MINISTRY OF HEALTH OF UKRAINE

ODESSA NATIONAL MEDICAL UNIVERSITY

Department of clinical immunology, genetics and medical biology

APPROVED

Vice-rector for research and educational work,

_____ Eduard BURYACHKOVSKY

01 September 2023

METHODOLOGICAL DEVELOPMENTS

FOR THE INDEPENDENT WORK OF HIGHER EDUCATION STUDENTS

IN THE ACADEMIC DISCIPLINE

MEDICAL BIOLOGY

Level of higher education: second (master's**)**

branch of knowledge: 22 «Health Care»

speciality: 221 «Dentistry»

educational and professional program: Dentistry

Developers:

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Developments are discussed and approved at a methodic meeting of the Department of Clinical Immunology, Genetics and Medical Biology.

Minutes № 1, 28.08.2023.

Head of the department, professor. Sergiy GONCHARUK

Reviewed and approved at a meeting of the Department of Medical Biology and Chemistry
Minutes № 1 7.09 2023.

Head of the department Gennady Stepanov

Reviewed and approved at a meeting of the Department of Medical Biology and Chemistry
Minutes № ___ _____ 202____.

Head of the department_____

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Methodical development for independent work #1

Topic: Old age as the final stage of human ontogenesis. Theories of aging

Purpose: To study the characteristics of the manifestations of human aging at all levels of the organization. Find out the problems of gerontology, geriatrics. To study modern theories of aging and be able to interpret them

Basic concepts: aging, theories of aging, gerontology, geriatrics, thanatology, clinical, biological death

2. Self-control question

1. The period of old age as a natural stage of the postnatal period of human ontogenesis.

2. Manifestations of aging at different levels of the living organism.

3. Morphological characteristics of aging processes.

4. Gerontology and geriatrics.

5. Modern theories of aging.

6. The role of social factors and preventive medicine in ensuring longevity.

7. Death as the end of individual development. Thanatology.

8. Clinical and biological death. Stages of dying.

9. Revitalization of the body (resuscitation), its practical significance.

3. Tasks for working out the theoretical material:

Fill out an orientation card for independent training of a higher education applicant using literature on the topic

Instructions for completing the task	Student answers with additions in class
1. Gerontology is the science of	
2. Geriatrics is the science of	
3. Specify the manifestations of human aging at different levels: 1) molecular genetic: A,B,G 2) cellular: A B, C 3) organism: A ,B,C,B,E	
4. Indicate the main theories of aging and briefly explain their essence:	

5. Name the modern theory of aging and briefly explain its essence:	
6.Thanatology is ...	
7. What is clinical death characterized by?	
8. What is biological death	
9. Resuscitation is ...	

4. MCQs for self-control:

1. In the process of aging, changes occur in the human body at all levels of the living organization - from molecular-genetic to organismal. What science studies the mechanisms of these processes?

A. Geriatrics

B. Gerontology

C. Thanatology

D. Valeology

E. Sanology

2. More than 300 theories are known that explain the causes and mechanisms of the aging process. Most of them have historical significance. What are the most likely mechanisms of this process?

A. Gene mutations

B. Transferred diseases

C. Chromosomal aberrations

D. Genetically programmed

E. Genetic program and gene mutations

3. During a person's life, the following changes occurred: the vital capacity of the lungs decreased, blood pressure increased, atherosclerosis developed, and the skeleton was deformed. What period of ontogenesis do these changes most likely correspond to?

A. Newborns

B. Yunatskyi

C. Second maturity

D. Oblique

E. Old age

4. In old age, the frequency of diseases increases significantly. Diseases of people of this age are studied by a special science. What is her name?

A. Thanatology

B. Gerontology

C. Sanology

D. Valeology

E. Geriatrics

5. In the cells of the human body, the content of water in the cytoplasm decreased, the level of oxidative processes, ATP, the intensity of nucleic acid synthesis decreased, the synthesis of necessary proteins and other substances was disrupted, mitotic activity was insignificant. What period of ontogenesis do these changes most likely correspond to?

A. Newborns

B. To a teenager

C. Yunatskyi

D. First maturity

E. Old age

6. The following changes occurred in a healthy woman: her height decreased, her skin lost elasticity, her vision and hearing deteriorated. What period of ontogenesis do these changes most likely correspond to?

A. Newborns

B. To a teenager

C. Yunatskyi

D. First maturity

E. Old age

6. List of recommended literature (main, additional, electronic information resources):

Main:

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P.138-140.

Methodical development for independent work #2

Topic: Genetic danger of environmental pollution. The concept of mutagens and antimutagens

Purpose: To form an idea about spontaneous and induced mutations, mutagenic factors (physical, chemical, biological). Understand the concept and purpose of genetic monitoring. Learn the

concepts of mutagens and antimutagens, methods of reducing the risk of somatic and induced mutations

Basic concepts: spontaneous mutations, induced mutations, mutagenic factors, comutagens, antimutagens

1. Theoretical questions:

Plan

1. Spontaneous and induced mutations.

2. Modifiers of mutagenic activity: commutagens, antimutagens.

3. Genetic monitoring.

2. Questions for self-control:

1. What are spontaneous and induced mutations?

2. Causes of spontaneous mutations. Factors affecting the frequency of spontaneous mutations.

3. Causes of induced mutations. Classification and general characteristics of mutagenic factors.

4. What are commutagenes? Examples of mutagens.

5. What are antimutagens? Examples.

6. Genetic danger of environmental pollution at the modern stage.

7. Genetic monitoring of the population.

3. Tasks for processing theoretical material:

Fill out an orientation card for independent training

Instructions for completing the task	Student answers with additions in class
1. What are spontaneous mutations?	
2. What are induced mutations?	
3. What are mutagenic factors?	
4. Give examples of mutagenic factors: 1) physical 2) chemical 3) biological	
5. Genetic monitoring is…	
6. What are comutagens	
7. Give examples comutagens	
8. What are antimutagens?	
9. Give examples of antimutagens:	

4. MCQs for self-control:

1. It has been experimentally established that a normal allele of a gene functions in some somatic cells, and a pathological allele in others. What is the name of such a phenomenon?

A. Gene mutation

B. Mosaicism

C

. Chromosomal aberration

D. Generative mutation

E. Genomic mutation

2. There are substances that in a certain way enhance the effects of various environmental mutagens, although they do not have the ability to cause mutations by themselves. What name did they get?

A. Chemical mutagens

B. Inducers

C. Komutagens

D. Repressors

E. Antimutagens

3. Taking β-carotene helps to protect the human genome from the influence of mutagenic factors of various nature. What is the common name given to this and similar substances?

A. Inductor

B. Antimutagen

C. Compressor

D. Komutagen

E. Biological mutagen

4. During the study, it was established that the phenotypic effects of mutations in various genes are combined into one group, as a result of which it includes various genetic diseases. What name did such cases get?

A. Chromosomal aberrations

B. Phenocopy

C. Genomic mutations

D. Genocopy

E. Gene mutations

6. List of recommended literature (main, additional, electronic information resources):

Main:

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

Methodical development for independent work #3

Topic: Methods of human genetics: dermatoglyphic, immunological, somatic cell hybridization

Purpose: To study the possibilities of the dermatoglyphic method in the diagnosis of hereditary disorders of a person. Understand the importance of somatic cell hybridization for human chromosome mapping, the synthesis of monoclonal antibodies, the importance of the immunological method in human genetics.

Basic concepts: dermatoglyphics, dactyloscopy, palmoscopy, plantoscopy, finger patterns, palmar triradius atd, transverse groove on the palm, somatic cell hybridization, synkaryon, heterokaryon, immunogenetics

2. Questions for self-control:

1. Who proposed the dermatoglyphic method, its essence.

2. Definition of the terms "dermatoglyphics", dactyloscopy, palmoscopy, plantoscopy.

3. Rules for recording finger patterns, determining the angle, etc.

4. The importance of the dermatoglyphic method.

5. Method of hybridization of somatic cells.

6. What is immunogenetics? The importance of determining blood group affiliation.

3. Tasks for processing theoretical material:

Fill out an orientation card for independent training

Instructions for completing the task	Student answers with additions at class
1. Define the terms: - fingerprinting - - palmoscopy - - plantoscopy -	
2. List the types of skin patterns: A B C	
3. Specify the value of the angle of the triradius atd in the norm (a) and with syndromes:	

- Down - Patau - Edwards - Shereshevsky-Turner - Klinefelter	
4. What is the essence of the somatic cell hybridization method?	
5. Define the terms: A) heterokaryon B) synkaryon	
5. For what purpose is the somatic cell hybridization method used?	
6. Why is the method of immunogenetics used?	

5. MCQs for self-control:

1. For the purpose of identifying the identity of the criminal, the forensic expert studied the relief patterns of the skin on the pads of the fingers and palms. What method of human genetics did he use in this case?

A. Clinical and genealogical

B. Cytogenetic

C. Biochemical

D. Population-statistical

E. Dermatoglyphic

2. In 1960, the microbiologist Zh. Barskyi, while growing tissues of two lines of mice outside the body in culture, noticed that some cells, based on their morphological and biochemical characteristics, turned out to be intermediate between the original parental cells. This scientist is considered to be the originator of which method of human genetics?

A. Clinical and genealogical

B. Cytogenetic

C. Hybridization of somatic cells

D. Immunological

E. Biochemical

.3. Constructing maps of human chromosomes using traditional genetic methods is difficult. Thanks to the implementation of which method of human genetics, this became possible?

A. Population-statistical

B. Biochemical

C. Immunological

D. Hybridization of somatic cells

E. Modeling

4. In order to reproduce some hereditary human diseases (hemophilia, muscular dystrophy, non-growth of the upper lip, hard palate, etc.), doctors select and study mutant lines of animals (dogs, guinea pigs, ferrets, gophers, mice, rats, etc.), having similar violations. The theoretical basis of these studies was created by M.I. Vavilov in the law of homologous series. What method of human genetics is carried out in this way?

A. Cytogenetic

B. Biochemical

C. Population and statistical

D. Modeling

E. Immunological

6. List of recommended literature (main, additional, electronic information resources):

Main:

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P. 167-171, 219-220.

Methodical development for independent work #4

Topic: Using the formula of the Hardy-Weinberg law in medicine to determine the genetic structure of human populations.

Purpose: To understand the possibilities of applying the Hardy-Weinberg law to study the genetic structure of human populations.

Basic concepts: ideal population, panmixia, gene frequency, law of genetic balance, real population, dem, isolate.

2. MCQs for self-control:

1. What is the genetic structure of a population?

2. What is the frequency of a gene (genotype). What is it expressed in?

3. Hardy-Weinberg law.

4. What is an ideal population? What is it characterized by?

5. Why can the Hardy-Weinberg law be used in medical genetics?

6. The practical significance of the Hardy-Weinberg law

3. Fill out an orientation card for independent training

Instructions for completing the task	Student answers with additions at class
1. For what purpose is the population-statistical method used in medicine:	
2. The law formulated by Hardy and Weinberg is called a law	
3. Formulate the Hardy-Weinberg law and write down its formula	
4 State the characteristics of an ideal population: A B C D	
5. In what ways does the real population differ from the ideal one?	
6. Genes of dominant traits in populations do not replace genes of recessive traits, because	
7 What is the Hardy-Weinberg law used for in medicine?	

4. Tasks for self-control

1. Does a disease caused by a recessive gene disappear in the population if patients do not produce offspring? Why?

2. Why is it necessary to periodically change the poison with chemical means of combating harmful insects?

3. Sickle cell anemia is an autosomal recessive disease. Patients usually die in childhood. However, the frequency of the gene is very high in malaria belt countries. Why does the gene for sickle cell anemia not disappear due to natural selection?

5. Solve the problems:

1. Calculate the frequency of dominant (p) and recessive (q) alleles: a) in a group consisting of 60 BB homozygotes and 40 bb homozygotes; b) in a group consisting of 160 individuals with the DD genotype and 40 individuals with the dd genotype.

2. In the population of the Italian population of one of the American cities, between 1928 and 1942, about 26,000 children were born, of which 11 were homozygotes for the recessive gene t, which causes Cooley's thalassemia (hemolytic anemia). Determine the genetic structure of the population (frequency of alleles T and t, frequency of genotypes TT, Tt, tt).

3. Cystic fibrosis (an autosomal recessive disease) occurs with a frequency of 1/1,600 newborns in the Odesa region. Determine the frequency of heterozygotes for the cystic fibrosis gene.

4. Calculate In the human population, brown-eyed individuals occur with a frequency of 51%, and blue-eyed individuals with a frequency of 49%. Determine the frequency of heterozygotes among brown-eyed people.

6. List of recommended literature (main, additional, electronic information resources):

Main:

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P.227-231.

Methodical development for independent work #5

Topic: Blood fluks are the causative agents of human parasitic diseases. The causative agents of metagonimosis, nanophytosis.

Purpose: To study the morphology and life cycles of blood fluks, their pathogenic effect, as well as methods of diagnosis and methods of prevention of schistosomiasis. To find out the morphological features and life cycles of pathogens of metagonimosis and nanophytosis.

Basic concepts: fluks, blood fluks, biohelminths, schistosomiasis, metagonimosis, nanophytosis

2. Questions for self-control:

1. Systematic position of schistosomas.

2. Features of the morphology of blood flucks, geographical distribution, life cycles, localization, ways of transmission, diagnosis, prevention.

3. Peculiarities of the morphology of metogonyms, geographical distribution, life cycles, localization, ways of transmission, diagnosis, prevention.

4. Features of the morphology of nanophytes, geographical distribution, life cycles, localization, ways of transmission, diagnosis, prevention.

3. Fill out an orientation card for independent training

Fill in the table "Life cycles of flucks and their medical significance"

Name The causative agents of	Latin name	The name of the disease	Definitive hosts	Localization	Intermediate host first	Intermediate host second	Ways of human infection	Invasive for humans stage	Diagnostics
urogenital schistosomiasis									
Intestinal									

schistosomiasis									
Japanese schistosomiasis									
Metagonimosis									
Nanophytosis									

4. MCQs for self-control:

1. A student who arrived from Lebanon turned to the doctor with complaints of pain in the lower abdomen, in the area of the bladder, during urination. Microscopy of urine sediment revealed erythrocytes, relatively large eggs of yellowish color, oval shape, size 140x80 microns, on one of the poles of which there is a spike. What trematodosis did this young man get?

A. Fasciolosis

B. Paragonimosis

C. Opisthorchosis

D. Schistosomiasis (bilhartiasis)

2. Urogenital schistosomiasis (bilhartiasis) is widespread in China, Vietnam, Iran, and other countries due to the fact that the local population grows rice, on the plantations of which favorable conditions are created for development molluscs of the genus Bullinus. What stage of the causative agent of this disease is invasive for humans?

A. Cercaria

B. Redia

C. Sporocyst

D. Metacercaria

E. Adoleskaria

3. A female student, who arrived from Yemen after the summer vacation, complains of pain in the lower abdomen. Earlier, according to the patient's stories, she had itching, rashes on the skin, headache, general weakness, and loss of appetite. In the area where she temporarily lived, there is a pond in which local residents constantly bathed, sometimes washed clothes, and she did it several times. What trematodosis can be predicted in this girl?

A. Paragonimosis

B. Schistosomiasis (bilhartiasis)

C. Opisthorchosis

D. Dicroceliosis

E. Fasciolosis

4. A student who arrived from Syria turned to the doctor complaining of pain in the lower abdomen. During faecal microscopy, oval-shaped eggs, approximately 145x90 microns in size with a spike on the side, were found. What diagnosis will the doctor make?

A. Genitourinary schistosomiasis

B. Paragonimosis

C. Japanese schistosomiasis

D. Dicroceliosis

E. Intestinal schistosomiasis

5. A man who arrived in Ukraine from Australia turned to a urologist with complaints of pain during urination. Eggs with a terminal spike were found in the sediment of urine taken for microscopic examination during the day. What trematodosis can the doctor predict?

A. Intestinal schistosomiasis

B. Dicroceliosis

C. Genitourinary schistosomiasis

D. Opisthorchosis

E. Japanese schistosomiasis

6. During the examination, the patient was diagnosed with metagonimosis. What is the prevention of this disease?

A. Wash your hands;

B. Do not use unwashed vegetables;

C. Do not use poorly thermally processed fish;

D. Do not use poorly heat-treated liver of animals;

E. Do not use poorly heat-treated beef.

7. During the examination, a foreign citizen was found to have nanophytosis. How could he get infected?

A. When swimming in the river;

B. When eating meat;

C. When eating fish;

D. Through dirty hands;

E. By mosquito bites.

8. A patient who arrived from Egypt complains of pain in the lower abdomen that worsens during urination. During the interview, it was found that he often bathed in the river during the hot time of the day. In the urine of the patient, impurities of blood and eggs of the parasite with a thorn were found. What disease can be predicted?

A. Opisthorchosis;

B. Schistosomiasis;

C. Dicroceliosis;

D. Paragonimosis;

E. Fasciolosis.

9. Schistosomiasis is a severe helminthic disease widespread in Africa, Asia and Latin America. How does a person get infected with these diseases?

A. When drinking unboiled water;

B. When bitten by insects;

C. When eating fish;

D. When it contacts with polluted water;

E. When eating crustaceans.

10. A patient came to the hospital with fever with chills, joint pain, nausea, vomiting, diarrhea, enlarged spleen, etc. The patient worked in Egypt on irrigated fields. The doctor diagnosed schistosomiasis. Who is the intermediate host in the development cycle of these helminths?

A. Ants;

B. Fish;

C. Crayfish;

D. Crabs;

E. Molluscs.

11. What is the personal prevention of schistosomiasis:

A. Hand washing;

B. Do not swim in contaminated water bodies;

C. Do not eat infected beef;

D. Do not use freshwater crayfish and crabs;

E. It is good to thermally process fish.

12. Determine where schistosomes are located in the human body:

A. Gut;

B. Lungs;

C. Veins of the bladder, intestines;

D. Pancreas;

E. Liver.

13. Name what material is examined for the diagnosis of genitourinary schistosomiasis:

A. Faeces;

B. Urine;

C. Blood;

D. sputum;

E. Bile.

14. Indicate which trematode eggs have spines:

A. Fasciola hepatica;

B. Opisthorhis felineus;

C. Nanophyetus salmincola;

D. Schistosoma japonicum;

E. Clonorchis sinensis.

6. List of recommended literature (main, additional, electronic information resources):

Main:

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P. 285-289.

Methodical development for independent work No. 6

Topic: Guinea warm and filariae are the causative agents of human diseases

Purpose: To study the peculiarities of the structure and life cycles of the Guinea warm and filaria. Understand methods of diagnosis and methods of prevention of these nematodes.

Basic concepts: nematodosis, biohelminth, round worm, dracunculosis, filaria, filariasis.

Plan

1. Rishta (Guinea warm) is the causative agent of dracunculosis. Geographic distribution, morphology, life cycle, diagnosis, prevention.

2. Filariae are the causative agents of filariasis. Geographic distribution, morphology. Peculiarities of life cycles, transmissive way of transmission. Diagnosis and prevention of filariasis.

2. Questions for self-control:

1. Guinea worm. Geographic distribution, peculiarities of morphology and life cycle. Ways of transmission, pathogenic action, diagnostics.

2. Prevention of dracunculosis. What is devastation?

3. Filaria. Geographic distribution, peculiarities of structure and life cycles.

4. Bancroft's filaria (Wuchereria bancrofti) - the causative agent of Wuchereriosis; peculiarities of morphology and life cycle, pathogenic action.

5. Brugia (Brugia malaji) – causative agent of brugiosis; peculiarities of morphology and life cycle, pathogenic effect.

6. Loa-loa (Loa loa) - the causative agent of loaosis; peculiarities of morphology and life cycle, pathogenic effect.

7. Onchocerca (Onchocerca volvulus) - the causative agent of onchocerciasis; peculiarities of morphology and life cycle, pathogenic effect.

8. Diagnosis and prevention of filariasis.

3. Tasks for processing theoretical material:

Complete the table "Diagnostic signs and life cycles of roundworms"

The Latin name of the helminth	Size (cm)	Life expectancy	Larva	Definitive host	Intermediate hosts
Rishta					
Bancroft's filaria					

Fill in the table "Epidemiological features of roundworms"

Name of the helminth	Name of the disease	Localization	Invasive stage	Source of infection	Laboratory diagnostics	Prevention
Rishta						
Bancroft's filaria						

Fill in the table "Life cycles of filaria"

Name	Latin name	Name of the disease	Definitive	Localization	Intermediate host	Invasive stage	Pathogenic action	Laboratory diagnostics
Bancroft's filaria								
Brugia								
Loa loa								

6. List of recommended literature (main, additional, electronic information resources):

Main:

2. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P. 318-324.

Methodical development for independent work #7

Topic: Principles and content of basic laboratory methods for diagnosing helminthiasis. Purpose: To learn the essence and principles of basic methods of laboratory diagnosis of trematodes, cestodes and nematodes. Understand the characteristic morphological features of the eggs of suckers, tapeworms and roundworms

Basic concepts: parasitological diagnosis of helminthiasis, helminthoscopy, larvoscopy, ovoscopy, immunological diagnosis, serological reactions, trematodes, cestodoses, nematodes

1. Theoretical questions:

1. Methods of parasitological diagnosis of helminthiasis: helminthoscopy, larvoscopy, ovoscopy.

2. General features and individual morphological features of the eggs of suckers, tapeworms and roundworms.

2. Questions for self-control

1. Classification of methods of diagnosis of helminthiasis.

2. What are helminthoscopy, ovoscopy and larvoscopy?

3. Methods of helminthoscopy. Which helminth infections are used for diagnosis?

4. Ovoscopy methods: native smear methods and its modifications, concentration methods.

5. Features of diagnosis of teniarynchosis and enterobiosis.

6. Principles of larvoscopy methods What helminthiasis are they used to diagnose?

7. Features of the structure of eggs of trematodes, cestodes and nematodes.

3. Fill out an orientation card for independent training

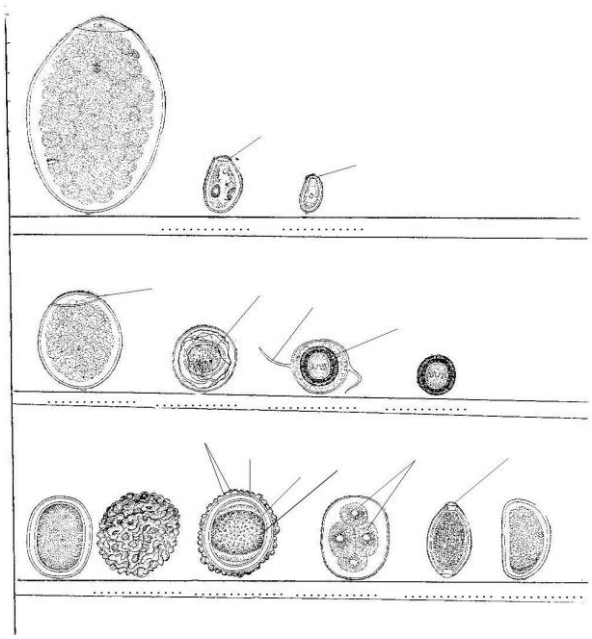
Instructions for completing the task	Student answers with additions in class
1. Specify the main groups of methods of laboratory diagnosis of helminthiasis: A B	
2. Name the parasitological methods: 1) macroscopic - 2) microscopic – A,B	
3. Specify the biological material used to diagnose helminthiasis: A B C D	
4. Name the method of helminthoscopy:	
5. Specify the helminth infections that can be diagnosed by the method of larvoscopy: A B C	
6. Name the main methods of ovoscopy:	

A B C D	
7. Specify the helminthiases that are diagnosed by the ovoscopy method: A B C	
8. Name the special methods of diagnosis of teniarynchosis and enterobiosis: A B	
9. Name diseases for the diagnosis of which allergy test is used: A B	
10. Specify the characteristics of trematodes eggs:	
11. List the common features of tapeworm eggs:	
12. Specify the distinctive features of roundworm eggs: a) ascaris b) pinworm c) whipworm d) hookworm	

Complete the table "Morphological features of eggs of trematodes, cestodes and nematodes"

Classes of helminths	Color	Form	Presence of a cover	Presence of an oncosphere
Trematodes				
Cestodes				
Nematodes				

Sign the species of helminths to which the eggs in the picture belong, indicate the size of the eggs



5. MCQs for self-control:

1. The fisherman caught fish from the river, fried it a little on the fire and ate it, almost half raw. A few weeks later, he developed signs of damage to the liver and pancreas. Laboratory analysis of feces showed the presence of small helminth eggs of oval shape 25–30 μm with a cap on one pole. What trematodosis is the fisherman most likely infected with?

A. Opisthorchosis

B. Dicroceliosis

C. Schistosomiasis

D. Fasciolosis

E. Paragonimosis

2. A 15-year-old girl was taken to the hospital with inflammation of the appendix. There are signs of anemia in the blood. In the feces, helminth eggs were found, which have a lemon-like shape (50x30 microns), with "corks" at the poles. What kind of helminth parasitizes the girl?

A. Echinococcus

B. Gastric

C. Hookworm

D. Whipworm

E. Dwarf stickleback

3. In a patient suffering from pneumonia for a week, microscopic sputum revealed helminth larvae. Eosinophilia in the blood. What diagnosis can be thought of in this case?

A. Echinococcosis

B. Ascariasis

C. Paragonimosis

D. Taeniosis

E. Fasciolosis

4. Specify the features of eggs of the trematode type of structure:

A. Eggs have a thick shell and a variety of shapes

B. Oval or round, gray in color, inside there is an embryo with 6 hooks - oncosphere

C. Eggs are oval, have a spike at one pole

D. The shape is oval, the shell is thin, smooth, the egg contains an embryo at the stage of 2-8 blastomeres

E. Eggs have an oval shape, a cap on one pole and a tubercle on the opposite

5. Specify the features of cestode type eggs:

A. Eggs have a thick shell and a variety of shapes

B. Oval or round, gray in color, inside there is an embryo with 6 hooks - oncosphere

C. Eggs are oval, have a spike at one pole

D. Eggs have an oval shape, a cap at one pole and a tubercle at the opposite pole

E. The shape is oval, the shell is thin, smooth, the egg contains an embryo at the stage of 2-8 blastomeres

6. Ovoscopy of sputum is a method of laboratory diagnosis:

A. Ascariasis

B. Echinococcosis

C. Paragonimosis

D. Taenia

E. Fasciolosis

7. Scraping from perianal folds and the sticky tape method (Graham's method) are special methods of laboratory diagnostics:

A. Ascariasis

B. Echinococcosis

C. Trichocephalosis

D. Schistosomiasis

E. Enterobiosis

8. In a patient with symptoms of gastrointestinal tract damage and anemia, hookworm is suspected. Fecal ovoscopy is performed for diagnosis. Detection of which helminth eggs will confirm the diagnosis?

A. Eggs have a thick shell and a variety of shapes

B. Oval or round, gray in color, inside there is an embryo with 6 hooks - oncosphere

C. Eggs are oval, have a spike at one pole

D. The shape is oval, the shell is thin, smooth, the egg contains an embryo at the stage of 2-8 blastomeres

E. Eggs have an oval shape, a cap on one pole and a tubercle on the opposite

6. List of recommended literature (main, additional, electronic information resources):

Main:

3. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. –Vinnytsia: Nova Knyha, 2019. P.324-331.

Methodical development for independent work #9

Topic: Plants, mushrooms and animals poisonous to humans.

Purpose: To study representatives of plants and mushrooms that are poisonous to humans, as well as various species of animals. To characterize the biologically active compounds included in the composition of poisons of various types. To study the therapeutic effect of small doses of poisons of biological origin.

Basic concepts: poison, poisonous plants, poisonous species of mushrooms, primary poisonous animals, secondary poisonous animals.

Poisonous organisms

Poison is defined as any chemical substance which, when taken into the organism, acts injuriously, tending to cause death or serious detriment to health. The poisonous organisms are met in all continents of the world and represented by all kingdoms, including animals, plants and fungi.

Poisonous animals

Poisonous animals can be primary or secondary poisonous. Primary poisonous animals produce toxins by themselves. They can be passively or actively poisonous. Passively poisonous are animals that accumulate toxic products of metabolism in certain organs or tissues. Eating of such organs causes intoxication. Example is fresh water cyprinid fish marinka (Schizothorax intermedius) in Central Asia and Ukraine. Ovary, testis and gills of this fish are highly toxic (especially in spring), but the fish freed from the entrails are harmless and tasteful. Another famous example of passively poisonous animal is fugu fish, described below.

Actively poisonous animals possess special organs for poison production and accumulation. They are considered as armed if have special organs for toxin inoculation (spines, sting, fangs and other). Spiders, insects, some fish, snakes are the examples. Unarmed actively poisonous organisms don’t have special organs of poison injection and toxin acts if get on the skin or mucose membranes of a victim (frogs). The fields of medicine and zoology often distinguish a poison from venom, though

these terms are interchangeable. Poison is absorbed through the skin or ingested, while venom is injected into another organism by a bite or sting. Thus, fungi and plants are poisonous and animals can be poisonous (some fish, frogs, salamander and other) or venomous (spiders, scorpions, insects, some fish, snakes).

Secondary poisonous organisms do not produce toxins by themselves. They accumulate toxins taken up from the food or produced by symbionts. If the level of toxicity is high, consuming of such organisms result in secondary poisoning. For instance, during the blooms of toxic marine dinoflagellates algae, feeding bivalve mollusks of Saxidomus genus concentrate the toxin. Consuming of the mollusks contaminated with toxic level of algae saxitoxin leads to neurological symptoms, hypertension and tachycardia (paralytic shellfish poisoning). While most patients recover without treatment, weakness may progress to respiratory paralysis and death. Representatives of several animal phylums are dangerous to human beings.

Venemous Coelenterata

Portuguese man o'war or physalia (Physalia physalis) belongs to phylum Cnidaria (formerly referred to phylum Coelenterata), class Hydrozoa. It is the most dangerous jellyfish found in European waters, most commonly found in the open ocean in tropical and subtropical regions. By the fact it is a colony of tiny animals known as zooids. Colony is translucent, bilaterally symmetrical, with the tentacles at one end. It gets its name from a gas filled blue, purple, pink, or mauve bladder (pneumatophore) which sits above the water and resembles a type of 18th century Portuguese warship. Tentacles grow in average to 10 meters and can reach some times 30 meter in length. They carry the stinging specialized capsules with venomous threads – nematocysts. The venom-filled nematocysts in the tentacles of the Portuguese man o' war can paralyze small fish and other prey. Venom of physalia affects cell membranes, contains ATPase, DNAase, RNAase, fibrinolysin and other enzymes. Stings usually cause severe pain, leaving whip-like, red welts on the skin that normally last two or three days after the initial sting, though the pain should subside after about 1 to 3 hours. However, the venom may cause fever, swelling of the larynx, airway blockage, cardiac distress, and an inability to breathe. In extreme cases can cause death. The First Aid begins with the application of salt water to rinse away any remaining microscopic nematocysts – rubbing or touching the wound causes it the discharge of any nematocysts still attached to the skin.

Box Jellyfish or sea wasp (Chironex Fleckeri) belongs to phylum Cnidaria, class Cubozoa. This jellyfish or the cubozoan bell (named as it is square in horizontal cross section) is widely regarded as the most poisonous animal in the world. Although the notoriously dangerous species of box jellyfish are largely restricted to the tropical Indo-Pacific region, various species of box jellyfish can be found widely, including the Atlantic Ocean and the east Pacific Ocean, the Mediterranean Sea, coastal waters of Japan and South Africa. The bell of the box jellyfish is so transparent that it is nearly invisible; tentacles produce nematocysts with venom. Venom action is necrotic and hemolytic. The immediate sensation is sharp burning pain, after that dermatitis and skin necrosis develop. Once the toxin reaches the blood, blood pressure increases. This can lead to a heart attack, and ultimately death. The First Aid. Flushing with vinegar is used to deactivate undercharged nematocysts to prevent the release of additional venom.

Arthropods include spiders and scorpions (class Arachnida), centipedes and millipedes (subphylum Myriapoda) and insects (class Insecta) with both venomous and poisonous (certain beetles release toxins when are crashed) representatives. Millipedes and centipedes have an elongated body composed of various numbers of segments. They are worldwide in distribution. Millipedes release toxin when pressed or crushed (for instance, while putting a shoe with a

millipede inside). Their body fluids contain toxins (cyanides and other) that cause local inflammation and hyperpigmentation of skin. As a first aid applying alcohol that is toxin solvent soon after contact is useful. Centipedes, that are carnivorous arthropods, inject their venom into a prey by modified first pair of legs. The bite of centipede cause intense pain, local edema and redness. In some cases headache, malaise and anxiety are observed. The representatives of Scolopendra genus reach up to 25–30 cm long and can cause serious injuries. First aid includes washing site of bite with soap and water and application of cold compress.

Representatives of several orders of class Insecta are venomous. Bees, wasps and hornets are venomous insects of order Hymenoptera. They inject venom using a stinger in the abdomen. A honey bee (Apis mellifera, family Apoidea) was one of the first domesticated insect that is kept to this day for production (honey, beeswax, royal jelly, propolis, pollen) and pollination activities. Venom apparatus includes two glands (venom or acidic gland and the alkaline gland) that are associated with the base of the stinger (modified ovipositor). There are backward pointing barbs on a stinger that make its removing difficult. When the bee pulls the stinger away it remains in the skin along with part of the hindgut of the bee, so after the stinging the bee dies. Bee venom contains at least 50 toxic proteins and peptides (melittin, hyaluronidase, phospholipase A, acid phosphatase, histamine and other). These components affect cell membranes by influencing activity of membrane-anchored enzymes and blockage of Ca-dependent potassium channels. Sting of a single bee causes pain, local irritation and swelling. Multiple stings cause renal failure, heart failure and sometimes death. If one has allergy to bee venom even a single sting can cause anaphylactic shock and death. The aggressive hybrids of African and European bees originated in Brazil have caused envenomations and deaths across the Americas. The first aid is careful removing of remaining stinger.

The wasps and hornets belong to the family Vespidae. Example is common wasp (Vespula ulgaris) that originally was native to Europe, but now is met in North America, Africa and Australia and Asian giant hornet (Vespa mandarinia), the world's largest hornet, native to temperate and tropical Eastern Asia. The structure of venomous apparatus is similar to that of honey bee, but stinger is easily removed by the insect. Venom contains mixture of different proteins and peptides with neurotoxic and enzymatic activities, some components can cause hypotension, increasing in vessels permeability and contraction of smooth muscles. Stings are painful. A large number of stings or allergy can lead to death.

Venomous and poisonous Fish belongs to phylum Chordata, class Chondrichthyes (cartilage fish) and Osteichthyes (bony fish). Example of venomous cartilage fish is common stingray (Dasiatis pastinaca). It is found in the northeastern Atlantic Ocean, and the Mediterranean and Black seas. The common stingray has venomous tail span by which it can inflict excruciating wound. Venom causes hypotension, breathing failure and sometimes leads to convulsions and collapse. Another example of venomous stingray species is ocellate river stingray (Potamotrygon motoro) inhabiting river basins in tropical and subtropical South America. Stingrays are dangerous for people who wade in shallow water and tread on them.

The most venomous known bony fish is reef stonefish (Synanceia verrucosa). It inhabits tropical waters of the Pacific and Indian oceans. Reef stone fish is an ambush predator, waiting its prey on the bottom. Its dorsal area is lined with sharp and stiff spines, each of which has venom sacs. Venom has hemolytic and cardyotoxic action. If one steps on the fish spine, it pierces the sole and venom is injected. It results in severe pain, tissue necrosis, paralysis and can be fatal if not treated.

The lionfish (twelve species of Pterois genus)is a venomous coral reef fish. They were thought to be the most venomous fish until recent years when stonefish stole the title. These fish have venomous dorsal, anal, and pelvic spines covered by a loose sheath that moves down and compresses venom glands when the spine punctures tissue. A sting from these fish can cause extreme pain, swelling, and in very severe cases, cardiovascular collapse. First aid includes removing of affected individual away from the water, removing the stinger (if visible) and immersion of the affected limb in a hot water to denature the proteins in the venom.

Example of passively poisonous fish is grass puffer fish (Takifugu niphobles). The species of the pufferfish family are met in the northwest Pacific Ocean. Their intestine, liver and ovary contain the extremely potent poison tetrodotoxin. The poison has neurotoxic action blocking sodium channels of neurons. Consuming of inadequate cooked puffer fish is potentially lethal to human.

Poisonous Amphibians belong to phylum Chordata, class Amphibia. In most of cases intoxication of humans is caused by the contact with skin glands of poisonous amphibians. Example is fire salamander (Salamandra salamandra) of Caudata order which is met in Europe including Ukraine. The distinct feature of fire salamander is black color with yellow spots or strips to a varying degree. The colored portions of the animal skin coincide with location of poisonous glands (usually are concentrated around the head). Toxin causes hypertension and muscle convulsions.

Extremely toxic are poison dart frogs (order Anura) of family Dendrobatidae. It includes about 130 species, inhabiting Central and South America. Examples are Phyllobates terribilis or yellow poison frog, Phyllobates aurotaenia or Kokoe poison frog, Dendrobatus auratus or green-and-black poison dart frog. These are small frogs (up to 47 mm) with brightly colored bodies; intensity of coloration correlates with the toxicity of the species. Steroid alkaloid batrachotoxin and other components of frog's poison keep sodium channels of nerve cells open depolarizing nerve and muscle cells irreversibly. Simply touching of frog can induce life-threatened loss of muscle control, convulsions, paralysis, high fever, arrhythmia and eventually cardiac failure.

The amphibians got name "dart frogs" as indigenous American Indians used toxic secretion of these frogs to poison the tips of blow darts.

Venemous reptiles belong to phylum Chordata, class Reptilia, order Squamata, suborder Serpentes. The venom apparatus of poisonous snakes consists of a modified teeth (the fangs) by which venom is delivered into prey, and the venom glands where toxin is produced and stored. The most dangerous of Europe's snakes are representative of Viperidae family (vipers). Different species (about 60) are found throughout Europe, Asia and Africa. Examples are asp viper or Vipera aspis (southwestern Europe), common European viper or Vipera berus (southeastern Europe, including Ukraine) and meadow viper or Vipera ursine (steppes of Europe and Asia, including Ukraine), blunt-nosed viper or Vipera lebetina (North Africa, Middle East, India). The length varies in different species from 60–65 cm (European vipers) to 160 cm (blunt-nosed viper). Head is broad, triangular and distinct from neck. Most have some kind of zigzag dorsal pattern down the entire length of their bodies and tails. The head usually has distinctive dark V or X-shaped pattern on the back. Venom is produced in main venom glands behind each eye. The fangs are movable and turned to lie to the roof of mouth. This folding allows vipers to have the longest fangs of all venomous snakes. The hollow poison canal runs through the fangs opening at the tip. Poison has hemolytic action. Severity of affection depends on species. In case of European vipers bite local symptoms include intense pain and local swelling. Further symptoms may include hemorrhagic necrosis (the breakdown of blood vessels) at the place of bite and in inner organs, sometimes

cardiovascular failure and faints are observed. In severe cases bite causes death (1 % in case of common European viper bite and 10% in case of blunt-nosed viper bite).

Famous subfamily of Viperids is pit vipers or crotaline snakes found in Eurasia and in North and South America. They are distinguished by the presence of a heat-sensing pit organ located between the eye and the nostril on either side of the head. Representatives of pit vipers are rattlesnakes, lanceheads (endemic to Central and South America) and Asian pit vipers. Rattlesnakes (genus Crotalus) range in size from 50–60 cm to over 150 cm. Most species are easily recognized by their characteristic rattle on the end of their tail. Venom is hemotoxic and neurotoxic. Common symptoms include swelling, severe pain, tingling, weakness, anxiety, nausea and vomiting, hemorrhaging, perspiration, and eventually heart failure and death. First Aid for bites by Viperid snakes is to keep person calm and at rest, remaining to keep venom from spreading. The place of bite should be kept below the level of the patient's heart. Wound should be covered with loose bandage. Most traditional first aid measures are useless and potentially dangerous (cauterization, incision, and suction by mouth). Patient must be transported to the hospital as soon as possible for antitoxic serum injection.

One of the most dangerous families of snakes is Elapidae family found in tropical and ub-tropical regions around the world. Examples are King cobra (Ophiophagus hannah), Egyptian cobra (Naja haje), Indian cobra (Naja naja), spitting cobra (Naja sputatrix), Dendroaspis sp. (mamba).

Cobra snakes are recognizable by their wide hoods, and are able to spit their toxins. Size of these snakes varies from 2 to 5,5 meters depending on species. Cobras have several methods for delivering their venom to their prey. Some cobras can spit their venom into a victim's eyes, causing extreme pain and blindness. However, the most common method of venom delivery is injection into a victim's body through their bite. The fangs are small and non-retractable with anterior groove for venom delivering. Venom is mostly neurotoxic. Ohanin, a protein component of the king cobra venom, causes inhibition of locomotor activity and hyperalgesia (increased sensitivity to pain) in mammals. Other components have cardiotoxic and cytotoxic effects. The ammount of neurotoxin king cobra can deliver in a single bite is enough to kill an elephant or twenty human beings. The toxin is immensely painful, and once it enters the blood stream, it can cause human death within thirty minutes.

Black mamba (Dendroaspis polylepis) is a very dangerous African snake. Black mambas are fast, nervous, and when threatened, highly aggressive. They have been blamed for numerous human deaths. The adult snake is up to three meters long with olive, brownish, gray, or sometimes khaki back skin color. Mamba got its name because of inky black mouth. Poison is neurotoxic and cardiotoxic, causes initial headache, profuse perspiration and salivation, than collapse and death. First Aid is same as in Viperid bite. Proper and immediate treatment with antitoxic serum is critical to avoid death.

Poisonous Plants

Poisonous plants are the plants that produce toxins as a defense from consuming by herbivores animals. Plant toxins (phytotoxins) include vast array of different chemicals like alkaloids, glycosides, terpenoids, anthocyanins, phenols and other that either kill or retard the development of the herbivores. According to the action phytotoxins are divided into neurotoxic, hepatotoxic and nephrotoxic. Some irritates digestive tract, affect skin and have teratogenic action. Same chemical can affect several organs simultaneously. Examples of poisonous plants are given below.

Aconite or wolfsbane (Aconitum napellus) belongs to the flowering plants (Angiosperms or Magnoliophyta), family Ranunculaceae. The name wolfsbane comes from its use by ancient Greek shepherds who would tip there arrows in aconite to kill wolves. Aconite growths throughout northern Europe and Asia and is possibly the most poisonous plant in Europe. It is a perennial plant up to 1 meter tall with hairless stem and rounded leaves divided into 5 to 7 deeply lobed segments. The flowers are dark purple to bluish purple. All parts of the plant contain alkaloid aconitine. It is a potent neurotoxin that can causes vomiting and diarrhea, irregular heartbeat and death from respiratory failure. Just touching the plant can cause severe symptoms whilst ingesting often proves fatal. First aid: make a proper assessment of airway, breathing, circulation and neurological status of the patient. Symptomatic patients should be hospitalized for 24 hours.

Lily of the Valley (Convallaria majalis) belongs to the flowering plants (Angiosperms or Magnoliophyta), family Asparagaceae. It's a perennial flower that grows in the valley (thus its name). It is native of Europe but can be found throughout the cool temeperature Northen hemispere. The stems grow to 15–30 cm tall, with one or two leaves. The flowering plants have a raceme of 5–15 bell-shaped white flowers on the stem apex. All parts of the plant are toxic, containing more than 30 different glycosids with heart-arresting action and saponins. Some clinical symptoms of ingesting this plant include nausea, vomiting, diarrhea, irregular heartbeat and pulse, mental confusion. In extreme cases, it can lead to coma and death. In medicine lily of the valley is effectively used for the treatment of some cardiovascular diseases.

Poisonous Fungi

Poisons produced by fungi are called mycotoxins. Examples of disease causing mycotoxins produced by microfungi are ergot alkaloids and aflatoxin. Ergotamine is produced in the sclerotia of ergot fungus (genus Claviceps), which are common parasites of various cereals (wheat, maize and other herbs). Consuming of bread baked from contaminated flour causes ergotism (St. Anthony's fire). It manifests in two forms: gangrenous and convulsive. Gangrenous form is caused by abnormal blood supply to the extremities due to vasoconstriction. Fingers and toes are mostly affected. Convulsive form is a result of ergotamine neurotoxic effect and manifests as headache, painful seizers and psychosis. Ergot alkaloids are used in medicine as pharmaceuticals.

Aflatoxins are produced by mold fungi of Aspergillus species. These are saprotrophic species that colonize peanuts, maize, and pistachios during gather, transit and storage of harvest. Aflatoxin B1 produced by Aspergillus flavus is the most potent natural carcinogen that causes liver cancer if consumed with food.

Mushrooms regularly cause people poisoning. It is a seasonal phenomenon, associated with the mass gathering of mushrooms, usually in summer and autumn. It can be caused by toxins produced by fungi or accumulation of environmental toxic substances if mushrooms were gathered near the highway, the industrial enterprises and agriculture al lands on which chemicals are used.

The most famous example of poisonous mushrooms is death cap (Amanita phalloides) of phylum Basidiomycota. A. phalloides forms ectomycorrhizas with various broadleaved trees. It is common for Europe, northern Africa and west Asia. In some cases the death cap has been introduced to new regions with the cultivation of non-native species of oak, chestnut, and pine. The large fruiting bodies (mushrooms) appear in summer and autumn; the caps are generally greenish in colour, with a white stipe and gills. It contains two groups of peptide toxins – the amatoxins and phallotoxins. The main amatoxin – α-amanitin inhibits RNA-polymerase II that arrest synthesis of mRNA (transcription) thus synthesis of essential proteins that kills cells. Mostly liver and kidneys are affected. Phallotoxins have toxic effect on liver cells. If a person consumes

a death cap by accident, symptoms do not manifest immediately. Symptoms are delayed but severe affection of internal organs at this period takes place. The first symptoms resolve two to three days after the ingestion. They include abdominal pain, diarrhea and vomiting, later hypotension, tachycardia and jaundice develop. Coma due to fulminant liver failure and accumulation of normally liver-removed substances ends with death in six to sixteen days after the poisoning.

Another well-known poisonous mushroom is fly agaric or fly amanita (Amanita muscaris) of phylum Basidiomycota. It is common throughout the temperate and boreal regions of the Northern Hemisphere. Fly agaric has red cap with yellow to yellowish-white warts. Amanita muscaris contains several toxins one of which, muscimol, is psychoactive. In case of the mushroom consumtion toxic effect appears in 20 to 90 minutes. Manifestations vary and include nausea, low blood pressure, salivation, sweating, loss of equilibrium and mood changes. In severe cases delirium develops. Medical aid. In most of cases consuming of poisonous plants and mushrooms require immediate specialized medical aid and is fatal without treatment.

MCQs for self-control

1. The most potent natural carcinogen aflatoxin B is produced by:

A. Fungi of Aspergillus species

B. Ergot fungus

C. Fly agaric

D. Death cap

E. Water hemlock

2. Passively poisonous is:

A. Honey bee

B. Tiger centipede

C. Lion fish

D. Salamandra

E. Meadow viper

3. Rattle snakes are identified by the:

A. Rattle sound

B. Black body

C. Big eyes

D. Long body

E. Shock sound

4. King cobra is found in:

A. India

B. Japan

C. Europe

D. Africa

E. Arabia

5. Black mamba's back skin color is:

A. Red

B. Brownish

C. Black

D. White

Main literature

1. Medical Biology / Bazhora Yu. I., Bulyk R. Ye., Chesnokova M. M. [et al.]. – 2nd ed. – Vinnytsia: Nova Knyha, 2019. PP. 414-426

List of recommended materials

Main literature

2. 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 rectricted ed. – Hoboken : Pearson Higher Education, 2016. - 560 pp.

3. Chiodini P. L. Atlas of Medical Helmintology 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 & morehttp://www.sci-news.com/news/biology
6. link to the most thought-provoking, well researched online items in the world of science and technologyhttps://scitechdaily.com/news/biology/
7. Web atlas of medical parasitology http://www.atlas.or.kr/about/index.html