

MINISTRY OF HEALTH OF UKRAINE
ODESSA NATIONAL MEDICAL UNIVERSITY
Department of medical biology and chemistry

APPROVED

Vice-rector for research and educational work,


Eduard BURYACHKOVSKY

01 of September, 2024.

CURRICULUM ON EDUCATIONAL DISCIPLINE
“BIOLOGY WITH BASIS OF GENETICS”

The level of high education: second (magister)

Branch of knowledge: 22 “Health Care”

Speciality: 226 “Pharmacy, industrial pharmacy”

Educational- professional program: Pharmacy, industrial pharmacy

Curriculum is proposed on the base of the educational- professional program “Pharmacy” for education of specialists of second(magister) level of high education for the speciality 226 “Pharmacy, industrial pharmacy “ of the branch of knowledge 22 “Health Care” approved by the Scientific Committee of ONMedU (minutes № 10 from 27 of June, 2024).

Developers:

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Curriculum was discussed and approved at a methodic meeting of the Department of Medical Biology and Chemistry.

Minutes № 1, 26.08.2024.

Head of the department

Gennady STEPANOV

Agreed with the guarantor of EPP

Liana UNGURYAN

Approved by the subject cycle methodical commission for pharmaceutical disciplines of ONMedU Minutes №1 from 30. 08. 2024

Head of the committee for pharmaceutical disciplines of

Natalia FIZOR

1. Description of the discipline:

Name of indicators	Branch of knowledge, specialty, specialization, level of higher education	Characteristics of the discipline	
The total number of: Credits – 4 Hours – 120 Module sections – 5	branch of knowledge 22 «Health care» speciality 226 « Pharmacy, industrial pharmacy » level of higher education second (master's)	<i>Full-time education</i>	
		<i>Compulsory discipline</i>	
		<i>Year of study</i>	<i>1</i>
		<i>Semester</i>	<i>I-II</i>
		<i>Lectures</i>	<i>20 hours</i>
		<i>Practical classes</i>	<i>40 hours</i>
		<i>Independent work</i>	<i>60 hours</i>
		<i>Individual tasks</i>	<i>0</i>
	<i>Forms of final control</i>	<i>Differential credit</i>	

1. The purpose and tasks of the discipline

The purpose formation of knowledge and practical skills of human biology for assimilation by students of a block of disciplines supplying natural- scientific and professional-practical education

The main tasks are:

1. To explain regularities of the vital functions of organism of a man at molecular-biological and cellular levels of living matter organisation;
2. To determine the displays of action of general biological laws in ontogenesis of a man.
3. To determine biological essence and mechanisms of development of disease, which arise up as a result of anthropogenic changes in an environment.
4. To explain essence and mechanisms of phenotypic manifestation of hereditary disorders in a man.
5. To make a preliminary conclusion about parasitic invasion in a man
6. To determine the methods of prevention of disorders caused by parasites.

The process of studying the discipline is aimed at forming elements of the following competencies:

Integral competencies of magister:

The ability to solve typical and complex specialized tasks and practical problems in a professional activity in the field of health care/pharmacy, or in the process of learning, which involves conducting research and/or implementing innovations and is characterized by the complexity and uncertainty of conditions and requirements.

General competencies:

- GC1. Ability to think abstractly, analyze and synthesize, learn and be modernly educated.
- GC 02. Knowledge and understanding of the subject area and understanding of professional activity.
- GC 03. Ability to communicate in the national language both orally and in writing.
- GC 06. Ability to work in a team.
- GC 10. The ability to act socially responsibly and consciously.
- GC 11. Ability to apply knowledge in practical situations.
- GC 12. The desire to preserve the environment.

GC 15. Knowledge and understanding of the subject area and understanding of professional activity

GC 16. The ability to conduct experimental research at the appropriate level. Ability to act socially responsibly and consciously.

Special competences of the specialty (SC):

SC 01. Ability to integrate knowledge and solve complex pharmacy problems in broad or multidisciplinary contexts.

SC 02. The ability to collect, interpret and apply data necessary for professional activity, research and implementation of innovative projects in the field of pharmacy.

SC 04. The ability to clearly and unambiguously convey one's own knowledge, conclusions and arguments in the field of pharmacy to specialists and non-specialists, in particular to people who are studying.

SC 07. The ability to carry out sanitary and educational work among the population for the purpose of prevention of common diseases, prevention of dangerous infectious, viral and parasitic diseases, as well as for the purpose of promoting timely detection and support of adherence to the treatment of these diseases according to their medical and biological characteristics and microbiological features. SC 1. Ability to carry out sanitary and educational work among the population.

Programm learning outcomes:

PLO 01. Have and apply specialized conceptual knowledge in the field of pharmacy and related fields, taking into account modern scientific achievements.

PLO 02. Critically understand scientific and applied problems in the field of pharmacy.

PLO 03. Have specialized knowledge and skills/skills for solving professional problems and tasks, including for the purpose of further development of knowledge and procedures in the field of pharmacy.

PLO 08. Develop and implement innovative projects in the field of pharmacy, as well as related interdisciplinary projects taking into account technical, social, economic, ethical, legal and environmental aspects.

PLO 09. Formulate, argue, clearly and concretely convey to specialists and non-specialists, including those seeking higher education, information based on one's own knowledge and professional experience, the main trends in the development of world pharmacy and related industries.

PLO 10. To carry out sanitary and educational work among the population for the purpose of prevention and in case of outbreaks of dangerous infectious, viral and parasitic diseases.

PLO 28. To carry out professional communication in the state language, use oral communication skills in a foreign language, analyzing specialized texts and translating foreign language information sources.

PLO 37. To contribute to the preservation of health, in particular the prevention of diseases, the rational prescription and use of medicinal products. To faithfully fulfill one's professional duties, to comply with the legislation on the promotion and advertising of medicinal products. Possess psychological communication skills to achieve trust and mutual understanding with colleagues, doctors, patients, consumers

Upon completion of the study of the discipline "Medical biology" students must

know:

- levels of living matter organization;
- forms of life and their fundamental properties;
- structural and functional organization of eukaryotic cell;
- molecular bases of heredity;
- cell cycle and types of cell division;
- main laws of heredity in mono-, di- and polyhybrid crossing and linked inheritance;
- genetic inheritance of blood groups by ABO antigen system and of rhesus factor;

- genetic inheritance of sex in human and sex-linked characters;
- variation , its forms and properties;
- methods of human genetics: pedigree, twins, dermatoglyphic, cytogenetic, molecular-genetic, biochemical and population-statistic methods;
- classification of hereditary diseases and principles of prenatal diagnosis of hereditary diseases;
- forms of reproduction of organisms;
- gametogenesis, forms of sex cells;
- definition of ontogenesis and its periodization;
- main stages of embryogenesis, molecular and cellular mechanisms of differentiation;
- types of regeneration;
- types of transplantation, reasons of tissue incompatibility;
- forms of symbiosis, parasitism as biological phenomenon;
- principles of classification of parasites and hosts;
- ways of transmission of parasitic diseases: obligate transmissive, facultative transmissive diseases; vector-borne and natural focal disease. - basics of prevention of parasitic diseases;
- causative agents of the most common protozoa, trematodes, cestodes, and nematodes;
- principles of laboratory diagnosis of helminthiasis;
- arthropods - vectors and pathogens of human diseases, the concept of mechanical and specific vectors, poisonous Arthropodes;
- the concept of population as an elementary unit of evolution, the population structure of humanity, demes, isolates; the concept of population as an elementary unit of evolution, the population structure of humanity, demes, isolates, functional types of people's response to environmental factors ("sprinter", "stayer", "mixed");
- concept of biological rhythms, their medical significance;
- the subject of ecology; types of environment, environmental factors;
- adaptive ecotypes of people;
- the role of man as an ecological factor, the main directions and results of anthropogenic changes in the surrounding environment;
- examples of plants and animals poisonous to humans;

Able:

- to solve case studies of the main discipline sections;
- to differentiate cell components;
- to make ideogram of human chromosomes;
- to identify the primary structure, number of amino acids, molecular weight of polypeptide structure of the gene encoding it;
- to analyze the structure of genes of pro- and eukaryotes;
- to analyze the sequence of gene regulation expression stages;
- to define the types of mendelian characters inheritance in human;
- to expect genotypes and phenotypes of offspring by the genotypes of the parents;
- to exclude paternity in determining blood groups of parents and child;
- to analyze complex mechanisms of humans traits inheritance;
- to develop measures to reduce the display of a pathological condition in patients with inherited pathology;
- to choose appropriate methods for the study of human heredity genetic for diagnosis of various diseases;
- to calculate the probability of hereditary diseases manifestation in off springs depending on gene penetrance;
- to differentiate chromosomal disease in humans;
- to conduct genealogical analysis of pedigrees with hereditary disease;

- to determine the role of heredity and environment in characters development (according to the twins analysis);
- to calculate the genetic composition of human populations;
- to apply the biogenetic law, to determine ontophylogenetic congenital malformations;
- to compare mechanisms of congenital malformations of various human genesis;
- to learn the basic principles of regeneration and transplantation;
- to determine the place of man as a biological object in the system of nature;
- to justify parasitic diseases belonging to the group of transmissible human and natural foci;
- to diagnose macro- and microspecimens of agents and carriers of parasitic diseases;
- to identify the different stages of parasites life cycle;
- to justify the methods of parasitic diseases laboratory diagnosis;
- to differentiate invasions diagnosis by laboratory methods;
- to prove the effectiveness of parasitic diseases prevention methods, depending on the ways of infection;
- to predict the impact of environmental factors on human.

Master skills:

- of microscoping technique;
- of making temporary micropreparations;
- of construction and analysis of family human pedigrees;
- of ideogram analysis;
- of belonging to blood group according to ABO system;
- of determination of protozoose pathogens species belonging;
- of determination of helminthes and their eggs species belonging;
- of determination of carriers of infections species belonging.

2. Content of the academic discipline

Module section 1. Molecular and cellular level of life organization

Topic 1. Introduction into the course of biology with bases of genetics. Levels of organization and fundamental characters of living matter. Optical systems in biological experiences.

Biology as a science about biological peculiarities of human vital activity, studies regularities of heredity, variation in human ontogenesis and morphophysiological and social adaptation of humans towards environment according to the biosocial nature of a man.

Modern stage of development of general and medical biology. Role of biology in the system of medical education.

Biological essence of life. Life forms, main properties and strategy of life. Levels of life organization and main biological phenomena in the each level. Importance of biological knowledge about level organization for medicine.

Human place in the system of organic world. Correlation of physical, chemical, biological and social phenomena in human activities.

Optical systems in biological experiences. Optical microscope and how to work with it. Techniques of temporal slides preparation and studying.

Topic 2. Biological membranes. Transport across the cell membrane.

Chemical composition of the cell: macro- and microelements. Water, the importance of hydrogen bonds in the life processes of the cell. Organic compounds as carbonaceous substances of living organisms.

The cell as an open system. Assimilation and dissimilation. Cell membranes, their structure and functions. The principle of compartmentalization. Cell receptors..

Transport of substances through the plasmalemma. Organization of substance and energy flows in the cell. Stages of energy exchange. Energy supply of the cell, ATP. Distribution of energy.

Topic 3. Morphology of the eukaryotic cell. Structural components of cytoplasm.

Structural and functional organization of eukaryotic cell

Cytoplasm and cytoskeleton. Cyclosis. Organelles of cytoplasm - membranous and non membranous, tasks and principles of functioning. Inclusions and its functions. Methods of studying the structure and functioning of the cell.

Topic 4. Structural components of nucleus. Chromosomes morphology. Human karyotype.

Nucleus as the central information apparatus of the cell. Structure of interphase nucleus. Chromosomal and genomic levels of organization of heredity material. Euchromatin and heterochromatin. Nucleolus as a derivative of chromosomes, its role in ribosome production.

Human karyotype. Morphological and functional characteristics and classification of human chromosomes. Rules of chromosomes. Chromosomes analysis. Ideogram.

Topic 5. Characteristics of the nucleic acids

Molecular basis of heredity. Characteristics of the nucleic acids: DNA and RNA, their role in the storage and transmission of the hereditary information, chemical structure and organization, species specificity. DNA replication. Maintenance of the genetic constancy of the cells, self-correction and repair of DNA.

Topic 6. Organization of information flow in the cell. Regulation of gene expression.

Gene as a unit of the genetic function. Gene structure in prokaryotes and eukaryotes. Genes: structural, regulatory genes, tRNA and rRNA. Genetic code and its properties.

Organization of information flow in the cell. Transcription. Processing, splicing. Translation: initiation, elongation, termination. Post translation modifications of the proteins.

Regulation of gene expression in prokaryotes. Operon system. Peculiarities of gene activity regulation in eukaryotes. Molecular mechanisms of variation in humans.

Topic 7. Cell life cycle. Cell division.

Temporal organization of the cell. Life cycle of the cell (cell cycle). Types of cell division: mitosis, amitosis. Endomitosis, polyteny. Changes of the cell and its structures during the mitotic cycle (interphase and mitosis).

Cell growth, growth factors. Mitotic activity of tissues. Violations of mitosis, somatic mutations. Life of cells outside the body. Cell cloning.

Meiosis, its biological significance.

Module section 2. Biology of individual development.

Topic 8. Biological peculiarities of human reproduction. Gametogenesis. Fertilization.

Reproduction as a mechanism that provides morphogenetic continuity of generations. Gametogenesis. Fertilization in humans – restoration of diploid set of the chromosomes, recombination in posterity. Peculiarities of the human reproduction as a result of his biosocial nature.

Topic 9. Molecular-genetic mechanisms of ontogenesis. Peculiarities of the prenatal period of ontogenesis. Ontogenesis process disruptions and their place in human pathology. Periods of postembryonic human development.

Ontogenesis: type, periods and stages. Embryonic period of the development in human.. Differentiation on the molecular-genetic, cellular and tissue levels. Congenital defects, its

classification: hereditary, exogenic, multifactorial; gametopathy, blastopathy, embryopathy, phetopathy.

Regulation of gene function in ontogenesis. Experimental studying of embryonic development. Problem of differentiation and interaction of blastomeres. Embryonic induction.

Regulation of cleavage and its failure (twins, congenital defects).

Critical periods of development. Teratogenesis. Teratogenic factors of environment.

Postembryonic period of ontogenesis, its periodization. Growth and differentiation in postnatal period. Peculiarities of the postnatal period of human development because of its biosocial nature. Senility as a final stage of human ontogenesis. Modern theories of aging.

Biological fields, biological rhythms and its medical importance. Types and ways of repair. Types of transplantation in humans.

Module section 3. Regularities of inheritance and variation. Methods of human genetics.

Topic 10. Organismal level of organization of genetic information. Manifestations of the main regularities of inheritance on the example of Mendelian traits of a person (mono-, di- and polyhybrid crossing)

Genetics: subject and tasks, periods; main terms and notions. Principles of hybridologic analysis.

Monohybrid cross: law of dominance, law of segregation. Law of "gamete purity". Cytological basis of the laws.

Test cross and its practical usage.

Lethal genes. Deviations from the expected ratio.

Di- and polyhybrid cross: law of independent assortment and its cytological basis.

Primary and secondary pleiotropy.

Dominant and recessive modes of inheritance of normal and pathological characters.

Topic 11. Multiple alleles. Genetics of blood groups. Interaction of allele and non-allele genes.

Multiple alleles. Inheritance of blood groups of ABO and MN antigen systems. Rh-factor. Rh-conflict. Immunogenetics: subject and tasks. Tissue and species specificity of the proteins, its antigen properties.

Gene interaction and its manifestations in different types of inheritance.

Interaction of the allele (dominance, incomplete dominance, overdominance, co-dominance) and non allele (complementarity, epistasis, polymery) genes. Polygenic inheritance of quantitative traits.

Topic 12. Chromosomal theory. Genetic linkage. Genetics of sex.

Gene linkage. Peculiarities of linked inheritance. Chromosomal theory of heredity.

Mechanisms of crossing over: cytological proves and biological importance.

Genetic maps of human chromosomes. Methods of human chromosome mapping. Modern state of human genome studying.

Non-chromosomal heredity.

Inheritance of sex in humans. Mechanisms of genetic differentiation in humans and its failure. Bisexual nature of humans. Psychosocial aspects.

Inheritance of sex-linked diseases in humans. Sex-linked, sex-influenced and sex-limited characters.

Topic 13. Variation in human as feature of life and genetic phenomenon: phenotypic and genotypic variation.

Variation, its forms and manifestations on the organism level: phenotypic and genotypic variation.

Modification and norm of reaction. Prolonged modifications. Statistic regularities of modification.

Recombination, its sources.

Mutations and its phenotypic manifestation.

Classification of mutations: numerical and structural chromosome aberrations, gene mutations. Spontaneous and induced mutations. Mutagens: physical, chemical, biological. Genetic monitoring. Genetic danger of pollution. Notion of anti-mutagens and co-mutagens.

Topic 14. Methods of human genetics. Pedigree and twins' methods, cytogenetic, biochemical methods. Methods of DNA-diagnosis. Population-statistics methods.

Basis of medical genetics. Man as a specific subject of genetic analysis. Methods of human heredity studying.

Genealogical method. Rules of pedigree composition. Pedigree analyses.

Twins' method. Detection of the genotype and environment influence on the manifestation of pathological characters in humans.

Dermatoglyphic, immunological methods and hybridization of somatic cells.

Population-statistic method. Law of constancy of genetic structure of the population. Usage of Hardy-Weinberg's law for studying of the genetic structure of the population.

Classification of hereditary disorders in humans

Chromosomal diseases caused by quantitative or qualitative chromosomal aberrations; mechanisms of its formation.

Cytogenetic methods. Karyotyping. Analysis of karyotypes of patients with hereditary disorders. Detection of X and Y-chromatin as method of diagnosis of chromosomal disorders.

Gene (molecular) diseases: inborn errors of metabolism, diseases of the protein, amino acids, carbohydrate, lipids, nucleic acids, minerals, vitamins, hormones metabolism; Mechanisms of its development and principles of laboratory diagnosis. .

Gene engineering. Biotechnology. Gene therapy. Medical-genetic aspects of the family. Medical-genetic concealing. Prevention of heredity diseases. Prenatal diagnosis of the heredity pathology.

Module section 4. Medical and biological basics of parasitology. Medical protozoology and helminthology

Topic 15. Medical and biological basis of parasitism. Medical protozoology.

Introduction into the course of medical parasitology. The origin and evolution of parasitism.

Principles of parasites classification. The principles of interaction between the parasite and the host. Morphological adaptation of the parasites. The concept of intensity and extensiveness of invasion.

Characteristics and classification of protozoa.

Kingdom Zoa, subkingdom Protozoa, Phylum Sarcostigophora. Sarcodina. Dysenteric amoeba (*Entamoeba histolytica*), intestinal amoeba (*Ent. coli*), gingival amoeba (*Ent. gingivalis*). Geographical distribution, morphofunctional peculiarities, life cycles of dysenteric amoeba. Ways of infection, laboratory diagnosis and prophylaxis of amebiasis.

Phylum Ciliophora, class Ciliata, *Balantidium coli*. Geographical distribution, morphofunctional peculiarities, life cycle of balantidium. Ways of infection, laboratory diagnosis and prophylaxis of balantidiasis.

Type Apicomplexa. Class Sporozoa. Geographical distribution, morphofunctional peculiarities, life cycles of malaria parasites and toxoplasma. Ways of infection, laboratory diagnosis and prophylaxis. Methods of laboratory diagnosis of the diseases.

Topic 16. Medical helminthology. Type Flat worms. Class Flukes.

Medical helminthology. Flat worms – human parasites. Type Flat worms (Plathelminthes). Class Flukes (Trematoda) - agents of the human diseases.

Geographical distribution, morphofunctional peculiarities, life cycle of liver fluke (*fasciola*), cat fluke (*Opisthorchis felineus*), lancet fluke (*Dicrocoelium lanceatum*), lung fluke (*Paragonimus*). Ways of infection, pathogenicity, laboratory diagnosis and prophylaxis.

Agents of metagonimosis, nanophietosis. Blood flukes – agent of parasitic diseases

Molluscs, crustacean and chordata as intermediate hosts of helminths.

Topic 17. Medical helminthology. Type Flat worms. Class tapeworms.

Phylum Flatworms (Plathelminthes). Class (Cestoidea). Geographical distribution, morphofunctional peculiarities, life cycles of pork tapeworm, beef tapeworm. Ways of infection, pathogenicity, laboratory diagnosis and prophylaxis of teniasis, cysticercosis, taeniarhynchosis.

Geographical distribution, morphofunctional peculiarities, life cycle of dwarf tapeworm, broad tapeworm, echinococcus, alveococcus. Ways of infection, pathogenicity, laboratory diagnosis and prophylaxis of hymenolepidosis, diphyllbothriasis, echinococcosis, alveococcosis.

Topic 18. Medical helminthology. Type Round worms.

Phylum Roundworms (Nemathelminthes). Class Nematoda (Nematoda) Round worms as agents of the human disease. Geographical distribution, morphofunctional peculiarities, life cycle of ascaris, pinworm, whipworm. Ways of infection, pathogenicity, laboratory diagnosis and prophylaxis of ascariasis, ancylostomiasis, necatoriasis.

Geographical distribution, morphofunctional peculiarities, life cycle of enterobiosis, trichocephaliasis, trichinosis. Ways of infection, pathogenicity, laboratory diagnosis and prophylaxis.

Guinea worms, filarial worms as agents of human diseases

Vector-borne and natural-foci diseases

Principles and techniques of the main micro- and macroscopic methods of stool test, water, soil and etc. for detection of helminths. Peculiarities of egg morphology of the flukes, tapeworms and roundworms. K. I. Stryabin's notion about dehelminthation and devastation, total and partial eradication of the parasites.

Module section 5. Medical arachnoentomology. Biosphere and human being.

Topic 19. Medical arachnoentomology. Ticks and insects – causative agents and disease vectors.

Morphology, nutrition and reproduction of arachnids. Spiders and scorpions as a poisonous animals. Ticks as agents of the diseases, vectors and natural reservoirs of the infectious diseases. Medical importance of ticks - dwellers of the human shelters.

Progressive and regressive changes in the organization of the Insecta class depending on the environment. Peculiarities of morphology, nutrition and reproduction of insects. The medical importance of lice, fleas, bedbugs, cockroaches as pathogens and carriers of pathogens of infectious diseases.

Mosquitoes, flies, sandflies, their medical importance

Gnats and its components: characteristics, importance as intermediate hosts of helminths and vectors of human disorders.

Topic 20. The biosphere as a system supplying human existence. Human ecology. Adaptation to environmental conditions. Adaptation, stress

Structure and functions of biosphere. Main aspects of the V. I. Vernadsky notion about biosphere organization. Noosphere. Modern concepts of biosphere. Mankind as an active geological force. Protection of biosphere in national and international programs.

Human ecology. Environment as ecological concept. Kinds of environment. Factors of environment. Types of ecosystems. Anthropocenosis. Anthropogenic migration of elements. Ecological prediction. Healthy, discomfort, extreme environment. Adequate and inadequate environmental conditions. Human adaptation to extreme conditions. Adaptive ecological types of humans: arctic, tropic, zones of temperate climate, deserts, highland.

Characteristics of poisonous plants, fungi, animals.

3. The structure of the academic discipline

Topic	Hours number			
	totally	including		
		L.	Pr.cl.	ISW
Module section 1. Molecular- cellular level of life organization				
Topic 1. Introduction into the course of biology with bases of genetics.. Levels of organization and fundamental characters of living matter. Optical systems in biological experiences.	4		2	2
Topic 2. Biological membranes. Transport across the cell membrane.	4,5	0,5	2	2
Topic 3. Morphology of the eukaryotic cell. Structural components of cytoplasm.	5	1	2	2
Topic 4. Structural components of nucleus. Morphology of chromosomes. Human karyotype.	4,5	0,5	2	2
Topic 5. Characteristic of nucleic acids	4		2	2
Topic 6. Organization of information flow in cells. Regulation of gene expression.	8	2	2	4
Topic 7. Cell cycle. Cell division	6		2	4
<i>Totally for constant section 1</i>	<i>36</i>	<i>4</i>	<i>14</i>	<i>18</i>
Module section 2. Biology of ontogenesis				
Topic 8. Reproduction and its forms. Biological peculiarities of human reproduction. Gametogenesis. Fertilization.	4		2	2
Topic 9. Molecular-genetic mechanisms of ontogenesis. Peculiarities of the prenatal period. Disruptions of ontogenesis and their place in human pathology. Periods of postembryonic human development.	6		2	4
<i>Totally for constant section 2</i>	<i>10</i>		<i>4</i>	<i>6</i>
Module section 3. Regularities of inheritance and variation. Methods of human genetics.				
Topic 10. Organism level of genetic information organization. Manifestations of the main regularities of inheritance on the example of Mendelian traits of a person (mono-, di- and polyhybrid crossing)	5	1	2	2
Topic 11 Multiple alleles. Genetics of blood groups. Interaction of allele and non-allele genes.	5	1	2	2
Topic 12. Chromosomal theory. Genetic linkage. Genetics of sex.	6	2	2	2
Topic 13. Variation in human as feature of life and genetic phenomenon: phenotypic and genotypic variation	4		2	2
Topic 14. Methods of human genetics. Pedigree and twins' methods, cytogenetic, biochemical methods. Methods of DNA-diagnosis. Population-statistics methods.	8	2	2	4
<i>Totally for constant section 3</i>	<i>28</i>	<i>6</i>	<i>10</i>	<i>12</i>
Module section 4. Medical and biological basics of parasitology. Medical protozoology and helminthology				

Topic 15. Medical and biological basis of parasitism. Medical protozoology.	8	2	2	4
Topic 16. Medical helminthology. Type Flat worms. Class Trematoda.	7	1	2	4
Topic 17. Medical helminthology. Type Flat worms. Class tapeworms	7	1	2	4
Topic 18. Medical helminthology. Type Round worms.	8	2	2	4
<i>Totally for constant section 4</i>	<i>30</i>	<i>6</i>	<i>8</i>	<i>1</i>
Module section 5. Medical arachnoentomology. Biosphere and human being.				
Topic 19. Medical arachnoentomology. Ticks and insects – causative agents and disease vectors.	6	2	2	2
Topic 20. The biosphere as a system supplying human existence. Human ecology. Adaptation to environmental conditions. Adaptation, stress	4	2		2
<i>Totally for constant section 5</i>	<i>10</i>	<i>4</i>	<i>2</i>	<i>4</i>
<i>Preparation for differential credit</i>	<i>4</i>			<i>4</i>
Differential credit	2		2	
Total (hours)	120	20	40	60

5. Topics of the lectures / seminar / practical / laboratory classes

5.1. Topics of the lectures

№	Topic	Hours
1	Lecture 1. Introduction into the biology with bases of genetics. Structural and functional organization of the cell.	2
2	Lecture 2. Molecular basis of heredity. Realisation of hereditary information.	2
3	Lecture 3. Organism level of organization of genetic information. Introduction into genetics, interaction of allele and non-allele genes.	2
4	Lecture 4. Chromosomal theory. Genetic linkage. Genetics of sex.	2
5	Lecture 5. Methods of studying heredity in human. Pedigree, twins, cytogenetic, population-statistic methods. Biochemical method and DNA-diagnostic.	2
6	Lecture 6. Introduction into medical parasitology. Medical and biological basis of parasitism. Protozoa – human parasites.	2
7	Lecture 7. Medical helminthology. Flat worms as human parasites.	2
8	Lecture 8. Phylum Roundworms. Roundworms – causative agents of human diseases.	2
9	Lecture 9. Medical arachnoentomology. Arthropods as causative agents of invasions and vectors of infections.	2
10	Lecture 10. Biosphere as a system that ensures human existence. Basis of human ecology.	2
	<i>Totally</i>	<i>20</i>

5.2. Topics of seminar classes

Seminar classes are not provided.

5.3. Topics of practical classes

№	Topic	Hours
1	Practical class 1. Levels of living matter organization. Optical systems in biological studies.	2
2	Practical class 2. Biological membranes. Transport across the cell membrane.	2
3	Practical class 3. Morphology of eukaryotic cell. Structural components of cytoplasm	2
4	Practical class 4. Nucleus. Chromosomes morphology. Human karyotype.	2
5	Practical class 5. Characteristics of nucleic acids.	2
6	Practical class 6. Organization of information flow in the cell. Regulation of gene expression.	2
7	Practical class 7. Cell cycle. Cell division. Reproduction and its forms.	2
8	Practical class 8. Biological peculiarities of human reproduction. Gametogenesis. Fertilization.	2
9	Practical class 9. Peculiarities of prenatal and postnatal development in human.	2
10	Practical class 10. Peculiarities of human genetics. Mendelian human characters (mono- and dihybrid, polyhybrid crossing).	2
11	Practical class 11. Multiple alleles. Blood groups genetics. Interaction of genes.	2
12	Practical class 12. Chromosomal theory. Linked inheritance.	2
13	Practical class 13. Variation. Phenotypic and genetic variation.	2
14	Practical class 14. Methods of human genetics. Pedigree, twins, cytogenetic, population-statistic methods. Biochemical method and DNA-diagnostic.	2
15	Practical class 15. Protozoa. Disenteric amoeba, Balantidium, giardia lamblia, trychomohas, malaria parasites, toxoplasma.	2
16	Practical class 16. Flat worms. Liver fluke, cat (Siberian) fluke and lung fluke.	2
17	Practical class 17. Tape worms. Beef, pork, dwarf worms, echinococcus, broad tapeworm.	2
18	Practical class 18. Round worms. Ascaris, pin worm, whip worm, trichina	2
19	Practical class 19. Arthropoda. Arachnoideans as agents and vectors of diseases. Insects as human ectoparasites.	2
20	Practical class 20. Differential credit	2
Total hours		40

5.4. Topics of laboratory classes

Laboratory classes are not provided.

6. Independent work

№	Types of SIW	Hours
1	<i>Preparation for practical classes</i>	56

2	<i>Preparation for differential credit</i>	4
	Total hours	60

7. Teaching methods

Lectures.

Practical classes: conversation, explanations, case studies, practical work.

Independent work: independent work with the textbooks from main and additional list of the literature, independent work with the data base, independent case studies.

8. Forms of control and evaluation methods (including criteria for evaluating learning outcomes)

Current control is carried out on the basis of control of theoretical knowledge, practical skills and abilities: recitation, testing, assessment of practical skills conducting, case studies, assessment of activity in the classroom.

Final control: Differential credit

The structure of the current assessment in the practical lesson:

1. Assessment of theoretical knowledge on the topic of the lesson:
 - methods: recitation, interview, case studies;
 - maximum point - 5, minimum point - 3, unsatisfactory point - 2.
2. Assessment of practical skills and abilities on the topic of the lesson:
 - Case studies, methods: assessing the accuracy of practical skills conducting
 - maximum point- 5, minimum point - 3, unsatisfactory point - 2;

Criteria for current assessment in the practical class

Grade	Criteria for assessment
Excellent «5»	The student is fluent in the material, takes an active part in the discussion and case studies, confidently demonstrates practical skills during performing and interpreting of practical work on the topic of the lesson, expresses his opinion on the topic of the lesson.
Good «4»	The student is well versed in the material, participates in the discussion and case studies, demonstrates practical skills while performing practical work with some mistakes, expresses his opinion on the topic of the lesson.
Satisfactorily «3»	The student does not have enough knowledge on theoretical material, insecurely participates in the discussion and case studies, performs practical work with significant errors.
Unsatisfactorily «2»	The student does not have knowledge on theoretical material, does not participate in the discussion and case studies, does not demonstrate practical skills during the practical work on the topic of the lesson.

Only those applicants who have fulfilled the requirements of the training program in the discipline, have no academic debt and their average score for the current educational activity in the discipline is at least 3.00 are admitted to the final control in the form of a differentiated credit.

Evaluation of the learning results of the applicants during the final control - of differential credit

The content of the evaluation activity	Scores
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1. Evaluation of theoretical knowledge on the subject of the lesson (one question according to content modules 1 and 2, one question according to content module 3 and one question from content modules 4,5)	3
2. Assessment of practical skills and abilities (one task according to content modules 1 and 2, one task according to content module 3)	2

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Criteria for evaluating the results of education of students on differential credit

«5»	is given to the applicant who has answered all the questions, is able to successfully perform the tasks provided for in the program, has mastered the content of the main and additional literature, has realized the interrelationship of individual sections of the discipline, their importance for the future profession, has shown creative abilities in understanding and using the educational and program material, showed the ability to independently update and replenish knowledge; the level of competence is high (creative);
«4»	is given to the applicant who has fully answered 4 questions, demonstrated full knowledge of the curriculum material, successfully completed the tasks provided by the program, mastered the basic literature recommended by the program, showed a sufficient level of knowledge in the discipline and is capable of their independent updating and renewal in the course of further education and professional activity; the level of competence - sufficient (constructive-variable);
«3»	is given to the applicant who has fully answered 3 questions, has demonstrated knowledge of the main curriculum material to the extent necessary for further education and subsequent work in the profession, copes with the tasks provided for in the program, has made individual errors in answers and tasks, but has the necessary knowledge to overcome the mistakes made under the guidance of a scientific and pedagogical worker; level of competence - average (reproductive)
«2»	is given to the applicant who did not demonstrate sufficient knowledge of the main educational program material, made fundamental mistakes in the performance of the tasks provided for by the program, cannot use the knowledge in further studies without the help of a teacher, did not manage to master the skills of independent work; the level of competence is low (receptive-productive)

9. Distribution of points obtained by applicants of higher education

The obtained average score for the academic discipline for applicants who have successfully mastered the work program of the academic discipline is converted from a traditional four-point scale to points on a 200-point scale, as shown in the table:

National grade for the discipline	Total grades for the discipline
Excellent «5»	185-200
Good «4»	151-184
Satisfactorily «3»	120-150
Unsatisfactorily «2»	Less than 120

A multi-point scale (200-point scale) characterizes the actual success of each applicant in learning the educational component. The conversion of the traditional grade (average score for the academic discipline) into a 200-point grade is performed by the information and technical department of the University.

According to the obtained points on a 200-point scale, the achievements of the applicants are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows you to evaluate the achievements of students from the educational component who are studying in the same course of the same specialty, according to the points they received.

The ECTS scale is a relative-comparative rating, which establishes the applicant's belonging to the group of better or worse among the reference group of fellow students (faculty, specialty). An "A" grade on the ECTS scale cannot be equal to an "excellent" grade, a "B" grade to a "good" grade, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" according to the ECTS scale do not coincide with the limits of grades "5", "4", "3" according to the traditional scale. Acquirers who have received grades of "FX" and "F" ("2") are not included in the list of ranked acquirers. The grade "FX" is awarded to students who have obtained the minimum number of points for the current learning activity, but who have not passed the final examination. A grade of "F" is given to students who have attended all classes in the discipline, but have not achieved a grade point average (3.00) for the current academic activity and are not admitted to the final examination.

Applicants who study in one course (one specialty), based on the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Conversion of the traditional grade from the discipline and the sum of points on the ECTS scale

ECTS Point	Statistics indicator
«A»	The best 10 % of the students
«B»	Next 25 % students
«C»	Next 30 % students
«D»	Next 25 % students
«E»	Next 10 % students

10. Methodological support of the discipline

- Curriculum of the discipline;
- Syllabus of the discipline;
- Power point presentations of lectures;
- Methodological recommendations and developments for the teacher;
- Methodical instructions for students for practical classes;
- Methodical materials providing independent work of students;
- Electronic data bank of MCQ tasks by sections of the discipline.

11. List of control questions for the differential credit

Content part 1. Molecular- cellular level of life organization

1. Definition of biology as a science. The place and the goals of biology in pharmacological education. Definition of life according to a modern level of biology science. Forms and properties of living matter. Structural levels of life organization, their importance for medicine.
2. Cell as an elementary structural and functional unit of living matter. The pro- and eukaryotes. Cell theory, its modern state and importance for medicine.
3. Morphology and physiology of the cell. Cytoplasm and organelles.
4. Cell membranes. Chemical composition of the cytoplasmic membrane. Its structure.
5. The structure of the cell nucleus. Its function. Chromatin and levels of organization of hereditary material. Give the definition of euchromatin and heterochromatin.
6. Chemical composition and morphology of chromosomes. The structure of chromosomes in

- metaphase of mitosis. Shapes of chromosomes. Human karyotype. The classification of human chromosomes. The significance of the karyotype studying in medicine.
7. Molecular level of hereditary information organization. Nucleic acids. DNA structure and functions.
 8. Gene structure. Structural genes, regulatory genes. The genetic code and its properties.
 9. DNA replication, its importance. Self correction and DNA reparation.
 10. The main stages of protein biosynthesis in the cell.
 11. What is translation? Initiation, elongation, termination. Posttranslational modification.
 12. Peculiarities of realization of hereditary information in eukaryotes. Exons and introns organization of eukaryotic genes. Processing, splicing.
 13. Regulation of genes expression in pro- and eukaryotes. Operon.
 14. Cell cycle, its periods. Interphase and its stages. Cell division. Mitosis. Failure of mitosis.
 15. Meiosis. Mechanisms of recombination.
 16. Subject and goals of human genetics and medical genetics. Allelic genes. Homozygotic and heterozygotic organisms. Genotype, phenotype. Penetrance and gene expression.
 17. Laws of heredity in monohybrid crossing. I and II laws of G. Mendel. Mendelian characters. Single gene disorders.
 18. Di and polyhybrid cross. Third Mendel's law
 19. Multiple alleles. Inheritance of ABO blood groups and Rh-factor. Significance for medicine. Rh-conflict.
 20. Interaction of allelic genes: dominance, incomplete dominance, co-dominance.
 21. Interactions of non-allelic genes: complementary, epistasis.
 22. Polymeric character inheritance in human. Pleyotropy.
 23. Linked inheritance of genes (the law of Morgan). Crossing over. Chromosomal theory of inheritance.
 24. Inheritance of sex in humans. Chromosomal disorders caused by abnormal number of sex chromosomes.
 25. Inheritance of sex-linked characters.
 26. Variation, its forms and importance for ontogenesis and evolution.
 27. Modification, its characteristics. Norm of reaction. Phenocopy.
 28. Genotypic variation, its forms. Recombination. Mechanisms of origin and significance.
 29. Mutations and its phenotypic manifestations. Classification of mutations according to the genotype changes. Spontaneous and induced mutations.
 30. Gene mutations, mechanisms of origin. The concept of single gene and multiple gene disorders.
 31. Chromosomal aberrations. Mechanisms of origin. Examples of the diseases.
 32. Genome mutations (numerical chromosomal aberration). Polyploidy, haploidy, monosomy, polysomy.
 33. Hereditary disorders caused by abnormal number of autosomes and sex chromosomes.
 34. Mutations in germ and somatic cells, their significance. Mosaicism.
 35. Mutagenic agents, it classification. Genetic monitoring.
 36. Disorders with hereditary predisposition. Concept of multifactorial disorders.
 37. Human as a specific subject of genetic analysis. Genealogic method (pedigree analysis) and twins methods of medical genetics.
 38. Cytogenetic methods of medical genetics. Prenatal diagnostics of hereditary diseases. Medical genetic aspects of a family. Medical genetic concealing.
 39. Population-statistical method of human genetics. Biochemical method for the study of genetic diseases. Screening programs.
 40. Peculiarities of reproduction in human. Gametogenesis. Spermatogenesis and oogenesis. Human germ cells. Fertilization. Peculiarities in human
 41. Ontogenesis, its periods. Embryonic development, its stages. Provisory organs.
 42. Molecular and cellular mechanisms of differentiationю Differentiation of germ layers and

- tissues. Embryonic induction. Cloning of tissues and organisms.
43. Critical periods of embryonic development in human. Teratogenic factors. Modern classification of congenital abnormalities: hereditary, teratogenic, multifactorial, embryopathy, fetopathy, phylogenetic (ancestral) and non-phylogenetic.
 44. Postnatal development of man and its periodization. Neuro-hormonal regulation of growth and development. Tumor growth.
 45. Aging as a stage of ontogenesis. Theories of aging. The concept of gerontology and Geriatrics. Clinical and biological death. Thanatology.
 46. Regeneration of tissues and organs. Types of regeneration, importance for medicine. Importance of regeneration processes in human. Typical and atypical regeneration.
 47. Problems of transplantation. Types of transplants (grafts). Problem of graft rejection.
 48. Homeostasis. Mechanisms of its regulation on different levels of organization of living matter.
 49. Parasitism. Principles of parasite- human host interaction. Ways of adaptation. Vector-borne (transmissible) disease. Facultative-transmissible and obligate-transmissible diseases. Specific and mechanical vectors.
 50. Classification of parasites (obligate, facultative, temporary, constant, endo- and exoparasites). The definitive and intermediate hosts. Parasites life cycles. Rotation of generations and change of host phenomenon. The definitive and intermediate hosts. Obligate, facultative, temporary hosts. Natural focal diseases.
 51. Giardia Lamblia, the name of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of disease.
 52. Trichomonas vaginalis, the name of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of disease.
 53. Agents of cutaneous and visceral leishmaniasis, the names of diseases, morphology, life cycles of parasites. Way of transmission, the principles of diagnosis and prevention of diseases.
 54. Trypanosoma species, names of the diseases, morphology, life cycles of parasites. Way of transmission, the principles of diagnosis and prevention of the diseases.
 55. Dysentery amoeba, name of the disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 56. Balantidium, name of the disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 57. Plasmodium (malaria parasite), the names of the diseases, morphology, life cycles of parasites. Way of transmission, the principles of diagnosis and prevention of the disease.
 58. Toxoplasma, the names of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 59. Phylum Plathelminthes. Classification, morphological and physiological peculiarities, medical importance. Concept of bio- and geohelminthes. Examples.
 60. Liver fluke, the names of disease, morphology, life cycles of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 61. Cat (Siberian) fluke, the names of disease, morphology, life cycle of parasites. Way of transmission, the principles of diagnosis and prevention of the disease.
 62. Lung fluke, the names of diseases morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 63. Pork (armed) tapeworm, the names of diseases, morphology, life cycle of parasites. Way of transmission, the principles of diagnosis and prevention of the diseases. Cysticercosis. Modes of transmission and prevention measures.
 64. Beef (unarmed) tapeworm, the names of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
 65. Dwarf tapeworm, the names of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.

66. Echinococcus and alveococcus. The names of diseases, morphology, life cycles of parasites. Way of transmission, the principles of diagnosis and prevention of the diseases.
67. Broad (fish) tapeworm, the names of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
68. Phylum Roundworms. Classification, main characters of organization, medical importance of main representatives.
69. Ascaris, the names of disease, morphology, life cycle of parasites. Way of transmission, the principles of diagnosis and prevention of disease. Larva of animal round worms as the agents of the diseases (*Larva migrans* syndrome).
70. Pinworm. The name of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
71. Whipworm, the names of disease, morphology, life cycles of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
72. Trichina worm, the name of disease, morphology, life cycle of parasites. Way of transmission, the principles of diagnosis and prevention of diseases.
73. Guinea worm. The name of disease, morphology, life cycle of parasite. Way of transmission, the principles of diagnosis and prevention of the disease.
74. Phylum Arthropoda. Classification, morphology, medical importance. Poisonous Arthropods.
75. Mites as human pathogens (itch mite and follicle mite).
76. Ticks as the vectors of human diseases (Ixodidae, Gamasidae and Argasidae ticks).
77. Class of Insects. Morphology, features of development, medical significance of representatives.
78. Flies. Species of the flies. Peculiarities of the morphology and life cycle, medical importance.
79. Mosquitoes. Species, peculiarities of the structure and development, medical importance.
80. Lice. Species, morphology and life cycle, medical importance.
81. Fleas. Morphology and life cycle. Species of fleas. Bed bug and its medical importance.

List of practical skills that are controlled during the differential credit:

- to master the technique of microscoping
- to prepare temporary specimens
- to differentiate cell components
- to make ideogram of a healthy and sick human on chromosome diseases
- to identify the primary structure, amino acids number, molecular weight of polypeptide by the gene structure encoding it
- to analyze the sequence of gene regulation expression stages in pro- and eukaryotes
- to determine the type of inheritance of normal and pathological human Mendelian traits
- to determine genotypes and phenotypes of offspring by the genotypes of the parents
- to exclude paternity in determining blood groups of parents and child
- to analyze the complex mechanisms of human traits inheritance
- to calculate the probability of hereditary diseases manifestation in the offspring depending on gene penetrance
- during karyotype analysis to determine chromosomal syndromes
- to build a family tree and spend its genealogical analysis of a patient with hereditary disease
- to calculate the role of heredity and environment in the characters development (for twins analysis results)
- to calculate the genetic structure of human populations
- to compare origin mechanisms of human congenital malformations of different genesis

- to determine the place of a biological object in the system of nature
- to prove the belonging of human parasitic diseases to the group of vector born diseases
- to diagnose the carriers of pathogens and parasitic diseases on micro and macro specimens
- to determine the species identity of human protozoa pathogens
- to identify the different stages of the parasites life cycle
- to justify the methods of laboratory diagnosis of parasitic diseases in human
- to determine the vectors of infections
- to prove the effectiveness of parasitic diseases prevention methods based on their modes of infection
- to predict the influence of environmental factors on the human body.

12. List of recommended materials

Main literature

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. – Vinnytsia: Nova Knyha, 2019. 448 p.

Additional literature

1. Before we are born : Essentials of embryology and birth defects / Keith L. Moore, T. V. N. Persaud, Mark G. Torchia. – 9th ed. – Elsevier, 2016. 348 pp.
2. Campbell biology / Lisa Urry, Michael Cain, Steven Wasserman, [et al.].– 11th restricted ed. – Hoboken : Pearson Higher Education, 2016. - 560 pp.
3. Chiodini P. L. Atlas of Medical Helminthology and Protozoology 4th ed. – Churchill Livingstone, 2003. 87 pp.
4. Peter Turnpenny, Sian Ellard. Emery's Elements of medical genetics.-15th ed.,– Elsevier, 2017. 400 pp.
5. Essential Cell Biology : textbook / B.M. Alberts, D. Bray, K. Hopkin [et al]. – 4th ed., rev. and upd. NY: Garland Publishing Inc., 2019. 862 p.
6. Bruton J. Bogitsh, Clint E. Carter. Human parasitology – 4th ed., – Elsevier, 2013. 430 pp.
7. T. W. Salder. Langman's medical embryology. – 14th ed. – Wolter Kluwer Health, 2018. - 423 pp.
8. Lynn B. Jorde, John C. Carey, Michael J. Bamshad. Medical genetics. 5th ed. Elsevier, 2016. 356 pp.
9. David. T. John, William A. Petri. Markell and Voge's Medical parasitology. – 9th ed. – Elsevier, 2017. 463 pp.
10. M. R. Speicher, S. E. Antonarakis, F. G. Motulsky. Vogel and Motulsky's human genetics. Problems and approaches.- 4th ed. – Springer, 2010. 981 pp.
11. Young Ian. D. Medical genetics. – 2nd ed. – Oxford university press, 2010. 304 pp.

13. Information resources:

1. Testing Center - the base of licensing test tasks "Krok" - 1: <http://testcentr.org.ua/>
2. OMIM (Online Mendelian Inheritance in Man) – An Online Catalog of Human Genes and Genetic Disorders <http://omim.org/>
3. The tech interactive: <https://genetics.thetech.org/genetics-news>
4. Phys.org internet news portal provides the latest news on science. <https://phys.org/biology-news/>

5. Sci-News.com provides the latest science news from around the world, covering breaking news in astronomy and astrophysics, archaeology, paleontology, medicine, biology, physics, genetics & more <http://www.sci-news.com/news/biology>
6. link to the most thought-provoking, well researched online items in the world of science and technology <https://scitechdaily.com/news/biology/>
7. Web atlas of medical parasitology <http://www.atlas.or.kr/about/index.html>

