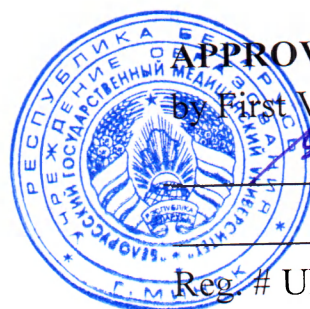


MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS  
EDUCATIONAL INSTITUTION  
BELARUSIAN STATE MEDICAL UNIVERSITY

Контрольный  
экземпляр



APPROVED

By First Vice-Rector, Professor  
I.N.Moroz

27.06.2023

Reg. # UD-091-029/2324/edu.

**MEDICAL BIOLOGY AND GENERAL GENETICS**

**Curriculum of educational institution  
in the educational discipline for the specialty:**

**7-07-0911-01 «General Medicine»**

Curriculum is based on the educational program «Medical Biology and General Genetics», approved 27.06.2023, registration # УД-091-029/2324/уч.; on the educational plan in the specialty 7-07-0911-01«General Medicine», approved 17.05.2023, registration # 7-07-0911-01/2324/mf.

**COMPILERS:**

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**RECOMMENDED FOR APPROVAL:**

by the Department of Biology of the educational institution «Belarusian State Medical University»  
(protocol # 11 of 05.06.2023)

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»  
(protocol # 6 of 27.06.2023)

## EXPLANATORY NOTE

«Medical Biology and General Genetics» – the academic discipline of the natural science module, which contains systematized scientific knowledge about the structural and functional organization of living matter and about human being as its integral part in the aspect of the needs of modern medicine.

The aim of the discipline «Medical Biology and General Genetics» is the formation of basic professional competencies for diagnosis of hereditary and congenital disorders, parasitic diseases, their treatment and prevention.

The objectives of the discipline «Medical Biology and General Genetics» are to form students' scientific knowledge about:

basic concepts of cytology, molecular and cell biology, genetic engineering, genetics, developmental biology and evolutionary theory, parasitology and biosphere science;

mechanisms of storage and realization of genetic information in prokaryotes and eukaryotes; mechanisms of transgenesis and genomic editing; causes and mechanisms of development of hereditary, multifactorial and parasitic human diseases; genetic basis for realization of hereditary information in individual development;

the most important clinical manifestations of parasitosis, methods of diagnosis and prevention;

mutagenic, teratogenic and carcinogenic factors; natural and anthropogenic factors affecting human health;

skills and abilities necessary for:

solving cases in molecular biology, general and medical genetics, parasitology;

calculating the frequencies of genes and genotypes in human populations using the Hardy-Weinberg law;

constructing and analyzing human pedigrees, making conclusions about the type of inheritance and the probability of giving birth to a sick child;

development of recommendations for the use of methods of prenatal diagnosis of human hereditary pathology.

The knowledge, skills, and abilities acquired during the study of the academic discipline «Medical Biology and General Genetics» are necessary for successful mastering of the following academic disciplines: «Histology, Cytology and Embryology», «Biological Chemistry», «Microbiology, Virology, Immunology» «Epidemiology», «General Surgery», «Dermatovenerology», «Infectious Diseases» modules: «Pediatric Module», «Internal Diseases Module».

Studying the educational discipline «Medical Biology and General Genetics» should ensure the formation of students' basic professional competencies:

BPC. Work with optical devices, compile a human (patient) lineage, solve problems in molecular biology, general and medical genetics, parasitology, define pathogens of parasitic diseases and their carriers on macro- and micropreparations.

**As a result of studying the discipline «Medical Biology and General Genetics» the student should**

**know:**

basic biological processes, determining the features of living matter at different organization levels

position of human in the nature, its characteristics as a biological and social being, and his relationship with the environment;

the processes of matter, energy and information flow in the cell;

mechanisms of regulation of gene expression;

methods of transgenesis, genomic editing and gene therapy;

patterns of inheritance of normal and pathological traits in humans;

main types of variability and their manifestations in humans;

influence of genetic factors on human health;

methods for diagnosing hereditary diseases;

peculiarities of human reproduction and related bioethical problems;

peculiarities of human embryonic and post-embryonic ontogenesis; biological aspects of aging and death;

phylogenesis of human organ systems, mechanisms of ontophylogenetically determined defects;

peculiarities of regeneration in humans; problems of organ and tissue transplantation;

basics of homeostasis, biorhythmology and their medical aspects;

biological and medical peculiarities of human ecology and valeology;

forms of biotic relationships in nature; relationship of the parasite and the host at the organism and population levels;

peculiarities of morphology, development cycles, ways of human infection, pathogenic effect of main parasitic protists, helminthes and arthropods; methods of diagnosis and prevention of diseases caused by them;

the main groups of poisonous organisms;

**be able to:**

solve case problems in molecular biology, general and medical genetics, parasitology;

make recommendations for the use of methods of prenatal diagnosis of human hereditary pathology;

calculate the frequencies of alleles and genotypes in human populations using the Hardy-Weinberg law;

carry out a comparative characterization of the structure, processes of vital activity, the role in nature of organisms belonging to different taxonomic groups;

determine cause-and-effect relations between the structure, functions of cell organelles and diseases arising from their malfunctioning;

apply knowledge about the main methods of diagnosis and prevention of diseases caused by parasitic protists, helminthes and arthropods in their professional activities;

**master:**

skills of working with optical instruments (magnifying glass, light microscope);

skills of constructing and analyzing human idiograms;

skills in constructing and analyzing human pedigrees, conclusions about the type of inheritance and the probability of giving birth to a sick child;

skills in diagnosing parasitological micropreparations;

skills of identifying Barr body.

**Total number** of hours for the study of the discipline is 216 academic hours. Classroom hours according to the types of studies: lectures - 16 hours (including 5 academic hours of supervised student independent work), laboratory classes - 70 hours, student independent work (self-study) - 130 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (1<sup>st</sup> semester), and examination (2<sup>nd</sup> semester).

Form of higher education – full-time.

### ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures (including supervised independent work)	supervised student independent work	laboratory studies (practical classes and seminars)		
1-79 01 01 «General Medicine»	1	108	44	8	3	36	64	credit
	2	108	42	8	2	34	66	examination

## THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	laboratory
<b>1. Molecular and Cell Biology</b>	<b>8</b>	<b>20</b>
1.1. Medical biology as a science, its role in the training of a physician. Subject matter, objectives and methods of cytology	-	2
1.2. Structural and functional organization of the cell	-	2
1.3. Structurally functional organization of the genome	-	2
1.4. Cell cycle	-	2
1.5. Mechanism of gene expression	2	2
1.6. Regulation of gene expression	2	2
1.7. Genomics. DNA analysis methods	-	2
1.8. Genetic engineering	2	2
1.9. Omics technologies. Molecular genetic methods in science and medicine	2	4
<b>2. General and Medical Genetics</b>	-	<b>16</b>
2.1. The mechanisms of heredity	-	2
2.2. Genetic linkage. Biology and genetics of sex	-	2
2.3. Variability. Mutagenesis. Carcinogenesis	-	2
2.4. Population genetics	-	2
2.5. Human genetics	-	2
2.6. Hereditary disorders	-	2
2.7. Genetic counselling. Prenatal diagnosis	-	4
<b>3. Developmental biology</b>	<b>6</b>	<b>8</b>
3.1. Reproduction of living matter	2	2
3.2. Ontogenesis in mammals and human	-	4
3.3. Homeostasis and chronobiology	2	-
3.4. Biological basis of regeneration and transplantation	-	2
3.5. Evolution of organ systems in chordates	2	-
<b>4. Medical parasitology</b>	<b>2</b>	<b>26</b>
4.1. General parasitology	2	2
4.2. Medical protistology	-	4
4.3. Medical helminthology	-	8
4.4. Medical arachnoentomology	-	10
4.5. Poisonous and venomous organisms	-	2
<b>Total hours</b>	<b>16</b>	<b>70</b>

## **CONTENT OF THE EDUCATIONAL MATERIAL**

### **1. MOLECULAR AND CELL BIOLOGY**

#### **1.1. Medical biology as a science, its role in the training of a physician.**

##### **Subject matter, objectives and methods of cytology**

The nature of life, the role of proteins and nucleic acids in the organization of living systems. Organization levels of living matter. Human as a biological and social being. The role of biology in medical education.

Cytology. Methods of cytology (light microscopy, fluorescence microscopy, electron microscopy and histochemistry and immunohistochemistry, differential centrifugation, autoradiography, morphometry, etc.).

The method of light microscopy. The structure of light microscope. The instructions for working with a microscope.

Cell as the least structural and functional unit of life. General characteristics of viruses, prokaryotes and eukaryotes.

#### **1.2. Structural and functional organization of the cell**

Models of plasma membrane. The structure, properties and functions of plasma membrane. Transport across the membrane: passive transport (simple diffusion, facilitated diffusion, osmosis), active transport (ion channels, their functions), endocytosis, exocytosis.

Cytosol. Cytoskeleton: microtubules, intermediate filaments, microfilaments. Vesicular transport. Nuclear localization signal.

Assimilation and dissimilation. Ribosomes. Endomembrane system (nucleus, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, endosomes, vesicles).

Photosynthesis and chemosynthesis, fermentation and respiration. Stages of catabolism, mitochondria, enzymes of mitochondria.

Disorders caused by impairments of cellular activities (mitochondrial diseases, lysosomal storage diseases, peroxisomal disorders and prion diseases).

#### **1.3. Structurally functional organization of the genome**

Organization of hereditary material in viruses, prokaryotes and eukaryotes. Organization levels of genetic material in eukaryotes (gene, chromosome and genome levels).

Gene organization level of hereditary material. The main functions of gene. Properties of genes. Structure of deoxyribonucleic acid (DNA). Watson and Crick postulates. Evidence for the role of DNA in the transmission of hereditary information (transformation and transduction). Ribonucleic acid (RNA) and its types.

Genome organization level of hereditary material. Chromosome organization level of hereditary material. DNA condensation in eukaryotes. Chromatin remodeling. Euchromatin and heterochromatin.

The structure and functions of nucleus.

Types of chromosomes. Rules of chromosomes. Karyotype and idiogram. Nomenclatures of human chromosomes.

Nuclear genes and cytoplasmic genes. Cytoplasmic inheritance.

#### **1.4. Cell cycle**

The flow of genetic information in the cell. Semi-conservative mechanism of DNA replication. Replicon.

Cell cycle. Interphase. Types and types of cell division: binary fission of bacteria, amitosis, mitosis, endomitosis, polyteny.

Mitosis: characteristics of phases, distribution of genetic material, biological significance.

Meiosis: characteristics of phases, distribution of genetic material, biological significance.

Cell cycle regulators (cyclins and cyclin-dependent kinases). Cell proliferation and cell death. Necrosis and apoptosis. Caspases.

#### **1.5. Mechanisms of gene expression**

The Central Dogma of Molecular Biology.

Genetic code and its properties.

Transcription. Transcription factors. Eukaryotic mRNA synthesis: primary transcript, pro-mRNA processing, splicing. Alternative splicing. Transcriptome. Reverse transcription.

Aminoacyl-tRNA synthetases. Translation: initiation, elongation and termination. Proteome. Metabolome.

Posttranslational modifications of proteins. Protein folding. Chaperones. Utilization of proteins in cell. Proteasomes. Ubiquitin.

#### **1.6. Regulation of gene expression**

Housekeeping and tissue-specific genes. Human genome: protein-coding genes, RNA genes, non-coding sequences (repeats, introns, junk DNA). DNA transposons and retrotransposons.

Lac and trp operons. Polycistronic RNA.

Regulation of transcription in eukaryotes: preinitiation complex. Enhancers, silencers.

Epigenetic mechanisms of controlling gene expression: histone modifications, cytosine methylation, CpG-islands, regulatory systems of non-coding RNA.

International human genome research projects: Human genome, ENCODE, Roadmap.

#### **1.7. Genomics. DNA analysis methods**

Analysis of genetic material. Methods of DNA analysis: gel electrophoresis, restriction analysis, hybridization of nucleic acids, DNA microarrays.

Polymerase chain reaction (PCR), reaction components, stages of the method. PCR variants: qPCR, RT-PCR (reverse transcription), nested PCR, multiplex PCR, methylation-sensitive PCR.

DNA sequencing: Sanger sequencing, next generation sequencing (NGS): pyrosequencing, nanopore sequencing, bisulfite sequencing.

#### **1.8. Genetic engineering**

Aims, objectives and stages of genetic engineering. Methods allowing to obtain genes for transgenesis. Recombinant DNA. Construction of vectors, their types: plasmids, cosmids, viral and phage vectors, phasmids, shuttle vectors.



Introduction of recombinant DNA into a recipient cell. Selection of transformed cells. Selective and reporter genes.

Biotechnology and its significance in medicine. Genetically modified organisms (GMO). Food products containing GMOs.

### **1.9. Omics technologies. Molecular genetic methods in science and medicine**

Medical applications of genetic engineering: production of protein products, monoclonal and polyclonal antibodies, recombinant antigens. DNA probes.

Genome editing tools: CRISPR/Cas 9, TALEN. Perspectives for medicine and bioethical problems of genomic editing.

The concept of bioinformatics. Phylogenetic analysis. Internet databases and online services containing information about nucleotide sequences (Blast, NCBI).

Personalized medicine. Pharmacogenetics. Gene therapy. Molecular genetic markers for tumors. Cancer genetic diagnostics.

Methods used for diagnosis of genetic disorders: direct sequencing, PCR, restriction fragment length polymorphism (RFLP) analysis, single-strand conformation polymorphism (SSCP) analysis, DNA-microarrays.

## **2. GENERAL AND MEDICAL GENETICS**

### **2.1. The mechanisms of heredity**

Genetics. The subject, methods and tasks of Genetics. Hybridological analysis.

Monohybrid crossing. Hypothesis of Purity of Gametes. Test cross. Backcrossing.

Polyhybrid cross. Limitations of Mendel's laws. Pleiotropy.

Intra-allelic interaction (complete and incomplete dominance, superdominance, codominance and allelic exclusion). Multiple alleles. Inheritance of blood groups (ABO, MN, Rh).

Inter-allelic interaction (complementary gene action, inhibitory gene action, polymeric gene interaction and position effect). Bombay blood group.

### **2.2. Genetic linkage. Biology and genetics of sex**

T. Morgan's experiments. Complete and partial genetic linkage. Crossing over and recombination of traits. Autosomal and gonosomal linkage groups. Basic provisions of chromosomal theory of heredity. Genetic and cytological chromosome maps.

Sex as a biological trait. Sex-limited, sex-influenced, sex-linked and holandric inheritance.

Determination and development of sex in ontogenesis. Peculiarities of sex determination in humans: physical, intermediate and socio-psychological determinants. Genetic mechanisms of gonadogenesis in humans. Barr body, Mary Lyon's hypothesis of X chromosome inactivation.

Disruption of sex formation in humans. Ethical aspects associated with sex, disorders of sex development, sex change and transsexualism.

### **2.3. Variability. Mutagenesis. Carcinogenesis**

Variability. Types of variability. Phenotypic plasticity. Morphosis. Phenocopies. Medical aspects of phenotypic plasticity.

Genotypic variability. Combinative variability and its mechanisms. Genetic variation caused by mutations. Causes of mutations: Replication errors, unequal crossing over, mutagens. Mechanisms of mutagenesis. Genocopies. Physical, chemical and biological mutagens. Supermutagens. Genetic hazards of environmental pollution with mutagens. Classification of mutations.

Genome stability and DNA repair. Types of DNA repair: excision repair, double-strand break repair, direct reversal repair. Antimutagens. Medical aspects of DNA repair.

Carcinogenesis. Oncogenes and tumor suppressor genes.

#### **2.4. Population genetics**

Population. Ecological and genetic characteristics of populations. Gene pool. Ideal population. Hardy-Weinberg equilibrium. Factors disturbing Hardy-Weinberg equilibrium. Natural selection. Mutations. Migration. Genetic drift, founder effect, bottleneck effect. Non-random mating, inbreeding, assortative mating, inbreeding coefficient.

Population structure of humanity. Large populations, demes and isolates. Peculiarities of gene pool of isolates. Effects of elementary evolutionary factors on human populations.

Human genetic polymorphism, its biological, medical and social aspects. Genetic burden, its biological essence and medical significance.

#### **2.5. Human genetics**

Current tasks of human genetics. Human being as a specific object of genetic analysis.

The main methods human genetics: pedigree analysis, twin study, cytogenetic techniques, the methods of population genetics, biochemical diagnostic techniques, the methods of molecular genetics.

Methods used for diagnosis of numerical and structural chromosomal abnormalities: karyotyping, SKY, FISH and SNP array-based karyotyping.

Rapid diagnostic tests: Guthrie bacterial inhibition assay, detection of sex chromatin.

Neonatal screening of monogenic disorders. Screening programs in the Republic of Belarus.

#### **2.6. Hereditary disorders**

Monogenic hereditary disorders: disorders of amino acid, carbohydrate, lipid and nucleic acid metabolism, coagulation system disorders, mineral metabolism disorders, hemoglobinopathies.

Human disorders caused by numerical and structural chromosomal abnormalities. Partial monosomies and trisomies. Uniparental disomy.

Multifactorial and polygenic (complex) genetic disorders. Mitochondrial diseases.

Approaches to the treatment of human hereditary disorders.

#### **2.7. Genetic counselling. Prenatal diagnosis**

Genetic counselling. Indications for direction to genetic counseling.

Diagnosis, prognosis and calculation of genetic risk. The Addition and Multiplication Rules of Probability, Bayes' theorem, calculation of prior and posterior

probability. Assessing the severity of medical and social consequences of hereditary pathology. Ethical and legal aspects of genetic counseling. Medical and family secrecy.

Moral, Ethical and Legal Problems of Medical Genetic Counseling. Medical and Family Confidentiality.

Methods of prenatal diagnosis of hereditary pathology (alpha-fetoprotein test, ultrasonography, chorionic villus sampling (CVS), amniocentesis, placentocentesis, cordocentesis and fetoscopy). Prenatal screening in the Republic of Belarus. Ethical aspects of prenatal diagnosis. National policy on induced termination of pregnancy.

### **3. DEVELOPMENTAL BIOLOGY**

#### **3.1. Reproduction of living matter**

Reproduction of living things. Sexual and asexual reproduction, their forms and biological roles. Hermaphroditism and dioeciousness. Lateral gene transfer.

Ovogenesis and spermatogenesis in humans. Regulation of gametogenesis. Characteristics of human gametes. Insemination. Peculiarities of fertilization in humans.

Assisted reproductive technologies (ART) in overcoming infertility in humans: artificial insemination; in vitro fertilization (IVF) and its variations (intracytoplasmic sperm injection (ICSI), oocyte donation; surrogacy; assisted hatching; cytoplasmic transfer).

Preimplantation genetic diagnosis. Medical research using human embryos, and associated ethical problems.

#### **3.2. Ontogenesis in mammals and human**

Periodization of ontogenesis. Determination of phenotype by genetic and environmental factors in ontogenesis.

Prezygotic period of ontogenesis. Prenatal period of ontogenesis. Genetic control of prenatal development. Significance of ooplasmic segregation, totipotency of zygote, selective gene expression. Interactions between parts of developing embryo. Embryonic induction, positional information of embryonic cells.

Critical periods of human prenatal ontogenesis, teratogenic factors.

Genomic imprinting. Diseases of genomic imprinting.

Periodization of postnatal ontogenesis in humans. Genetic control of postnatal ontogenesis. The influence of external and internal factors on postnatal ontogenesis. Growth and development of the organism and their regulation. Acceleration. Human constitution and habitus. Critical periods of postnatal ontogenesis.

Molecular and genetic basis of aging. Gerontology and Geriatrics. Clinical and biological death. Resuscitation and its biological aspects. Moral and ethical problems of euthanasia.

#### **3.3. Homeostasis and chronobiology**

Human organism as an open and self-regulating system. Regulation of homeostasis. Cybernetic basis of homeostasis. Levels and mechanisms of homeostasis regulation.

Biorhythmology. Medical significance of chronobiology. Chronoprophylaxis, chronodiagnosics and chronotherapy.

### 3.4. Biological basis of regeneration and transplantation

Regeneration. Physiological regeneration as a mechanism maintaining homeostasis. Classification of cells according to their regenerative ability.

Reparative regeneration, its types and mechanisms. Regulation of regeneration. Importance of regeneration for biology and medicine. Regenerative medicine.

Transplantation. Types of transplantation: autotransplantation, allotransplantation, homotransplantation and xenotransplantation. Tissue incompatibility. Immunological mechanisms of tissue incompatibility and ways to overcome it. HLA system.

Cultivation of cells and tissues outside human body, tissue preservation. Stem cells. Cell lines in biological and medical experiments. Artificial organs. Cultivation of human organs in animals and decellularization, therapeutic cloning, 3D-bioprinting.

Ethical and legal aspects of transplantation: death certificate, concept of brain death, donation and its commercialization.

### 3.5. Evolution of organ systems in chordates

Ontogenesis and phylogenesis. Von Baer's Law. Recapitulation. Biogenetic law. The concept of cenogenesis and palingenesis. The teaching of A. N. Severtsov on phyllembryogenesis. Correlations in the course of individual development.

Evolution of integumentary, skeletal, nervous, circulatory, respiratory, digestive, urinary and reproductive systems of chordates. Malformations of human organ systems which can be explained by the evolution of these systems.

## 4. MEDICAL PARASITOLOGY

### 4.1. General parasitology

Parasitism as an antagonistic form of symbiosis. Parasitocoenosis. Microbiome. Medical parasitology, its goals and objectives. Classification of parasitic diseases.

Classification of parasites. Classification of hosts.

Characteristics of the parasite-host system. Transmission routes of parasites. Pathogenic action and specificity of parasites. Morphophysiological and biological adaptations of parasites. Responses of the host organism to the invasion of parasites. Parasitic system.

### 4.2. Medical protistology

Phylum *Sarcomastigophora*. The most common parasites of the class *Zoomastigota* (*Giardia duodenalis*, *Trichomonas vaginalis*, *Trypanosoma spp.*, *Leishmania spp.*) and the class *Sarcodina* (*Entamoeba coli*, *Entamoeba gingivalis*, *Entamoeba histolytica*).

Phylum *Apicomplexa*. Human parasites of the class *Sporozoa*: *Plasmodium spp.*, *Toxoplasma gondii*, *Cryptosporidium spp.*)

Phylum *Infusoria*. Parasitic protists of the class *Ciliata*: *Balantidium coli*.

Laboratory diagnosis of the diseases caused by pathogenic protists. Prevention of protozoan diseases.

### 4.3. Medical helminthology

Phylum *Platyhelminthes*, class *Trematoda* – *Fasciola hepatica*, *Opisthorchis felinus*, *Paragonimus westermani*, *Schistosoma spp.*, cercariasis schistosomatid dermatitis.

Class *Cestoda* - *Taenia solium*, *Taenia saginata*, *Hymenolepis nana*, *Echinococcus granulosus*, *Echinococcus multilocularis*, *Diphyllobothrium latum*.

Phylum *Nemathelminthes*, class *Nematoda* - *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis*, *Toxocara canis*, *Enterobius vermicularis*, *Trichinella spiralis*, *Dirofilaria repens*, *Dracunculus medinensis*, *Onchocerca volvulus*, *Wuchereria bancrofti*, *Brugia malayi*, *Loa loa*.

Methods of diagnosis of intestinal and tissue helminth infections of humans. Prevention of helminth infections.

### 4.4. Medical arachnoentomology

The concept of natural focal diseases.

Phylum *Arthropoda*. Class *Arachnida*: morphology, biology and medical significance of the ticks and mites of the families *Ixodidae*, *Argasidae*, *Sarcoptidae*, *Acaridae* and *Demodecidae*, infraorder *Gamasina*.

Phylum *Arthropoda*. Class *Insecta*: morphology, biology and medical significance of cockroaches (*Blattoidea*), lice (*Anoplura*), fleas (*Aphaniptera*), bugs (*Heteroptera*), mosquitoes (*Culicidae*), sand flies (*Phlebotominae*), flies (*Muscidae*), black flies (*Simulidae*), botflies (*Oestridae*, *Gastrophilidae*, *Hypodermatidae*), horse-flies (*Tabanidae*), biting midges (*Ceratopogonidae*).

Control of parasitic arthropods. Prevention of parasitic and vector-borne diseases.

### 4.5. Poisonous and venomous organisms

Poisonousness and venomousness is a universal phenomenon in living nature. The concept of poisons, venoms and toxins. Classification of poisonous and venomous animals.

Poisonous animals of the phylum: *Coelenterata*, *Arthropoda* and *Chordata* (*Chondrichthyes*, *Osteichthyes*, *Amphibia*, *Reptilia*).

Physiological characteristics of the toxins of invertebrates (jellyfishes, spiders, hymenopterans), their effect on humans; first aid and prevention of bites and stings.

Physiological characteristics of the toxins of vertebrates (fishes, amphibians, reptiles), their effect on humans; first aid and prevention of bites and stings and poisonings.

Poisonous mushrooms and plants, their characteristics.

The value of poisonous and venomous organisms as a source of materials for pharmacy and medicine.

## ACADEMIC DISCIPLINE CURRICULAR CHART

Section, topic #	Section (topic) name	number of hours				Self-studies	Form of control
		lectures	supervised student independent work	practical (laboratory or)			
<b>1<sup>st</sup> semester</b>							
<b>1.</b>	<b>Molecular and Cell Biology</b>	<b>8</b>	<b>3</b>	<b>20</b>	<b>34</b>		
1.1	Medical biology as a science, its role in the training of a physician. Subject matter, objectives and methods of cytology	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, the work with optical instruments (microscope, magnifying glass)	
1.2	Structural and functional organization of the cell	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology	
1.3	Structurally functional organization of the genome	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, making human idiograms and their analysis	
1.4	Cell cycle	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology	
1.5	Mechanism of gene expression	2	0,5	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology	

	Gene expression. Epigenetics	2	1	-	2	Reports, electronic tests, conference presentations, publication of articles, reports
1.6	Regulation of gene expression	-	-	2	3	interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology
1.7	Genomics. DNA analysis methods	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology
1.8.	Genetic engineering	2	0,5	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in molecular biology, conference presentations, publication of articles, reports
	Postgenomic medicine	2	1	-	2	Reports, electronic tests, conference presentations, publication of articles, reports
1.9	Omics technologies. Molecular genetic methods in science and medicine	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
	Colloquium in molecular biology	-	-	2	3	Interview, test, control questioning, electronic test
<b>2.</b>	<b>General and medical Genetics</b>	-	-	<b>16</b>	<b>30</b>	
2.1	The mechanisms of heredity	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in the inheritance of normal and pathological traits
2.2	Genetic linkage. Biology and genetics of sex	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in the inheritance of X linked genes, detection of Barr body

2.3	Variability. Mutagenesis. Carcinogenesis	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in the inheritance of normal and pathological traits
2.4	Population genetics	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the problems in calculation of allele and genotype frequencies using Hardy-Weinberg law
2.5	Human genetics	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports, compiling and analysis of pedigrees
2.6	Hereditary disorders	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, determining the chance of giving birth to a sick child, conference presentations, publication of articles, reports
2.7	Genetic counselling. Prenatal diagnosis	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
	Colloquium in molecular biology and genetics	-	-	2	4	Credit
	<b>2<sup>nd</sup> semester</b>					
3.	<b>Developmental biology</b>	<b>6</b>	<b>1,5</b>	<b>8</b>	<b>23</b>	
3.1	Reproduction of human. Methods for overcoming infertility	2	0,5	-	3	Reports, electronic tests, conference presentations, publication of articles, reports



3.1.	Reproduction of living matter	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
3.2.	Ontogenesis in mammals and human	-	-	4	7	
	Prenatal ontogenesis in mammals and human	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
	Postnatal ontogenesis in human	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
3.3	Homeostasis and chronobiology	2	0,5	-	3	Reports, electronic tests
3.4	Biological basis of regeneration and transplantation	-	-	2	4	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
3.5	Evolution of organ systems in chordates	2	0,5	-	2	Reports, electronic tests
<b>4.</b>	<b>Medical parasitology</b>	<b>2</b>	<b>0,5</b>	<b>26</b>	<b>43</b>	
4.1	Ecological parasitology	2	0,5	-	2	Reports, electronic tests
4.1	General parasitology	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
4.2	Medical protistology	-	-	4	6	
	Medical protistology I. Phylum <i>Apicomplexa</i> , class <i>Sporozoa</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the cases in the disease caused by parasitic protists
	Тип Medical protistology II. Phylum <i>Sarcomastigophora</i> , classes <i>Sarcodina</i> and <i>Zoomastigota</i> . Phylum <i>Infusoria</i> , class <i>Ciliata</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports

4.3	<i>Medical helminthology</i>	-	-	8	12	
	Medical helminthology I. Phylum <i>Plathelminthes</i> , class <i>Trematoda</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, solving the cases in the disease caused by helminths
	Medical helminthology II. Phylum <i>Plathelminthes</i> , class <i>Cestoda</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
	Medical helminthology III. Phylum <i>Nemathelminthes</i> , class <i>Nematoda 1</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
	Medical helminthology IV. Phylum <i>Nemathelminthes</i> , class <i>Nematoda 2</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
4.4	<i>Medical arachnoentomology</i>	-	-	10	17	
	Medical arachnoentomology I. Phylum <i>Arthropoda</i> , class <i>Arachnida</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
	Medical arachnoentomology II. Phylum <i>Arthropoda</i> , class <i>Insecta 1</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop
	Medical arachnoentomology III. Phylum <i>Arthropoda</i> , class <i>Insecta 2</i>	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports
	Colloquium in parasitic micropreparations	-	-	2	4	Interview, test, control questioning, electronic test
	Colloquium in parasitology	-	-	2	4	Interview, test, control questioning, electronic test

4.5	Poisonous and venomous organisms	-	-	2	3	Interview, test, accounts of home practical exercises with oral defense, accounts of classroom practical exercises with oral defense, electronic test, electronic workshop, conference presentations, publication of articles, reports, examination
		16	5	70	130	
	<b>Total number</b>					

## INFORMATION AND INSTRUCTIONAL UNIT

### LITERATURE

#### Basic (relevant):

1. Медицинская генетика и паразитология для студентов, обучающихся по специальности «Лечебное дело» = Medical Genetics and Parasitology for the students studying in the specialty «General Medicine»: учеб.-метод. пособие / В. Э. Бутвиловский [и др.]. – Минск : БГМУ, 2019. – 220 p.

#### Additional:

2. Medical biology : practical book for the students studying in the specialty «General medicine» : practical book / V. E. Butvilovsky [et al.]. – 3<sup>rd</sup> edition – Minsk : BSMU, 2019 – 106 p.

3. Medical biology : methodological recommendations for the students studying in the speciality «General medicine» V.E. Butvilovsky [et al.]. – Minsk : BSMU, 2018. – 56 p.

4. Medical biology : textbook / Bazhora Yu.I., Bulyk R.Ye., Chesnokova M.M. [et al.]. – Vinnytsia : Nova Knyha, 2018. – 448 p.

### METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time for independent work can be used for:

- preparation for lectures and classes;
- preparation for colloquia, credits and examinations in the discipline;
- preparation of thematic reports and presentations;
- performing practical tasks;
- making an abstract of educational literature;
- making reviews of scientific literature in a given topic;
- compiling of informative and demonstration materials (posters, tables and etc.);
- compiling a thematic selection of literary sources, Internet sources.

### METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

Main forms of supervised student independent work:

- presentation of reports;
- studying topics and problems that have not been discussed at the lectures;
- taking notes of original sources (sections of anthologies, collections of documents, monographs, textbooks);
- computer testing;
- preparation of didactic materials;
- participation in active forms of education.

Control of supervised student independent work is carried out in the form of:  
test paper;

final class, colloquium in the form of an oral interview, written work, testing; discussion of abstracts; assessment of an oral reply to a question, presentation, report or problem solving; checking up abstracts, written reports, accounts, prescriptions; individual interview.

#### **LIST OF AVAILABLE DIAGNOSTIC TOOLS**

The following forms are used for competences assessment:

##### Oral form:

interviews;  
conference reports;

##### Written form:

tests;  
control questioning;  
reports;  
article/report publications  
the work with optical instruments (microscope, magnifying glass;  
solving the problems in molecular biology;  
making human idiograms and their analysis;  
solving the problems in the inheritance of normal and pathological traits;  
solving the problems in the inheritance of X linked genes, detection of Barr body;  
solving the problems in calculation of allele and genotype frequencies using Hardy-Weinberg law;  
compiling and analysis of pedigrees;  
determining the chance of giving birth to a sick child;  
solving the cases in the disease caused by helminths;  
credit.

##### Oral-written form:

accounts of classroom practical exercises with oral defense;  
accounts of home practical exercises with oral defense;  
examination.

##### Technical form:

electronic tests;  
electronic workshops (practicals);

#### **LIST OF AVAILABLE TEACHING METHODS**

Traditional method (lecture, laboratory practicals);

Active (interactive) methods:

- Problem-Based Learning (PBL);
- Team-Based Learning (TBL);
- Research-Based Learning (RBL).

#### **LIST OF PRACTICAL SKILLS**

1. Work with optical instruments (magnifying glass, light microscope).
2. Solution of problems in molecular biology.
3. Solving problems on genetic patterns of inheritance of normal and pathological traits, sex-linked inheritance.
4. Drawing up and analyzing pedigrees: determining the type of disease inheritance, establishing the genotypes of all members of the pedigree.
5. Determining the genetic risk of having a child with a hereditary pathology.
6. Solving problems to calculate the frequencies of genes and genotypes in human populations according to the formula of the Hardy-Weinberg law.
7. Construction and analysis of human karyotype.
8. Identification of Barr body.
9. Solving the problems in parasitology.
10. Diagnosis of micropreparations of parasites.

### **LIST OF EQUIPMENT USED**

Teaching aids, computers, computer networks, multimedia equipment, TV sets, light microscopes, electronograms, chemical reagents, spatulas, slides and covers, filter paper, magnifying glass, micro preparations, macro preparations.

### **LIST OF LECTURES**

#### **1<sup>st</sup> semester**

1. Flow of genetic information in the cell.
2. Gene expression. Epigenetics.
3. Genetic engineering.
4. Postgenomic medicine.

#### **2<sup>nd</sup> semester**

1. Reproduction of human. Methods for overcoming infertility.
2. Ecological parasitology.
3. Congenital malformations in the context of the evolution of organ systems.
4. Homeostasis and chronobiology.

### **LIST OF LABORATORY STUDIES**

#### **1 семестр**

1. Medical biology as a science, its role in the training of a physician. Subject matter, objectives and methods of cytology.
2. Structural and functional organization of the cell.
3. Structurally functional organization of the genome.
4. Cell cycle.
5. Mechanism of gene expression.
6. Regulation of gene expression.
7. Genomics. DNA analysis methods.
8. Genetic engineering.
9. Omics technologies. Molecular genetic methods in science and medicine.

10. Colloquium in molecular biology.
11. The mechanisms of heredity.
12. Genetic linkage. Biology and genetics of sex.
13. Variability. Mutagenesis. Carcinogenesis.
14. Population genetics.
15. Human genetics.
16. Hereditary disorders.
17. Genetic counselling. Prenatal diagnosis.
18. Colloquium in molecular biology and genetics.

### 2 семестр

1. Reproduction of living matter.
2. Prenatal ontogenesis in mammals and human.
3. Prenatal ontogenesis in human.
4. Biological basis of regeneration and transplantation.
5. General parasitology.
6. Medical protistology I. Phylum Apicomplexa, class Sporozoa.
7. Медицинская протистология II. Тип Medical protistology II. Phylum Sarcomastigophora, classes Sarcodina and Zoomastigota. Phylum Infusoria, class Ciliata.
8. Medical helminthology I. Phylum Plathelminthes, class Trematoda.
9. Medical helminthology II. Phylum Plathelminthes, class Cestoda.
10. Medical helminthology III. Phylum Nemathelminthes, class Nematoda (1).
11. Medical helminthology IV. Phylum Nemathelminthes, class Nematoda (2).
12. Medical arachnoentomology I. Phylum Arthropoda, class Arachnida.
13. Medical arachnoentomology II. Phylum Arthropoda, class Insecta (1).
14. Medical arachnoentomology III. Phylum Arthropoda, class Insecta (2).
15. Colloquium in parasitic micropreparations.
16. Colloquium in parasitology.
17. Poisonous and venomous organisms.

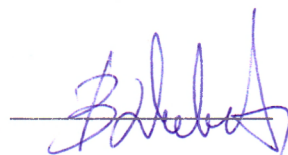
**PROTOCOL OF THE CURRICULUM APPROVAL  
BY OTHER DEPARTMENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum
1. Bioorganic Chemistry	The department of Bioorganic Chemistry	No suggestions for changes in the content of the curriculum for the discipline	(protocol # 11 of 05.06.2023);
2. Histology, Cytology, Embryology	The department of Histology, Cytology, Embryology	No suggestions for changes in the content of the curriculum for the discipline	(protocol # 11 of 05.06.2023);
3. Microbiology, Virology, Immunology	The department of Microbiology, Virology, Immunology	No suggestions for changes in the content of the curriculum for the discipline	(protocol # 11 of 05.06.2023);
4. Infectious diseases	The department of Infectious diseases	No suggestions for changes in the content of the curriculum for the discipline	(protocol # 11 of 05.06.2023);



**COMPILERS/AUTHORS:**

Head of the Department of Biology of the educational institution «Belarusian State Medical University», Ph.D., associate professor



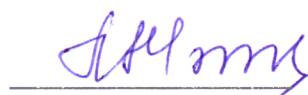
V.V.Davydov

Senior teacher of the Department of Biology of the educational institution «Belarusian State Medical University»



V.V.Grigorovich

Associate Professor of the Department of Biology of the educational institution «Belarusian State Medical University», Ph.D., associate professor



L.M.Sychik

Curriculum content, composition and the accompanying documents comply with the established requirements.

Dean of the Medical Faculty for International Students of the educational institution «Belarusian State Medical University»

26.06. 2023



O.S.Ishutin

Methodologist of the educational institution «Belarusian State Medical University»

26.06. 2023



S.V.Zaturanova