Appx 2

to the Order of March 23, 2023 № 244

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of animal anatomy, histology and pathomorphology named after academician V. H. Kasianenko

"ЗАТВЕРДЖУЮ"
Декан факультету ветеринарної медицини
ЧИКОЛА ШВЕЛІХОВСЬКИЙ
Протокол № 11 від 01 червня 2023 р.

"СХВАЛЕНО"
на засіданні кафедри анатомії, гістології
і патоморфології тварин ім. акад. В.Г. Касьяненка
Протокол № 15 від 15 травня 2023 р.
Олег МЕЛЬНИК

"РОЗГЛЯНУТО"
Гарант програми
д.вет.н., зав. каф. терапії і
клінічної діагностики
Наталія ГРУШАНСЬКА

PROGRAM OF THE COURSE

"CYTOLOGY, HISTOLOGY & EMBRYOLOGY"

Specialization **211 – Veterinary Medicine**
Educational program **Veterinary Medicine**
Faculty of Veterinary Medicine
Developer: Tetiana A. Mazurkevych, Doctor of Veterinary Sciences, As. Prof.

Kyiv – 2023

1. Description of the Course
“Cytology, Histology & Embryology”

Field of knowledge, specialization, educational program, educational degree		
Educational degree	*Master*	
Specialisation	*211 «Veterinary Medicine»*	
Educational program	*Veterinary Medicine*	
Characteristics of the course		
Type	Compulsory	
Total number of hours	180	
Number of ECTS credits	6	
Number of content modules	6	
Form of assessment	Test, Exam	
Indicators of discipline for full-time and part-time forms of study		
	Full-time education	**Distance education**
Course (year of study)	1, 2	-
Semester	2, 3	-
Lecture classes	60 hrs.	- hrs.
Laboratory classes	90 hrs.	- hrs.
Self-study	30 hrs.	- hrs.
Number of weekly classroom hours for the full-time form of study	5 hrs.	

2. Purpose, objectives, and competencies of the course

The discipline "Cytology, Histology, Embryology" **purpose** is the students' cognition of the patterns of the structure of the animal organism at the cellular, tissue and organ levels of the structural organization and its individual development.

The discipline "Cytology, Histology, Embryology" **objectives** (outcomes):

Students will be able to use light microscope and will know some histological techniques.

Students will be able to describe general ultrastructural features and functions of cells and their extracellular matrix.

Students will be able to describe the characteristic structural features and function of each of the basic tissues.

Student will be able to describe the characteristic structural features and function of the animal's organs.

Students will know the ultrastructure of germ cells, histophysiology of fertilization, early embryonic development of vertebrates, differentiation of germs layers and axial organs.

Student will be able to identify the basic tissues and the most important organs when shown glass slides.

Student will be able to apply the information described above to successfully complete the clinical discipline that follow.

As a result of studying the discipline, the student should

***know*:** some histological techniques, micro- and ultrastructure and histophysiology of eukaryotic cells, structure and functions of epithelial, connective, muscle and nervous tissues, microstructure and function of systems and apparatuses of animal organs, micro- and ultrastructure of germ cells, histophysiology of fertilisation, early stages of vertebrate animals embryogenesis, differentiation of germ layers and axial organs;

***able*:** master the light microscopy technique, have the skills of "reading" micrographs, determine the compartments of eukaryotic cell, determine the types of tissues and their varieties, determine the organs from which histological slides are made.

Acquisition of competencies:

Integrated competence (IC):

The ability to solve complex tasks and problems in the field of veterinary medicine, which involves research and/or implementing innovations and is characterized by uncertainty of conditions and requirements;

General competencies (GC):

7. Ability to conduct research at the appropriate level;

11. Ability to evaluate and ensure the quality of work performed;

professional (special) competencies (PC):

1. The ability to establish the features of the structure and functioning of cells, tissues, organs, their systems and apparatus of the animals organism of different classes and species - mammals, birds, fish and other vertebrates;

2. The ability to use tools, special devices, instruments, laboratory equipment and other technical means to carry out the necessary manipulations during professional activities;

Program learning outcomes (PLO):

1. Know and correctly use the terminology of veterinary medicine.
3. To determine the essence of the physicochemical and biological processes that occur in animals' organism in normal and pathological conditions
5. Establish a link between the clinical manifestations of the disease and the results of laboratory tests.

3. Program and structure of the course for:

– complete full-time form of study

Names of content modules and topics	Hours				
	weeks	total	including		
			lectures	lab	self
Content Module 1. Cytology					
Topic 1. Insight into Histology. Cell theory	1-2	7	2	3	1
Topic 2. Overview of eukaryotic cells. Cell theory. The chemical composition of cells	2-3	6	2	3	-
Topic 3. Structure of Eukaryotic Cell	3-4	7	2	3	1
Topic 4. Structure of Eukaryotic Cell	4-5	7	2	3	1
Topic 5. Structure of Eukaryotic Cell. Cell division	5-6	6	2	3	1
Quiz 1	6	2			1
Total for content module 1		**30**	**10**	**15**	**5**
Content Module 2. Embryology					
Topic 6. The structure, function and development of germ cells	6-7	7	2	3	1
Topic 7. Gametogenesis. General characteristics of embryogenesis	7-8	7	2	3	1
Topic 8. Differentiation of Germ Layers and Axial Organs. Embryogenesis of vertebrates	8-9	7	2	3	1
Topic 9. Embryogenesis of birds and mammals	9-10	7	2	3	1
Quiz 2	11	2			1
Total for content module 2		**25**	**8**	**12**	**5**
Content Module 3. General Histology					
Topic 10. General characteristics of tissues. Epithelia	10-11	6	2	3	1
Topic 11. Extracellular matrix. Connective tissue	11-12	6	2	3	-
Topic 12. Proper Connective Tissue	12-13	6	2	3	1
Topic 13. Supportive tissues	13-14	7	2	3	1
Topic 14. Muscle Tissue	14-15	7	2	3	-
Topic 15. Nervous tissue	15	6	2	3	1
Quiz 3	15	2			1
Total for content module 3		**35**	**12**	**18**	**5**
Content Module 4. Special Histology (Comparative Organology). Cardiovascular System. Lymphoid Organs. Endocrine System					
Topic 16. Cardiovascular System	1-2	7	2	3	1

Topic 17. Lymphoid Organs (Central organs)	2-3	7	2	3	1
Topic 18. Lymphoid Organs (Peripheral organs)	3-4	7	2	3	1
Topic 19. Endocrine System	4-5	7	2	3	1
Quiz 4	5	2			1
Total for content module 4		**25**	**8**	**12**	**5**
Content Module 5. Special Histology (Comparative Organology). Integumentary System. Digestive System. Respiratory System. Urinary System.					
Topic 20. Integumentary System	5-6	6	2	3	1
Topic 21. Digestive System (head gut)	6-7	6	2	3	-
Topic 22. Digestive System (anterior, middle and posterior gut)	7-8	6	2	3	1
Topic 23. Digestive System (extramural glands of the digestive system)	8-9	6	2	3	-
Topic 24. Respiratory System	9-10	7	2	3	1
Topic 25. Urinary System	10-11	7	2	3	1
Quiz 5	10	2			1
Total for content module 5		**35**	**12**	**18**	**5**
Content Module 6. Special Histology (Comparative Organology). Reproductive System. Nervous System. Sense organs					
Topic 26. Female Reproductive System	11-12	6	2	3	1
Topic 27. Male Reproductive System	12-13	7	2	3	-
Topic 28. Nervous System	13-14	6	2	3	1
Topic 29. Sense organs (eye)	14-15	7	2	3	1
Topic 30. Sense organs (ear)	15	7	2	3	1
Quiz 6	15	2			1
Total for content module 6		**30**	**10**	**15**	**5**
Total hours		**180**	**60**	**90**	**30**

4. Laboratory class topics

№	Topic titles	Hours
1	Microscope. How to use microscope. Histological laboratory	2
2	Paraffin technique. Hematoxylin and eosin staining	2
3	General morphology of eukaryotic cells. Mitochondria. Endoplasmic reticulum. Golgi complex	2
4	Centrioles. Cytoplasmic inclusions (nutritive, secretory, pigment)	2
5	Nucleus. Mitosis. Amitosis	2
6	Structure of spermatozoa in mammals and bird. Structure of mammal oocyte	2
7	Fertilization. Syncaryon. Zygote cleavage in Lancet fish and Amphibia. Blastula	2
8	Unequal cleavage. Blastula	2
9	Frog's neurula. Gastrulation in birds	2
10	Germ layers and axial organs of chick embryo	2
11	Fetal membranes of birds and mammals. Placenta	2
12	Surface epithelia	2
13	Blood of mammals, birds, amphibians	2
14	Mesenchyme and mucous connective tissue. Reticular tissue. Adipose tissue	2
15	Loose connective tissue. Dense connective tissue	2
16	Cartilage and bone tissue	2
17	Smooth muscle tissue. Skeletal and cardiac muscle tissue	2
18	Neurons. Chromatophilic substance. Neurofibrils	2
19	Neuroglia. Nerve fibers (unmyelinated and myelinated). Synapses	2
20	Heart. Elastic and muscular arteries	2
21	Muscular vein. Blood capillaries	2
22	Red bone marrow. Thymus. Bursa of Fabricius	2
23	Lymph node. Spleen. Palatine tonsils	2
24	Hypophysis	2
25	Adrenal glands. Thyroid gland. Parathyroid gland	2
26	Skin with hair. Skin without hair. Eyelid	2
27	Mammary gland (lactating and non-lactating)	2
28	Horn skin derivatives. Hooves	2
29	Tooth crown and root. Development of tooth	2
30	Tongue (lingual and foliate papilla). Salivary glands	2
31	Esophagus	2
32	Glandular stomach	2
33	Avian stomach	2
34	Compound stomach (rumen, reticulum, omasum	2
35	Duodenum, jejunum, colon	2
36	Liver. Pancreas	2
37	Trachea. Mammal's and bird's lung. Blood/air barrier (scheme)	2
38	Kidney. Ureter. Scheme of nephron	2
39	Ureter. Urinary bladder	2

40	Ovary. Corpus luteum. Uterine tube (oviduct)	2
41	Uterus. Vagina	2
42	Testis. Epididymis testis. Prostate	2
43	Spinal cord. Cerebral cortex. Cerebellum	2
44	Dorsal root ganglia. Nerve	2
45	Posterior wall of eyeball. Cornea. Organ of Corti	2

8. Independent work topics

№	Topic titles	Hours
1.	Histological techniques	1
2.	Chemical properties of cell membrane	1
3.	Cell contacts, peroxisomes, microtubules, microfilaments	1
4.	Cilia and flagella	1
5.	Non-cellular structures of organism	1
6.	Structure of spermatozoa in birds	1
7.	Structure of amphibian and fish oocytes	2
8.	Stages of birds and mammals development	2
9.	Postembryonic hematopoiesis	1
10.	Ultrastructure of collagen fibers	1
11.	Ultrastructure of actin and myosin myofilaments	1
12.	Macroglia and microglia	1
13.	Reflex arc. Regeneration of nerve tissue.	1
14.	Structure of arterioles and venules	1
15.	Structural features of the avian immune organs	1
16.	Structure of tonsils and aggregated lymphoid nodules	1
17.	Diffuse neuroendocrine system. APUD system	2
18.	Structural features of skin in different species of domestic animals	1
19.	Development of liver and pancreas. Endocrine part of pancreas	1
20.	Structure of glands of the perianal region	1
21.	Outer and Inner breathing. The structure of birds' lung	1
22.	Histophysiology of the kidney	1
23.	Structural features of bird's ovary and oviduct	1
24.	Structural and functional features of autonomic nervous system	2
25.	Vestibular and auditory apparatus	2

5. Samples of control questions, tests for assessing the level of knowledge acquisition by students

1. Modern principal theses of cell theory. Base them.
2. Organization and function of ribosomes.
3. Enumerate types of cell division. Endomitosis.
4. Microscope construction.
5. Ultrastructure and transport function of plasmalemma.
6. Element composition, physical and chemical properties of protoplasm.

7. Organization and function of lysosomes and peroxisomes.
8. Non-cellular structures of a cell.
9. Enumerate stages of histologic sections preparation. Describe hematoxylin and eosin staining.
10. Organization and function of Golgi apparatus.
11. Enumerate organelles which perform special function in a cell. Organization of cilia and flagella.
12. Micro- and ultrastructure and function of mitochondria.
13. Organization and function of ribosomes.
14. Give a definition of a cell. Enumerate cell's properties as an alive elementary system.
15. Organization and function of cell center.
16. Cytoplasmic inclusions (definition, types).
17. How to use light biological microscope.
18. Organization of plasma membrane. Cell's contacts.
19. Enumerate membrane-bound organelles. Describe microtubules and microfilaments.
20. Enumerate principal parts of a cell. Describe mitochondria.
21. Enumerate composing parts of a nucleus. Describe its membrane and nucleoplasm.
22. Organization and classification of chromosomes.
23. Enumerate types of cell division. Describe amitosis.
24. Organization, types and functions of Endoplasmic reticulum.
25. Cell cycle. Describe mitosis.
26. Enumerate cell's contacts.
27. Enumerate composing parts of a nucleus. Describe its membrane and nucleolus.
28. Cell cycle. Describe interphase.
29. Composing parts and functions of a nucleus.
30. Development and organization of smooth muscle tissue.
31. Macroglia: cell composition, functions and development.
32. Classification of neurons.
33. Development and organization of nervous tissue. Synapses.
34. Structure of myofibril.
35. Classification of muscle tissue according to the origin.
36. Development and organization of striated muscle tissue.
37. Structure of neurons.
38. Regeneration of muscle tissue.
39. Organization of muscle fiber and skeletal muscle.
40. Nerve endings (receptors).
41. Neurons' classification.
42. Development and organization of smooth muscle tissue.
43. Nerve fibers. Arrangement of fibers into nerve.
44. Microglia. The origin of its development.
45. Structure and types of chemical synapses.
46. Regeneration of nervous tissue.
47. Development and classification of nervous tissue.

48.Organization of muscle fiber.
49.Morphofunctional classification of muscle tissue.
50.Organization and classification of neurons.
51.Organization of neuromuscular spindle apparatus.
52.Enumerate cells, which constitute macroglia.
53.Structure of myelinated nerve fibers.
54.Organization of neuromuscular junctions (motor end-plate).
55.Classification of muscle tissue (genetic).
56.Organization of cardiac muscle tissue.
57.Give definition of nerve fiber. Describe myelinated nerve fiber.
58.Classification of receptors according to source and type of stimuli.
59.Development, composition and functions of neuroglia.
60.Organization of skeletal muscle contractile apparatus (myofibril).
61.Classification of neurons.
62.Development and organization of striated muscle tissue.
63.Non-myelinated nerve fibers.
64.Classification of receptors.
65.Organization of cardiac muscle tissue.
66.Nerve fibers. Arrangement of fibers into nerve.
67.Enumerate cells, which constitute macroglia.
68.Organization of muscle fiber and skeletal muscle.
69.Structure and types of synapses.
70.Microglia. The origin of its development

6. Teaching methods

- Lectures using multimedia projectors;
- Laboratory studies and demonstration experiments;
- Providing additional weekly counseling for students;
- Survey in class;
- Written tests;
- Knowledge control in test form
- Examination in test form;
- Discussions and workshops on histologic topics.

7. Forms of assessment

- Passing of laboratory work;
- Writing module tests;
- Test;
- Exam.

8. Distribution of grades received by students

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 03.03.2021, protocol №7)

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Not passed

In order to determine the rating of a student (listener) in the discipline $\mathbf{R_{dis}}$ (up to 100 points), the rating from the exam $\mathbf{R_{ex}}$(up to 30 points) is added to the rating of a student's academic work $\mathbf{R_{aw}}$ (up to 70 points): $\mathbf{R_{dis} = R_{aw} + R_{ex}}$ **.**

9. Educational and methodological support

1. Methodical recommendations to laboratory classes on "Cytology, Embryology and Histology" discipline for students of Veterinary Medicine Faculty. Part I (methods of microscopy, histological techniques, cytology, general embryology, general histology). Т. Мазуркевич, В. Хомич. К.: Видавничий центр НУБіП України, 2020.
2. Methodical recommendations to laboratory classes on "Cytology, histology and embryology" discipline for students of Veterinary Medicine faculty. Part II Special Histology (Comparative Organology). Т. А. Мазуркевич, В. Т. Хомич. К.: Видавничий центр НУБіП України, 2020.
3. Workbook for the discipline «Cytology, Gistology, Embryology» Part I (methods of microscopy, histological techniques, cytology, general embryology, general histology) for students ED «Master» Faculty of Veterinary Medicine specialty 211 «Veterinary Medicine». В. Т. Хомич, Т. А. Мазуркевич, Н. В. Дишлюк, Ж. Г. Стегней, С. І. Усенко. К.: Видавничий центр НУБіП України, 2023.
4. Workbook for the discipline «Cytology, Gistology, Embryology» Part II Special Histology (Comparative Organology) for students ED «Master» Faculty of Veterinary Medicine specialty 211 «Veterinary Medicine». В. Т. Хомич, Т. А. Мазуркевич, Н. В. Дишлюк, Ж. Г. Стегней, С. І. Усенко. К.: Видавничий центр НУБіП України, 2022.

10. Recommended sources of information

Basic literature

1. Хомич В.Т. Лекції з цитології, ембріології та гістології свійських тварин: Навчальний посібник. К.: ТОВ "Аграр Медіа Груп", 2012. 296 с.
2. Новак В.П., Пилипенко М.Ю., Бичков Ю.П. Цитологія, гістологія, ембріологія: підручник за заг. ред. В.П.Новака (2-е вид., змін. і доп.) К.: Дакор, 2008. 512 с.
3. Хомич В.Т., Мазуркевич Т.А., Дишлюк Н.В., Стегней Ж.Г. Практикум з цитології, гістології та ембріології свійських тварин: Навчальний посібник /За редакцією В.Т. Хомича.-К.:ЦП Компринт, 2017. 228 с.

4. Хомич В.Т., Мазуркевич Т.А., Дишлюк Н.В., Стегней Ж.Г. Цитологія, ембріологія і гістологія свійських тварин у запитаннях і відповідях. Навчальний посібник К.:, Аграр Медіа Груп, 2013. 232 с.
5. Melnyk N. Histology, cytology and embryology. K., 2020. 370 c.
6. Ulrich D. Color atlas of embryology. Thieme, 1995. 383 p.

Supporting literature

1. Хомич В.Т., Рудик С.К., Левчук В.С. Морфологія сільськогосподарських тварин. К.: Вища освіта, 2003. 527 с.
2. Луцик О.Д., Іванова А.І., Кабак К.С. Гістологія людини. Львів: Мир, 1992. 400 с.
3. Banks W.J. Applied Veterinary Histology. 1993. 527 p.
4. Dellmann H.-D., Carithers J.R. Cytology and Microscopic Anatomy. 1996. 406 p.
5. Bacha W.J., Wood L.M. Color Atlas of Veterinary Histology. 1990. 269 p.

Information Resources

1. « LUMEN Histology from Loyola. Excellent slides plus explanatory text. *** http://www.meddean.luc.edu/lumen/MedEd/Histo/frames/histo_frames.html
2. https://elib.vsmu.by/bitstream/123/9813/1/Miadzelets-AD_Selected%20themes%20of%20histology%20cytology%20and%20embryology%20core_2005.pdf