

**Semmelweis University**  
**Department of Anatomy, Histology and Embryology**  
**2020/2021**

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

# **MICROSCOPIC ANATOMY HANDBOOK**



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# 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

**Histology** - Demonstration of the fine structure of cells and tissues composing the organs of the human body specifically to provide the future clinicians/medical doctors 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).

**Embryology** – the subject 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 practical 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: 3 x 45 min; second semester: 2 x 45 min.

**ECTS CREDITS:** Altogether 9 (first semester: 5; 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:** Cell sciences, Microscopic Anatomy I.

# Academic Year 2020/202

## EM II. Microscopic Anatomy and Embryology II.

Weeks	Lectures (online)	Lecturer	Departmental personal consultations <i>Selected Mondays 14.00 - 15.40</i>	Groups in lecture halls <b>Lenhossék      Huzella</b>		Histology laboratory <i>Tuesdays EM 1-6 12.00-13.30 and EM 7-12 14.00- 15.30 Wednesdays EM 13-17 10.00-11.30 Fridays EM 18-19 8.00-9.30</i>
<b>Week 1</b> 09. 7- 11.	1. Cellular components of lymphatic tissue. Thymus, tonsils, MALT 2. Structure and circulation of lymph nodes and spleen	<i>1 Nagy 2 Nagy</i>	-			Thymus, tonsils 43a, 43c, 47, 42a, 42b, 46, 48
<b>Week 2</b> 09. 14- 18.	3. Microscopy of the CNS – fine structure of the spinal cord (spinal reflexes, receptors, effectors, monosynaptic/proprioceptive reflexes 4. Microscopy of the CNS – Nociceptive (withdrawal) and autonomic reflex arcs	<i>3 Alpár 4 Altdorfer</i>	-			Lymph node, spleen 40, 45, 1a, 1b
<b>Week 3</b> 09. 21- 25.	5. Microscopy of the CNS – Nerve tissue. Fine structure of the cerebral cortex 6. Microscopy of the CNS – Diencephalon, thalamic nuclei	<i>5 Pálfi 6 Dobolyi</i>	1.1 Lymphatic organs, spinal cord 1.2 Lymphatic organs, spinal cord	<i>EM 1-5 Alpár EM 6-10 Alpár</i>	<i>EM 11-15 Nagy EM 16-19 Nagy</i>	Histology of the peripheral nervous system 88, 67, 53, 79, 75, 6, 151b, 33b
<b>Week 4</b> 09.28 - 10. 2.	7. Microscopy of the CNS – Sensory systems, epicritical and protopathic sensibilities 8. Microscopy of the CNS – Motor systems, pyramidal tract	<i>7 Kozsurek 8 Nemeskéri</i>	-			Histology of the central nervous system 101, 22, 111, 80, 96, 16, 20
<b>Week 5</b> 10. 5-9.	9. Microscopy of the CNS – Brainstem nuclei and pathways. Brainstem monoaminergic systems 10. Microscopy of the CNS – Structure and connections of the basal ganglia.	<i>9 Dóra 10 Ádám</i>	-			<b>Midterm test 1</b> (Histology slides of weeks 1-4)  Microscopy of the CNS – consultation 1.
<b>Week 6</b> 10. 12- 16.	11. Microscopy of the CNS – Microscopy of the cerebellum, pathways 12. Microscopy of the CNS – Limbic system	<i>11 Csáki 12 Kocsis</i>	2.1 Cortex, tracts, cerebellum 2.2 Cortex, tracts, cerebellum	<i>EM 1-5 Ádám EM 6-10 Ádám</i>	<i>EM 11-15 Horváth EM 16-19 Horváth</i>	Microscopy of the CNS – consultation 2.
<b>Week 7</b> 10. 19- 23. <i>Friday Oct 23.</i>	13. Microscopy of the CNS – Hypothalamus, the hypothalamo-hypophysial system 14. Microscopy of the CNS – Endocrine organs (pineal, thyroid, parathyroids, adrenal glands)	<i>13 Tóth 14 Barna</i>	-			Microscopy of the CNS – consultation 3. <b>No classes on Friday</b>
<b>Week 8</b> 10. 26- 30.	15. Development of the neural tube. Cranio-caudal and dorso-ventral differentiation 16. Differentiation of the brain vesicles	<i>15 Kálmán 16 Csillag</i>	-			Microscopy of the CNS – consultation 4. Development of the CNS
<b>Week 9</b> 11. 2-6.	17. Formation and derivatives of the neural crest and placode ectoderm 18. Development of the skull	<i>17 Nagy 18 Adorján</i>	3.1 Development of the nervous system 3.2 Development of the nervous system	<i>EM 1-5 Nagy EM 6-10 Nagy</i>	<i>EM 11-15 Kálmán EM 16-19 Kálmán</i>	<b>Midterm test 2</b> Microscopy of the CNS, Development of the nervous system  Endocrine system 1. Hypothalamus, pituitary gland 14, 105a
<b>Week 10</b> 11. 9- 13.	19. Development of the vertebral column, limb development 20. Skin and appendages. Mammary gland	<i>19 Nemeskéri 20 Székely</i>	-			Endocrine system 2. Thyroid, parathyroid and adrenal glands, pineal body, endocrine cells 102, 104, 32, 70, 44, 97
<b>Week 11</b> 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	<i>21 Alpár 22 Szél</i>	-			Histology of palm skin, scalp skin. Mammary gland 59, 153, 11, 107, 93 Palpebra 39
<b>Week 12</b> 11. 23- 27	23. Optic nerve, visual pathway, visual reflexes. Development of the eye 24. External ear, middle ear - tympanic cavity, tympanic membrane, auditory ossicles	<i>23 Szél 24 Katz</i>	4.1 Skin, visual system, optic tract 4.2 Skin, visual system, optic tract	<i>EM 1-5 Barna EM 6-10 Barna</i>	<i>EM 11-15 Katz EM 16-19 Katz</i>	Histology of the organ of vision: eye bulb, retina, lacrimal gland 29, 30, 113
<b>Week 13</b> 11.30- 12.4.	25. Bony and membranous labyrinth. Vestibular system 26. Spiral organ of Corti. Auditory pathway. Development of the organ of hearing	<i>25 Hanics 26 Puskár</i>	-			Histology of the organ of hearing cochlea, macula 36, 4
<b>Week 14</b> 12.7-11.	27. Microscopy of the CNS – Olfactory and gustatory systems 28. Drugs of abuse, opiates and receptor mediated actions in the CNS	<i>27 Vereczki 28 Wenger</i>	-			Revision

## EM II. Microscopic Anatomy and Embryology II.

### List of slides

Weeks	Histology laboratory <i>Tuesdays EM 1-6 12.00-13.30 and EM 7-12 14.00- 15.30</i> <i>Wednesdays EM 13-17 10.00-11.30      Fridays EM 18-19 8.00-9.30</i>
<b>Week 1</b> 09. 7-11.	<b>Lymphatic system 1</b> 43. a Thymus (HE) 43. c Thymus 47. Palatine tonsil (HE) 42. a Palatine tonsil (CD20 immunocytochemistry) 42. b Palatine tonsil (CD3 immunocytochemistry) 46. Lingual tonsil (HE) 48. Pharyngeal tonsil (HE)
<b>Week 2</b> 09. 14-18.	<b>Lymphatic system 2</b> Lymph node, spleen 40. Lymph node (rat, semithin, toluidine blue) 45. Spleen (human, HE) 1. a Spleen (CD20 immunocytochemistry) 1. b Spleen (CD3 immunocytochemistry)
<b>Week 3</b> 09. 21-25.	<b>Histology of the peripheral nervous system</b> 88. Peripheral nerve (sciatic nerve, HE) 67. Autonomic ganglion (celiac ganglion, Bielschowsky's impregnation) 53. Autonomic ganglion (submandibular gland, HE) 75. Motor end plate (cholinesterase enzyme histochemistry) 79. Spinal cord + dorsal root ganglion (Luxol Fast blue + cresyl violet) 6. (Vater-)Pacinian corpuscle (plantar skin, HE) 151b, 33.b
<b>Week 4</b> 09.28 -10. 2.	<b>Histology of the central nervous system</b> 101. Spinal cord (Luxol Fast blue + cresyl violet) 111. Cortex cerebri (Bodian) 22. Cortex cerebri (pre- and postcentral gyri, Nissl) 80. Cerebellar cortex (HE) 96. Cerebellar cortex (neurofilament immunocytochemistry) 20. Hippocampus + choroidal plexus (Nissl) 16. Mesencephalon (Luxol fast blue + cresyl violet)
<b>Week 5</b> 10. 5-9.	<b>Midterm test 1</b> (Histology slides of weeks 1-4) Microscopy of the CNS – consultation 1.
<b>Week 6</b> 10. 12-16.	Microscopy of the CNS – consultation 2.
<b>Week 7</b> 10. 19-23.	Microscopy of the CNS – consultation 3. <b>No classes on Friday</b> <i>Friday Oct 23.</i>
<b>Week 8</b> 10. 26-30.	Microscopy of the CNS – consultation 4. Development of the CNS
<b>Week 9</b> 11. 2-6.	<b>Midterm test 2</b> Microscopy of the CNS, development of the nervous system  <b>Endocrine system 1.</b> 14. Hypothalamus (Chrom haematoxylin floxin/ GÖMÖRI) 105. Pituitary gland (Chrom haematoxylin floxin/GÖMÖRI)
<b>Week 10</b> 11. 9-13.	<b>Endocrine system 2.</b> 44. Pineal body (HE) 102. Thyroid gland (HE) 104. Parathyroid gland (HE) 32. Suprarenal gland (HE) 70. Endocrine pancreas/ islands of Langerhans (HE) 97. Corpus luteum (HE)
<b>Week 11</b> 11.16-20.	<b>Histology of palm skin, scalp skin. Mammary gland</b> 59. Palm skin (HE) 153. Glomus organ, nail (HE) 11. Scalp skin (HE) 107. Mamma lactans (HE) 93. Mamma non lactans (HE) <b>Histology of the organ of vision 1</b> 39. Eyelid (HE)
<b>Week 12</b> 11. 23-27	<b>Histology of the organ of vision 2</b> 29. Eye bulb (HE) 30. Retina (semithin, toluidine blue) 113. Lacrimal gland (HE)
<b>Week 13</b> 11.30-12.4.	<b>Histology of the organ of hearing</b> 36. Cochlea / organ of Corti (semithin, toluidine blue) 4. Macula (semithin, toluidine blue)
<b>Week 14</b> 12.7-11.	Revision

## **ONLINE LECTURES AND PERSONAL CONSULTATIONS DURING THE PRESENT SEMESTER**

### ***covid19 protocol***

There will be two lectures a week during the present semester. Lectures listed in the schedule (see above) will be held as online lectures since a safe social distance would not be possible to keep within the lecture halls.

Lectures (including a voice over) or theirs links together with the lecture notes will be uploaded in Moodle where students may access them as well as further study aids. Here the students may log in via SeKA using a personal name and password.

(<https://itc.semmelweis.hu/moodle/login/index.php>)

In order to help our students we are willing to regularly hold personal consultations in the lecture halls where only the designated groups are entitled to participate. See the schedule for the topics and order of appearance. We expect you to watch the uploaded lectures to gain the most from these consultations where we would summarize the most important core material and you may ask questions.

Please thoroughly check the order of appearance because only members of the listed groups are eligible to participate.

# **SUBJECT MATTER OF THE PRESENT SEMESTER**

## **I. Histology of the 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

<b>Midterm test I.</b>	Written midterm (Moodle) Topic: Histology of the lymphatic system, histology of the nervous system Date: 5 <sup>th</sup> week
<b>Midterm test II.</b>	Written (Moodle) Topic: Microscopy and development of the central nervous system. Date: 9 <sup>th</sup> 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).

## EM 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%**.

**Mid-term examinations:** During the semester, both practical and theoretical knowledge will regularly be evaluated. There are two written (Moodle) midterm tests during the semester. Attendance at these midterms is obligatory or the semester is not accepted. Students absent 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 form 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"><li>1. Use hand sanitizers upon entering.</li><li>2. Use <b>rubber gloves</b> when touching the keyboard or the mouse of the digital equipment.</li><li>3. You may clean the surfaces with wet towels before you start using them.</li><li>4. Food and drinks are <b>strictly forbidden</b> on the premises of the department.</li></ol> |
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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

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

**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

**Stevens & Lowe's Human Histology**, Elsevier, 4th ed ISBN 978-0-723435020, 2015.

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

## RECOMMENDED LITERATURE

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

**Histology Manual 1-3.** by A. Nemeskéri and K. Kocsis: István Apáthy's Foundation, 2019.

**A. L. Kierszenbaum Histology and Cell Biology**: An Introduction to Pathology, 4th Edition, Paperback with STUDENT CONSULT Online Access and E-Book ISBN: 9780323085885; 2015

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

### ***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)).

# TOPIC LIST OF THE FINAL EXAMINATION

(2 Histology slides and 1 theory question from the topics of Embryology and Microscopy of the nervous system)

## ***General Histology***

Concept of basic tissues  
Definition and classification of epithelial tissue  
Simple epithelia  
Stratified epithelia  
Membrane specializations of 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  
Histology of the bone tissue  
Intramembranous ossification  
Endochondral ossification  
Growth and remodeling of bone  
Smooth muscle and myoepithelial cells  
Skeletal muscle tissue  
Cardiac muscle tissue  
Nervous tissue

## ***Histology of organs***

Histological structure of arteries and arterioles  
Composition of capillaries and veins  
Wall structure of hollow organs  
Histology of the lip, tongue and teeth  
Structure of the esophagus  
Histology of the airways (epiglottis, larynx, trachea, lung)  
Histology of the stomach  
Structure of the small and large intestines  
Histology of the liver and biliary passages including the gall bladder  
Histology of the pancreas  
Histology of the kidney and the urinary passages (ureter, urinary bladder)  
Histology of the testicles together with the epididymis  
Histology of the prostate, seminal vesicle, spermatic cord  
Histology of the penis  
Histology of the ovary, uterine tube; corpus luteum  
Histology of the uterus  
Histology of the vagina  
Placenta, umbilical cord

## ***General Embryology***

Spermatogenesis, spermiogenesis  
Oogenesis  
Fertilization, cleavage of the zygote  
Blastocyst formation; the bilaminar embryonic disc  
Implantation  
Formation of body axes, parts of the early embryo (yolk sac, amnion, chorion, body stalk)

Gastrulation

Formation of the intraembryonic mesoderm; the notochord

Neurulation (neural tube and neural crest)

Derivatives of ectoderm, endoderm and mesoderm

Folding of the embryo

The structure and function of the placenta

Development of the fetal membranes (chorion and amnion), umbilical cord

Twin formation

### ***Development of internal organs***

Development of the primitive vascular systems

Development of the heart

Development of arteries

Development of veins (inferior vena cava, portal vein, superior vena cava, azygos and hemiazygos)

Fetal circulation

Face development (oral and nasal cavities)

Development and differentiation of the foregut

Derivatives of pharyngeal pouches and grooves

Derivatives of pharyngeal arches

Development of the tongue, tooth development

Development and differentiation of the midgut

Development and differentiation of the hindgut

Formation of the liver and pancreas

Development of the peritoneum

Development of the lower airways including the lungs

Development of the diaphragm, divisioning of the body cavities

Kidney development

Development of the urinary passages

Gonadal development, formation and migration of primordial stem cells

Development of the male genital tract

Development of the female genital tract

Development of the male/female external genitals

### ***Lymphatic organs***

Lymphatic tissues in general, cellular components

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

**Neurohistology**

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)

Microscopy of the autonomic nervous system, tracts

**Endocrine organs**

Microscopical anatomy and development of the pituitary gland. Portal circulation

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)

Histology of the mammary gland (mamma lactans et non-lactans)

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