

Semmelweis University
Department of Anatomy, Histology and Embryology

Faculty of Dentistry
2nd year 1st semester

September 2020

MICROSCOPIC ANATOMY HANDBOOK



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Anatomy, Histology and Embryology for ED students

TEACHING DEPARTMENT:

SEMMELWEIS UNIVERSITY

Department of Anatomy, Histology and Embryology

Budapest, Tűzoltó utca 58.

H-1094 Budapest

<http://semmelweis.hu/anatomia>

LEARNING OBJECTIVES

Demonstration of the fine structure of cells and tissues composing the organs of the human body specifically to provide the future doctors of dental medicine with a valid body of information describing the microscopical elements of clinically significant morphological structures (including cell biology, general histology and the histology of organs).

General embryology demonstrates the steps of the formation of a new human being together with the stages of intrauterine development, including the clinically relevant aspects of the development of organ systems. Teaching is done in the form of lectures and histology laboratory classes

Competences acquired by completion of the course:

Understanding the microscopical composition of the human body together with the understanding of human development in order to draw parallels with macroscopical anatomy. Clear understanding of histological structure and function. Ability to identify basic structural elements within the tissue specimen. Identification of general directions/landmarks within digitized tissue slides.

LECTURES: First semester: 2 x 45 min; second semester: 2 x 45 min.

PRACTICAL CLASSES: First semester: 2 x 45 min; second semester: 2 x 45 min.

ECTS CREDITS: Altogether 8 (first semester: 4; second semester: 4).

MIDTERM TESTS: Written (in the Moodle system)

ACCEPTENCE OF THE SEMESTER:

Active participation in laboratory sessions 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%**. Attendance will be recorded in the classes.

TYPE OF EXAMS: oral and written

First semester: semifinal examination (oral), second semester: final exam (oral and written)

The final examination consists of written and oral (practical and theoretical) parts

1. Written pretest (e-learning module – access to SeKA account is obligatory)
2. Oral examination (identification of structures on digitized histological slides) including relevant theoretical questions from the fields of Histology and Embryology

COURSE DESCRIPTION

Microscopic Anatomy and Embryology II.

Lectures and histology classes

Subject matter: Histology of the lymphatic system, together with the histology and developmental aspects of the central and peripheral nervous systems, endocrine organs and organs of special senses, including the skin.

Credits: 4

Prerequisites: Macroscopic Anatomy II (successful final examination)
Microscopic Anatomy and Embryology I (successful examination)

Academic Year 2020/2021
Faculty of Dentistry

ED II. Microscopic Anatomy and Embryology II.

Weeks	Lectures <i>Mondays 10.00 - 11.40</i>	Lecturer	Histology laboratory <i>Mondays 8.00-9.30</i>
Week 1 09. 7-11.	1. Cellular components of lymphatic tissue. Thymus, tonsils, MALT 2. Structure and circulation of lymph nodes and spleen	1 Nagy 2 Nagy	Thymus, tonsils
Week 2 09. 14-18.	3. Nerve tissue: neurons and glial cells, synapses, receptors and effectors 4. Microscopy of the CNS – Fine structure of the spinal cord, spinal nerves	3 Tóth 4 Gerber	Lymph node, spleen
Week 3 09. 21-25.	5. Microscopy of the CNS – Spinal reflexes, receptors and effectors, proprioceptive, nociceptive (withdrawal) and autonomic reflex arcs 6. Microscopy of the CNS – Fine structure of the cerebral cortex. Cortical fields, Brodmann areas	5 Kozsurek 6 Pálfi	Histology of the peripheral nervous system
Week 4 09.28 - 10. 2.	7. Microscopy of the CNS – Microscopy of the cerebellum, pathways. Functional considerations 8. Microscopy of the CNS – Cranial nerve nuclei	7 Vereczki 8 Barna	Histology of the central nervous system
Week 5 10. 5-9.	9. Microscopy of the CNS – Thalamic nuclei. 10. Microscopy of the CNS – Sensory systems, epicritical and protopathic pathways arising from the brain stem	9 Vereczki 10 Kozsurek	Midterm test 1 (Histological slides of weeks 1-4)
Week 6 10. 12-16.	11. Microscopy of the CNS – Motor systems, pyramidal tract. 12. Microscopy of the CNS – Extrapyramidal system: structure and connections of the basal ganglia. Brainstem monoaminergic system	11 Shahbazi 12 Lendvai	<i>Microscopy of the CNS – consultation</i> <i>Cross sections of the brainstem</i>
Week 7 10. 19-23. <i>Friday Oct 23.</i>	13. Microscopy of the CNS – Limbic system 14. Microscopy of the CNS – Hypothalamus, the hypothalamo-hypophysial system	13 Gerber 14 Vereczki	<i>Microscopy of the CNS - consultation</i>
Week 8 10. 26-30.	15. Histology of the endocrine organs: Thyroid, parathyroid, suprarenal glands, hypophysis, pineal body 16. Differentiation of the neural tube. Cranio-caudal and dorso-ventral differentiation. Differentiation of the brain vesicles	15 Tóth 16 Puszkár	<i>Microscopy of the CNS - consultation</i>
Week 9 11. 2-6.	17. Formation and derivatives of the neural crest and placode ectoderm 18. Development of the skull.	17 Adorján 18 Székely	Midterm test 2 (Microscopy of the CNS. Development of the nervous system) Endocrine system I
Week 10 11. 9-13.	19. Development of the vertebral column, limb development 20. Skin and appendages. Mammary gland	19 Adorján 20 Székely	Endocrine system II
Week 11 11.16-20.	21. Fibrous and vascular coats of the eyeball. Lens, chambers of the eye, vitreous body, accommodation 22. Inner coat of the eyeball, retina.	21 Gerber 22 Kozsurek	Histology of palm skin, scalp skin. Mammary gland
Week 12 11. 23-27	23. Visual pathway, visual reflexes. Development of the eye 24. External ear, middle ear.	23 Vereczki 24 Lendvai	Histology of the organ of vision
Week 13 11.30-12.4.	25. Bony and membranous labyrinth. Vestibular system 26. Spiral organ of Corti. Auditory pathway. development of the organ of hearing	25 Pálfi 26 Puszkár	Histology of the organ of hearing
Week 14 12. 7-11.	27. Microscopy of the CNS – Olfactory and gustatory systems 28. Consultation	27 Shahbazi 28 Gerber	Revision

ED II. Microscopic Anatomy and Embryology II.

List of slides (FOK series)

Weeks	Histology laboratory Mondays 8.00-9.30
Week 1 09. 7-11.	Lymphatic system I. 47. Palatine tonsil (HE) <i>DEM : ÁOK 42. Palatine tonsil (T/B cell IHC)</i> 48. Lingual tonsil (HE) <i>DEM: ÁOK 48. Pharyngeal tonsil (HE)</i> 49. Thymus (HE)
Week 2 09. 14-18.	Lymphatic system II. 44. Lymph node (HE) 45. Spleen (HE) 46. Spleen (rinsed, HE) <i>DEM: ÁOK 1.a, b Spleen (T/B cell IHC)</i>
Week 3 09. 21-25.	Histology of the peripheral nervous system 36. Peripheral nerve (cross section, HE) <i>DEM: Peripheral nerve (OsO4 impregnation), 6. nerves in the skin(HE)</i> 37. Pseudounipolar neurones (DRG, HE) 38. Multipolar neurones (autonomic ggl, AgNO3 impregnation) <i>DEM: Autonomic ggl in the intestinal wall (HE)</i> 43. Motor end plate (striated muscle, ACh esterase histochemistry)
Week 4 09.28 -10. 2.	Histology of the central nervous system 39. Spinal cord (multipolar neurones, Nissl) 40. Cerebral cortex (pyramidal neurones, Bielschowsky) 42. Cerebral cortex (pyramidal neurones, Golgi) 94. Hippocampus (HE) 95. Cerebellar cortex (HE) 41. Cerebellar cortex (GFAP ICC)
Week 5 10. 5-9.	Midterm test 1 Histological slides of weeks 1-4
Week 6 10. 12-16.	Microscopy of the CNS – cross sections of the brain stem 99. Mesencephalon (Luxol fast blue + Nissl) 100. medulla oblongata (Luxol fast blue + Nissl)
Week 7 10. 19-23.	<i>Microscopy of the CNS - consultation</i>
Week 8 10. 26-30.	<i>Microscopy of the CNS - consultation</i>
Week 9 11. 2-6.	Midterm test 2 Microscopy of the CNS Endocrine system I. 90. Epiphysis/ pineal body (HE) 86. Hypophysis/ pituitary gland (HE) 87. Hypophysis/ pituitary gland (chrom–hematoxyline-phloxin/Gömöri)
Week 10 11. 9-13.	Endocrine system II. 88. Thyroid gland (HE) <i>DEM 74. Leydig cells, testicle (HE)</i> 89. Parathyroid gland (HE) <i>78. Ovarian follicles (HE)</i> 92. Adrenal/suprarenal gland (HE) <i>79. Corpus luteum (HE)</i> <i>70. Islets of Langerhans, pancreas (HE)</i>
Week 11 11.16-20.	Histology of palm skin, scalp skin. Mammary gland 6. Palm skin (HE) 11. Scalp/hairy skin (HE) 17. Scalp/hairy skin (AZAN) 18. Scalp/hairy skin (Hornowsky) 85. Mamma non lactans (HE) 93. Mamma lactans (HE)
Week 12 11. 23-27	Histology of the organ of vision 96. Eye bulb (HE) 97. Retina (semithin section, toluidine blue) 9. Pigment epithelium (unstained) 33. Lacrimal gland (HE)
Week 13 11.30-12.4.	Histology of the organ of hearing 98. Cochlea (semithin section, toluidine blue)
Week 14 12. 7-11.	Revision

ED II.

Subject matter of the present semester

I. Histology of lymphatic organs

II. Neurohistology

- a) Histology of neurons and supporting elements
- b) Fine structure of peripheral nerves
- c) Receptors and effectors, interneuronal synapses
- d) Histology of the brain and spinal cord

III. Development of the locomotor system

- a) Membranous and cartilaginous neurocranium and viscerocranium
- b) Development of the limbs and vertebral column
- c) Development of the muscular system

IV. Development of the nervous system and organs of special senses

- a) Development and primary differentiation of the neural tube
- b) Development of the peripheral nervous system (neural crest, placodes)
- c) Development of the organ of vision
- d) Development of the organ of hearing&equilibrium

V. Microscopy of the central nervous system

- a) Microscopic anatomy of brain and spinal cord
- b) Nuclei and tracts of brain and spinal cord
- c) Microscopy of the autonomic nervous system, tracts

VI. Organs of special senses (histology and embryology)

- a) Organ of vision, visual pathways
- b) Organ of hearing and equilibrium, auditory pathways, vestibular system
- c) Organ of smell, olfactory pathways
- d) Organ of taste, gustatory pathways
- e) Skin and appendages

VII. Endocrine organs (histology and embryology)

- a) Hypothalamo-hypophysial system
- b) Endocrine glands and cells

Midterm test I. Written midterm (Moodle)
Topic: Histology of the lymphatic system, histology of the nervous system
Date: 5th week

Midterm test II. Written (Moodle)
Topic: Microscopy and development of the central nervous system.
Date: 9th week

Final examination

Topics: Subject matter of the two semesters

1. Written pretest
2. Oral examination - identification of structures on 2 digitized tissue slides, as well as 1 theoretical question from the subject matter of the two semesters (see the Topic list).

ED II ANNOUNCEMENTS

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

Signing of the lecture book: active participation in histology lab sessions is obligatory. Students should attend at least 75% of the scheduled hours, including the obligatory midterm examination, to gain a signature proving the validity of the semester. Absences are therefore limited in **25%**.

Midterm examinations: During the semester, both practical and theoretical knowledge will regularly be evaluated. There are two written (Moodle) midterm tests during the semester. The midterms should be successfully passed or the semester is not accepted. Students absent or having an unsuccessful result from the test should reattend at a given timepoint or their semester will not be accepted. The results of all tests will appear on the personal achievement cards.

Exemptions from part of the semifinal examination - if the average of the two midterm marks is at least 4.00, students are offered to be exempted from the written part of the semifinal examination with the following marks: good (4) - if the midterm results are 4+4 or 3+5; excellent (5)- if the midterm results are 4+5 or 5+5. These students only need to take the oral part of the final examination.

Please note that only marks from the first, official, attempt are counted in, marks earned at the retake midterm are not considered. Furthermore, the result of the first attempt cannot be improved by taking the retake midterm.

The final examination is composed of the following parts:

Topics: Subject matter of the two semesters

Written pretest (if not exempted)

Oral examination (identification of structures on 2 digitized tissue slides, as well as

1 theoretical question from the subject matter of the two semesters (see the Topic list).

Please note: *Students may register for, or deregister from, the examinations via the neptun system. In case neither the first nor the repeated takes of a semifinal exam have been successful the exam has to be postponed to the following exam period as a 'CV' exam (if there are possibilities left).*

WORK / ENVIRONMENTAL PROTOCOL AND INFECTION CONTROL

GENERAL RULES

1. Students may only enter following **temperature control** at the main entrance.
2. **Masks are to be worn at all times** while on the premises of the Department.
3. Please keep a **1.5 -2 m social distance** towards everybody.
4. Do not touch, or come into close contact with, other people (e.g., no handshakes).
5. Frequently wash your hands using soap and warm water.
6. Sanitise your hand frequently.
7. Do not touch your face or eye.
8. It is **STRICTLY FORBIDDEN** to consume food, drinks or chewing gum **anywhere** on the premises of the department (including lecture halls, dissection rooms, histology laboratories or on the hallways, staircases).
9. Use paper tissues in case you cough or sneeze and dispose of them immediately in the designated bins.

SPECIFIC RULES CONCERNING THE HISTOLOGY LABORATORIES

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| <ol style="list-style-type: none">1. Use hand sanitizers upon entering.2. Use rubber gloves when touching the keyboard or the mouse of the digital equipment.3. You may clean the surfaces with wet towels before you start using them.4. Food and drinks are strictly forbidden on the premises of the department. |
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FIRE SAFETY PROTOCOL

Please make sure to adhere to the rules of fire safety regulation with full compliance, paying special attention to the following:

1. The use of naked light or smoking is **STRICTLY PROHIBITED** on the premises of the Department, including the building and the yard.
2. In case of fire, a loud fire alarm signal is to ring throughout the building. In case of a fire drill, the building must be left organized, with the guidance of the teacher/instructor of the group, using the exits as quick as possible. Escape routes are posted on every floor.
3. The use of elevators is **STRICTLY PROHIBITED** during a fire drill.
4. Every lecture room has 3 accessible entrances/exits. Students usually enter and leave through the lower single entrance under normal circumstances. When necessary, i.e. in case of fire, the upper 2 doors could also be opened using the keys kept in the fire cassettes next to the doors.
5. All fire cases or signs/ suspicion of a possible fire should be reported to the teacher of the group.
6. No electrical devices should be plugged in a connector different from the designated ones. Only electrical devices in an intact and perfect condition should be used.

List of textbooks

The Developing Human – Clinically Oriented Embryology, 10th ed. by KL Moore, TVN Persaud and M Torchia, Saunders, 2015; ISBN 9780323313384

Histology: A Text and Atlas: With Correlated Cell and Molecular Biology; 7th Edition by MH Ross and W Pawlina ; Wolters Kluwer 2015, ISBN 9781451187427

Wheater's Functional Histology, A Text and Colour Atlas, 6th Edition by B Young, G O'Dowd and P Woodford Churchill Livingstone, Edinburgh, 2013, ISBN 9780702047473

Oral Anatomy, Histology and Embryology, 4th Edition, by B. Berkovitz Paperback with STUDENT CONSULT Online Access and e-book ISBN: 9780723434115 Copyright: 2009

Functional Anatomy, Histology and Embryology for medical and dental students by M. Réthelyi and J. Szentágothai, Medicina, 2018.

Recommended textbooks

Langmann's Medical Embryology, 13th Edition by TW Sadler, Wolters Kluwer, ISBN 9781469897806, 2014

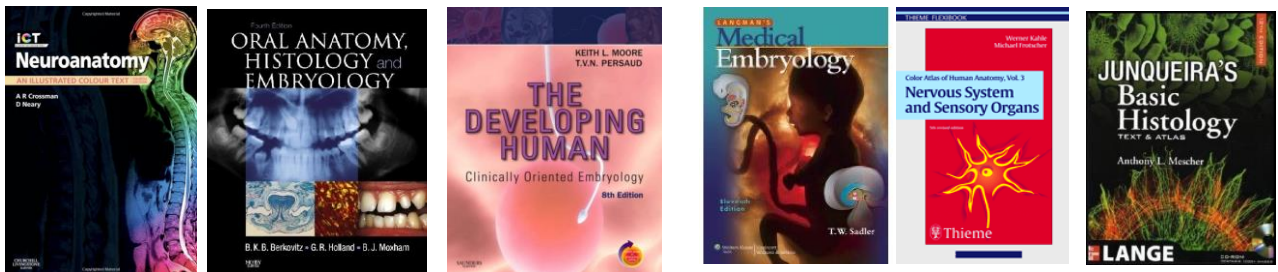
Junqueira's Basic Histology: Text and Atlas; 13th Edition by Anthony Mescher, New York, McGraw-Hill Medical, 01/03/2013 ISBN13 978007178033

Wheater's Functional Histology, A Text and Colour Atlas, 6th Edition by B Young, G O'Dowd and P Woodford ISBN 9780702047473, Churchill Livingstone, Edinburgh, 2013.

Illustrated Dental Embryology, Histology, and Anatomy, 3rd Edition by Mary Bath-Balogh ISBN: 9781437717303, 2011.

Further study aids:

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology (<http://semmelweis.hu/anatomia>) or from Knowledgebase on the Library homepage: (https://lib.semmelweis.hu/knowledge_base).



TOPICS OF THE FINAL EXAM

General Histology

Concept of basic tissues
Definition and classification of epithelial tissue
Simple epithelia
Stratified epithelia
Glandular epithelia
Pigment epithelium, sensory neuroepithelium
Cells of connective tissue
Ground substance and fibres of connective tissue
Types of connective tissue
Blood and the corpuscular elements of blood
Histology of the bone marrow, maturation of erythrocytes and platelets
Differentiation of granulocytes, lymphocytes and monocytes
Histology of cartilage and bone tissue
Intramembranous ossification. Endochondral ossification. Growth and remodeling of bone
Smooth muscle and myoepithelial cells
Skeletal muscle tissue
Cardiac muscle tissue
Histology of arteries and arterioles
Histology of veins and capillaries

Histology of organs

Wall structure of hollow organs
General composition of parenchymal (solid/compact) organs
Histology of the lip and tongue
Histology of the respiratory tract. Larynx. Trachea. Lung
Histology of the esophagus and stomach
Histology of the small and large intestines. Fine structure of the intestinal villi, enteroendocrine system
Histology of the liver. Gall bladder, biliary ducts
Histology of the pancreas
Histology of kidney. Ureter. Urinary bladder
Histology of the male and female gonads and genital organs/ducts
Histology of the uterus (proliferative, secretory phases) menstrual cycle, vagina

General Embryology

Spermatogenesis, spermiogenesis
Oogenesis
Fertilization, cleavage of the zygote
Blastocyst formation; the bilaminar embryonic disc
Implantation
Formation of body axes
Formation of the intraembryonic mesoderm; the notochord
Neurulation (neural tube and neural crest)

Derivatives of ectoderm
Derivatives endoderm
Differentiation of the intraembryonic mesoderm
Folding of the embryo
Development of the primitive cardiovascular system
The structure and function of the placenta
Development of the fetal membranes (chorion and amnion) and the umbilical cord

Development of internal organs

Development of the heart, looping of the heart tube
Formation of atria, development of the interatrial septum
Formation of ventricles, development of the aorticopulmonary septum
Development of arteries
Development of the inferior vena cava
Development of the portal vein
Development of the superior vena cava, azygos and hemiazygos veins
Fetal circulation
Development and differentiation of the midgut
Development and differentiation of the hindgut
Formation of the liver and pancreas
Development of the lower airways including the lungs
Kidney development
Development of the urinary passages
Gonadal development
Development of the male genital tract
Development of the female genital tract
Development of the male/female external genitals
Development and divisioning of the body cavities
Development of the peritoneum

Maxillofacial Histology and Embryology

Enamel
Amelogenesis
Dentin
Dentinogenesis
Structure of the dental papilla
Cementum (two types)
Parodontium
Gingiva – subdivisions and histology
Tooth development
Tooth eruption
Development of the mandible and maxilla
Development of the face. Formation of the nasal cavity and paranasal sinuses
Microscopic Anatomy and development of the primary and secondary palates
Microscopic Anatomy and development of the tongue
Microscopic Anatomy and development of salivary glands
Derivatives of pharyngeal pouches and grooves
Derivatives of pharyngeal arches

Lymphatic organs

Histological structure of lymph nodes
Spleen (fine structure and circulation)
Thymus
Tonsils, MALT

Development of the nervous system and organs of special senses

Development and primary differentiation of the neural tube
Development of brain vesicles
Development of the peripheral nervous system (neural crest, placodes)
Development of the organ of vision
Development of the organ of hearing&equilibrium

Development of the locomotor system

Membranous and cartilaginous neurocranium and viscerocranium
Development of the limbs and vertebral column
Development of the muscular system

Histology of the nervous system

Histology of the neurons developing from the neural tube
Glial cells
Histology of the neurons and supporting cells developing from the neural crest
Fine structure of peripheral nerves
Receptors and effectors
Interneuronal synapses

Microscopy of the central nervous system

Fine structure (microscopy) of the spinal cord
Proprioceptive reflexes
Nociceptive reflexes
Autonomic reflexes
Fine structure of the medulla oblongata
Fine structure of the pons
Fine structure of the midbrain
Classification of cranial nerve nuclei
Tracts of the brain stem
Reticular formation, monoaminergic systems
Fine structure of the cerebellum
Cerebellar afferents and efferents
Fine structure of the thalamus
Hypothalamo-hypophyseal system
Fine structure of the basal ganglia
Fine structure of the cerebral cortex, cortical fields
Tracts of the protopathic sensibility (anterolateral system)
Tracts of the epicritic sensibility (posterior funiculus/medial lemniscus)
Corticospinal tract (pyramidal tract)
Extrapyramidal system
Limbic system (nuclei and tracts)

Endocrine organs

Microscopical anatomy of the pituitary gland; development of the posterior lobe
Microscopical anatomy and development of the anterior and intermediate lobes of the pituitary gland
Blood supply of the pituitary gland
Microscopical anatomy of the pineal gland
Microscopical anatomy and the development of the thyroid gland
Microscopical anatomy and the development of the parathyroid gland
Microscopical anatomy and the development of the suprarenal gland
Histology of the islands of Langerhans

Organs of special senses

Microscopical structure and development of the skin (scalp and palm)
Histology and development of skin appendages, mammary gland
Coats of the eyeball
Chambers of the eye, vitreous body
Lens, accommodation
Visual pathway, visual reflexes
External ear, tympanic membrane. Tympanic cavity, auditory tube, hearing ossicles.
Organ of Corti. Auditory pathway
Vestibular system
Bony and membranous labyrinth
Cochlea and cochlear duct
Organs of olfaction and taste

External ocular muscles, eye movements
Accessory and protective apparatus of the eye (palpebrae, conjunctiva, fasciae, lacrimal apparatus)
External ear, tympanic membrane. Tympanic cavity, auditory tube. Hearing ossicles (joints, muscles)
Organ of Corti. Auditory pathway. Vestibulocochlear nerve.
Vestibular system
Bony and membranous labyrinth, vestibulum
Cochlea, cochlear duct
Organ of olfaction, olfactory pathway, olfactory nerve
Organ of taste, central processing of taste (tracts)