

# MICROSCOPIC ANATOMY AND EMBRYOLOGY II.

## Department of Anatomy, Histology & Embryology

**Credit value: 4**

**Number of lessons per week: 4 lectures: 2 practical course: 2 seminar: 0**

### **Type of the course: compulsory course**

Subject code: AOKANT674\_2A

Name of the course leader: **Dr. Alán Alpár, Professor, Head of Department**

Contact details: : Semmelweis University, Department of Anatomy, Histology and Embryology, +36 1 459 1500 / 53609

### **Objectives of the subject, its place in the medical curriculum:**

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).

The part covering the microscopy of the CNS provides the students with a basic knowledge concerning the major roles of the brain together with the spinal cord with special reference to function and structure. The development of the nervous systems together with the detailed morphological/histological/developmental description of organs of special senses as well as the endocrine system will also be discussed. Teaching is done in the form of lectures and histology laboratory classes

### **Place where the subject is taught (address of the auditorium, seminar room, etc.):**

Semmelweis University, Department of Anatomy, Histology and Embryology  
Budapest 1094, Tűzoltó utca 58.

### **Successful completion of the subject results in the acquisition of the following competencies:**

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.

### **Course prerequisites:**

Cell science,  
Microscopic anatomy and embryology I,  
Macroscopic Anatomy and Embryology II.

### **Number of students required for the course (minimum, maximum) and method of selecting students):**

Obligatory for all registered students, on the basis of registration via the NEPTUN system.

How to apply for the course:

Via the NEPTUN system.

### **Detailed curriculum:**

#### *List of lectures*

1. week:	Cellular components of lymphatic tissue. Thymus, tonsils, MALT Structure and circulation of lymph nodes and spleen
2. week:	Nerve tissue Development of the neural tube, craniocaudal and dorsoventral differentiation. Divisions of the central nervous system
3. week:	Formation and derivatives of the neural crest and placode ectoderm Fine structure of the spinal cord (spinal reflexes, receptors, effectors)
4. week:	Brain tracts, neurotransmitters, neuronal circuits, "connectomics" Central autonomic nervous system. Monoaminergic and cholinergic neurones and pathways. „Ascending Reticular Activating System" (ARAS)

5. week:	Somatosensory system. Spinal and trigeminal sensory pathways. Thalamus, cortical areas. Viscerosensory system. Role of the reticular formation, thalamus, insula and the prefrontal cortices in visceral sensory activities
6. week:	Neuroanatomy of pain. Referred pain. Cerebral inhibition of pain sensation. Neuroanatomy of movements/locomotion I. Motor cortical areas, planning and programming of movements. Motor pathways
7. week:	Neuroanatomy of movements/locomotion II. The role of cerebellum and basal ganglia in eliciting movements. Gait control mechanism. Visceromotor system. Control of micturition. Spinal motor reflexes.
8. week:	External ear. Middle ear Inner ear. Bony and membranous labyrinth. Development of the organ of hearing.
9. week:	Spiral organ of Corti. Auditory pathway. Neuroanatomy of hearing, understanding and control of speech. Fine structure of the labyrinth, tracts of the vestibular system. Control of balancing and posture together with the movements of the eye and head. Awareness of spatial position.
10. week:	Fibrous and vascular coats of the eyeball. Lens, chambers of the eye, vitreous body, accommodation. Lacrimal gland, lacrimal apparatus. Inner coat of the eyeball, retina. Development of the eye.
11. week:	Neuroanatomy of vision. Visual pathway, visual recognition, neuroanatomy of reading and understanding of written/text. Endocrine system I. Hypothalamus, the hypothalamo-hypophysial system, epiphysis
12. week:	Endocrine system II. Thyroid, parathyroid, adrenal glands. Energy metabolism, neuroanatomy of food intake, taste sensation and olfaction. Structure and functional significance of the reward system.
13. week:	Limbic system. Amygdala, hippocampus. Circadian rhythm, sleep/wake cycle; neuroanatomy of resting state and activation.
14. week:	Behaviour and motivation. Neuroanatomy of emotions, empathy, well-being, aggression, fear, anxiety and depression. Cognitive functions. Neuroanatomy of determination, planning, alertness together with learning&memory, personality, consciousness and creativity.

#### *Histology laboratories*

1. week:	Lymphatic system I.
2. week:	Lymphatic system II.
3. week:	Histology of the peripheral nervous system
4. week:	Microscopy of the CNS - consultation 1.
5. week:	Histology of the central nervous system
6. week:	Microscopy of the CNS - consultation 2.
7. week:	Microscopy of the CNS - consultation 3.
8. week:	Midterm test
9. week:	Histology of the organ of hearing
10. week:	Histology of the organ of vision I.
11. week:	Histology of the organ of vision II.
12. week:	Skin. Endocrine system 1.

13. week:	Midterm
14. week:	Endocrine system 2.

**Other subjects concerning the border issues of the given subject (both compulsory and optional courses).**

**Possible overlaps of themes:**

Macroscopic Anatomy I - II.

Cell sciences, cell biology

Certain chapters of Biochemistry. The endocrine and central nervous systems are also discussed in Physiology

**Special study work required to successfully complete the course:**

none

**Requirements for participation in classes and the possibility to make up for absences:**

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

**Methods to assess knowledge acquisition during term time:**

The knowledge of students will be checked in written (Moodle) midterm tests (held prospectively in weeks 8 and 13). Attendance is obligatory at the two midterm tests. Students absent from the tests should reattend at one of the offered retakes. The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester (<http://semmelweis.hu/anatomia>).

**Requirements for signature:**

Active participation in at least 75% of dissection room sessions, including the midterm tests (irrespective of the result) is obligatory for every student.

**Type of examination:**

Final (written and oral) examination, topics: subject matter of the two semesters (Microscopic Anatomy and Embryology I-II.). Examiners are delegated by the Course Director with the consent of the Head of Department. Final examinations consist of written theoretical and oral practical parts.

**Requirements of the examination:**

During the final examination the knowledge of students will be tested. Final examinations are composed of written (theoretical) and oral (practical) parts with the latter being conducted with the use of digitized histological tissue slides.

**1. Written pretest (e-learning module)**

**2.**

**Microscopic Anatomy - identification of structures on digitized tissue slides - including relevant theoretical questions from the subject matter of the semester**

**Topic list for the semifinal examination:**

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**Microscopic Anatomy and Embryology I.**

(see there)

**Microscopic Anatomy and Embryology II.**

***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

***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  
Brain tracts, neurotransmitters, neuronal circuits, "connectomics"  
Central autonomic nervous system. Monoaminergic and cholinergic neurones and pathways.  
„Ascending Reticular Activating System" (ARAS)  
Somatosensory system. Spinal and trigeminal sensory pathways. Thalamus, sensory cortical areas.  
Viscerosensory system. Role of the reticular formation, thalamus, insula and the prefrontal cortices in visceral sensory activities.  
Neuroanatomy of pain. Referred pain. Cerebral inhibition of pain sensation.  
Motor cortical areas, planning and programming of movements. Motor pathways.  
The role of cerebellum and basal ganglia in eliciting movements. Gait control mechanism.  
Visceromotor system. Control of micturition. Spinal motor reflexes.  
Energy metabolism, neuroanatomy of food intake, taste sensation and olfaction. Structure and functional significance of the reward system.  
Limbic system. Amygdala, hippocampus.  
Circadian rhythm, sleep/wake cycle; neuroanatomy of resting state and activation.  
Behaviour and motivation. Neuroanatomy of emotions, empathy, well-being, aggression, fear, anxiety and depression.  
Cognitive functions. Neuroanatomy of determination, planning, alertness together with learning&memory, personality, consciousness and creativity.

### **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 and skin appendages  
Coats of the eyeball  
Chambers of the eye, vitreous body  
Lens, accommodation  
Neuroanatomy of vision. Visual pathway, visual recognition, neuroanatomy of reading and understanding of written/text.  
External ear, tympanic membrane. Middle ear, auditory tube, hearing ossicles.  
Spiral organ of Corti. Auditory pathway. Neuroanatomy of hearing, understanding and control of speech.  
Fine structure of the labyrinth, tracts of the vestibular system. Control of balancing and posture together with the movements of the eye and head. Awareness of spatial position.  
Organs of taste and olfaction.

### **Method and type of evaluation:**

Final examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is conducted with the help of digitized histological tissue slides.

Students are given separate marks for each part of the examination. Unsuccessful partial examinations result in the failure of the semifinal examination. When failing at the practical part, the written test will not have to be repeated in case the result was a 4 or a 5 only. Upon the termination of the examination the Chairman of the Examination Committee composes the final mark from the partial marks earned in the written and practical parts.

**How to register for the examination?** Via the NEPTUN system

### **Possibilities for exam retake:**

According to the Study and Examination Policy

**Printed, electronic and online notes, textbooks, guides and literature (URL address for**

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## **online material) to aid the acquisition of the material:**

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### **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.
- 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)).