LECTURE COMPLEX

Discipline: “Nervous system, sensory organs, vision, hearing and balance are normal”

Discipline Code: NSSOVHBN 2209

Educational Program Code and Title: 6B10115 “Medicine”

Total Academic Hours/Credits: 120 hours / 4 credits

Year and Semester of Study: 2nd year, 3rd semester

Lecture Hours: 4 hours

Shymkent, 2025 y

The lecture complex was developed in accordance with the working curriculum (syllabus) of the discipline "Nervous system, sensory organs, vision, hearing and balance are normal" and was discussed at the meeting of the department.

Protocol №11 from "26" 06 2025

Head of the department, Professor Tanabaev B.D.

Lecture №1

1. Topic:

General concept of the nervous system. Principles of organization of the nervous system. Structure of the spinal cord. Simple and complex reflex arcs. Spinal nerves.

2. Objective:

To provide an understanding of the nervous system. To study the principles of organization of the nervous system. To demonstrate that the nervous system ensures regulation and coordination of the body's activities as an integrated whole and its interaction with the external environment. To study the structural and functional unit of the nervous system — the reflex arc. To examine the structure of the spinal cord and spinal nerves, the formation of plexuses, their topography, and areas of innervation.

3. Lecture Abstract:

The nervous system is a set of anatomically and functionally interconnected structures that provide regulation and coordination of the body's activities as a unified whole and its interaction with the external environment.

The nervous system appeared in the course of evolution as an integrative system. Unlike other integrative systems, it performs its functions very quickly, precisely, and for a short duration.

According to the topographical principle, the nervous system is divided into the central and peripheral systems. From a functional point of view, it is divided into the somatic and autonomic (vegetative) systems.

The structural unit of the nervous system is the nerve cell — the neuron (or neurocyte).

The basis of the nervous system's activity is the reflex. Numerous reflex actions are divided into unconditioned and conditioned. The morphological basis of a reflex is the reflex arc. In a simple reflex arc, there are three neurons: afferent, intercalary (interneuron), and efferent.

The complexity of reflex arcs increases due to the addition of intercalary links.

The spinal cord (medulla spinalis) lies in the vertebral canal and in adults represents a long (45 cm in men and 41–42 cm in women) slightly flattened cylindrical cord, which cranially continues directly into the medulla oblongata and caudally ends with a conical taper, the conus medullaris, at the level of the second lumbar vertebra.

This fact has practical significance: to avoid damaging the spinal cord during a lumbar puncture for cerebrospinal fluid collection or spinal anesthesia, the needle must be inserted between the spinous processes of the third and fourth lumbar vertebrae.

The spinal nerves (nervi spinales) are arranged in regular order (neuromeres) corresponding to the myotomes (myomeres) of the trunk and alternating with the vertebral segments. Each nerve corresponds to a particular area of skin (dermatome).

Humans have 31 pairs of spinal nerves, namely: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal pair. Each spinal nerve arises from the spinal cord by two roots — the posterior (sensory) and the anterior (motor); both roots unite into a single trunk that exits the vertebral canal through the intervertebral foramen.

4. Illustrative Materials:

Tables, slides, models, charts, posters, anatomical torso, and the interactive anatomical table "Pirogov."

5. Literature:

Specified in Appendix №1

6. Control Questions (Feedback):

What is the structural and functional unit of the nervous system?

What is the structure of a simple reflex arc?

How is the nervous system classified?
Name the central organs of the nervous system.
Name the peripheral organs of the nervous system.
Define the spinal cord.
Define spinal nerves.

Lecture №2

1. Topic:
General overview of the brain. Structure of the cerebral cortex. Meninges of the brain. Cranial nerves.
2. Objective:
To study the structural features of the brain and its meninges.
3. Lecture Abstract:
The brain is the highest part of the central nervous system. It develops from the anterior end of the neural tube and passes through the stages of three and five brain vesicles. Each part of the brain has its own functional, morphological, and clinical significance.
The telencephalon (end brain) is derived from the anterior brain vesicle and includes the pallium (cerebral mantle), olfactory brain, basal nuclei, and lateral ventricles.
The outer layer of the pallium is the cerebral cortex (cortex cerebri), which is the most important part of the brain — the material substrate of higher nervous activity and the regulator of all vital functions of the body.
The formation of the cerebral cortex is one of the most progressive achievements in the evolution of the vertebrate brain. From a phylogenetic point of view, the human cerebral cortex consists of the old and new cortex. The number of cortical layers varies from 5 to 8, with most areas having a six-layered structure.
Within the cortex, projection and association centers are located. According to I.P. Pavlov, the morphological and functional centers, afferent pathways, and receptors represent analyzers of specific modalities.
The brain is located in the cranial cavity and roughly conforms to its internal shape. Its superolateral (dorsal) surface is convex, corresponding to the cranial vault, while the inferior (basal) surface is relatively flat and irregular.
The brain consists of three major parts:
Cerebrum (large brain) Cerebellum Brainstem (truncus encephalicus)
The cerebral hemispheres form the largest part of the brain, followed by the cerebellum in size, and the remaining smaller portion is the brainstem.
The meninges of the brain (meninges) are a direct continuation of the spinal meninges and consist of three layers: dura mater, arachnoid mater, and pia mater.
The dura mater encephali is a dense, whitish connective tissue membrane located externally to the other layers.
The arachnoid mater encephali, as in the spinal cord, is separated from the dura by a narrow capillary slit — the subdural space.
The pia mater encephali closely adheres to the brain surface, penetrating all its grooves and fissures, and contains blood vessels and vascular plexuses. Between the pia mater and the vessels lies the perivascular space, which communicates with the subarachnoid space.
4. Illustrative Materials:
Tables, slides, brain models, charts, posters, torso, and the interactive anatomical table “Pirogov.”
5. Literature:
Specified in Appendix №1

6. Control Questions (Feedback):
What is the structural and functional unit of the nervous system? What are the functions of the nervous system?
How is the nervous system classified?
Name the central organs of the nervous system.
Name the peripheral organs of the nervous system.
Define the brain.
Describe the meninges of the brain.

Lecture №3

1. Topic:
Sensory organs. The organs of vision and smell. Conductive pathways of the sensory organs.
2. Objective:
To study the structural and functional features of the organs of vision and smell.
3. Lecture Abstract:
Light served as a stimulus that led to the emergence of a special organ of vision — organum visus — in the animal world. Its main components in all animals are specialized sensory cells derived from the ectoderm, capable of perceiving light stimuli. These cells are mostly surrounded by pigment, which directs light in a specific path and absorbs excess rays.
The retina contains a chain of three neurons:
The first neuron – photoreceptor cells (rods and cones), forming the receptor apparatus of the visual analyzer.
The second neuron – bipolar neurocytes.
The third neuron – ganglion cells, whose axons form the fibers of the optic nerve (n. opticus).
The olfactory organ (organum olfactus) consists mainly of sensory (neurosensory) olfactory cells lining the olfactory pit, which is an ectodermal evagination.
The olfactory cells form the first neurons of the olfactory pathway; their axons pass through the cribriform plate (lamina cribrosa) of the ethmoid bone within the olfactory nerves (nn. olfactorii) and terminate in the olfactory bulbs (bulbi olfactorii) at the olfactory glomeruli (glomeruli olfactorii).
Here begin the second neurons — mitral cells, whose axons travel in the olfactory tract and terminate in the gray matter of the olfactory trigone (trigonum olfactorium), anterior perforated substance (substantia perforata anterior), and septum pellucidum.
Most fibers reach the cortex of the parahippocampal gyrus (gyrus parahippocampalis) and uncus, where the cortical center of the olfactory analyzer is located.
4. Illustrative Materials:
Tables, slides, anatomical models, charts.
5. Literature:
Specified in Appendix №1
6. Control Questions (Feedback):
Define the sensory organs.
Name the components of the analyzers.
What are the outer, inner, and visual axes of the eyeball?
What is the ciliary body and what are its structural components?
How are the muscle bundles of the ciliary muscle oriented, and what function does each bundle perform during contraction?
Which structures belong to the light-refracting media of the eye?
Where is the aqueous humor produced, and where does it drain?

Where is each of the six extraocular muscles attached to the eyeball, and in what direction does each move it?
What is the Tenon's capsule, and what is its function?
What is meant by the conjunctival sac and the conjunctival fornix?
What structures are included in the lacrimal apparatus?
Draw the scheme of the visual pathway and name the neurons transmitting impulses.
In which part of the nasal cavity is the olfactory area located, and why is it called so?

Lecture №4

1. Topic:
The organs of hearing, balance, and taste. Conductive pathways of the sensory organs.
2. Objective:
To study the structure and function of the auditory, vestibular, and gustatory organs.
3. Lecture Abstract:
The external ear (auris externa) consists of the auricle (auricula) and the external auditory canal (meatus acusticus externus).
The auricle, commonly called the ear, is formed by elastic cartilage covered with skin. The auditory canal consists of cartilaginous and bony parts.
The middle ear (auris media) includes the tympanic cavity and the auditory (Eustachian) tube, which connects the cavity to the nasopharynx.
The auditory tube (tuba auditiva, Eustachii) serves to equalize air pressure between the tympanic cavity and the external atmosphere, which is essential for proper transmission of sound vibrations to the labyrinth.
Functionally, the auditory organ — the peripheral part of the auditory analyzer — is divided into:
Sound-conducting apparatus: external and middle ear, and certain structures of the inner ear (perilymph and endolymph).
Sound-perceiving apparatus: inner ear.
Air vibrations collected by the auricle pass through the external auditory canal, strike the tympanic membrane, and cause it to vibrate.
Fibers from the vestibular nerve travel through the inferior cerebellar peduncle (tractus vestibulocerebellaris) to the cerebellum; some fibers reach the cerebellum directly without synapsing in the vestibular nuclei. The connection between the vestibular nuclei and the spinal cord occurs via the vestibulospinal tract (tractus vestibulospinalis).
Gustatory fibers terminate in the nucleus solitarius (nucleus solitarius nn. intermedii, glossopharyngei et vagi) of the medulla oblongata and pons, where the second neuron is located.
This nucleus is connected with motor nuclei involved in chewing and swallowing, as well as with the spinal cord (control of breathing, coughing, and vomiting).
Axons of the second neurons ascend to the thalamus, where the third neuron of the gustatory pathway begins, projecting to the cortical center of the gustatory analyzer.
4. Illustrative Materials:
Tables, slides, anatomical models, charts.
5. Literature:
Specified in Appendix №1
6. Control Questions (Feedback):
Define the sensory organs.
Name the components of the analyzers.
List the components of the auditory organ.
List the components of the organ of balance.

List the components of the organ of taste.

APPENDIX №1

Electronic resources:

1. SKMA Electronic Library – https://e-lib.skma.edu.kz/genres
2. Republican Interuniversity Electronic Library (RIEL) – http://rmebrk.kz/
3. Digital Library “Aknurpress” – https://www.aknurpress.kz/
4. Electronic Library “Epigraph” – http://www.elib.kz/
5. Epigraph – Multimedia Textbook Portal – https://mbook.kz/ru/index/
6. Electronic Library System IPR SMART – https://www.iprbookshop.ru/auth
7. Information and Legal System “Zan” – https://zan.kz/ru
8. Medline Ultimate EBSCO - https://research.ebsco.com/
9. eBook Medical Collection EBSCO - https://research.ebsco.com/
10. Scopus - https://www.scopus.com/

Electronic textbooks:

1. Curtis, J. Anatomy & Physiology : A simplified guide to the structures and systems of the human body. / Jason Curtis.: Strength and Conditioning Course, 2020. https://rmebrk.kz/book/1178693
2. Frank H. Netter Netter Atlas of Human Anatomy. Classic Regional Approach. - Eight edition - PA: Elsevier, 2023 https://rmebrk.kz/book/1186042
3. Анатомия человека = Human Anatomy : учебное пособие / Е. С. Околокулак, Ф. Г. Гаджиева, С. А. Сидорович, Д. А. Волчкевич. — Минск : Вышэйшая школа, 2021. — 416 с. — ISBN 978-985-06-3304-0. — Текст : электронный // Цифровой образовательный ресурс IPR SMART : [сайт]. — URL: https://www.iprbookshop.ru/119959.html (дата обращения: 13.01.2025). — Режим доступа: для авторизир. пользователей
4. Klein, Robert M., Enders, George C. Anatomy, Histology, and Cell Biology : PreTest . . - Third Edition - Kansas City: Medical, 2007. – 638 https://rmebrk.kz/book/1169836
5. Kahle, W. et al. Color Atlas and Textbook of Human Anatomy : In 3 Volumes. Vol. 1: Locomotor System / W. Kahle, H. Leonhardt, W. Platzer. - 4th edition - Нью-Йорк, 1992. - 435 https://rmebrk.kz/book/1007683
6. Kahle, W. et al. Color Atlas and Textbook of Human Anatomy : In 3 Volumes. Vol. 2: Internal Organs / W. Kahle, H. Leonhardt, W. Platzer. - 4th edition - Нью-Йорк, 1992. – 372 https://rmebrk.kz/book/1007684
7. Kahle, W. et al. Color Atlas and Textbook of Human Anatomy : In 3 Volumes. Vol. 3: Nervous System and Sensory Organs / W. Kahle, H. Leonhardt, W. Platzer. - 4th edition - Нью-Йорк, 1992. – 376 https://rmebrk.kz/book/1007685
8. Susan Standring Gray - 42nd Edition - UK: Elsevier, 2020. – 2941 https://rmebrk.kz/book/1186064
9. Frank H. Netter Netter Atlas of Human Anatomy. Classic Regional Approach. - Eight edition - PA: Elsevier, 2023. – 1148 https://rmebrk.kz/book/1186042
10. Jonh T. Hansen Netter - 4th edition - PA: Elsevier, 2019. – 630 https://rmebrk.kz/book/1186043
11. Anatomy & Physiology : A simplified guide to the structures and systems of the human body. / Jason Curtis.: Strength and Conditioning Course, 2020. – 181 https://rmebrk.kz/book/1178693
12. Seyed Ali Khonsary Book Review: Atlas of Anatomy - Head, Neck, and Neuroanatomy. - Surgical neurology international 4/28/2020. - 85 с.// eBook Medical Collection EBSCO
13. Анатомия человека = Human Anatomy : учебное пособие / Е. С. Околокулак, Ф. Г. Гаджиева, С. А. Сидорович, Д. А. Волчкевич. — Минск : Вышэйшая школа, 2021. — 416 с. -: https://www.iprbookshop.ru/119959.html
14. K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology. - Sixth Edition - India: Jaypee Brothers Medical Publishers, 2012. – 1097 https://rmebrk.kz/book/1186092
15. Бородулина, О.В. Цитология и гистология – Cytology and histology : Практикум. / Костанайский гос. педагогический университет им. У. Султангазина. - Костанай: КГПУ им.У.Султангазина, 2020. - 100 с. https://rmebrk.kz/book/1173375
16. Leslie P. Gartner Textbook of Histology. - Fourth edition - Philadelphia, PA: Elsevier, 2017. - 732https://rmebrk.kz/book/1186044
17. Зиматкин, С. М. Гистология, цитология и эмбриология. Атлас учебных препаратов = Histology, Cytology, Embryology. Atlas of practice preparations : учебное пособие / С. М. Зиматкин. — 2-е изд. — Минск : Вышэйшая школа, 2020. — 88 с. — ISBN 978-985-06-3202-9. — Текст : электронный // Цифровой образовательный ресурс IPR SMART : [сайт]. — URL: https://www.iprbookshop.ru/120132.html (дата обращения: 13.01.2025). — Режим доступа: для авторизир. Пользователей
18. Neelam Vasudeva, Sabita Mishra, Textbook of Human Histology: With Color Atlas and Practical Guide. - Eighth Edition - India: Jaypee Brothers Medical Publishers, 2016. – 353 https://rmebrk.kz/book/1186062

Basics

1. Chaurasia's, B. D. Human Anatomy [Text] : textbook in 4 vol. Vol. 2. Lower limb, Abdomen and pelvis / B. D. Chaurasia's. - 7th ed. - New Delhi : CBS Publishers & Distributors Pvt Ltd, 2016. - 498 p. Перевод заглавия: Анатомия человека

2. Chaurasia's, B. D. Human Anatomy [Text] : textbook in 4 vol. Vol. 2. Lower limb, Abdomen and pelvis / B. D. Chaurasia's. - 6 th ed. - New Delhi : CBS Publishers & Distributors Pvt Ltd, 2013. - 463 p.Перевод заглавия: Анатомия человека
3. Prives, M. Human Anatomy. Volume I [Текст] : учебник / M. Prives, N. Lusenkov, V. Bushkovich. - Moscow : Mir Publishers, 1989. - 608 p
1. Prives, M. Human Anatomy. Volume II [Текст] : учебник / M. Prives, N. Lusenkov, V. Bushkovich. - Moscow : Mir Publishers, 1989. - 440 p
2. Netter F. H.Atlas of Human Anatomy. Saunders / Elsevier, 2014
3. Drake R. L., Vogl A. W., Mitchell A. W. M. Gray's Anatomy for Students Churchill Livingstone, Elsevier, 2014
4. Morales R., Diego M. D., Sabahi M., Obrzut M., Najera E., Monterroso C.D., Bsat S., Adada B., Borghei R.H. A primer to vascular anatomy of the brain: an overview on anterior compartment, Springer-Verlag Italia, 2024. // Scopus
5. Prasad S., Galetta S.L. Anatomy and physiology of the afferent visual system, Harvard Medical School, Boston, MA. - United States, 2011. // Scopus

Additional

1. Netter, Frank H. Atlas of human anatomy. textbook/Frank H. Netter. Philadelphia. Elsevier. 2014. 531 p.
2. Clinical Atlas of Human Anatomy : textbook / Peter H. Abrahams [et.al.]. - 8th ed. - Edinburgh : Elsevier, 2019. - 393 p.Перевод заглавия: Клинический атлас анатомии человека
3. Sperelakis, Nikolas. Essentials of Physiology [Текст] = Основы физиологии: монография / Nikolas Sperelakis. - Boston : New York : Toronto, London, 1996. - 722 c
4. Netter F. H.Atlas of Human Anatomy. Saunders / Elsevier, 2014
5. Usmle Step 1. Anatomy [Text] : lecturer notes / J. White [et. al.]. - New York : [s. n.], 2019. - 386 p. - (Kaplan Medical). - ISBN 978-1-5062-3646-9 : б/ц Перевод заглавия: Шаг 1. Анатомия