

Description of the academic discipline The academic discipline is aimed at forming in higher education applicants systemic theoretical knowledge about the basic biological processes that underlie the formation of traits.

In the process of mastering the course, applicants must master knowledge about the main stages of development of genetic research and methods used in veterinary genetics. Practical skills of cytogenetic analysis are important in order to identify animals-carriers of cytogenetic disorders, understanding molecular genetic processes, in particular protein biosynthesis, properties and functioning of the genetic code, as well as mechanisms of gene expression regulation. Considerable attention is paid to the study of mutations, their types and role in the formation of hereditary variability. One of the emphases of the course is the formation of understanding of global biological processes that underlie the mechanisms of maintaining biological diversity, the accumulation of genetic load in local populations of animals of various species of domestic animals during inbreeding of small breeds.

The course involves mastering the laws of inheritance of traits, including the classical laws of Mendel, various types of interaction of allelic and non-allelic genes to understand the formation of qualitative characteristics, as well as the features of the formation and manifestation of quantitative traits that have a complex polygenic nature.

A separate block is devoted to pathogenetics, genealogical analysis, compiling pedigrees and their study in order to establish the type of inheritance of hereditary diseases.

In the process of studying the discipline, students learn to use genetic databases of genomic analysis and Mendelian traits (phens), including hereditary diseases caused by a mutation in one gene, as well as academically competently apply science-intensive information when preparing abstracts of reports, scientific articles and presentations, as well as group work skills, which contributes to their acquisition of soft skills.

Field of knowledge, specialization, educational program, educational degree	
Educational degree	Masters
Specialty	H6- Veterinary Medicine
Educational program	Veterinary Medicine
Characteristics of the course	
Type	Obligatory
Total number of hours	120
Number of ECTS credits	4
Number of content modules	3
Course project (work) (if applicable)	-
Form of assessment	<i>Exam</i>

Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	
Semester	2	
Lecture classes	30hr.	
Practical, seminar classes	-	
Laboratory classes	30 hr.	
Self-study	60 hr.	
Individual assignments	- hr.	
Number of weekly classroom hours for the full-time form of study	4 hr.	

1. Purpose, competencies and program outcomes of the academic discipline

Goal: to provide students with theoretical and practical knowledge for future effective production and research activities aimed at improving animal health. Genetics is the theoretical foundation of disciplines such as animal breeding and selection.

Acquisition of competencies:

Integral competence (IC): Ability to solve complex tasks and problems in the field of veterinary medicine, which involves conducting research and/or implementing innovations and is characterized by uncertainty of conditions and requirements.

General competencies (GC):

- **GC 1.** Ability for abstract thinking, analysis, and synthesis.
- **GC 2.** Ability to apply knowledge in practical situations.
- **GC 3.** Knowledge and understanding of the subject area and profession.
- **GC 7.** Ability to conduct research at an appropriate level.
- **GC 8.** Ability to learn and acquire modern knowledge.
- **GC 13.** Ability to make decisions and act while adhering to the principle of zero tolerance for corruption and any other forms of academic or professional dishonesty.

special competencies (SC):

SC 1. Ability to determine the structure and function of cells, tissues, organs, and organ systems of animals of different classes and species, including mammals, birds, insects (bees), fish, and other vertebrates.

Program learning outcomes (PLO):

PLO 1. Know and correctly use veterinary medicine terminology.

PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal body under normal conditions and in pathology.

PLO 10. Propose and apply appropriate innovative methods and approaches to solving professionally relevant problem situations.

“Day One” Competencies according to European Union requirements

1. Demonstrate understanding of the ethical and legal frameworks within which a veterinarian must operate, including professional aspects, animal welfare considerations, animal owners, public health, and social and environmental aspects related to professional activities.
2. Understand research methods and the contribution of both fundamental and applied research to science, as well as the implementation of the 3Rs principle (Replacement, Reduction, Refinement).
3. Communicate effectively with animal owners, the public, professional colleagues, and relevant authorities, using language appropriate to the target audience, while adhering to strict principles of confidentiality and privacy.
4. Apply principles of effective interpersonal interaction, including communication, leadership, management, teamwork, mutual respect, and other “soft skills.”
5. Work effectively as part of a multidisciplinary team in the provision of veterinary services and recognize the contribution of all team members.
6. Demonstrate critical thinking skills and the ability to review and evaluate literature and presentations.
7. Understand and apply the principles of the One Health concept to ensure appropriate clinical practice in veterinary medicine, as well as evidence-based veterinary medicine.
8. Demonstrate the ability to critically analyze evidence, deal with incomplete information, manage unpredictable situations, and adapt knowledge, skills, and practical abilities to different production or clinical scenarios.
9. Demonstrate commitment to lifelong learning, personal improvement, and professional development. This includes documenting and reflecting on professional experience, as well as taking steps to improve professionalism and competence.
10. Regularly participate in self-assessment and peer review processes in order to improve the effectiveness of one’s own work and the work of the entire team.
11. Obtain an accurate and objective history of an individual animal or group of animals, including their management and environmental conditions.

2. Programme and Structure of the Academic Discipline

Names of content modules and topics	Number of hours													
	Full-time form							Part-time form						
	weeks	total	including					total	including					
			l	p	lab	ind	self		l	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Module 1. History, methods and theoretical principles of genetics. Cytogenetic bases of heredity.														
Topic 1: History of genetics, modern and classical methods of genetic analysis	1	8	2		-		6							
Topic 2: Cytological basis of heredity.	2-3	22	4		7		11							
Total for content module 1	3	30	6		7		17							
Content Module 2. Molecular basis of heredity														
Topic 3. Molecular basis of heredity. DNA.	4-7	30	8		8		14							
Total for content module 2	4	30	8		8		14							
Module 3. <i>Patterns of inheritance of traits in sexual reproduction.</i>														
Topic 4: Variability	8-9	10	4		1		5							
Topic 5: Interaction of allelic genes. Mendel's laws.	10	8	2		2		4							
Topic 6. Interaction of non-allelic genes.	11	10	2		2		6							
Topic 7. Linkage inheritance of genes, crossover.	12	6	2		2		2							
Topic 8. Genetics of sex.	13	6	2		2		2							
Topic 9. Population genetics. The Hardy-Weinberg law.	14	6	2		2		2							
Topic 10. Pathogenetics of agricultural animals	15	14	2		4		8							
Total for content module 3	8	60	16		15		29							
TOTAL HOURS	15	120	30		30		60							

3. Lecture Topics

No.	Topic title	Hours
1	Genetics as a science. History, methods, and applications in veterinary medicine	2
2	Cytological basis of heredity. Mitosis. Disorders of mitosis. Meiosis. Gametogenesis. Disorders of meiosis	4
3	Molecular basis of heredity. DNA, replication	2
4	Molecular basis of heredity. RNA, transcription, translation	2
5	Genetic code. Mutations related to the genetic code	2
6	Regulation of gene expression	2
7	Variability. The impact of mutations on animal health	4
8	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	2
9	Interaction of non-allelic genes. Polygenic traits. Hereditary polygenic diseases	2
10	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
11	Sex genetics. Disorders of sexual development in animals	2
12	Population genetics. Hardy-Weinberg law	2
13	Pathogenetics. Genealogical analysis	2
	Total	30

4. Laboratory work

No	Topic title	Number of hours
1	Structure of the cell. Organelles that ensure the transmission and implementation of hereditary information, their function.	2
2	The cell cycle. Mitosis. Structure of eukaryotic chromosomes. Karyotypes of agricultural animals. Solving problems.	2
3	Meiosis. Gametogenesis.	2
4	Knowledge control for the first content module	1
5	Molecular basis of heredity. The structure of a nucleotide, DNA. Solving tasks.	2
6	The central dogma of molecular biology. Structure of RNA, transcription Solving tasks.	2
7	Schemes of replication, transcription, translation. Solving tasks.	2
8	Protein synthesis.	1
7	Knowledge control for the second content module	1
8	Monohybrid, analytical crossing. Solving tasks.	2
9	Hybrid and polyhybrid crossing. Solving tasks.	2
10	Interaction of non-allelic genes. Complementary action of genes, epistasis, polymeric. Solving tasks.	2
11	Crossover. Solving problems on linked inheritance of genes. Construction of genetic maps.	2
12	Genetics of populations. Solving tasks.	2
13	Pathogenetics of agricultural animals	4
	Knowledge control for the third content module	1
	Total	30

5. Independent work

No.	Topic title	Hours
1	Genetics as a science. History, methods, and use in veterinary medicine	6
2	Cytological basis of heredity. Mitosis and its disorders	6
3	Cytological basis of heredity. Meiosis and its disorders. Gametogenesis	6
4	Molecular basis of heredity. DNA, replication	2
5	Molecular basis of heredity. RNA, transcription, translation	4
6	Genetic code. Mutations related to the genetic code	4
7	Regulation of gene expression	4
8	Variability. The impact of mutations on animal health	4
9	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	4
10	Interaction of non-allelic genes. Polygenic traits	6
11	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
12	Sex genetics. Disorders of sexual development in animals	2
13	Population genetics. Hardy-Weinberg law	2
14	Pathogenetics. Genealogical analysis	8
	Total	60

6. Methods and tools for assessing learning outcomes:

- oral or written questioning;
- interview;
- testing;
- defense of laboratory and practical work;
- peer assessment, self-assessment.

7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory and practical classes);
- problem-based learning;
- practice-oriented learning;
- case method;
- project-based learning;
- research-based learning;
- educational discussions and debates;
- teamwork;
- visual method (illustrations, demonstrations);
- work with educational and methodological literature;
- video-based learning (distance, multimedia, web-based, etc.);
- independent work (task completion);
- individual research work of higher education students.

8. Assessment of learning outcomes

Assessment of students' knowledge is carried out on a 100-point scale and is converted into a national grade according to the current *Regulation on Examinations and Tests at NUBiP of Ukraine*.

8.1. Distribution of points by types of learning activities

Type of learning activity	Learning outcomes	Assessment
Module 1. Cytological Basis of Heredity		
Topic 1. History of genetics development, modern and classical methods of genetic analysis. Independent work 1. History of genetics development, modern and classical methods of genetic analysis.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Know the main stages in the development of genetics; genetics as a science; and the main modern and classical methods of genetic analysis.</p> <p>Know the main stages of the cell cycle and the role of cell organelles in the storage, transmission, and expression of genetic information.</p> <p>Be able to prepare and analyze cytogenetic preparations of domestic animals and identify carriers of cytogenetic abnormalities.</p> <p>Know the main stages of meiosis and gametogenesis, errors in chromosome segregation during meiosis, and their consequences for animal health and reproductive performance.</p>	5
Topic 2. Cytological basis of heredity. Cell cycle. Mitosis. Laboratory work 1. Cytological basis of heredity. Cell cycle. Mitosis.		5
Independent work 2. Cytological basis of heredity.		5
Mitosis. Mitosis disorders. Solving tasks according to assigned number.		5
Topic 2. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders. Laboratory work 3. Study of karyotype abnormalities in different animal species.		5
Independent work 3. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders and their consequences.		5
Module test 1.		70
Total for Module 1		100
Module 2. Molecular Basis of Heredity		
Topic 3. Molecular basis of heredity. DNA, replication. Laboratory work 3. Introduction to the structure of DNA.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Skills: Operate with concepts of the main genetic categories.</p> <p>Knowledge: Understand the structure, properties, functions, and types of DNA; the main stages of DNA replication; the structure and functions of different types of RNA; the main stages of transcription and its role in the expression of genetic information.</p>	5
Independent work 4. Structure of nucleotides and DNA replication.		5
Laboratory work 5. Central dogma of molecular biology.		5
Laboratory work 6. Properties of the genetic code.		5
Independent work 6. Mutations related to the genetic		5
		5

Continuation of Table 8.1

Самостійна робота 7. Мутації, пов'язані з регуляцією експресії генів і їх вплив на здоров'я тварин.	Understand the concept of a gene as a unit of transcription. Know the basic properties of the genetic code, the stages of translation of genetic information. Errors in the implementation of genetic information that underlie the hereditary variability of breeds of domestic animals	5
Module test 2.		60
Total for Module 2		100
Модуль 3. Закономірності успадкування ознак при статевому розмноженні		
Topic 4. Variability Laboratory work 7. Variability, its types. Genomic mutations. Genome disorders and their impact on animal health.	PRN 1. Know and correctly use the terminology of veterinary medicine. PRN 3. Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions.	5
Independent work 8. Variability. Impact of mutations on animal health (at the student's choice)		5
Topic 5. Interaction of allelic genes. Mendel's laws. Laboratory work 8. Interaction of allelic genes. Mendel's laws. Drosophila practical. Monogenic diseases.	PRN 10. Propose and use appropriate innovative methods and approaches to solving problem situations of professional origin. Know the main types of variability. Distinguish the influence of various factors on the implementation of genetic information.	5
Independent work 9. Interaction of allelic genes. Mendel's laws. Hereditary monogenic diseases..практикум. Моногенні захворювання.		5
Topic 6. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits. Laboratory work 8. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits.	Know the main patterns of inheritance of traits in mono-, di- and polyhybrid crossing. Be able to apply the results of hybridological analysis to analyze the patterns of inheritance of phenotypes. Know the main types of gene interaction and patterns of inheritance of traits with the simultaneous influence on the trait of several non-allelic genes (epistasis, polymer, complementary action of genes)	5
Independent work 10. Interaction of non-allelic genes. Polymeric traits. Hereditary polygenic diseases.		5
Topic 7. Linked inheritance of genes. Laboratory work 11. Crossing over. Linked inheritance of genes. Drosophila practical work.	Understand the basic provisions of chromosome theory. Be able to analyze the results of crossing with linked inheritance of genes located on one chromosome.	5
Independent work 11. Linked inheritance of genes. Crossing over. Analysis of genetic maps		5
Topic 8. Sex genetics. Laboratory work 10. Sex genetics. Sexual development disorders. Drosophila practical work.	Understand the genetic mechanisms of sex determination, the patterns of inheritance of sex-linked traits. Know and be able to use the Hardy-Weinberg law.	5
Topic 9. Population genetics. Laboratory work 12. Population genetics. Hardy-Weinberg law. Problem solving.		5

Модуль 3. Закономірності успадкування ознак при статевому розмноженні		
Independent work 13. Population genetics. Hardy-Weinberg law. Problem solving.		5
Topic 10. Pathogenetics. Laboratory work 13. Pathogenetics. Genealogical analysis. Solving problems to determine the type of inheritance by pedigree.		5
Independent work 14. Pathogenetics. Genealogical analysis. Building a pedigree (individual task)		5
Module test 3.		30
Total for Module 3		100
Coursework	$(M1 + M2)/2 * 0,7 \leq 70$	
Exam	30	
Total for the course	(Coursework + exam) ≤ 100	

8.2 Scale for assessing knowledge of a higher education applicant

Higher education applicant rating,	points National system grade (exams/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Evaluation Policy

Deadline and Retake Policy	Works submitted after the deadline without good reason are evaluated with a lower grade. Re-siting of modules is carried out with the permission of the lecturer if there are good reasons (for example, illness).
Academic Integrity Policy	Cheating during tests and exams is prohibited (including using mobile devices). Term papers, essays must have correct text references to the literature used
Attendance Policy	Attendance of classes is mandatory. For objective reasons (for example, illness, international internship) training can be carried out individually (in online form in agreement with the dean of the faculty)

9. Educational and methodological support

- electronic training course of the academic discipline (on the educational portal of NUBiP of Ukraine eLearn - <https://elearn.nubip.edu.ua/course/view.php?id=5054>);
- lecture notes and their presentations (in electronic form);
- textbooks, study guides, workshops;
- methodological materials on studying the academic discipline for higher education applicants of full-time and part-time forms of obtaining higher education.

10. Recommended sources of information

1. Подоба Б. Є., Качура В. С., Дідик М. В. Генетична експертиза у скотарстві К.: Урожай : 1991. 176 с.
2. Kostenko Svitlana, Svyrydenko Nataliya, Ruslan Oblap, Nina Novak DGAT1 Gene Polymorphism influence on a lactic productivity of Ukrainian black-and-white milk breed cows Book of Abstracts of the 4th International Scientific Conference Agrobiodiversity for Improve the Nutrition, Health and Quality of Human and Bees Life. September 11-13. Nitra-2019. Pp. 103.
3. Костенко С. О., Свириденко Н. П. Генетика у ветеринарній медицині. Навчальний посібник для студентів ОС Магістр спеціальності 211 – ветеринарна медицина, К.: Редакційно-видавничий відділ НУБіП України, 2021. 242 с.
4. Костенко С.О., Супрун І.О., Сидоренко О.В. Збірник задач з генетики К.: Видавничий центр НУБіП України, 2010. 181с.
5. Методологія оцінки генотипу тварин за молекулярно- генетичними маркерами у тваринництві України за наук. ред. акад. НААН М.В. Гладія. К.: Аграр. наука, 2015. 212 с
6. Молекулярно-генетичні та біотехнологічні дослідження в галузі тваринництва/ Б.Є. Подоба, К.В. Копилов, С.І. Ковтун, К.В. Копилова, Ю.В. Подоба., М. Л. Добрянська/ за наук. ред. акад. М.В. Зубця. – К.: Аграр.наука, 2013. 248с.
7. Проценко М.Ю. Генетика К.:”Вища школа”, 1994. 303 с.
8. Трофименко О.Л., Гиль М.І. Генетика популяцій. Навчальний посібник. Миколаїв: 2003, 226 с.
9. Трофименко О.Л.. Популяційна генетика - К: КВІЦ. 2006. 640с.

Scientific journals

1. <http://gsejournal.biomedcentral.com> - Genetics, Selection, Evolution
2. www.genetics.org - Genetics
3. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1439-0388](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1439-0388) - J. of Animal Breeding and Genetics
4. <http://jabng.org> - Journal of Animal Breeding and Genomics
5. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1365-2052](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-2052) - Animal Genetics
6. www.nature.com/nrg/index.html - Nature Reviews Genetics
7. www.nature.com/ng/index.html - Nature Genetics
8. www.nature.com/hdy/index.html - Heredity
9. <http://link.springer.com/journal/122> - Theoretical and Applied Genetics
10. <http://link.springer.com/journal/10709> - Genetica
11. www.annualreviews.org/journal/genet - Annual Reviews. Genetics
12. www.scirp.org/journal/ojgen - Open Journal of Genetics
13. www.animalsciencepublications.org/publications/jas - Journal of Animal Science
14. www.animal-journal.eu - Animal
15. <https://animalgenetics.us/>
16. <https://onlinelibrary.wiley.com/journal/13652052>

Information resources

1. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
2. Non-laboratory animal phenotype database <https://omia.org/home/>
3. National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information
4. <http://www.aphis.usda.gov/biotechnology/index/shtml> USDA Biotechnology Website
5. <http://www.fass.org/> Federation of Animal Science Societies
6. <http://www.nature.com/nbt/index.html> Nature Biotechnology
7. www.bio.org BIO Society
8. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
9. Non-laboratory animal phenotype database Online Mendelian Inheritance in Animals (OMIA) <https://omia.org/home/>
10. <http://www.youtube.com/watch?v=9kQpYdCnU14> Interactive animation
11. <http://www.youtube.com/watch?v=bFNjxKHP8Jc>
12. <http://wishart.biology.ualberta.ca/BacMap>

Genetic databases:

- OMIA – Online Mendelian Inheritance in Animals
- Browse OMIA – a convenient section for searching by species, trait, gene or inheritance type.
- Animal QTLdb – a database of quantitative traits, QTL and association data for animals.
- OMIA: a genetic database for animal traits and diseases

Bos taurus	https://www.ncbi.nlm.nih.gov/genome/?term=bos+taurus
Canis lupus familiaris	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9615&build=3.1
Equus caballus	https://www.ncbi.nlm.nih.gov/genome/?term=Equus+caballus
Felis catus	http://www.ncbi.nlm.nih.gov/genome?term=felis%20catus
Oryctolagus cuniculus	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9986&build=1.1
Ovis aries	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9940&build=100.0
Sus scrofa	https://www.ncbi.nlm.nih.gov/genome/?term=Sus+scrofa

Description of the academic discipline The academic discipline is aimed at forming in higher education applicants systemic theoretical knowledge about the basic biological processes that underlie the formation of traits.

In the process of mastering the course, applicants must master knowledge about the main stages of development of genetic research and methods used in veterinary genetics. Practical skills of cytogenetic analysis are important in order to identify animals-carriers of cytogenetic disorders, understanding molecular genetic processes, in particular protein biosynthesis, properties and functioning of the genetic code, as well as mechanisms of gene expression regulation. Considerable attention is paid to the study of mutations, their types and role in the formation of hereditary variability. One of the emphases of the course is the formation of understanding of global biological processes that underlie the mechanisms of maintaining biological diversity, the accumulation of genetic load in local populations of animals of various species of domestic animals during inbreeding of small breeds.

The course involves mastering the laws of inheritance of traits, including the classical laws of Mendel, various types of interaction of allelic and non-allelic genes to understand the formation of qualitative characteristics, as well as the features of the formation and manifestation of quantitative traits that have a complex polygenic nature.

A separate block is devoted to pathogenetics, genealogical analysis, compiling pedigrees and their study in order to establish the type of inheritance of hereditary diseases.

In the process of studying the discipline, students learn to use genetic databases of genomic analysis and Mendelian traits (phens), including hereditary diseases caused by a mutation in one gene, as well as academically competently apply science-intensive information when preparing abstracts of reports, scientific articles and presentations, as well as group work skills, which contributes to their acquisition of soft skills.

Field of knowledge, specialization, educational program, educational degree	
Educational degree	Masters
Specialty	H6- Veterinary Medicine
Educational program	Veterinary Medicine
Characteristics of the course	
Type	Obligatory
Total number of hours	120
Number of ECTS credits	4
Number of content modules	3
Course project (work) (if applicable)	-
Form of assessment	<i>Exam</i>

Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	
Semester	2	
Lecture classes	30hr.	
Practical, seminar classes	-	
Laboratory classes	30 hr.	
Self-study	60 hr.	
Individual assignments	- hr.	
Number of weekly classroom hours for the full-time form of study	4 hr.	

1. Purpose, competencies and program outcomes of the academic discipline

Goal: to provide students with theoretical and practical knowledge for future effective production and research activities aimed at improving animal health. Genetics is the theoretical foundation of disciplines such as animal breeding and selection.

Acquisition of competencies:

Integral competence (IC): Ability to solve complex tasks and problems in the field of veterinary medicine, which involves conducting research and/or implementing innovations and is characterized by uncertainty of conditions and requirements.

General competencies (GC):

- **GC 1.** Ability for abstract thinking, analysis, and synthesis.
- **GC 2.** Ability to apply knowledge in practical situations.
- **GC 3.** Knowledge and understanding of the subject area and profession.
- **GC 7.** Ability to conduct research at an appropriate level.
- **GC 8.** Ability to learn and acquire modern knowledge.
- **GC 13.** Ability to make decisions and act while adhering to the principle of zero tolerance for corruption and any other forms of academic or professional dishonesty.

special competencies (SC):

SC 1. Ability to determine the structure and function of cells, tissues, organs, and organ systems of animals of different classes and species, including mammals, birds, insects (bees), fish, and other vertebrates.

Program learning outcomes (PLO):

PLO 1. Know and correctly use veterinary medicine terminology.

PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal body under normal conditions and in pathology.

PLO 10. Propose and apply appropriate innovative methods and approaches to solving professionally relevant problem situations.

“Day One” Competencies according to European Union requirements

1. Demonstrate understanding of the ethical and legal frameworks within which a veterinarian must operate, including professional aspects, animal welfare considerations, animal owners, public health, and social and environmental aspects related to professional activities.
2. Understand research methods and the contribution of both fundamental and applied research to science, as well as the implementation of the 3Rs principle (Replacement, Reduction, Refinement).
3. Communicate effectively with animal owners, the public, professional colleagues, and relevant authorities, using language appropriate to the target audience, while adhering to strict principles of confidentiality and privacy.
4. Apply principles of effective interpersonal interaction, including communication, leadership, management, teamwork, mutual respect, and other “soft skills.”
5. Work effectively as part of a multidisciplinary team in the provision of veterinary services and recognize the contribution of all team members.
6. Demonstrate critical thinking skills and the ability to review and evaluate literature and presentations.
7. Understand and apply the principles of the One Health concept to ensure appropriate clinical practice in veterinary medicine, as well as evidence-based veterinary medicine.
8. Demonstrate the ability to critically analyze evidence, deal with incomplete information, manage unpredictable situations, and adapt knowledge, skills, and practical abilities to different production or clinical scenarios.
9. Demonstrate commitment to lifelong learning, personal improvement, and professional development. This includes documenting and reflecting on professional experience, as well as taking steps to improve professionalism and competence.
10. Regularly participate in self-assessment and peer review processes in order to improve the effectiveness of one’s own work and the work of the entire team.
11. Obtain an accurate and objective history of an individual animal or group of animals, including their management and environmental conditions.

2. Programme and Structure of the Academic Discipline

Names of content modules and topics	Number of hours													
	Full-time form							Part-time form						
	weeks	total	including					total	including					
			l	p	lab	ind	self		l	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Module 1. History, methods and theoretical principles of genetics. Cytogenetic bases of heredity.														
Topic 1: History of genetics, modern and classical methods of genetic analysis	1	8	2		-		6							
Topic 2: Cytological basis of heredity.	2-3	22	4		7		11							
Total for content module 1	3	30	6		7		17							
Content Module 2. Molecular basis of heredity														
Topic 3. Molecular basis of heredity. DNA.	4-7	30	8		8		14							
Total for content module 2	4	30	8		8		14							
Module 3. <i>Patterns of inheritance of traits in sexual reproduction.</i>														
Topic 4: Variability	8-9	10	4		1		5							
Topic 5: Interaction of allelic genes. Mendel's laws.	10	8	2		2		4							
Topic 6. Interaction of non-allelic genes.	11	10	2		2		6							
Topic 7. Linkage inheritance of genes, crossover.	12	6	2		2		2							
Topic 8. Genetics of sex.	13	6	2		2		2							
Topic 9. Population genetics. The Hardy-Weinberg law.	14	6	2		2		2							
Topic 10. Pathogenetics of agricultural animals	15	14	2		4		8							
Total for content module 3	8	60	16		15		29							
TOTAL HOURS	15	120	30		30		60							

3. Lecture Topics

No.	Topic title	Hours
1	Genetics as a science. History, methods, and applications in veterinary medicine	2
2	Cytological basis of heredity. Mitosis. Disorders of mitosis. Meiosis. Gametogenesis. Disorders of meiosis	4
3	Molecular basis of heredity. DNA, replication	2
4	Molecular basis of heredity. RNA, transcription, translation	2
5	Genetic code. Mutations related to the genetic code	2
6	Regulation of gene expression	2
7	Variability. The impact of mutations on animal health	4
8	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	2
9	Interaction of non-allelic genes. Polygenic traits. Hereditary polygenic diseases	2
10	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
11	Sex genetics. Disorders of sexual development in animals	2
12	Population genetics. Hardy-Weinberg law	2
13	Pathogenetics. Genealogical analysis	2
	Total	30

4. Laboratory work

No	Topic title	Number of hours
1	Structure of the cell. Organelles that ensure the transmission and implementation of hereditary information, their function.	2
2	The cell cycle. Mitosis. Structure of eukaryotic chromosomes. Karyotypes of agricultural animals. Solving problems.	2
3	Meiosis. Gametogenesis.	2
4	Knowledge control for the first content module	1
5	Molecular basis of heredity. The structure of a nucleotide, DNA. Solving tasks.	2
6	The central dogma of molecular biology. Structure of RNA, transcription Solving tasks.	2
7	Schemes of replication, transcription, translation. Solving tasks.	2
8	Protein synthesis.	1
7	Knowledge control for the second content module	1
8	Monohybrid, analytical crossing. Solving tasks.	2
9	Hybrid and polyhybrid crossing. Solving tasks.	2
10	Interaction of non-allelic genes. Complementary action of genes, epistasis, polymeric. Solving tasks.	2
11	Crossover. Solving problems on linked inheritance of genes. Construction of genetic maps.	2
12	Genetics of populations. Solving tasks.	2
13	Pathogenetics of agricultural animals	4
	Knowledge control for the third content module	1
	Total	30

5. Independent work

No.	Topic title	Hours
1	Genetics as a science. History, methods, and use in veterinary medicine	6
2	Cytological basis of heredity. Mitosis and its disorders	6
3	Cytological basis of heredity. Meiosis and its disorders. Gametogenesis	6
4	Molecular basis of heredity. DNA, replication	2
5	Molecular basis of heredity. RNA, transcription, translation	4
6	Genetic code. Mutations related to the genetic code	4
7	Regulation of gene expression	4
8	Variability. The impact of mutations on animal health	4
9	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	4
10	Interaction of non-allelic genes. Polygenic traits	6
11	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
12	Sex genetics. Disorders of sexual development in animals	2
13	Population genetics. Hardy-Weinberg law	2
14	Pathogenetics. Genealogical analysis	8
	Total	60

6. Methods and tools for assessing learning outcomes:

- oral or written questioning;
- interview;
- testing;
- defense of laboratory and practical work;
- peer assessment, self-assessment.

7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory and practical classes);
- problem-based learning;
- practice-oriented learning;
- case method;
- project-based learning;
- research-based learning;
- educational discussions and debates;
- teamwork;
- visual method (illustrations, demonstrations);
- work with educational and methodological literature;
- video-based learning (distance, multimedia, web-based, etc.);
- independent work (task completion);
- individual research work of higher education students.

8. Assessment of learning outcomes

Assessment of students' knowledge is carried out on a 100-point scale and is converted into a national grade according to the current *Regulation on Examinations and Tests at NUBiP of Ukraine*.

8.1. Distribution of points by types of learning activities

Type of learning activity	Learning outcomes	Assessment
Module 1. Cytological Basis of Heredity		
Topic 1. History of genetics development, modern and classical methods of genetic analysis. Independent work 1. History of genetics development, modern and classical methods of genetic analysis.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Know the main stages in the development of genetics; genetics as a science; and the main modern and classical methods of genetic analysis.</p> <p>Know the main stages of the cell cycle and the role of cell organelles in the storage, transmission, and expression of genetic information.</p> <p>Be able to prepare and analyze cytogenetic preparations of domestic animals and identify carriers of cytogenetic abnormalities.</p> <p>Know the main stages of meiosis and gametogenesis, errors in chromosome segregation during meiosis, and their consequences for animal health and reproductive performance.</p>	5
Topic 2. Cytological basis of heredity. Cell cycle. Mitosis. Laboratory work 1. Cytological basis of heredity. Cell cycle. Mitosis.		5
Independent work 2. Cytological basis of heredity.		5
Mitosis. Mitosis disorders. Solving tasks according to assigned number.		5
Topic 2. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders. Laboratory work 3. Study of karyotype abnormalities in different animal species.		5
Independent work 3. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders and their consequences.		5
Module test 1.		70
Total for Module 1		100
Module 2. Molecular Basis of Heredity		
Topic 3. Molecular basis of heredity. DNA, replication. Laboratory work 3. Introduction to the structure of DNA.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Skills: Operate with concepts of the main genetic categories.</p> <p>Knowledge: Understand the structure, properties, functions, and types of DNA; the main stages of DNA replication; the structure and functions of different types of RNA; the main stages of transcription and its role in the expression of genetic information.</p>	5
Independent work 4. Structure of nucleotides and DNA replication.		5
Laboratory work 5. Central dogma of molecular biology.		5
Laboratory work 6. Properties of the genetic code.		5
Independent work 6. Mutations related to the genetic		5
		5

Continuation of Table 8.1

Самостійна робота 7. Мутації, пов'язані з регуляцією експресії генів і їх вплив на здоров'я тварин.	Understand the concept of a gene as a unit of transcription. Know the basic properties of the genetic code, the stages of translation of genetic information. Errors in the implementation of genetic information that underlie the hereditary variability of breeds of domestic animals	5
Module test 2.		60
Total for Module 2		100
Модуль 3. Закономірності успадкування ознак при статевому розмноженні		
Topic 4. Variability Laboratory work 7. Variability, its types. Genomic mutations. Genome disorders and their impact on animal health.	PRN 1. Know and correctly use the terminology of veterinary medicine. PRN 3. Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions.	5
Independent work 8. Variability. Impact of mutations on animal health (at the student's choice)		5
Topic 5. Interaction of allelic genes. Mendel's laws. Laboratory work 8. Interaction of allelic genes. Mendel's laws. Drosophila practical. Monogenic diseases.	PRN 10. Propose and use appropriate innovative methods and approaches to solving problem situations of professional origin. Know the main types of variability. Distinguish the influence of various factors on the implementation of genetic information.	5
Independent work 9. Interaction of allelic genes. Mendel's laws. Hereditary monogenic diseases..практикум. Моногенні захворювання.		5
Topic 6. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits. Laboratory work 8. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits.	Know the main patterns of inheritance of traits in mono-, di- and polyhybrid crossing. Be able to apply the results of hybridological analysis to analyze the patterns of inheritance of phenotypes. Know the main types of gene interaction and patterns of inheritance of traits with the simultaneous influence on the trait of several non-allelic genes (epistasis, polymer, complementary action of genes)	5
Independent work 10. Interaction of non-allelic genes. Polymeric traits. Hereditary polygenic diseases.		5
Topic 7. Linked inheritance of genes. Laboratory work 11. Crossing over. Linked inheritance of genes. Drosophila practical work.	Understand the basic provisions of chromosome theory. Be able to analyze the results of crossing with linked inheritance of genes located on one chromosome.	5
Independent work 11. Linked inheritance of genes. Crossing over. Analysis of genetic maps		5
Topic 8. Sex genetics. Laboratory work 10. Sex genetics. Sexual development disorders. Drosophila practical work.	Understand the genetic mechanisms of sex determination, the patterns of inheritance of sex-linked traits. Know and be able to use the Hardy-Weinberg law.	5
Topic 9. Population genetics. Laboratory work 12. Population genetics. Hardy-Weinberg law. Problem solving.		5

Модуль 3. Закономірності успадкування ознак при статевому розмноженні	
Independent work 13. Population genetics. Hardy-Weinberg law. Problem solving.	5
Topic 10. Pathogenetics. Laboratory work 13. Pathogenetics. Genealogical analysis. Solving problems to determine the type of inheritance by pedigree.	5
Independent work 14. Pathogenetics. Genealogical analysis. Building a pedigree (individual task)	5
Module test 3.	30
Total for Module 3	100
Coursework	$(M1 + M2)/2 * 0,7 \leq 70$
Exam	30
Total for the course	(Coursework + exam) ≤ 100

8.2 Scale for assessing knowledge of a higher education applicant

Higher education applicant rating,	points National system grade (exams/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Evaluation Policy

Deadline and Retake Policy	Works submitted after the deadline without good reason are evaluated with a lower grade. Re-siting of modules is carried out with the permission of the lecturer if there are good reasons (for example, illness).
Academic Integrity Policy	Cheating during tests and exams is prohibited (including using mobile devices). Term papers, essays must have correct text references to the literature used
Attendance Policy	Attendance of classes is mandatory. For objective reasons (for example, illness, international internship) training can be carried out individually (in online form in agreement with the dean of the faculty)

9. Educational and methodological support

- electronic training course of the academic discipline (on the educational portal of NUBiP of Ukraine eLearn - <https://elearn.nubip.edu.ua/course/view.php?id=5054>);
- lecture notes and their presentations (in electronic form);
- textbooks, study guides, workshops;
- methodological materials on studying the academic discipline for higher education applicants of full-time and part-time forms of obtaining higher education.

10. Recommended sources of information

1. Подоба Б. Є., Качура В. С., Дідик М. В. Генетична експертиза у скотарстві К.: Урожай : 1991. 176 с.
2. Kostenko Svitlana, Svyrydenko Nataliya, Ruslan Oblap, Nina Novak DGAT1 Gene Polymorphism influence on a lactic productivity of Ukrainian black-and-white milk breed cows Book of Abstracts of the 4th International Scientific Conference Agrobiodiversity for Improve the Nutrition, Health and Quality of Human and Bees Life. September 11-13. Nitra-2019. Pp. 103.
3. Костенко С. О., Свириденко Н. П. Генетика у ветеринарній медицині. Навчальний посібник для студентів ОС Магістр спеціальності 211 – ветеринарна медицина, К.: Редакційно-видавничий відділ НУБіП України, 2021. 242 с.
4. Костенко С.О., Супрун І.О., Сидоренко О.В. Збірник задач з генетики К.: Видавничий центр НУБіП України, 2010. 181с.
5. Методологія оцінки генотипу тварин за молекулярно-генетичними маркерами у тваринництві України за наук. ред. акад. НААН М.В. Гладія. К.: Аграр. наука, 2015. 212 с
6. Молекулярно-генетичні та біотехнологічні дослідження в галузі тваринництва/ Б.Є. Подоба, К.В. Копилов, С.І. Ковтун, К.В. Копилова, Ю.В. Подоба., М. Л. Добрянська/ за наук. ред. акад. М.В. Зубця. – К.: Аграр.наука, 2013. 248с.
7. Проценко М.Ю. Генетика К.:”Вища школа”, 1994. 303 с.
8. Трофименко О.Л., Гиль М.І. Генетика популяцій. Навчальний посібник. Миколаїв: 2003, 226 с.
9. Трофименко О.Л.. Популяційна генетика - К: КВІЦ. 2006. 640с.

Scientific journals

1. <http://gsejournal.biomedcentral.com> - Genetics, Selection, Evolution
2. www.genetics.org - Genetics
3. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1439-0388](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1439-0388) - J. of Animal Breeding and Genetics
4. <http://jabng.org> - Journal of Animal Breeding and Genomics
5. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1365-2052](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-2052) - Animal Genetics
6. www.nature.com/nrg/index.html - Nature Reviews Genetics
7. www.nature.com/ng/index.html - Nature Genetics
8. www.nature.com/hdy/index.html - Heredity
9. <http://link.springer.com/journal/122> - Theoretical and Applied Genetics
10. <http://link.springer.com/journal/10709> - Genetica
11. www.annualreviews.org/journal/genet - Annual Reviews. Genetics
12. www.scirp.org/journal/ojgen - Open Journal of Genetics
13. www.animalsciencepublications.org/publications/jas - Journal of Animal Science
14. www.animal-journal.eu - Animal
15. <https://animalgenetics.us/>
16. <https://onlinelibrary.wiley.com/journal/13652052>

Information resources

1. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
2. Non-laboratory animal phenotype database <https://omia.org/home/>
3. National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information
4. <http://www.aphis.usda.gov/biotechnology/index/shtml> USDA Biotechnology Website
5. <http://www.fass.org/> Federation of Animal Science Societies
6. <http://www.nature.com/nbt/index.html> Nature Biotechnology
7. www.bio.org BIO Society
8. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
9. Non-laboratory animal phenotype database Online Mendelian Inheritance in Animals (OMIA) <https://omia.org/home/>
10. <http://www.youtube.com/watch?v=9kQpYdCnU14> Interactive animation
11. <http://www.youtube.com/watch?v=bFNjxKHP8Jc>
12. <http://wishart.biology.ualberta.ca/BacMap>

Genetic databases:

- OMIA – Online Mendelian Inheritance in Animals
- Browse OMIA – a convenient section for searching by species, trait, gene or inheritance type.
- Animal QTLdb – a database of quantitative traits, QTL and association data for animals.
- OMIA: a genetic database for animal traits and diseases

Bos taurus	https://www.ncbi.nlm.nih.gov/genome/?term=bos+taurus
Canis lupus familiaris	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9615&build=3.1
Equus caballus	https://www.ncbi.nlm.nih.gov/genome/?term=Equus+caballus
Felis catus	http://www.ncbi.nlm.nih.gov/genome?term=felis%20catus
Oryctolagus cuniculus	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9986&build=1.1
Ovis aries	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9940&build=100.0
Sus scrofa	https://www.ncbi.nlm.nih.gov/genome/?term=Sus+scrofa

Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	
Semester	2	
Lecture classes	30hr.	
Practical, seminar classes	-	
Laboratory classes	30 hr.	
Self-study	60 hr.	
Individual assignments	- hr.	
Number of weekly classroom hours for the full-time form of study	4 hr.	

1. Purpose, competencies and program outcomes of the academic discipline

Goal: to provide students with theoretical and practical knowledge for future effective production and research activities aimed at improving animal health. Genetics is the theoretical foundation of disciplines such as animal breeding and selection.

Acquisition of competencies:

Integral competence (IC): Ability to solve complex tasks and problems in the field of veterinary medicine, which involves conducting research and/or implementing innovations and is characterized by uncertainty of conditions and requirements.

General competencies (GC):

- **GC 1.** Ability for abstract thinking, analysis, and synthesis.
- **GC 2.** Ability to apply knowledge in practical situations.
- **GC 3.** Knowledge and understanding of the subject area and profession.
- **GC 7.** Ability to conduct research at an appropriate level.
- **GC 8.** Ability to learn and acquire modern knowledge.
- **GC 13.** Ability to make decisions and act while adhering to the principle of zero tolerance for corruption and any other forms of academic or professional dishonesty.

special competencies (SC):

SC 1. Ability to determine the structure and function of cells, tissues, organs, and organ systems of animals of different classes and species, including mammals, birds, insects (bees), fish, and other vertebrates.

Program learning outcomes (PLO):

PLO 1. Know and correctly use veterinary medicine terminology.

PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal body under normal conditions and in pathology.

PLO 10. Propose and apply appropriate innovative methods and approaches to solving professionally relevant problem situations.

“Day One” Competencies according to European Union requirements

1. Demonstrate understanding of the ethical and legal frameworks within which a veterinarian must operate, including professional aspects, animal welfare considerations, animal owners, public health, and social and environmental aspects related to professional activities.
2. Understand research methods and the contribution of both fundamental and applied research to science, as well as the implementation of the 3Rs principle (Replacement, Reduction, Refinement).
3. Communicate effectively with animal owners, the public, professional colleagues, and relevant authorities, using language appropriate to the target audience, while adhering to strict principles of confidentiality and privacy.
4. Apply principles of effective interpersonal interaction, including communication, leadership, management, teamwork, mutual respect, and other “soft skills.”
5. Work effectively as part of a multidisciplinary team in the provision of veterinary services and recognize the contribution of all team members.
6. Demonstrate critical thinking skills and the ability to review and evaluate literature and presentations.
7. Understand and apply the principles of the One Health concept to ensure appropriate clinical practice in veterinary medicine, as well as evidence-based veterinary medicine.
8. Demonstrate the ability to critically analyze evidence, deal with incomplete information, manage unpredictable situations, and adapt knowledge, skills, and practical abilities to different production or clinical scenarios.
9. Demonstrate commitment to lifelong learning, personal improvement, and professional development. This includes documenting and reflecting on professional experience, as well as taking steps to improve professionalism and competence.
10. Regularly participate in self-assessment and peer review processes in order to improve the effectiveness of one’s own work and the work of the entire team.
11. Obtain an accurate and objective history of an individual animal or group of animals, including their management and environmental conditions.

2. Programme and Structure of the Academic Discipline

Names of content modules and topics	Number of hours													
	Full-time form							Part-time form						
	weeks	total	including					total	including					
			l	p	lab	ind	self		l	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Module 1. History, methods and theoretical principles of genetics. Cytogenetic bases of heredity.														
Topic 1: History of genetics, modern and classical methods of genetic analysis	1	8	2		-		6							
Topic 2: Cytological basis of heredity.	2-3	22	4		7		11							
Total for content module 1	3	30	6		7		17							
Content Module 2. Molecular basis of heredity														
Topic 3. Molecular basis of heredity. DNA.	4-7	30	8		8		14							
Total for content module 2	4	30	8		8		14							
Module 3. <i>Patterns of inheritance of traits in sexual reproduction.</i>														
Topic 4: Variability	8-9	10	4		1		5							
Topic 5: Interaction of allelic genes. Mendel's laws.	10	8	2		2		4							
Topic 6. Interaction of non-allelic genes.	11	10	2		2		6							
Topic 7. Linkage inheritance of genes, crossover.	12	6	2		2		2							
Topic 8. Genetics of sex.	13	6	2		2		2							
Topic 9. Population genetics. The Hardy-Weinberg law.	14	6	2		2		2							
Topic 10. Pathogenetics of agricultural animals	15	14	2		4		8							
Total for content module 3	8	60	16		15		29							
TOTAL HOURS	15	120	30		30		60							

3. Lecture Topics

No.	Topic title	Hours
1	Genetics as a science. History, methods, and applications in veterinary medicine	2
2	Cytological basis of heredity. Mitosis. Disorders of mitosis. Meiosis. Gametogenesis. Disorders of meiosis	4
3	Molecular basis of heredity. DNA, replication	2
4	Molecular basis of heredity. RNA, transcription, translation	2
5	Genetic code. Mutations related to the genetic code	2
6	Regulation of gene expression	2
7	Variability. The impact of mutations on animal health	4
8	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	2
9	Interaction of non-allelic genes. Polygenic traits. Hereditary polygenic diseases	2
10	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
11	Sex genetics. Disorders of sexual development in animals	2
12	Population genetics. Hardy-Weinberg law	2
13	Pathogenetics. Genealogical analysis	2
	Total	30

4. Laboratory work

No	Topic title	Number of hours
1	Structure of the cell. Organelles that ensure the transmission and implementation of hereditary information, their function.	2
2	The cell cycle. Mitosis. Structure of eukaryotic chromosomes. Karyotypes of agricultural animals. Solving problems.	2
3	Meiosis. Gametogenesis.	2
4	Knowledge control for the first content module	1
5	Molecular basis of heredity. The structure of a nucleotide, DNA. Solving tasks.	2
6	The central dogma of molecular biology. Structure of RNA, transcription Solving tasks.	2
7	Schemes of replication, transcription, translation. Solving tasks.	2
8	Protein synthesis.	1
7	Knowledge control for the second content module	1
8	Monohybrid, analytical crossing. Solving tasks.	2
9	Hybrid and polyhybrid crossing. Solving tasks.	2
10	Interaction of non-allelic genes. Complementary action of genes, epistasis, polymeric. Solving tasks.	2
11	Crossover. Solving problems on linked inheritance of genes. Construction of genetic maps.	2
12	Genetics of populations. Solving tasks.	2
13	Pathogenetics of agricultural animals	4
	Knowledge control for the third content module	1
	Total	30

5. Independent work

No.	Topic title	Hours
1	Genetics as a science. History, methods, and use in veterinary medicine	6
2	Cytological basis of heredity. Mitosis and its disorders	6
3	Cytological basis of heredity. Meiosis and its disorders. Gametogenesis	6
4	Molecular basis of heredity. DNA, replication	2
5	Molecular basis of heredity. RNA, transcription, translation	4
6	Genetic code. Mutations related to the genetic code	4
7	Regulation of gene expression	4
8	Variability. The impact of mutations on animal health	4
9	Interaction of allelic genes. Mendel's laws. Monogenic hereditary diseases	4
10	Interaction of non-allelic genes. Polygenic traits	6
11	Linked inheritance of genes. Crossing-over. Analysis of genetic maps	2
12	Sex genetics. Disorders of sexual development in animals	2
13	Population genetics. Hardy-Weinberg law	2
14	Pathogenetics. Genealogical analysis	8
	Total	60

6. Methods and tools for assessing learning outcomes:

- oral or written questioning;
- interview;
- testing;
- defense of laboratory and practical work;
- peer assessment, self-assessment.

7. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory and practical classes);
- problem-based learning;
- practice-oriented learning;
- case method;
- project-based learning;
- research-based learning;
- educational discussions and debates;
- teamwork;
- visual method (illustrations, demonstrations);
- work with educational and methodological literature;
- video-based learning (distance, multimedia, web-based, etc.);
- independent work (task completion);
- individual research work of higher education students.

8. Assessment of learning outcomes

Assessment of students' knowledge is carried out on a 100-point scale and is converted into a national grade according to the current *Regulation on Examinations and Tests at NUBiP of Ukraine*.

8.1. Distribution of points by types of learning activities

Type of learning activity	Learning outcomes	Assessment
Module 1. Cytological Basis of Heredity		
Topic 1. History of genetics development, modern and classical methods of genetic analysis. Independent work 1. History of genetics development, modern and classical methods of genetic analysis.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Know the main stages in the development of genetics; genetics as a science; and the main modern and classical methods of genetic analysis.</p> <p>Know the main stages of the cell cycle and the role of cell organelles in the storage, transmission, and expression of genetic information.</p> <p>Be able to prepare and analyze cytogenetic preparations of domestic animals and identify carriers of cytogenetic abnormalities.</p> <p>Know the main stages of meiosis and gametogenesis, errors in chromosome segregation during meiosis, and their consequences for animal health and reproductive performance.</p>	5
Topic 2. Cytological basis of heredity. Cell cycle. Mitosis. Laboratory work 1. Cytological basis of heredity. Cell cycle. Mitosis.		5
Independent work 2. Cytological basis of heredity.		5
Mitosis. Mitosis disorders. Solving tasks according to assigned number.		5
Topic 2. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders. Laboratory work 3. Study of karyotype abnormalities in different animal species.		5
Independent work 3. Cytological basis of heredity. Meiosis. Gametogenesis. Meiotic disorders and their consequences.		5
Module test 1.		70
Total for Module 1		100
Module 2. Molecular Basis of Heredity		
Topic 3. Molecular basis of heredity. DNA, replication. Laboratory work 3. Introduction to the structure of DNA.	<p>Program Learning Outcomes (PLOs): PLO 1. Know and correctly use veterinary medical terminology. PLO 3. Determine the essence of physicochemical and biological processes occurring in the animal organism in normal and pathological conditions. PLO 10. Propose and apply appropriate innovative methods and approaches to solving professional problems.</p> <p>Skills: Operate with concepts of the main genetic categories.</p> <p>Knowledge: Understand the structure, properties, functions, and types of DNA; the main stages of DNA replication; the structure and functions of different types of RNA; the main stages of transcription and its role in the expression of genetic information.</p>	5
Independent work 4. Structure of nucleotides and DNA replication.		5
Laboratory work 5. Central dogma of molecular biology.		5
Laboratory work 6. Properties of the genetic code.		5
Independent work 6. Mutations related to the genetic		5

Continuation of Table 8.1

Самостійна робота 7. Мутації, пов'язані з регуляцією експресії генів і їх вплив на здоров'я тварин.	Understand the concept of a gene as a unit of transcription. Know the basic properties of the genetic code, the stages of translation of genetic information. Errors in the implementation of genetic information that underlie the hereditary variability of breeds of domestic animals	5
Module test 2.		60
Total for Module 2		100
Модуль 3. Закономірності успадкування ознак при статевому розмноженні		
Topic 4. Variability Laboratory work 7. Variability, its types. Genomic mutations. Genome disorders and their impact on animal health.	PRN 1. Know and correctly use the terminology of veterinary medicine. PRN 3. Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions.	5
Independent work 8. Variability. Impact of mutations on animal health (at the student's choice)		5
Topic 5. Interaction of allelic genes. Mendel's laws. Laboratory work 8. Interaction of allelic genes. Mendel's laws. Drosophila practical. Monogenic diseases.	PRN 10. Propose and use appropriate innovative methods and approaches to solving problem situations of professional origin. Know the main types of variability. Distinguish the influence of various factors on the implementation of genetic information.	5
Independent work 9. Interaction of allelic genes. Mendel's laws. Hereditary monogenic diseases..практикум. Моногенні захворювання.		5
Topic 6. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits. Laboratory work 8. Interaction of non-allelic genes. Linked inheritance. Drosophila practical. Polygenic traits.	Know the main patterns of inheritance of traits in mono-, di- and polyhybrid crossing. Be able to apply the results of hybridological analysis to analyze the patterns of inheritance of phenotypes. Know the main types of gene interaction and patterns of inheritance of traits with the simultaneous influence on the trait of several non-allelic genes (epistasis, polymer, complementary action of genes)	5
Independent work 10. Interaction of non-allelic genes. Polymeric traits. Hereditary polygenic diseases.		5
Topic 7. Linked inheritance of genes. Laboratory work 11. Crossing over. Linked inheritance of genes. Drosophila practical work.	Understand the basic provisions of chromosome theory. Be able to analyze the results of crossing with linked inheritance of genes located on one chromosome.	5
Independent work 11. Linked inheritance of genes. Crossing over. Analysis of genetic maps		5
Topic 8. Sex genetics. Laboratory work 10. Sex genetics. Sexual development disorders. Drosophila practical work.	Understand the genetic mechanisms of sex determination, the patterns of inheritance of sex-linked traits. Know and be able to use the Hardy-Weinberg law.	5
Topic 9. Population genetics. Laboratory work 12. Population genetics. Hardy-Weinberg law. Problem solving.		5

Модуль 3. Закономірності успадкування ознак при статевому розмноженні	
Independent work 13. Population genetics. Hardy-Weinberg law. Problem solving.	5
Topic 10. Pathogenetics. Laboratory work 13. Pathogenetics. Genealogical analysis. Solving problems to determine the type of inheritance by pedigree.	5
Independent work 14. Pathogenetics. Genealogical analysis. Building a pedigree (individual task)	5
Module test 3.	30
Total for Module 3	100
Coursework	$(M1 + M2)/2 * 0,7 \leq 70$
Exam	30
Total for the course	(Coursework + exam) ≤ 100

8.2 Scale for assessing knowledge of a higher education applicant

Higher education applicant rating,	points National system grade (exams/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Evaluation Policy

Deadline and Retake Policy	Works submitted after the deadline without good reason are evaluated with a lower grade. Re-siting of modules is carried out with the permission of the lecturer if there are good reasons (for example, illness).
Academic Integrity Policy	Cheating during tests and exams is prohibited (including using mobile devices). Term papers, essays must have correct text references to the literature used
Attendance Policy	Attendance of classes is mandatory. For objective reasons (for example, illness, international internship) training can be carried out individually (in online form in agreement with the dean of the faculty)

9. Educational and methodological support

- electronic training course of the academic discipline (on the educational portal of NUBiP of Ukraine eLearn - <https://elearn.nubip.edu.ua/course/view.php?id=5054>);
- lecture notes and their presentations (in electronic form);
- textbooks, study guides, workshops;
- methodological materials on studying the academic discipline for higher education applicants of full-time and part-time forms of obtaining higher education.

10. Recommended sources of information

1. Подоба Б. Є., Качура В. С., Дідик М. В. Генетична експертиза у скотарстві К.: Урожай : 1991. 176 с.
2. Kostenko Svitlana, Svyrydenko Nataliya, Ruslan Oblap, Nina Novak DGAT1 Gene Polymorphism influence on a lactic productivity of Ukrainian black-and-white milk breed cows Book of Abstracts of the 4th International Scientific Conference Agrobiodiversity for Improve the Nutrition, Health and Quality of Human and Bees Life. September 11-13. Nitra-2019. Pp. 103.
3. Костенко С. О., Свириденко Н. П. Генетика у ветеринарній медицині. Навчальний посібник для студентів ОС Магістр спеціальності 211 – ветеринарна медицина, К.: Редакційно-видавничий відділ НУБіП України, 2021. 242 с.
4. Костенко С.О., Супрун І.О., Сидоренко О.В. Збірник задач з генетики К.: Видавничий центр НУБіП України, 2010. 181с.
5. Методологія оцінки генотипу тварин за молекулярно- генетичними маркерами у тваринництві України за наук. ред. акад. НААН М.В. Гладія. К.: Аграр. наука, 2015. 212 с
6. Молекулярно-генетичні та біотехнологічні дослідження в галузі тваринництва/ Б.Є. Подоба, К.В. Копилов, С.І. Ковтун, К.В. Копилова, Ю.В. Подоба., М. Л. Добрянська/ за наук. ред. акад. М.В. Зубця. – К.: Аграр.наука, 2013. 248с.
7. Проценко М.Ю. Генетика К.:”Вища школа”, 1994. 303 с.
8. Трофименко О.Л., Гиль М.І. Генетика популяцій. Навчальний посібник. Миколаїв: 2003, 226 с.
9. Трофименко О.Л.. Популяційна генетика - К: КВІЦ. 2006. 640с.

Scientific journals

1. <http://gsejournal.biomedcentral.com> - Genetics, Selection, Evolution
2. www.genetics.org - Genetics
3. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1439-0388](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1439-0388) - J. of Animal Breeding and Genetics
4. <http://jabng.org> - Journal of Animal Breeding and Genomics
5. [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1365-2052](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-2052) - Animal Genetics
6. www.nature.com/nrg/index.html - Nature Reviews Genetics
7. www.nature.com/ng/index.html - Nature Genetics
8. www.nature.com/hdy/index.html - Heredity
9. <http://link.springer.com/journal/122> - Theoretical and Applied Genetics
10. <http://link.springer.com/journal/10709> - Genetica
11. www.annualreviews.org/journal/genet - Annual Reviews. Genetics
12. www.scirp.org/journal/ojgen - Open Journal of Genetics
13. www.animalsciencepublications.org/publications/jas - Journal of Animal Science
14. www.animal-journal.eu - Animal
15. <https://animalgenetics.us/>
16. <https://onlinelibrary.wiley.com/journal/13652052>

Information resources

1. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
2. Non-laboratory animal phenotype database <https://omia.org/home/>
3. National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information
4. <http://www.aphis.usda.gov/biotechnology/index/shtml> USDA Biotechnology Website
5. <http://www.fass.org/> Federation of Animal Science Societies
6. <http://www.nature.com/nbt/index.html> Nature Biotechnology
7. www.bio.org BIO Society
8. Quantitative trait loci database <https://www.animalgenome.org/QTLdb/faq/>
9. Non-laboratory animal phenotype database Online Mendelian Inheritance in Animals (OMIA) <https://omia.org/home/>
10. <http://www.youtube.com/watch?v=9kQpYdCnU14> Interactive animation
11. <http://www.youtube.com/watch?v=bFNjxKHP8Jc>
12. <http://wishart.biology.ualberta.ca/BacMap>

Genetic databases:

- OMIA – Online Mendelian Inheritance in Animals
- Browse OMIA – a convenient section for searching by species, trait, gene or inheritance type.
- Animal QTLdb – a database of quantitative traits, QTL and association data for animals.
- OMIA: a genetic database for animal traits and diseases

Bos taurus	https://www.ncbi.nlm.nih.gov/genome/?term=bos+taurus
Canis lupus familiaris	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9615&build=3.1
Equus caballus	https://www.ncbi.nlm.nih.gov/genome/?term=Equus+caballus
Felis catus	http://www.ncbi.nlm.nih.gov/genome?term=felis%20catus
Oryctolagus cuniculus	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9986&build=1.1
Ovis aries	http://www.ncbi.nlm.nih.gov/projects/mapview/map_search.cgi?taxid=9940&build=100.0
Sus scrofa	https://www.ncbi.nlm.nih.gov/genome/?term=Sus+scrofa