatomy of basal nuclei
Lateral ventricles
Arterial circle of Willis and veins of the brain
Microscopic structure of cerebral cortex. Cortical areas
Spinothalamic tract
Dorsal funiculus-medial lemniscus system

Pyramidal tract
Extrapyramidal system
Limbic system
Cranial dura mater and its sinuses
Arachnoid and pia mater. Subarachnoid cisterns Cerebrospinal fluid
Central nuclei and peripheral distribution of cranial nerves III., IV., VI.
Nuclei of trigeminal nerve and distribution of ophthalmic nerve
Peripheral distribution of maxillary nerve
Peripheral distribution of mandibular nerve
Central nuclei and peripheral distribution of facial nerve
Central nuclei and peripheral distribution of glossopharyngeal nerve
Central nuclei and peripheral distribution of vagus nerve
Nuclei and branches of accessory and hypoglossal nerves
Cervical plexus
Brachial plexus
Dorsal rami of spinal nerves. Intercostal nerves
Lumbar plexus
Sacral plexus
General structure of autonomic nervous system
Cervical and thoracic part of sympathetic trunk
Abdominal and pelvic part of sympathetic trunk
Cranial parasympathetic
Sacral parasympathetic

CELL BIOLOGY TOPIC LIST

1. LIGHT AND ELECTRON MICROSCOPICAL HISTOTECHNIQUES

1. 1. The histotechnical steps of the routine light microscopical preparation. *Specimen blocks, flat mounts and whole mounts, smears. Microscopical viewing of living cells. Difficulties of the used technique.*
1. 2. Types of staining procedures. *Histochemistry, enzymehistochemistry (with examples). 'Native stain' = no staining.*
1. 3. Electron microscopical histotechnique. *Differences and similarities when comparing to light microscopy together with the possible underlying reasons. Special electron microscopical techniques.*

2. IMMUNOHISTOCHEMISTRY

2. 1. The steps and significance of the immunohistochemical procedure. *Effects of temperature, pH and fixation. Epitopes. Monoclonal and polyclonal immune sera (antibodies). Visualization of the immune complex.*
2. 2. Specificity, cross-reactivity, false positive and false negative results, controls. *Masking, detection, blocking. Combined labelling using two or more markers. Selecting the most suitable experimental subjects. The significance of confocal microscopy..*
2. 3 Immunohistochemical methods for electron microscopy (*i.e. post-embedding immunohistochemistry*). *Main differences when compared to the light microscopical (pre-embedding) procedure.*
2. 4. In situ hybridization. *The possible combinations with other methods. Advantages and disadvantages.*
2. 5. Autoradiography. *The possible combinations with other methods. Advantages and disadvantages.*

3. THE STRUCTURE AND FUNCTION OF THE CELL MEMBRANE

3. 1. Structure of the whole membrane. *The significance of lipid polarity. Main types of the lipid components. Flip-flop, rafts, lateral diffusion. Asymmetry. The specific research methods of the membrane structure. The structure and significance of the glycocalyx.*
3. 2. Protein components of the cell membrane. *Integral and peripheral proteins, transmembrane, extra- and intracellular types together with their importance. Function of membrane proteins. Aquaporins, orthogonally arranged particles. 'Multidrug resistance protein'.*
3. 3. Transport mechanisms through membranes. *The basic differences between active and passive transports, primary and secondary active transports, channels & carriers (carrier, transporter). What are the differences and similarities between the facilitated diffusion, simple diffusion and active transport? Uniport, cotransport, symport, antiport. Describe Na-K-ATP-ase pump relative to the previous processes.*

3. 4. The major means and significance of the exo- and endocytotic transports. *Facultative and regulated forms. The significance of the cellular membrane cycles together with the importance of their constant renewal. Why is a balanced exo-and endocytotic process is important?*

4. INTRACELLULAR MEMBRANOUS ORGANELLES

4. 1. Differences between the rough and smooth endoplasmic reticula (structure, function). *The significance of 'Detoxification'. How is a protein produced in the interior of the reticulum, what happens there? Translocators.*

4. 2. The significance and possible ways of protein molecule signalling. *The role of protein conformation. Chaperones (heat-shock proteins). Proteasomes.*

4. 3. The structure, parts and functions of the Golgi apparatus and its relationship with other membranous organelles.

4. 4. The lysosomal system. *Relationship with other membranous organelles and the cytosolic proteins. Fate of the endocytosed substances. Autophagocytosis.*

4. 5. Vesicular transport. *Cooperation and connections between membrane systems. Which cellular organelles produce lipo- and glycoproteins? Cytoplasmic membrane formation. Intracellular membrane formation. The fate of proteins produced within the rER. The fate of proteins produced by the free ribosomes.*

5. FURTHER CYTOPLASMIC CELLULAR ORGANELLES

5. 1. Protoplasm, cytoplasm, cytosol, nucleoplasm. *Cell fractionation, ultracentrifugation, gradients, characterization and use of cell fractions.*

5. 2. Structure, main functions and origin of mitochondria. *The significance of mitochondrial DNA genealogy. Porins, cardiolipin. Peroxisome, peroxides, peroxidases.*

5. 3. Comparison between prokaryotes and eukaryotes. *Evolutionary advantages of the latter, the theory of their formation. Endosymbiosis.*

6. THE NUCLEUS

6. 1. Composition of the nuclear membrane, connections to other membranous organelles. *Lamins. Structure of the nuclear pores, transport processes. Nucleoporins, importins, exportins.*

6. 2. The organization and shaping of the chromatin substance, forms of chromatin. *Constitutive and facultative heterochromatin. Territorial arrangement. Role of histones (in keywords), other proteins and nucleosomes. Nucleoplasm, interchromatic substance, matrix, nucleoskeleton. The structure, function and organization of the nucleolus.*

7. CELL SURFACE SPECIALIZATIONS, CELL-CELL ADHESIONS

7. 1. Cuticle, brush border, kinocilium, stereocilium. Function and EM & LM composition of the basal striations (*together with their molecular aspects*).

7. 2. Classification of cell adhesion molecules and their connections. *Homophilic, heterophilic contacts, direct, indirect, and cis/trans bindings, etc.. Lectins. The specificity of cell-cell adhesions.*

7. 3. Functional classification of cellular adhesion structures detected by the electron microscope. *Molecular basis of the E.M. structure. Role of catenins, plakins, vinculins, etc. Compare desmosomes and zonula (fascia, punctum) adherens. Significance of the interdigitated junctions. Gap junction; structure and function. Connexon, connexins. Heterophil, heteromer types.*

8. INTERCELLULAR SUBSTANCE (ICS), GROUND SUBSTANCE (GS); THE CELL - 'ICS (GS)' RELATIONSHIP

8. 1. Summary of the components and relations/connections of the intercellular substance. *Comparison with the glycocalyx. Glycosaminoglycans, their design principles, types and examples. Proteoglycans. Fibronectin and related compounds. Matrix metalloproteinases, significance of the ground substance restructuring.*

8. 2. Laminin receptors. *Integrins. Describe their features, and the connections formed by them. The dystroglycan-dystrophin complex, their relationship with the cytoskeleton or membrane skeleton. Compare them to cell-cell adhesions. Vinculin, talin, the role of alpha-actinin. The role of molecular RGD component.*

8. 3. LM & EM morphology and the molecular composition of the basement membrane and the basal lamina. *Laminins. The role and LM & EM morphology of basal striations.*

8. 4. The role of intercellular contacts in development and tissue formation. *The cell adhesion as a stimulus. Focal adhesion complex. Cell adhesions and cell division. Cell adhesions and migration. Cell adhesions and cell recognitions. Cell adhesions and cell shape. Role of the glycocalyx in the above mentioned procedures.*

8. 5. Cell polarity, apical and basolateral membranes, lateral diffusion, the role of tight junctions and the basal lamina.

9. CELLULAR SKELETON, CELL MOTILITY

9. 1. Summary of the cytoskeletal elements together with their functions. *The common (similar) features of their composition. Significance of associated proteins. Plectin. Motor proteins.*

9. 2. Microtubules. *The structure and function of the centriole. MTOC. MAPs. Dinein, kinesin.*

9. 3. Intermediate filaments. *Classification. Specificity. IFAPs. Roles and their relationship to the cell membrane. Plectin.*

9. 4. The organisation patterns (placement) of actin. *Stress fibers. Associated proteins and their functions (examples). Types of myosin. The membrane skeleton together with its functions.*

9. 5. The molecular basis of ameboid movement. *Receptors, cell adhesions, role of adherence (anchorage). Lamellipodium, filopodia. The role of the matrix metalloproteinases.*

9. 6. The general function of the actin-myosin system. *Troponin, tropomyosin, desmin, titin, nebulin, actinin, myomesin. Role of dystrophin. Calcium stores and their significance.*

10. CELL DIVISION

10. 1. The general description and phases of the cell cycle, main types. *Control points. Cyclins, Cdk's. Early changes in the chromatin and nuclear membrane. The structure and formation of chromosomes. Molecular diagnostic of chromosomes, high-resolution banding.*
10. 2. The stages of mitosis. *The cytocentrum and the mitotic spindle. Cell division defects.*
10. 3. The division of the cytoplasm. The recovery (reforming) of the cell nucleus. Amitosis, syncytium, plasmodium (examples). The essence of meiosis.
10. 4. Chromosomal sets, description of the genome, haplo-, diplo-polyploidia. Point, chromosomal and genomic mutations.
10. 5. The regulation of cell division. *Telomere, telomerase, transformed cells, immortalized cells, proto-oncogene, oncogene, tumor suppressor gene. External influence upon the dividing cells. Growth factors, adherence, focal adhesion complex, contact inhibition.*
10. 6. The main steps, two basic types and regulation of meiotic cell division. Crossing over.
10. 7. Place and time of meiotic divisions in the human body. The reasons of having two different gametes, the comparisons of the male and female gametes, developmental relevances. Composition of a sperm.

11. DEVELOPMENTAL BIOLOGY

11. 1. Stem cell, progenitor cell, precursor cell. *Clone, cell line, spare cells. Role of markers. The ability to divide. Postmitotic cells, the 'birth' of cells. Toti-, pluri-, (multi-, oligo-), bi- and unipotent cells (loss of cell potency). Determination in the absolute or relative terms. Differentiation, de-differentiation, regeneration.*
11. 2. Significance of induction. *Inducive 'signals'. Endocrine, paracrine, juxtacrine, matricrine, autocrine, introacrine effects. Why could the same induction result in different, or no, response in different cells? Induction 'window'. Primary organization center, secondary organizers, Induction chain. How does this affect the appearance of certain conserved (primordial) structures during embryonic development?*
11. 3. Regulatory signals of development, receptors and the cooperation of regulatory genes. *Early genes. Homeobox genes: Hox and Pax genes, etc. their influence upon the life of cells. Explain the basis for divergent development of two cells sharing an identical genetic fingerprint. Distribution of cytoplasmic factors, topical differences, lateral inhibition.*
11. 4. The role of uneven growth in morphogenesis (examples). Comparison of apoptosis and necrosis. Role of apoptosis in development.

12. THE CELL BIOLOGY OF THE NERVOUS SYSTEM

12. 1. The composition of synapses. Neurotransmission. Function and types of synaptic vesicles. Docking, recirculation.
12. 2. The composition and formation of the myelin sheath. Differences between the peripheral and central myelin sheaths.
12. 3. Composition of the blood brain barrier, the neuromorphological components of the Blood – CSF barrier.