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

<p>| 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, &quot;connectomics&quot; Central autonomic nervous system. Monoaminergic and cholinergic neurones and pathways. „Ascending Reticular Activating System” (ARAS) |</p>
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<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tr>
<td>5.</td>
<td>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</td>
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<td>11.</td>
<td>Neuroanatomy of vision. Visual pathway, visual recognition, neuroanatomy of reading and understanding of written/text. Endocrine system I. Hypothalamus, the hypothalamo-hypophysial system, epiphysis</td>
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<td>13.</td>
<td>Limbic system. Amygdala, hippocampus. Circadian rythm, sleep/wake cycle; neuroanatomy of resting state and activation.</td>
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**Histology laboratories**

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<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1.</td>
<td>Lymphatic system I.</td>
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<tr>
<td>2.</td>
<td>Lymphatic system II.</td>
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<td>3.</td>
<td>Histology of the peripheral nervous system</td>
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<td>5.</td>
<td>Histology of the central nervous system</td>
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<td>8.</td>
<td>Midterm test</td>
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<td>9.</td>
<td>Histology of the organ of hearing</td>
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<td>10.</td>
<td>Histology of the organ of vision I.</td>
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<tr>
<td>11.</td>
<td>Histology of the organ of vision II.</td>
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<td>12.</td>
<td>Skin. Endocrine system 1.</td>
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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 relevent theoretical questions from the subject matter of the semester

Topic list for the semifinal examination:

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.
- 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.
  - 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
- External ear, tympanic membrane. Middle ear, auditory tube, hearing ossicles.
  - 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 the Study and Examination Policy

Printed, electronic and online notes, textbooks, guides and literature (URL address for
online material) to aid the acquisition of the material:

**List of textbooks**

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

**Further study aids:**

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