

**Semmelweis University**  
**Department of Anatomy, Histology and Embryology**

**Faculty of Dentistry**  
**2<sup>nd</sup> year 1<sup>st</sup> semester**

**September 2024**

# **MICROSCOPIC ANATOMY AND EMBRYOLOGY II HANDBOOK**



**Dr. Andrea D. Székely**  
**Associate Professor**

Course Director of the English Language Program

**Dr. Gábor Gerber**  
**Full Professor**

Head of the Anatomy, Histology and Embryology subjects for the Faculty of Dentistry  
Dean of the Faculty of Dentistry



# Microscopic Anatomy and Embryology II

## 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

**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 2024/2025 Faculty of Dentistry**  
**ED II. Microscopic Anatomy and Embryology II.**

<b>Weeks</b>	<b>Lectures</b> <i>Tuesdays 10.00 - 11.45</i>	<b>Lecturers</b> <i>may change</i>	<b>Histology laboratory</b> <i>Tuesdays 15.00-16.30</i>
<b>Week 1</b> 09. 2-6.	1. Blood, corpuscular elements of blood. Bone marrow, erythropoiesis, leukopoeisis 2. Cellular components of lymphatic tissue. Thymus, tonsils, MALT	1 Puskár 2 Puskár	Blood Lymphatic system I. – tonsils
<b>Week 2</b> 09. 9-13.	3. Structure and circulation of lymph nodes and spleen 4. Nerve tissue: neurons and glial cells, synapses, receptors and effectors	3 Puskár 4 Tóth	Lymphatic system II. - thymus, lymph node, spleen Nerve tissue, PNS
<b>Week 3</b> 09. 16-20.	5. Differentiation of the neural tube. Cranio-caudal and dorso-ventral differentiation. Differentiation of the brain vesicles 6. Microscopy of the CNS – Fine structure of the spinal cord. Spinal reflexes, receptors and effectors	5 Kozsurek 6 Gerber	<i>Microscopy of the CNS – consultation I.</i> <i>Spinal reflexes, development of the spinal cord + slides</i>
<b>Week 4</b> 09. 23 - 27.	7. Formation and derivatives of the neural crest and placode ectoderm 8. Brain tracts, neurotransmitters, neuronal circuits, “connectomics” Structure of the cerebral cortex	7 Minkó 8 Székely	Nerve tissue, CNS (slides) <i>Brodman areas</i>
<b>Week 5</b> 09.30 – 10.4.	9. Somato-and viscerosensory systems. Sensory pathways with special reference to the cranial regions. 10. Thalamic nuclei. Functional connections between the sensory cortex, thalamus and insula.	9 10 Shahbazi	<i>Microscopy of the CNS – consultation II.</i> <i>Sensory pathways</i> <i>Development of the telencephalon</i> +slides
<b>Week 6</b> 10. 7-11.	11. Neuroanatomy of pain. 12. Structure of the cerebellum, cerebellar connections.	11 Gerber 12 Tóth	<i>Microscopy of the CNS – consultation III.</i> <i>Motor systems</i> <i>Structure, connectivity and development of the cerebellum</i>
<b>Week 7</b> 10. 14-18.	13. Neuroanatomy of movements/locomotion I. Somatomotor cortical tracts. Visceromotor system, control of micturition 14. Neuroanatomy of movements/locomotion II. Planning /programming of and eliciting movements. Gait control mechanism. The role of cerebellum and basal ganglia	13 Vereczki 14 Vereczki	<b><u>Midterm test 1</u></b> <b><i>Blood, lymphatic organs, microscopy of the CNS</i></b>
<b>Week 8</b> 10. 21-25. <b>Oct.23. is a National Holiday</b>	15. Central autonomic nervous system. Monoaminergic and cholinergic neurones and pathways. „Ascending Reticular Activating System” (ARAS) 16. External ear, middle ear.	15 Kozsurek 16 Gallatz	Motor systems
<b>Week 9</b> 10. 28. - 11. 1. <b>Nov. 1 is a National Holiday</b>	17. Inner ear. Bony and membranous labyrinth. Development of the organ of hearing. 18. Control of balance / posture together with the movements of the eye and head. Perception of spatial position	17 Tóth 18 Tóth	Organ of hearing and equilibrium (slides) <i>External ocular muscles (revision)</i>
<b>Week 10</b> 11. 4-8.	19. Spiral organ of Corti. Auditory pathway. Neuroanatomy of hearing, understanding and control of speech. 20. Fibrous and vascular coats of the eyeball. Lacrimal gland, lacrimal apparatus.	19 Puskár 20 Barna	Organ of vision <i>Innervation of the lacrimal gland</i>
<b>Week 11</b> 11. 11-15.	21. Inner coat of the eyeball, retina. Development of the eye 22. Neuroanatomy of vision. Visual pathway, visual recognition, orientation in space.	21 Lendvai 22 Lendvai	Endocrine organs I.
<b>Week 12</b> 11. 18-22.	23. Circadian rythm, sleep/wake cycle; neuroanatomy of resting state and activation. 24. Endocrine system: Hypothalamus, the hypothalamo-hypophysial system, epiphysis	23 Gerber 24 Tóth	<b><u>Midterm test 2</u></b> <b><i>Endocrine organs I.</i></b> <b><i>Organs of special senses</i></b>
<b>Week 13</b> 11. 25 – 29.	25. Taste sensation and olfaction. Limbic system. 26. Neuroanatomy of energy metabolism, food intake, hedonism and addiction	25 Gallatz 26 Gerber	Endocrine organs II Skin as a sensory organ
<b>Week 14</b> 12. 2-6.	27. Neuroanatomy of emotions, motivation, agression, empathy and behaviour. The reward system. 28. Neuroanatomy of stress, fear, anxiety and depression. Determination, alertedness, personality, consiousness, well-being.	27 Vereczki 28 Gerber	Revision

**List of slides (FOK series)      2024/2025      1st semester**

<b>Weeks</b>	<b>Histology laboratory</b> <i>Tuesdays 15.00-16.30</i>
<b>Week 1</b> 09. 2-6.	<b>Lymphatic system I.</b> 49. Thymus (HE) <span style="float:right">DEM    ÁOK 42. Palatine tonsil (T/B cell IHC)</span> 7. Palatine tonsil (HE)    48. Lingual tonsil (HE) <span style="float:right">ÁOK 48. Pharyngeal tonsil (HE)</span>
<b>Week 2</b> 09. 9-13.	<b>Lymphatic system II.</b> 44. Lymph node (HE) 45. Spleen (HE) <span style="float:right">DEM    ÁOK 1.a, b Spleen (T/B cell IHC)</span> <b>Histology of the peripheral nervous system</b> 36. Peripheral nerve (cross section, HE) <span style="float:right">DEM    Peripheral nerve (OsO4 impregnation)</span> 37. Pseudounipolar neurones (DRG, HE) <span style="float:right">6. nerves in the skin(HE)</span> 38. Multipolar neurones (autonomic ggl, AgNO3 impregnation) 43. Motor end plate (striated muscle, ACh esterase histochemistry)
<b>Week 3</b> 09. 16-20.	<b>Microscopy of the CNS – consultation I.    Spinal reflexes, development of the spinal cord</b> 39. Spinal cord (multipolar neurones, Nissl) Spinal reflexes. Development of the spinal cord
<b>Week 4</b> 09. 23 - 27.	<b>Histology of the central nervous system + major Brodmann areas</b> 40. Cerebral cortex (pyramidal neurones, Bielschowsky) 42. Cerebral cortex (pyramidal neurones, Golgi) 94. Hippocampus (HE)
<b>Week 5</b> 09.30 – 10.4.	<b>Microscopy of the CNS – consultation II. Sensory pathways &amp; Development of the telencephalon</b> 99. Mesencephalon (Luxol fast blue + Nissl) 100. medulla oblongata (Luxol fast blue + Nissl)
<b>Week 6</b> 10. 7-11.	<b>Microscopy of the CNS – consultation III. Motor systems &amp; Structure, connectivity and development of the cerebellum</b> 95. Cerebellar cortex (HE) 41. Cerebellar cortex (GFAP ICC)
<b>Week 7</b> 10. 14-18.	<b>Midterm test 1                      Blood, lymphatic organs, microscopy of the CNS</b>
<b>Week 8</b> 10. 21-25. <i>Oct.23. is a National Holiday</i>	<b>Motor systems</b>
<b>Week 9</b> 10. 28. - 11. 1. <i>Nov. 1 is a National Holiday</i>	<b>Histology of the organ of hearing &amp; equilibrium</b> 98. Cochlea (semithin section, toluidine blue) <span style="float:right">External ocular muscles (revision)</span> Macula (semithin section, toluidine blue) Ear lobe (Verhoeff's stain)
<b>Week 10</b> 11. 4-8.	<b>Histology of the organ of vision</b> 96. Eye bulb (HE)                      97. Retina (semithin section, toluidine blue) 33. Lacrimal gland (HE)
<b>Week 11</b> 11. 11-15.	<b>Endocrine system I.</b> <span style="float:right">DEM    74. Leydig cells, testicle (HE)</span> 90. Epiphysis/ pineal body (HE) <span style="float:right">78. Ovarian follicles (HE)</span> 86. Hypophysis/ pituitary gland (HE) <span style="float:right">79. Corpus luteum (HE)</span> 87. Hypophysis/ pituitary gland (chrom–hematoxyline-phloxin/Gömöri)
<b>Week 12</b> 11. 18-22.	<b>Midterm test 2                      Endocrine organs I. &amp; Organs of special senses</b>
<b>Week 13</b> 11. 25 – 29.	<b>Endocrine system II.</b> 88. Thyroid gland (HE)                      89. Parathyroid gland (HE) 92. Adrenal/suprarenal gland (HE) <span style="float:right">DEM    70. Islets of Langerhans, pancreas (HE)</span> <b>Histology of the skin</b> 6. Palm skin (HE)                      11. Scalp/hairy skin (HE)
<b>Week 14</b> 12. 2-6.	<b>Revision</b>

# **ED II. Microscopic Anatomy and Embryology II.**

## **Subject matter of the present semester**

### **I. Histology of the blood, lymphatic organs and the nervous system**

- a) Corpuscular elements of blood
- b) Histology of lymphoid tissue (lymph nodes, thymus, tonsils, spleen)
- c) Fine structure of peripheral nerves, neurons and supporting elements
- d) Receptors and effectors, interneuronal synapses
- e) Histology of the brain and spinal cord

### **II. Microscopy of the central nervous system, i.e., NEUROANATOMY \***

- 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

### **III. 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

### **IV. Endocrine organs (histology and embryology)**

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

### **V. 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

## Announcements

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

### Acceptance of the semester (signature)

1. Active participation in histology lab sessions is obligatory. Students should attend **at least 75% of the scheduled hours**, including the obligatory midterm examinations. Absences are therefore limited in **25%**.
2. **Successful midterm tests (passing with at least a 2).**

### MIDTERM TESTS

- Midterm test I.** Written (Moodle)  
Date: 8<sup>th</sup> week  
Topics: Histology of blood, lymphatic system, microscopy of the CNS (*except for the basal ganglia*)
- Midterm test II.** Written (Moodle)  
Date: 13<sup>th</sup> week  
Topics: Endocrine organs I.; Organs of special senses

*Midterm tests are **obligatory** tests, they can only be done on the day specified previously, and unless they are unsuccessful, they **cannot be retaken or upgraded**.*

***Unsuccessful midterms** (i.e., fail – 1) will have to be retaken at the given timepoints (TBA).*

**EXAM COMPETITION** – every student, whose **midterm marks are 4 or 5**, is invited to participate in a written competition on week 14.

**Topic list-** Subject matter of the two semesters

Students achieving **the level of a 4 or 5** at the competition may request **to be exempted from the written part of the final examination**.

## FINAL EXAMINATION

**Topics:** Subject matter of the two semesters

1. Written pretest (moodle, *unless exempted*)
2. Oral examination – (see the Topic list)
  - a) Identification of structures on 1 digitized tissue slide
  - b) 1 topic from the Microscopy of the CNS (i.e., Neuroanatomy)
  - c) *A further question from the topics of CNS tests whose cumulative score is less than 15 points collected from the test during weeks 6-7-8 (\*see above)*

The final mark is calculated from all 3 partial marks earned from each part.

**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

### GENERAL RULES

1. Frequently wash your hands using soap and warm water.
2. Sanitise your hand frequently.
3. Do not touch your face or eye.
4. 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).
5. Use paper tissues in case you cough or sneeze and dispose of them immediately in the designated bins.

### SPECIFIC RULES CONCERNING THE HISTOLOGY LABORATORIES

- |   |
|---|
| <ol style="list-style-type: none"><li>1. You may clean the surfaces with hygienic towels before you start using them.</li><li>2. Food and drinks are <b>strictly forbidden</b> in the Histology laboratory.</li></ol> |
|---|

### 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,** 4<sup>th</sup> 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

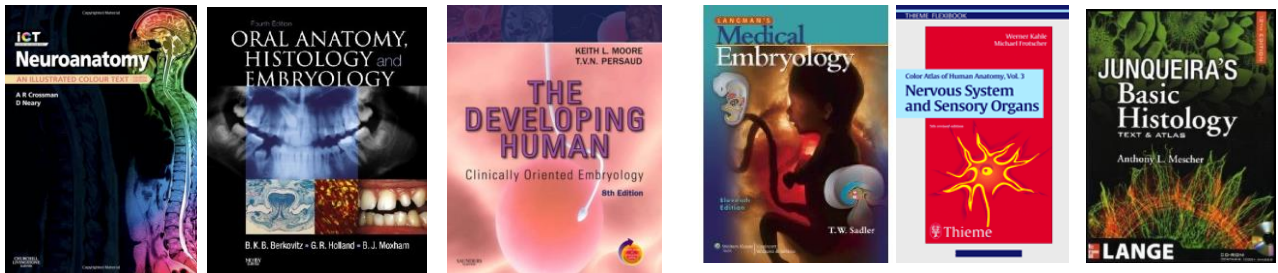
**Junqueira's Basic Histology:** Text and Atlas; 13th Edition by Anthony Mescher, New York, McGraw-Hill Medical, 01/03/2013 ISBN13 978007178033

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

**Illustrated Dental Embryology, Histology, and Anatomy,** 3<sup>rd</sup> 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](https://lib.semmelweis.hu/knowledge_base)).





# ANNOUNCEMENTS CONCERNING THE FINAL EXAMINATIONS IN MICROSCOPIC ANATOMY AND EMBRYOLOGY

Final examinations are generally held **as it appears in Neptun**

## REGISTRATION ISSUES

**Registration** has to be done in neptun according to the Study and Examination Policy. Registration closes 24/23 hours before the actual exam time.

**Absences** – no-show at the semifinal examination reduces the remaining examination possibilities and Students will have to pay a missed examination fee via neptun.

In case of health problems, students will have to present a **doctor's note within 3 working days** to be evaluated by the Head of Department. If accepted, the number of the student's examination possibilities will not be reduced.

**On the day of the examination, leave your bags in a locker and gather in front of the Histology lab 10 minutes before starting time.** Please make sure you have the following items on you:

**ID card/student card** (you may not start the examination without it)  
**SeKA login details** (memorize or write them down on a small piece of paper) \*  
**a pen or pencil** to aid you with the explanation of the slides and the oral question  
**in case of a retake exam – proof of payment** (except for the 1st retake)

\*Students who cannot login /forgot their password will be considered as „absent“ (see above) and have to sit for the examination on a different day

**Phones and smart watches have to be stored elsewhere during examinations.** Neither pens+papers may be with you during the written part. You cannot take notes or talk to your peers during the examination. Students found to use such items or breaking the aforementioned rules will be immediately suspended, the case recorded and the examination is terminated with a fail (1).

*For safety reasons you may keep your valuables (money, cards, IDs, etc) on you, however „large“ items, such as phones (switched off), tablets (switched off) and pencil cases will be collected upon entering the examination room.*

**No chewing gum, no food, no drinks are allowed while on the premises**

## PARTS OF THE SEMIFINAL EXAMINATION

### WRITTEN PART (Students may not leave the room during the test)

The test is composed of 40 simple / multiple choice questions

(Histology, Microscopy of CNS, Embryology:CNS, endocrine organs, organs of special senses)

Writing time: 40 minutes

**Passing rate: 20 points = 50%** (0-50%-fail, 50% - satisfactory, 65% - average, 75% - good, 85% - excellent)

- Following the completion of the test Students may view their results, however, neither questions may be asked nor notes may be taken during this time. Students may not leave the room before the inspection time expires.
- Students not reaching 50% percent in the written part cannot continue (i.e. fail) the examination and should leave.
- Students failing the examination in a subsequent practical part may be exempted from the written test during the retake examination if they gained a **good** (4), or **excellent** (5), result from the written test.

## ORAL / PRACTICAL PART

This part is also held in the Histology Laboratory. The oral examination consists of

- 1 digitized tissue slides (description)
- 1 theoretical question from a topic of the material studied during the two semesters (see the Topic list).

Further questions, other than the identification of the presented specimens, may arise, e.g. discussing the theoretical or developmental relevances. Students may be asked to produce schematic drawings as part of the examination (e.g. reflexes, cross sections of the brain stem or schematic drawings of histological images).

## MARKING SYSTEM

**The examination finishes in the Histology room, where Students are given a mark calculated from all the marks they earned during the examination.**

- If one part of an examination results in fail (1), the entire examination is terminated with a fail (1).
- In case the result of one of the parts is **1/2**, the overall result of the examination CANNOT be better than a pass (2). This mark can only be earned once during the examination.
- **Students failing the examination, may repeat the exam once „free“, every further attempt will be charged for.** The total number of examination seats is set (200% of the number of students in a given course), therefore the number of examination seats will not be increased\*.
- Students may request in writing to sit for an oral theory exam to replace the written part in case of a 2nd or 3rd retake examination. A request will have to be sent to the Course Director 48 hours before the examination day.
- **Retake of a successful examination** - students unhappy with the result of the examination may apply in writing with the Course Director, to retry the examination. They will be registered by the Course Director in neptun. ***Please note, that such a retake examination does not necessarily result in a better mark.***
- **Technical problems** concerning registration or deregistration via the neptun system are beyond the scope of the Department, Students should seek help from the neptun group of the Secretariat.
- The Registrar of the English Secretariat is not entitled to register or deregister students with the only exception of using the 4th chance upon getting the Dean's permission.



# TOPICS OF THE FINAL EXAMINATION

*(topics of the two semesters)*

## **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

Histology and development of skin appendages, mammary gland

## **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

### ***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)  
Pyramidal (tract) system  
Extrapyramidal system

Limbic system (nuclei and tracts)  
Reflex arc of mastication  
Anatomical bases for trigeminal pain  
Autonomic innervation of salivary glands  
Neuroanatomy of energy metabolism, food intake, hedonism and addiction  
Neuroanatomy of emotions, motivation, aggression, empathy and behaviour. The reward system.  
Neuroanatomy of stress, fear, anxiety and depression. Determination, alertness together with personality, consciousness and well-being.

### ***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 of the skin (scalp and palm)  
Coats of the eyeball  
Chambers of the eye, vitreous body  
Lens, accommodation  
Light reflex of the pupil  
Visual pathway, visual reflexes, optic nerve (CN2)  
Cornea reflex  
*(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)  
Vestibulocochlear nerve. (CN8)  
Organ of Corti. Cochlea, cochlear duct  
Auditory pathway.  
Vestibular system  
Bony and membranous labyrinth, vestibulum  
Organ of olfaction, olfactory pathway, olfactory nerve (CN 1)  
Organ of taste, taste buds, central processing of taste (tracts)

