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Ulyanovsk State University
Institute of Medicine, Ecology and Physical culture

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METHODICAL RECOMMENDATIONS
for practical work and independent work in the discipline "BIOLOGY"
for first-year students of the Faculty of Medicine

Ulyanovsk – 2019

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К75

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Methodological manual compiled in accordance with the Federal state educational standards in the direction of the preparation "General Medicine". This manual describes in detail the content of the course "Biology", reflects the sequence of topics and their contents, presents questions and tests to prepare for classes and independent work. This greatly facilitates the preparation of students for classes and contributes to a better study of educational material. The peer-reviewed methodological manual contains basic material, selected according to the programmatic issues cited, the sequence of presentation of the material reflects the traditional style of teaching biology.

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INTRODUCTION

***Aims of the discipline*:**

The formation of students scientific world view based on knowledge in biology, fundamental to scientific and practical medicine. To study the fundamental biological mechanisms of life and living systems and based on them questions of anthropogenetic, ontogensis, homeostasis, population genetics and human ecology, as well as master the skills of research and practical work in the field of anthropogenetic, anti-parasitic and vector-borne diseases.

The main **objectives** of the discipline is:

- mastering fundamental theories of biology (cell, gene, chromosomal, evolutionary theory of the origin of life on Earth, the theory of human origins);
- mastering the basic concepts of modern biology;
- studying of systematic and historical approaches to the study of multi-level living systems as a result of the evolutionary process;
- the mastery of the concept of "biological heritage of man" as the defining basis of physical and mental health;
- the study of the cognitive skills of work with biological objects, familiarization with of methods and approaches to studying them.

2. Place of the course in the curriculum:

- Discipline "Biology" is the basic discipline of mathematical and natural cycle of disciplines of the Federal state educational standard of higher professional education specialty “General medicine”;
- Study of biology in medical schools is based on the continuity of knowledge, skills and competencies obtained in the course of biology at secondary schools, as well as knowledge of chemistry, physics, geography, mathematics, history. Students should possess the necessary amount of knowledge in specific disciplines of biology (Botany, Zoology, Anatomy, General biology), which they mastered in secondary schools, and aimed at preparation for entrance examinations for admission to universities.
- Discipline "Biology" is the antecedent for the study subjects: normal physiology, physiology of visceral systems, pharmacology, patological anatomy.

3. Proposed results:

The course is aimed at the following general professional ***competence:*** GPC – 7 - the readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems.

<u>The proposed results of the course</u>

Students have to:

know:

general laws of the origin and evolution of life, anthropogenesis. The theory of biological systems, their organization, cellular and non-cellular forms of life; Cellular organization of living organisms, the distinguishing characteristics of pro - and eukaryotic cells, the role of cellular structures in the life of the cell, the mechanisms of energy production in living systems. Regularities of processes and mechanisms for the storage, transfer and use of biological information in the cell, principles of control of gene expression; Structural and functional organization of genetic material features of the genome of prokaryotes and eukaryotes. Cytological basis of reproduction, gametogenesis, structure of germ cells. The laws of genetics and its importance for medicine. Patterns of heredity and variation in individual development, biological basis of inherited human diseases and methods of their diagnostics. Regularities of individual development of organisms, human ontogenesis, molecular mechanisms of embryonic development, critical periods of ontogenesis. Environmental category environmental health issues, bioecological disease. The phenomenon of parasitism. The morphological features of the parasites, their life cycles, ways of infection, pathogenic action, symptoms, diagnosis, prevention of diseases. Parasitological and medical characteristics of arthropod - vectors and pathogens.

***be able to*:**

use educational, scientific, popular scientific literature, the Internet for professional activities. To use biological equipment. Research with magnifying equipment (microscopes, optical and simple loops). Cooking time and explore their products under a light microscope and magnifying glass. Put a simple biological experiment and analyze the results. Read and analyze the electron diffraction pattern of cell structures. In the form of generalized diagrams show the processes occurring in the cell. Using this notation, to solve problems on mitosis, meiosis, gametogenesis. Explain the causes and possible mechanisms of birth of children with chromosomal diseases. Solve problems on genetics, molecular, make the pedigrees using standard notation, analyze pedigrees. Compile and analyze the ideograms, using the Denver classification system chromosomes. Identify the type of parasite, stage of development of the proposed drug. To solve situational problems in parasitology.

be skilled at:

research with a microscope. Skills cooking time products. Skills mapping studied objects in the figures; Electron diffraction analysis skills. Skills determining of karyotype. Genetic approaches to solving problems. Standard notation for drawing pedigrees. Denver classification system for the analysis of chromosome ideograms microscopy.

TOTAL EMPLOYMENT OF DISCIPLINE
The volume of discipline in credits (total): 7 CU.
By type of academic work (in hours): 252

Type of educational work	**Number of hours**		
	Workload	**Hours per term**	
		1	**2**
Contact work of students with a teacher	144	72	72
Classroom:			
Lectures	36	18	18
Tutorials and practical's work	90	54	54
Independent work	54	36	36
Scope of testing (examination, test, colloquium)	36 Exam	Not provided	36
Total course of workload	252/10*	108	144
Total workload in credit units	7	3	4

Units and formats of academic activities
Form of study: full-time

Units	Total	Format			
		Class studies			Independent work
		Lectures	Laboratory work	Tutorials and work practical's	
Section 1. Cellular and molecular-genetically levels of organization of life					
Unit 1. Introduction to biology. The organization of life on Earth	8	2	-	4	2
Unit 2. Cell – the basic unit of life.	8	2	-	4	2

The most important biopolymers of the cell					
Unit 3. Chemical composition of cells	8	-	-	4	4
Unit 4. Morphofunctional organization of the cell	6	-	-	4	2
Unit 5. Classification and structure of cell organelles	8	2	-	4	2
Unit 6. Cell nucleus	6	2	-	2	2
Unit 7. Features of the organization of the cells of plants, animals and bacteria. Non-cellular forms of life	4	-	-	2	2
Unit 8. The cell as an open system. Energy metabolism	8	2	-	4	2
Unit 9. Cell life cycle	10	2	-	4	4
Section 2. Organismic (ontogenetic) level of organization of biological systems					
Unit 10. Reproduction of organisms	6	2	-	2	2
Unit 11. Genetics – is the science of heredity and variation. Genetic level of	10	2	-	4	4

organization of the genetic information					
Unit 12. Types and variants of Mendelian inheritance. The interaction of genes	6		-	4	2
Unit 13. Chromosomal and genomic levels of organization of the genetic information	6	-	-	4	2
Unit 14. Modification and combined variability	7	1	-	4	2
Unit 15. Mutational variability	7	1	-	4	2
Unit 16. Individual development of organisms	6	2	-	4	2
Unit 17. Embryonic development of organisms	4	-	-	4	2
Unit 18. Regularities and mechanisms of ontogenesis	6	2	-	4	2
Section 3. Population-specific level of organization of the living systems. Biogeocenotic and biosphere levels of organization of the biological systems.					
Unit 19. Evolution	6	2	-	4	2
Unit 20. The notion of biological species.	3	-	-	4	2

Unit 21. Anthropogenesis	6	2	-	4	2
Unit 22. Ecology	5	2	-	4	4
Unit 23. Parasitology. Protists. Class Sarcodina	5	2	-	4	4
Unit 24. Protists. Class Zoomastigophora	7	2	-	4	4
Unit 25. Protists. Classes Sporozoa and Cilliophora	3	-	-	4	4
Unit 26. Class Trematoda. Class Cestoda	6	2	-	6	2
Unit 27. Nemathelminthes. Medical importance of class Arachnids	7	2	-	4	2
Unit 28. Medical importance of class Insects	5	-	-	4	4
TOTAL:	180	36		108	54

Course contents.

Section 1. Cellular and molecular-genetical levels of organization of life.

Unit 1. Introduction to biology. The organization of life on Earth. Biology as a science of patterns, the mechanisms of functioning and development of organisms. Biology in the medical school. The definition of the essence of life. Fundamental properties of life. Evolutionary-based levels of organization of the life. Structure and working principles of the light microscope.

Unit 2. Cell – the basic unit of life. The most important biopolymers of the cell. The stages of development and the basic tenets (basic postulates) of cell theory (M. Schleiden and T. Schwann, R. Virchow). Modern cell theory. The most important biopolymers of the cell. Structure and function of proteins.

Unit 3. Chemical composition of cells. Structure and function of fats, carbohydrates, deoxyribonucleic acid in the cell. Structure, types and functions of RNA.

Unit 4. Morphofunctional organization of the cell. The concept of elementary biological membrane, the model of its structure and function. Transport of substances through the membrane. Characterization of active and passive transport of the membrane. The cytoplasm is the internal environment of the cell, its properties and functions.

Unit 5. Classification and structure of cell organelles. Classification of cell organelles. Structure and function of membrane cell organelles: endoplasmic reticulum, Golgi Complex, lysosomes, mitochondria, plastids of plant cells. Structure and function of membrane cell organelles: ribosomes, centrioles, microtubules, microfilaments. The structure and functions of organelles for specific purposes: cilia and flagella, myofibrils, neurofibril.

Unit 6. Nucleus.

The role of the cell nucleus during the life of the cell. Structure and functions of each part of the cell nucleus: nuclear shell, nucleoplasm, chromatin and nucleolus. Structural organization of chromatin.

Unit 7. Features of the organization of the cells of plants, animals and bacteria. Non-cellular forms of life.

Comparative characteristics of cells prokaryotes and eukaryotes. Comparison of the structure and functions of plant and animal cells. Non-cellular forms of life. Structure and features of vital activity of viruses.

Unit 8. The cell as an open system.

The concept of metabolism and its types. The relationship of plastic and energy metabolism.

Protein biosynthesis in the cell.

Energy metabolism and its stages.

Unit 9. Life cycle of the cell.

Life cycle of the cell. The interphase and its periods. DNA replication. Mitosis, its phases, and biological significance. Cell death and its phases.

Section 2. Organismic (ontogenetic) the level of organization of biological systems.

Unit 10. Reproduction of organisms.

Reproduction is a universal feature of living. Comparative characteristics of asexual and sexual reproduction of organisms. Types of asexual and sexual reproduction of organisms. Parthenogenesis. Meiosis, its phases and biological significance.

Unit 11. Genetics – is the science of heredity and variation. Genetic level of organization of the genetic information. Subject, objectives and methods of genetics. The laws of heredity of Gregor Mendel.

Cytological basis of the laws of Gregor Mendel. Evidence for the role of DNA as the hereditary material. Properties of genetic code. Gene – a functional unit of heredity. Classification, properties and localization of genes. The relationship between gene and trait. Hypothesis Beadle-Tatum. The hypothesis of Jacob-Mono (operon hypothesis). The chemical composition and structure of chromosomes.

Unit 12. Types and variants of Mendelian inheritance. The interaction of genes. The concept of allelic genes. Types of interaction between allelic genes: complete dominance, incomplete dominance, codominance, overdominance. Multiple allelism. Inheritance of blood groups of humans. The interaction of nonallelic genes: epistasis, complementarity, polymeria. Pleiotropy genes.Types and variants of Mendelian inheritance. Monogenic inheritance. Genetics of sex. Autosomal and sex-linked inheritance. Independent and linked recessive inheritance. Polygenic inheritance of the traits. Cytoplasmic inheritance.

Unit 13. Chromosomal and genomic levels of organization of the genetic information. Chromosome as a group of adhesion genes. Chromosomal theory of inheritance by Thomas Morgan. Characterization of the genome of prokaryotes and eukaryotes.

Unit 14. Modification and combined variability. Modification variability, especially, adaptive significance in ontogenesis and evolution. The concept of norm of the reaction. Mechanisms of combined variability (genetic recombination). The value of combined variability in ensuring genotypic diversity.

Unit 15. Mutational variability. Mutational variability. Classifications of mutations. The concept of the genetic, chromosomal mutations. Genomic mutations (euploidiya and aneuplodiya). Genetic, chromosomal and genomic of human disease.

Unit 16. Individual development of organisms. The concept of ontogenesis. Periods of ontogenesis. Gametogenesis (spermatogenesis. oogenesis). Fertilization, and it stages (penetration, activation, nuclei fusion). Cleavage. Yolk distribution in three kinds of egg cells. The Blastula. Types of blastula.

Unit 17. Embryonic development of organisms. Gastrulation, modes early and late gastrulation. The Gastrula, germ layers: ectoderm, mesoderm, and endoderm. Neurulation. Organogenesis. Extraembryonic organs (amniotic membrane, chorion, yolk sac, allantois, placenta): structure and physiological importance.

Unit 18. Regularities and mechanisms of ontogenesis. Differentiation in development. Stages and factors of differentiation. The mechanisms of ontogenesis. Embryonic induction as a mechanism of ontogenesis. The regeneration of organs and tissues as a process of development. The physiological and reparative regeneration. Methods of reparative regeneration.

Section 3. Population-specific level of organization of the living systems. Biogeocoenotic and biosphere levels of organization of the biological systems.

Unit 19. Evolution. Pre-Darwinian evolutionary ideas the period of formation. J.-B. Lamarck´s theory of evolution. The main provisions of the theory of evolution of the Charles Darwin. Modern (synthesis) theory of evolution. Factors of evolution.

Unit 20. The notion of biological species. Microevolution. Macroevolution. Modes of speciation. The species. Criteria for the species. The main directions of evolution (biological progress and regression). Ways to achieve of biological progress (aromorphosis, idioadaptation, total degeneration) and its forms.

Unit 21. Anthropogenesis. The position of Homo sapiens in the animal world. The qualitative uniqueness of the person. Biological and social factors of anthropogenesis. The role of biological factors of the anthropogenesis at the present stage.

Human races and the unity of the human species.

Unit 22. Ecology. Environmental factors: classification and general patterns of action of the environmental factors on a organism. The concept of trophic levels. The rule of the ecological pyramid. The biosphere. Biogeochemical cycles.

Unit 23. Parasitology. Protists. Class Sarcodina. Parasitism as an ecological phenomenon. Classification of animal parasitic forms. Ways of origin of the various groups of parasites. Interaction between parasite and host-level individuals. Factors of the action of parasite on the host organism. Factors action hostess on the parasite. Morphophysiological adaptation to a parasitic lifestyle. Population level of interaction of the parasites and their hosts. The life cycles of parasites. Intermediate and major host. Vector-borne and natural focal, parasitic and infectious diseases. Ecological principles to combat parasitic diseases. General characteristics of the class Sarcodina. Morphophysiology and the life cycle of Entamoeba histolytica. Diagnosis and prevention of amebiasis.

Unit 24. Protists. Class Zoomastigophora. General characteristics of the class Zoomastigophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of trypanosomiasis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of leishmaniasis, trypanosomiasis and giardiasis.

Unit 25. Protists. Classes Sporozoa and Cilliophora. General characteristics of the class Sporozoa. The life cycle of Plasmodium sp., pathogenesis, diagnosis and prevention of malaria. The life cycle of pathogens, pathogenesis, diagnosis and prevention of toxoplasmosis. General characteristics of the class Cilliophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of balantidiasis.

Unit 26. Class Trematoda. Class Cestoda. Types of Platyhelminthes (flatworms). Class Trematoda: The Flukes. The life cycle of pathogens, pathogenesis, diagnosis and prevention of fasciolasis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of opistorhosis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of lung fluke disease. The life cycle of pathogens, pathogenesis, diagnosis and prevention of dicroceliasis. Morphophysiology and the life cycle of blood fluke (Schistosoma).

Class Cestoda: The Tapeworms. The life cycle of pathogens, pathogenesis, diagnosis and prevention of teniasis and cysticercosis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of teniarinhosis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of hymenolepiasis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of diphyllobothriasis.

Unit 27. Nemathelminthes. Medical importance of class Arachnids. Characteristics of class Nematoda (roundworms). The life cycle of pathogens, pathogenesis, diagnosis and prevention of ascariasis, enterobiasis and trichinosis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of ankylostomiasis, strongyloidosis. The life cycle of pathogens, pathogenesis, diagnosis and prevention of guinea worm, filariosis. General characteristics of the class Arachnids. Troop mites: morphology, life cycle, medical value.

Unit 28. Medical importance of class Insects.

Morphophysiological characteristics and life cycle of the class Insects. Morphology, life cycle and medical importance of insects - ectoparasites (lice, fleas, houses and volfartova flies). Insects - the carriers of infectious and parasitic diseases (gnats, mosquitoes, sandflies, tsetse flies, midges), morphophysiological characteristics, life cycle and medical importance.

Practical's and tutorial contents.

Section 1. Cellular and molecular-genetic levels of organization of the life.

Unit 1. Introduction to biology. The organization of life on Earth. Format-practical's.

Discussion questions:

1. Biology as a science of patterns, the mechanisms of functioning and development of organisms.
2. Biology in the medical school.
3. The definition of the essence of life.
4. Fundamental properties of life.
5. Evolutionary-based levels of organization of the life.
6. Structure and working principles of the light microscope.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Fill in the gaps in sentences

1._____ is ability to maintain relatively constant internal conditions, different from their environment.

2._____ - the process of increasing the weight or volume of the structure of the organism, which is accompanied by quantitative changes. For example, increasing the number of cells.

3._____- the process of transition from one state to another, more perfect, the transition from an old qualitative state to a new qualitative state, from simple to complex, from lower to higher.

4._____is the ability to reproduce itself.

5._____ - the ability to coordinate the internal functions of the body.

6._____ is the body's ability to respond to stimuli of the internal and external environment.

TASKS FOR INDEPENDENT WORK

Fill in the gaps in sentences

1._____is group of individuals of one species living in isolation from similar groups of individuals of this species and is characterized by higher levels of interbreeding.

2._____ is a constant structure of the body, consisting of several tissues that have a particular shape, size, and performs a specific function.

3._____is a biological community of living organisms of different species, closely interacting with each other and with their environment, having the ability to self-replicate and self-regulation.

4._____is an open system, bounded from the environment by a membrane and containing within the cytoplasm with organelles and a nucleus.

5._____is a group of organs that together perform a common activity.

6._____is a group of individuals similar in morphological, physiological, biochemical and other characteristics, occupying a certain territory, having panmixia and giving fertile offspring.

7._____is a group of interdependent organisms of different species growing or living together in a specified habitat.

8._____is the totality of the planet's living organisms that inhabit certain areas of the atmosphere, hydrosphere and lithosphere.

9._____ is a group of cells and their derivatives, having a common origin, similar structure and functions grouped together to perform a specific activity.

10._____ is an open system consisting of interconnected organs and organ systems, and have the ability to self-regulation and has new features which are not in individual organ systems.

Unit 2. Cell – the basic unit of life. The most important biopolymers of the cell. Format-practical's.

Discussion questions:

1. The stages of development and the basic tenets (basic postulates) of cell theory (M. Schleiden and T. Schwann, R. Virchow).
2. Modern cell theory.
3. The most important biopolymers of the cell. Structure and function of proteins.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

1. Protein – heteropolymer, the monomers of which are

a) nucleotides

b) amino acids

c) phospholipids

d) nitrogenous bases

2. In the protein amino acids are connected by

a) hydrogen bond

b) ionic bond

c) metallic bond

d) peptide bond.

3. Peptide bond is formed between the carboxyl group of one amino acid and

a) carboxyl group of another amino acid

b) amino group of another amino acid

c) phosphate group of another amino acid

d) hydroxyl group of another amino acid

4. Peptide bond is

a) covalent polar bond.

b) covalent nonpolar bond.

c) hydrogen bond

d) ionic bond

5. Primary structure of the protein

a) chain of amino acids connected by hydrogen bonds

b) chain of amino acids connected by peptide bonds

c) chain of nucleotides connected by peptide bonds

d) chain of amino acids connected by covalent nonpolar bonds

6. Secondary structure of the protein

a) helix

b) globule

c) chain

d) two chain

7. Helix is folded in the form of globules by

a) formation of disulfide bridges between the radicals of amino acids

b) metallic bond

c) peptide bonds

d) covalent nonpolar bonds

8. The enzymes are

a) structural proteins

b) regulatory proteins

c) protective molecules

d) biological catalysts

9. The function of antibodies

a) transport

b) defense

c) catalysis

d) regulation

10. The protein which transports oxygen in the blood

a) insulin

b) hemoglobin

c) myosin

d) tubulin

TASKS FOR INDEPENDENT WORK

Insert missed words

1. Protein – heteropolymer, the monomers of which are _____.

2. In the protein amino acids are connected by _____ bond.

3. Peptide bond is formed between the carboxyl group of one amino acid and _____ of another amino acid.

4. Peptide bond is _____ bond.

5. Primary structure of the protein is chain of amino acids connected by_____ bonds

6. Secondary structure of the protein is _____.

7. Helix is folded in the form of globules by formation of _____between the radicals of amino acids.

8. The enzymes are proteins, which function as _____.

9. The function of antibodies is _____.

10. The protein which transports oxygen in the blood is _____.

Unit 3. Chemical composition of cells. Format- study discussion.

Discussion questions:

1. Structure and function of fats.
2. Structure and function of carbohydrates.
3. Structure and function of deoxyribonucleic acid in the cell.
4. Structure, types and functions of RNA.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1. Choose the correct answer

1. Monomers of DNA are

A. nucleotides

B. amino acids

C. phospholipids

D. nitrogenous bases

2. Each DNA nucleotide is composed of three parts:

A. phosphate, pentose sugar - ribose, nitrogenous base

B. carbonate, pentose sugar - deoxyribose, nitrogenous base

C. phosphate, pentose sugar - deoxyribose, nitrogenous base

D. phosphate, pentose sugar - deoxyribose, glucose

3. DNA consists of 4 types of nitrogenous bases

A. adenine, uracil, thymine, cytosine

B. adenine, guanine, uracil, cytosine

C. adenine, guanine, thymine, cytosine
D. adenine, guanine, thymine, uracil
4. Nucleotides of DNA are linked by
A. covalent polar bond
B. covalent nonpolar bond
C. hydrogen bond
D. ionic bond
5. Covalent polar bond is formed between
A. phosphate grope of one nucleotide and nitrogenous base of the second nucleotide
B. nitrogenous base of one nucleotide and sugar of the second nucleotide
C. nitrogenous base of one nucleotide and nitrogenous base of the second nucleotide
D. phosphate grope of one nucleotide and sugar of the second nucleotide
6. DNA chains are interconnected by
A. covalent polar bond.
B. covalent nonpolar bond.
C. hydrogen bond
D. ionic bond
7. In the DNA double helix:
A. adenine is complementary to thymine
B. adenine is complementary to guanine
C. uracil is complementary to thymine
D. cytosine is complementary to thymine
8. The structure of RNA nucleotides, unlike the DNA includes
A. sugar - ribose and the nitrogenous base adenine
B. sugar - deoxyribose and the nitrogenous base cytosine
C. sugar - deoxyribose and the nitrogenous base uracil
D. sugar - ribose and the nitrogenous base uracil
9. Chromatin is composed of
A. DNA and protein
B. RNA and protein
C. proteins only
D. DNA only
10. Highly condensed chromatin is called
A. euchromatin
B. heterochromatin
C. nucleosome
D. scaffold protein

TASKS FOR INDEPENDENT WORK

Task 1. Add the missing words

1. The process of DNA duplication is called _____.
2. The information in the language of nucleotides is copied into another language – the language of amino acids during the process of _____.
3. The monomers of DNA are _____.
4. Each nucleotide of DNA is composed of three parts: phosphate, _____ and _____.
5. DNA consists of 4 types of nitrogenous bases: adenine, guanine, _____and _____.
6. Polynucleotide molecules are formed when nucleotides are joined together by the formation of _____ bond by reaction between _____ of one nucleotide and the _____ of another nucleotide.
7. DNA chains are interconnected by _____ bond.
8. DNA is found in the _____ in Eukaryotic cells.
9. DNA is found in the _____in prokaryotic cells like bacteria.
10. The structure of RNA nucleotides, unlike the DNA, includes _____ and _____.
11. One _____ codes for one protein.
12. Cells with two copies of the genome are called _____.

Task 2. Find and correct mistakes, if any

1. DNA has two polynucleotide strands: one strand runs 5′ to 3′, whilst the other strand runs in the opposite direction 3′ to 5′.
2. Each nucleotide is composed of a five-membered pentose carbon sugar, a nitrogenous base (purine or pyrimidine) and an amino acid.
3. The purine bases (composed of fused five- and six-membered rings), adenine (A) and guanine (G) and the pyrimidine (a single six-membered ring) cytosine (C) and thymine (T) are found in both RNA and DNA.
4. In the double helix of DNA, nucleotide A pairs only with T, and C pairs only with G.
5. All bacteria, many viruses, mitochondria and chloroplasts have circular DNA.
6. First-order packaging involves the winding of the DNA around a core complex of five small proteins repeated twice, termed histones (H1, H2A, H2B, H3 and H4).
7. During G1 phase, each chromosome is duplicated, identical chromosomes (sister chromatids) remain attached to one another at a point called the centromere.
8. Most plants and animals contain two copies of their genome and called haploid.

9. Genome can be defined as the complete set of genes of a cell, organelle or virus.
10. There is a relation between the size of genome, number of genes, and organism complexity.

Unit 4. Morphofunctional organization of the cell. Format-practical's.

Discussion questions:

1. The concept of elementary biological membrane, the model of its structure and function.
2. Transport of substances through the membrane.
3. Characterization of active and passive transport of the membrane.
4. The cytoplasm is the internal environment of the cell, its properties and functions.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1 - test

1. The basis of the cell membrane is formed

a) by two layers of proteins
b) fatty acids
c) by two layers of nitrogenous compounds
d) by two layers of lipids

2. Each phospholipid has

a) hydrophilic (polar) head and three hydrophobic (nonpolar) tails.
b) hydrophilic (polar) head and two hydrophobic (nonpolar) tails
c) hydrophobic (nonpolar) head and two hydrophilic (polar) tails
d) hydrophilic (polar) tail and two hydrophobic (nonpolar) heads

3. The non-polar tails of the phospholipid molecule consist of

a) two long-chain glycerol
b) two long-chain choline
c) two long-chain fatty acids
d) three long-chain fatty acids

4. The polar heads of phospholipids in the bilipid layer

a) are located on its outer side
b) are located inside
c) are arranged randomly
d) are located both outside and inside

5. Model of membrane structure is

a) sandwich model
b) fluid mosaic model

c) lipid-electron model
d) mathematical model

6. Transmembrane proteins are

a) extrinsic proteins
b) peripheral proteins
c) integral proteins
d) hormones

7. The term fluid mosaic model of membrane structure. is used because

a) many proteins are not fixed but 'float' within the membrane so they are freely mobile within the plane of the phospholipid bilayer
b) proteins form a continuous layer on the surface of lipids
c) lipids form a continuous layer on the surface of proteins
d) many proteins are firmly fixed in the lipid bilayer

8. Polysaccharide layer on the external surface of the plasma membranes of animal cells has been termed

a) glycocalyx
b) cell wall
c) acrosome
d) dictyosome

9. The glycocalyx takes part

a) in cell division
b) in energy metabolism
c) in the formation of intercellular adhesions
d) to the enzymatic cleavage substances

10. Passive diffusion

a) is entirely dependent on the presence of a concentration gradient across the plasma membrane.
b) involves the transport of larger hydrophilic metabolites such as glucose and amino acids.
c) often operates against extreme concentration gradients
d) involves large molecules or small particles being engulfed by the plasma membrane, thus forming membrane-bound vacuoles (vesicles) within the cytoplasm.

Task 2. Add the missing words

1. The basis of the cell membrane is formed by two layers of _____.
2. Each phospholipid has a hydrophilic (polar) head and two hydrophobic _____.

3. The non-polar tail of the phospholipid molecule consists of two long-chain _____.

4. On the external surface of the plasma membranes of animal cells, many of the membrane proteins and some of the membrane lipids are conjugated with short chains of polysaccharide forming _____.

5. The type of transport which entirely dependent on the presence of a concentration gradient across the plasma membrane is called _____.

6. The type of transport which concentration-dependent and involves the transport of larger hydrophilic metabolites with help of so-called 'carriers' with which the metabolites bind specifically is called _____.

7. The type of transport which not only independent of concentration gradients but also often operates against extreme concentration gradients is called_____.

TASKS FOR INDEPENDENT WORK

Task 1 - test

1. Facilitated diffusion

a) is entirely dependent on the presence of a concentration gradient across the plasma membrane.

b) involves the transport of larger hydrophilic metabolites such as glucose and amino acids.

c) often operates against extreme concentration gradients

d) involves large molecules or small particles being engulfed by the plasma membrane, thus forming membrane-bound vacuoles (vesicles) within the cytoplasm.

2. Active transport

a) is entirely dependent on the presence of a concentration gradient across the plasma membrane.

b) involves the transport of larger hydrophilic metabolites such as glucose and amino acids.

c) often operates against extreme concentration gradients

d) involves large molecules or small particles being engulfed by the plasma membrane, thus forming membrane-bound vacuoles (vesicles) within the cytoplasm.

3. Bulk transport

a) is entirely dependent on the presence of a concentration gradient across the plasma membrane.

b) involves the transport of larger hydrophilic metabolites such as glucose and amino acids.

c) often operates against extreme concentration gradients
d) involves large molecules or small particles being engulfed by the plasma membrane, thus forming membrane-bound vacuoles (vesicles) within the cytoplasm.

4. Passive transport of substances through the membrane include
a) osmosis
b) exocytosis
c) endocytosis
d) pinocytosys

5. Active transport of substances through the membrane include
a) osmosis
b) diffusion
c) endocytosis
d) facilitated diffusion

6. If the cells placed in a hypotonic solution
a) the water will penetrate from the cell to the outside
b) the water will penetrate in cell
c) cell shrinks
d) the cell does not change

7. If the cells placed in hypertonic solution
a) the water will penetrate from the cell to the outside
b) the water will penetrate in cell
c) cell ruptures
d) the cell does not change

8. Phagocytosis
a) the process of penetration into the cell liquid droplets
b) the process of penetration of solid particles into the cell
c) the process of penetration of water into the cell
d) the process of penetration ions into the cell

9. Pinocytosis
a) the process of penetration into the cell liquid droplets
b) the process of penetration of solid particles into the cell
c) the process of penetration of water into the cell
d) the process of penetration ions into the cell

10. Cholesterol molecules of membrane can
a) play the role of enzymes
b) stabilise the phospholipid bilayer
c) participate in the process of osmosis
d) participate in the formation of cell-cell contacts

Task 2. Fill in the table "Transport across plasma membranes"

Type of transport	Dependence from concentration gradients	Examples of transported materials	Structures of membranes involved in the transport of substances
Passive diffusion			
Facilitated diffusion			
Active transport			
Bulk transport			

Unit 5. Classification and structure of cell organelles. Format-practical's.
Discussion questions:

1. Classification of cell organelles.
2. Structure and function of membrane cell organelles: endoplasmic reticulum, Golgi Complex, lysosomes, mitochondria, plastids of plant cells.
3. Structure and function of membrane cell organelles: ribosomes, centrioles, microtubules, microfilaments.
4. The structure and functions of organelles for specific purposes: cilia and flagella, myofibrils, neurofibril.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

1. The composition of the outer membrane of the cell includes:

a) proteins and lipids
b) carbohydrates and RNA
c) DNA and RNA
d) carbohydrates and DNA

2. The cell membrane organelles include

a) ribosomes
b) cell center

c) mitochondria
d) microtubules

3. The function of ATP synthesis in the cell is performed

a) ribosomes
b) cell center
c) mitochondria
d) microtubules

4. Protein synthesis was carried out in a cell

a) ribosomes
b) cell center
c) mitochondria
d) microtubules

5. The two membranes are limited

a) ribosomes
b) cell center
c) mitochondria
d) microtubules

6. Synthesis of complex substances in the cell provides a simple

a) Golgi complex
b) cell center
c) mitochondria
d) granular EPS

7. Dictyosome part of the

a) Golgi complex
b) cell center
c) mitochondria
d) granular EPS

8. Have their own DNA

a) Golgi complex
b) cell center
c) mitochondria
d) granular EPS

9. A stack of flat tank called the Golgi complex

a) dictyosome
b) matrix
c) chromatin
d) cristae

10. The liquid contents of mitochondria is called

a) dictyosome

b) matrix
c) chromatin
d) cristae

11. The function of storing genetic information in the cell is performed

a) ribosomes
b) microfilaments
c) mitochondria
d) core

12. The transport function of the membrane is provided

a) lipids
b) surface proteins
c) carbohydrates
d) integral proteins

13. rRNA and proteins are part of

a) ribosomes
b) microfilaments
c) mitochondria
d) core

14. The structures formed by the mitochondrial inner membrane, called

a) thylakoids
b) crista
c) grana
d) stroma

15. The pigment chlorophyll contained in

a) chloroplasts
b) chromoplasts
c) lekoplastah
d) leukocytes

16. The function of photosynthesis performed

a) chloroplasts
b) chromoplasts
c) lekoplasty
d) leukocytes

TASKS FOR INDEPENDENT WORK

Insert the missing word or answer the questions

1. The _____ is composed of DNA and protein.

A. chromatin
B. ribosome

C. flagellum
D. centriole
E. mitochondrion

2. Ribosomal subunits are manufactured by the _____.

A. peroxisome
B. lysosome
C. smooth endoplasmic reticulum
D. rough endoplasmic reticulum
E. nucleolus

3. _____ are the sites of protein synthesis.

A. Peroxisomes
B. Ribosomes
C. Golgi apparatuses
D. Mitochondria
E. Microfilaments

4. Which of these manufactures cellular membranes by adding membrane proteins and phospholipids to its own membrane?

A. ribosomes
B. nucleolus
C. Golgi apparatus
D. rough endoplasmic reticulum
E. lysosomes

5. The _____ is a selective barrier, regulating the passage of material into and out of the cell.

A. plasma membrane
B. lysosome
C. nuclear envelope
D. chloroplast
E. nucleus

6. Where is calcium stored?

A. centrioles
B. mitochondria
C. smooth endoplasmic reticulum
D. microtubules
E. rough endoplasmic reticulum

7. Which of these are hollow rods that shape and support the cell?

A. plasma membrane
B. peroxisomes
C. microtubules

D. microfilaments

E. chloroplasts

8._____ is/are identical in structure to centrioles.

A. Chromatin

B. Mitochondria

C. Basal bodies

D. Nuclear envelopes

E. Microfilaments

9. Which of these cannot rapidly pass directly through the phospholipids of the plasma membrane?

A. Water, glucose and hydrogen ion

B. Water

C. Hydrogen ion

D. Lipid soluble molecule

E. Glucose

10. What name is given to the process by which water crosses a selectively permeable membrane?

A. passive transport

B. phagocytosis

C. pinocytosis

D. osmosis

E. diffusion

11. Which of these organelles carries out cellular respiration?

A. smooth endoplasmic reticulum

B. mitochondrion

C. chromatin

D. ribosomes

E. nucleolus

Unit 6. Nucleus. Format-practical's.

Discussion questions:

1. The role of the cell nucleus during the life of the cell.
2. Structure and functions of each part of the cell nucleus: nuclear shell, nucleoplasm, chromatin and nucleolus.
3. Structural organization of chromatin.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

1. In DNA, _____ binds to thymine, guanine binds to _____ through _____ bonds.
2. A molecule of DNA or RNA is a polymer of _____.
3. Nucleosomal filament is_____.
4. Nucleus functions _____.
5. The double helix structure of a molecule of DNA is stabilized_____.
6. In DNA double helix a region along one DNA strand has this sequence of nitrogenous bases:

5'-TACGGTTAGGCCT-3'.

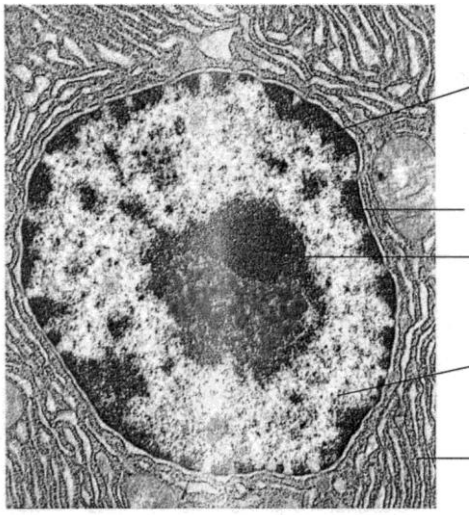
List the base sequence along the other strand molecule, clearly indicating the 5' and 3' ends of this strand.

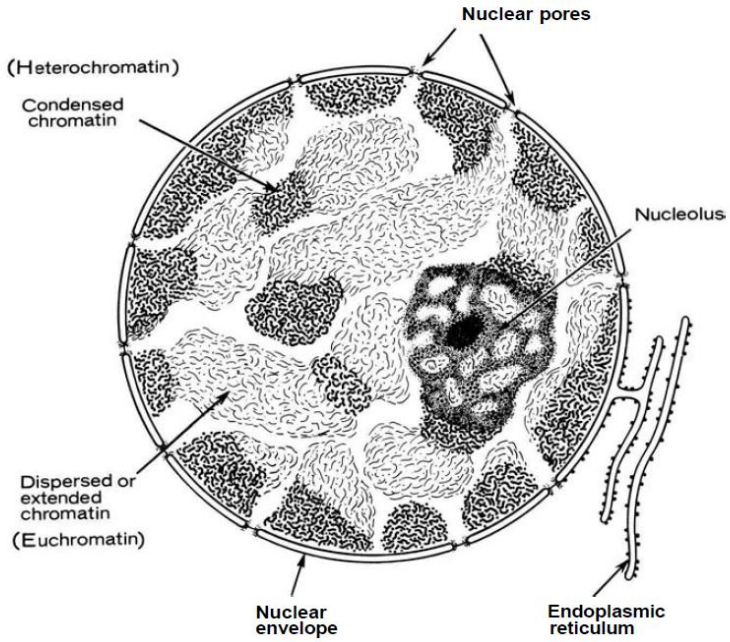
7.
8. Each nucleotide is composed of three parts _____.
9. Chromatin fiber is_____.
10. _____ is almost not visible in the light microscope and contains functionally active DNA.
11. The nucleus consists of nuclear envelope, _____,_____, nucleoli.
12. Each pore consists of a ring of _____ with a central channel.
13. Chromatin is the complex of _____with _____.
14. _____ has the form of grains and clumps in the light microscope , contains functionally inactive DNA
15. _____ is an electron-dense body, is a place where accumulate a large number of organic materials, large and small subunits of the ribosomes around the fragment of DNA encoding rRNA.
16. The function of the nucleolus is _____
17. The nuclear envelope contains numerous _____.

TASKS FOR INDEPENDENT WORK

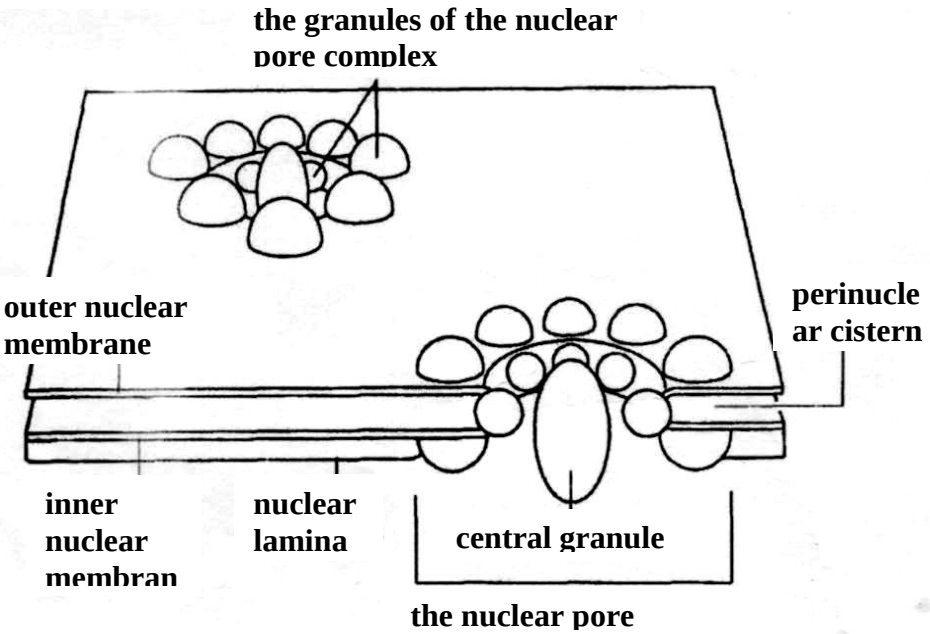
Task 1. Consider an electron micrograph of the nucleus.

Draw the micrograph. Mark the corresponding figures the following structures: the nuclear envelope (1), heterochromatin, occupying a peripheral position (2), euchromatin (4), the nucleolus (3), tanks EPS (5). Describe the main differences between heterochromatin from euchromatin.

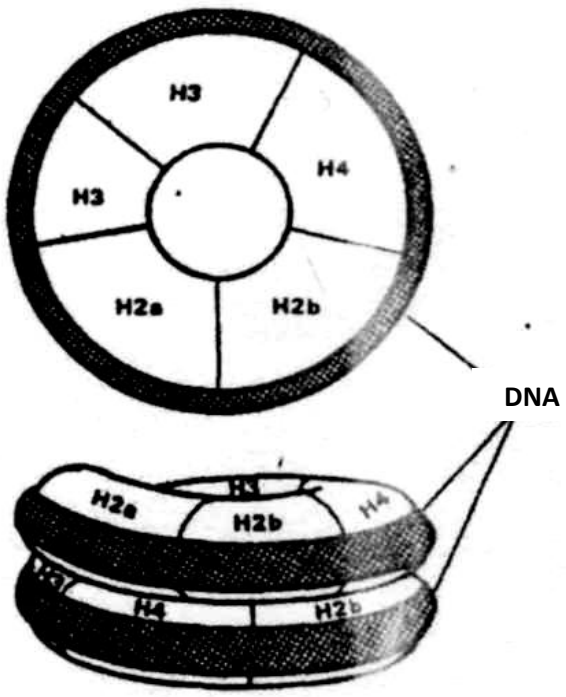



Nuclear pores
(Heterochromatin)
Condensed chromatin
Nucleolus
Dispersed or extended chromatin
(Euchromatin)
Nuclear envelope
Endoplasmic reticulum

Task 2. Look at the diagram of the structure of the pore complex.



The nuclear pore complex formed by 8 large protein granules, forming a circle near the edge of the pores and connecting the two nuclear membranes (inner and outer). Often at the center of the pores present large central pellet. It consists of newly synthesized subunits of the ribosome that was transported into the cytoplasm.

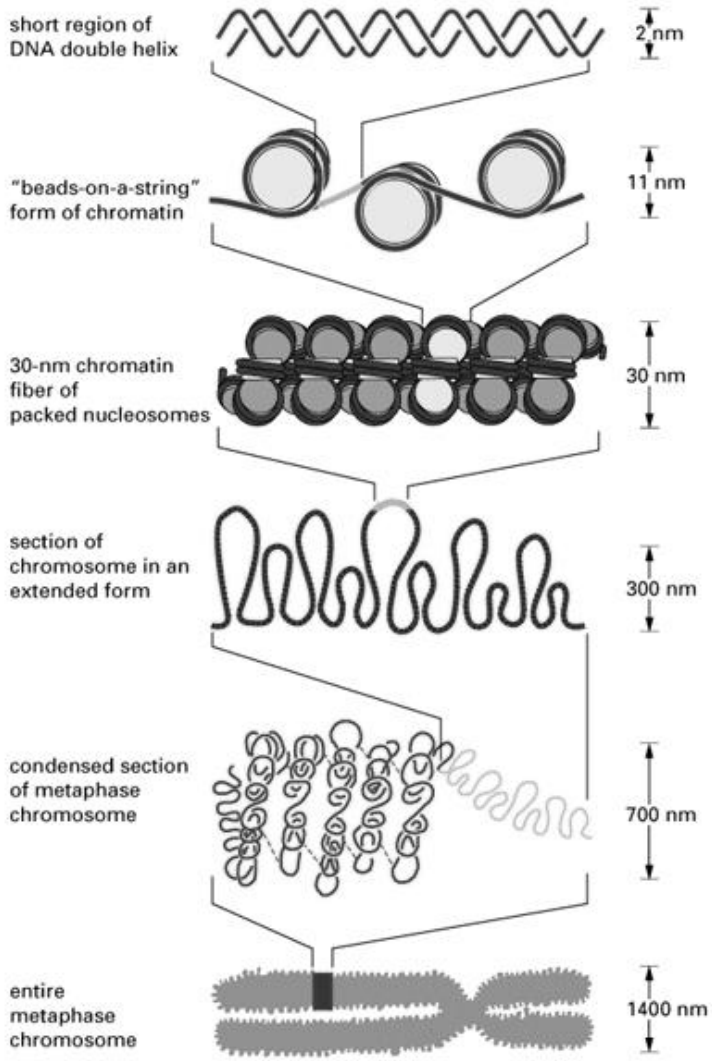


Task 3. Consider the structure of nucleosome.

Two copies of histones H2A, H2B, H3 and H4 form octamer. The DNA double helix lies on the surface of octamer and wrapped around it. The histone H1 connect the nucleosome.

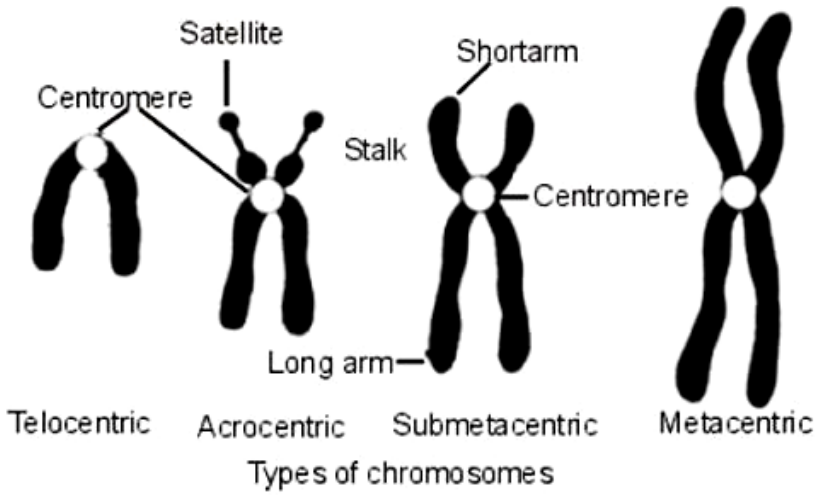
Draw the scheme of nucleosome, make a notation.

Task 4. Levels of packaging of chromatin in the cell nucleus.
Draw levels of DNA packaging, make a notation.



Task 5. Classification of chromosomes.

Consider the main types of chromosomes, draw them.



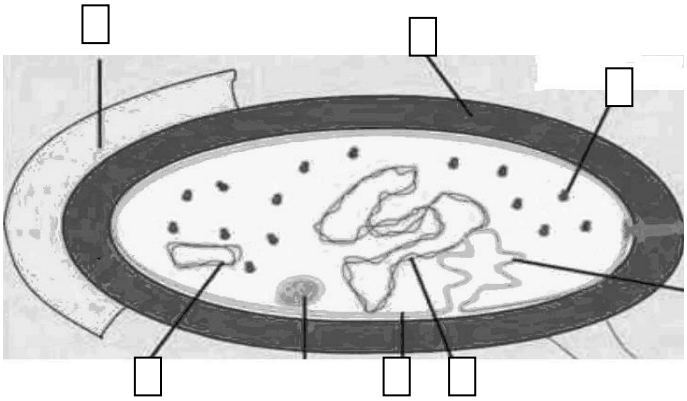
Unit 7. Features of the organization of the cells of plants, animals and bacteria. Non-cellular forms of life. Format- study discussion.

Discussion questions:

1. Comparative characteristics of cells prokaryotes and eukaryotes.
2. Comparison of the structure and functions of plant and animal cells.
3. Non-cellular forms of life.
4. Structure and features of vital activity of viruses.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1. Consider the structure of bacteria. Draw the scheme and make a mark. What structures are labeled 1-6?

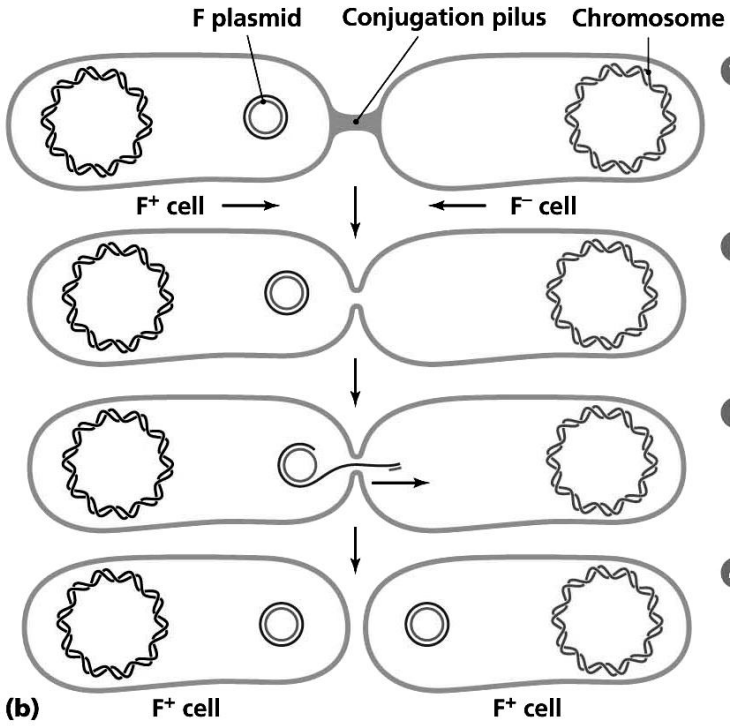


Task 2. Fill in the table "The difference between prokaryotes from eukaryotes"

Main features	Prokaryotes	Eukaryotes
Polysaccharide which is part of the cell wall		

The presence of the nucleus		
DNA characterization		
The presence of membranous organelles		
The presence of nonmembranous organelles		
The presence of plasmids		
Kinds of reproduction		

Task 3. Consider the scheme of bacterial conjugation.



TASKS FOR INDEPENDENT WORK

Task1. Complete the sentences:

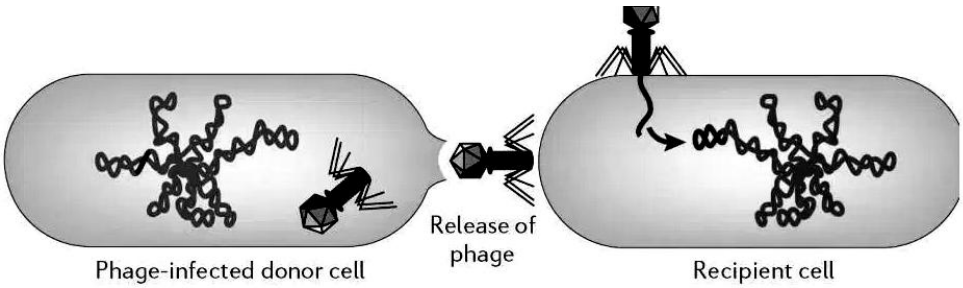
1. Some bacteria has additional DNA called _____.

2. Donor bacterium having the plasmid may form _____ by using sexual rod with a bacterium which has no plasmid.

3. First, double-stranded plasmid DNA is separated into two chains. One of the chains is transferred to _____.

4. Then, each bacterium completes the missing chain on the principle of _____.

Task 2. Consider the scheme of bacterial transduction.



Answer the questions in writing:

1. Who carries the fragment of DNA from one bacterium to another during transduction?
2. What to do after the penetration of the virus into a bacterium?
3. What is produced when the virus capsid surrounds the DNA of the bacteria?

Task 3. Read the text, find errors and correct them.

1. Viruses are permanent parasites that exhibit properties of living outside the host cell.
2. Heredity, variation and reproduction are characterized for viruses.
3. Outside the host cell viruses behave like structure of animate nature.
4. The viruses is a bridge between the animate and inanimate nature.
5. Viruses are not specific. They penetrate into the cells of a different type.
6. Viruses have the receptors to specific cells.
7. Animal viruses enter the cell by through the damaged cell wall.
8. Viruses bacteria - bacteriophages - enter the cell by injection.
9. The virus protein coat (capsid) is formed on the base of the nucleic acid of the host cell.
10. Virions leave the cell, either simultaneously or progressively by one.

Unit 8. The cell as an open system. Format-practical's.

Discussion questions:

1. The concept of metabolism and its types. The relationship of plastic and energy metabolism.
2. Protein biosynthesis in the cell.
3. Energy metabolism and its stages.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1. Choose the correct answer:

1. The function of tRNA is to

A. provide a site for polypeptide synthesis

B. transport amino acids to the ribosome
C. travel to the ribosome to direct the assembly of polypeptides
D. transcribe DNA
E. translates DNA

2. The function of mRNA is to
A. provide a site for polypeptide synthesis
B. transport amino acids to the ribosome
C. travel to the ribosome to direct the assembly of polypeptides
D. transcribe DNA
E. translates DNA

3. Together with proteins, rRNA
A. provides a site for polypeptide synthesis
B. transports amino acids to the ribosome
C. travels to the ribosome to direct the assembly of polypeptides
D. transcribes DNA
E. translates DNA

4. Transcription is initiated when RNA polymerase binds to
A. a promoter
B. an initiator
C. a transcriptor
D. a codon

5. Each time a nucleotide is added as the transcription bubble passes down the DNA, the RNA-DNA complex
A. elongates
B. rotates
C. shrinks
D. disassembles

6. Eukaryotic mRNA transcripts are protected from modification by
A. 5' caps
B. 5' poly-A caps
C. 3' caps
D. 5'-3' poly tails

7. In the process of transcription
A. the base sequence of DNA is copied into tRNA
B. a polypeptide is formed as specified by the genes in a chromosome
C. rRNA is specified by exons in DNA
D. a strand of mRNA is formed with base sequences complementary to those of DNA

E. mRNA is formed as coded by introns

8. The direct result of transcription is:

A. a duplicate DNA molecule
B. an RNA polymerase
C. a protein
D. mRNA
E. none of the above

9. The process of _____ cuts introns from the primary transcript and the final "processed" mRNA is produced.

A. RNA cleaving
B. RNA translocation
C. RNA elongation
D. RNA splicing
E. RNA releasing

10. Modifications of 3' ends of eukaryotic mRNA is called

A. polyadenylation
B. capping
C. splicing
D. translation

Task 2. Fill in the table

Type of RNA	Function	Location
rRNA		
mRNA		
tRNA		
snRNA		
snoRNA		
siRNA		
miRNA		

Task 3. Add the missing words

1. Most prokaryotic genes are made up of ____ main regions. At the centre, there is the sequence which will be copied in the form of RNA, called _____. To the 5′ side (upstream) of the strand which will be copied (the plus (+) strand) lies a region called the_____, and downstream of the transcription unit is the _____ region.

2. In prokaryotes the arrangement of genes in a functional group is called _____. The genes are closely packed with very few _____ gaps.

3. A single primary transcript (pre-mRNA) or “polycistronic mRNA” contains information from multiple genes, or _____.

4. The lactose (lac) operon encodes _____ involved in the regulation of _____ metabolism in *E. coli*. It contains three structural genes: ____, ____ and ____.

5. In bacteria, the structural genes are transcribed as a single mRNA, under control of one _____ and a regulator gene with its own _____.

6. In the absence of lactose, _____ synthesised by the regulator gene binds to the _____ DNA site and blocks RNA polymerase from binding the promoter.

7. In the presence of lactose, allolactose (a lactose isomer) binds _____ and cause its conformational change which alters its _____ domain. Catabolite activator protein (CAP) binds its DNA site (the CAP site) and recruits _____ to the promoter.

8. Compared to prokaryotic operons, eukaryotic genes devoted to a single pathway are most often physically _____ in the DNA; indeed such genes usually are located on different _____.

9. The eukaryotic genes exist in pieces of coding sequence, _____, separated by non-protein-coding segments, _____.

10. Some of the bacterial RNA and most of the eukaryotic RNA are _____ to various extent after their synthesis.

Task 4. Find and correct mistakes, if any

1. In prokaryotes, RNA polymerase binds to the promoter on DNA and starts building the RNA chain complementary to the minus (-) strand of the DNA, moving along this strand in a 5′ to 3′ direction.

2. Rho-independent terminators cause termination of transcription in the absence of any external factors by encoding an inverted nucleotide repeat.

3. Transcription of an operon produces several pre-mRNAs each encoding one structural gene.

4. In eukaryotes, TFIIB factor binds to the TATA box and recruits other general transcription factors and RNA polymerase II to the gene promoter.

5. The process of termination in RNA polymerase III involves hairpin-dependent termination similar to rho-independent termination of transcription in prokaryotes.

6. RNA Polymerase II continue to transcribe RNA until the terminator region.

7. The 5′ terminal cap is necessary for protection of mRNAs from degradation.

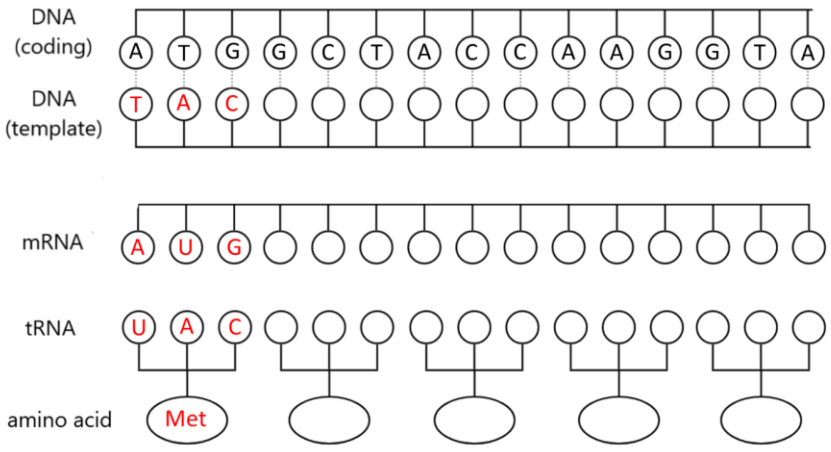
8. After cleavage and release of the mRNA, the 3′ end of almost all eukaryotic mRNAs is methylated.

9. In the process of alternative splicing different mRNAs are produced from the hnRNA transcripts from different genes.

10. An exon from one pre-mRNA can join to an exon from another pre-mRNA by the process called trans-splicing.

TASKS FOR INDEPENDENT WORK

Task 1. Following the example fill in the nucleotide and polypeptide chains produced as a result of transcription and translation of the coding DNA sequence:



Task 2. Choose the correct answer:

1. The genetic code consists of groups of three nucleotides called

A) codon
B) intron
C) anticodon
D) reading frame
E) exon

2. In eukaryotes, there are _____ codons that specify amino acids.

A) 21
B) 24
C) 61
D) 64
E) 60

3. Protein is a heteropolymer, the monomers of which are

A) nucleotides

B) amino acids
C) phospholipids
D) nitrogenous bases
4. In a protein, amino acids are connected by
A) hydrogen bonds
B) ionic bonds
C) metallic bonds
D) peptide bonds
5. Peptide bond is formed between the carboxyl group of one amino acid and
A) carboxyl group of another amino acid
B) amino group of another amino acid
C) phosphate group of another amino acid
D) hydroxyl group of another amino acid
6. Peptide bond is
A) covalent polar bond
B) covalent nonpolar bond
C) hydrogen bond
D) ionic bond
7. Primary structure of the protein
A) chain of amino acids connected by hydrogen bonds
B) chain of amino acids connected by peptide bonds
C) chain of nucleotides connected by peptide bonds
D) chain of amino acids connected by covalent nonpolar bonds
8. Secondary structure of the protein
A) helix
B) globule
C) chain
D) two chain
9. Helix is folded in the form of globules by
A) formation of disulfide bridges between the functional groups of amino acids
B) metallic bond
C) peptide bonds
D) covalent nonpolar bonds
10. In mitochondrial genomes, _____ is a "stop" codon.
A) UGA
B) UUU
C) AUA
D) UAA
E) AGA

11. In mRNA, the series of nucleotides CCC specifies
A) serine
B) proline
C) alanine
D) arginine
E) stop
12. In eukaryotes, the "start" codon also specifies the amino acid,
A) phenylalanine
B) valine
C) aspartate
D) methionine
13. The order in which nucleotides are moved along the ribosomes binding sites is
A) APE
B) PEA
C) EPA
D) EAP
14. In the formation of an initiation complex, a _____ is positioned first.
A) met-tRNA
B) ser-tRNA
C) tyr-rRNA
D) mval-tRNA
E) cyst-tRNA
15. Enzymes called amino acyl-tRNA synthetases
A) synthesizes tRNA
B) attaches amino acids to tRNA
C) strips tRNA from its amino acid in the process of translation
D) destroys excess tRNA molecules
E) helps tRNA synthesize amino acids
16. In mRNA the "start" sequence is
A) UAA
B) UAG
C) UGA
D) AUG
E) GUU
17. In the process of translation,
A) a strand of mRNA is formed with nucleotide sequences complementary to those of DNA
B) nucleotide sequences of tRNA are established

C) a polypeptide is formed in response to the rRNA nucleotide sequence
D) rRNA is synthesized with sequences complementary to those of tRNA
E) a polypeptide is formed as dictated by the nucleotide sequence in mRNA

18. A molecule of tRNA with the anticodon AAA will transport the amino acid
A) phenylalanine
B) lysine
C) proline
D) glycine
E) arginine

19. In messenger RNA, the nucleotide series UAG specifies
A) arginine
B) serine
C) stop
D) proline
E) aspartate

20. The direct result of translation is:
A) a duplicate DNA molecule
B) nRNA
C) a protein
D) mRNA
E) all of the above

21. Eukaryotic large ribosome subunit is
A) 30S
B) 40S
C) 50S
D) 60S
E) 70S

22. Prokaryotic large ribosome subunit is
A) 30S
B) 40S
C) 50S
D) 60S
E) 70S

23. Which of the following act as a template for the process of protein synthesis that takes place on ribosomes?
A) rRNA
B) DNA
C) tRNA
D) mRNA

24. The Shine-Dalgarno sequence is
A) a Wobble position
B) a stop codon
C) the reading frame of a gene
D) a short sequence that acts as a ribosomal binding site

Task 3. Insert the correct word:

1. Protein is a heteropolymer, the monomers of which are _____.
2. In the protein amino acids are connected by _____ bond.
3. Peptide bond is formed between the carboxyl group of one amino acid and _____ of another amino acid.
4. Peptide bond is _____ bond.
5. Primary structure of the protein is chain of amino acids connected by_____ bonds.
6. Secondary structures of the protein are _____ and _____.
7. α-Helix is folded in the form of globules by formation of _____between the functional groups of amino acids.
8. The folding of a newly synthesized protein is facilitated by other proteins called _____.
9. _____ increase the diversity of amino acids in proteins from 20 to about 100.
10. Insulin, synthesized as a longer precursor polypeptide, forms by two _____.

Task 4. Find and correct mistakes, if any:

1. The process of linking an amino acid to its specific tRNA is termed charging.
2. Anticodon in the rRNA base-pairs with a codon in mRNA so that the activated nitrogenous bases can be added to the growing polypeptide chain.
3. The number of tRNAs in most cells is more than the number of amino acids used in protein synthesis.
4. There are four tRNA binding sites on a ribosome.
5. Both prokaryotes and eukaryotes contain two different methionine tRNAs.
6. During initiation, the ribosome is assembled at the initiation codon in the rRNA with a methionyl initiator tRNA.

7. Both bacterial and eukaryotic cells build initiation complexes on the large ribosomal subunit.

8. The initiation codon in bacterial mRNA is usually AUG, but it can also be GUG, or more rarely, UUG.

9. The first peptide bond forms by the enzyme called peptidyl transferase, which is a part of the small ribosomal subunit.

10. The termination of translation occurs when a stop codon (UAG, UAA, or UGA) enters in the ribosomal A-site.

Unit 9. Life cycle of the cell. Format-practical's.

Discussion questions:

1. Life cycle of the cell.
2. The interphase and its periods.
3. DNA replication.
4. Mitosis, its phases, and biological significance.
5. Cell death and its phases.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1. Add the missing words

1. DNA replication process is based on the principle of _____.
2. DNA replicates in a _____ manner, i.e. each daughter duplex has one parental strand and one new strand.
3. DNA synthesis occurs from ___′ to ___′.
4. Enzymes that polymerize nucleotides into a new DNA strand are called _____.
5. The replication process starts at unique segments in a DNA molecule called _____.
6. The DNA under the control of one replication origin is called _____.
7. A specialized RNA polymerase called primase in E.coli or _____ in eukaryotes forms a short _____ complementary to the unwound template DNA strands.
8. DNA polymerases can add nucleotides only in the __′ to __′ direction from the RNA primer.
9. Finally, an enzyme called _____ joins the adjacent Okazaki fragments.
10. The process of ending DNA replication is called _____.

Task 2. Choose the correct answer

1. A template strand of DNA is 3' TAGGCATTGCA 5'. What is the complementary DNA strand that is created from this template during replication?

A. 5′ TGCAATGCCTA 3′

B. 5′ ATCCGTAACGT 3′

C. 5′ AUCCGUAACGU 3′

D. 5′ TAGGCATTGCA 3′

2. Which of the following correctly pairs the DNA replication enzyme with its function?

A. Topoisomerases work ahead of the replication fork to prevent supercoiling.

B. DNA polymerase I opens up the DNA at the replication fork.

C. Helicase seals gaps between DNA fragments.

D. DNA primase extends primers by adding nucleotides to the 3' prime end.

3. Which enzyme is responsible for binding Okazaki fragments together?

A. DNA ligase

B. DNA polymerase

C. RNA primase

D. DNA helicase

4. DNA replication results in two DNA molecules,

A. each one with two original strands

B. each one with two new strands

C. each one with one new strand and one original strand

D. one with two new strands and the other with two original strands

5. What enzyme cuts hydrogen bonds between strands of DNA during replication?

A. DNA ligase

B. DNA polymerase

C. RNA primase

D. DNA helicase

6. DNA polymerase synthesizes a daughter DNA chain in the direction of:

A. 5′ - 3′

B. 3′- 5′

C. 5′ - 5′

D. 3′ - 3′

7. Okazaki fragments contain the following number of nucleotides in eukaryotes:

A. 100-200

B. 1000-2000

C. 10-20

D. 10000-20000

8. RNA primers in prokaryotes are synthesized by the enzyme:

A. DNA ligase

B. DNA polymerase

C. RNA primase

D. DNA helicase

9. The lagging DNA chain is formed in the period:

A. Elongation

B. Termination

C. Initiation

D. Transcription

10. Fragments of Okazaki are formed in the period:

A. Elongation

B. Termination

C. Initiation

D. Transcription

Task 3. Find and correct mistakes, if any

1. DNA replicates in a conservative manner, i.e. each daughter duplex has one parental strand and one new strand.
2. DNA synthesis occurs from 5′ to 3′.
3. Nucleotides are added one at a time to the 5′ hydroxyl end of the DNA chain, forming new phosphodiester bonds.
4. Enzymes that polymerize nucleotides into a new DNA strand are called DNA ligases.
5. DNA polymerases can only add nucleotides in the 3′ to 5′ direction by catalyzing the formation of a phosphodiester bond between the first 5′-phosphate group of a new dNTP and the 3′-hydroxyl group of the last nucleotide in the newly synthesized strand.
6. The replication process starts at unique segments in a DNA molecule called replication origins.
7. Eukaryotic chromosomes have only one replicon.
8. In eukaryotic cells specific initiator proteins recognize and bind origin DNA sequences, forming an origin recognition complex (ORC).
9. A specialized RNA polymerase called primase in *E. coli* forms a short DNA primer complementary to the unwound template DNA strands.
10. The replicative polymerases can generate spontaneous errors when copying DNA.

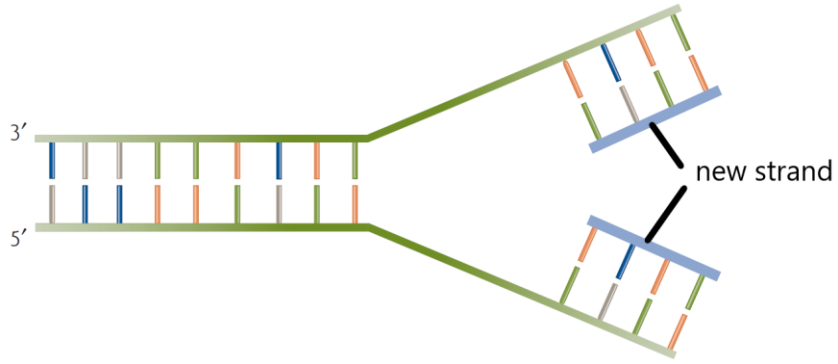
TASKS FOR INDEPENDENT WORK

Task 1. Answer the questions

1. What are the main features of DNA replication?
2. How much faster the replication happens in bacteria compared to mammals?
3. Which strand grows continuously towards the replication fork in semidiscontinuous replication?
4. What are the enzymes that participate in the replication process?
5. What enzyme replaces RNA primer on the leading strand with DNA?
6. What is the name of the fragments of the lagging strand?
7. What is a replicon? How many replicons are in *E. coli* and eukaryotic cells?
8. Why the formation of the origin recognition complex (ORC) is important in eukaryotes?
9. Which enzyme activity is responsible for the proofreading during the replication?

Task 2. The diagram below shows a replication fork in nuclear DNA.

1. Label the "leading strand" and "lagging strand" and indicate to which DNA strand Okazaki fragments are added.
2. Use arrows to show the direction of synthesis for each strand.



[*modified from Allison, L. Fundamental molecular biology, Blackwell Publishing, Malden, MA, 2007, 725 pp.*]

Section 2. Organismic (ontogenetic) the level of organization of biological systems.

Unit 10. Reproduction of organisms. Format-practical's.

Discussion questions:

1. Reproduction is a universal feature of living.
2. Comparative characteristics of asexual and sexual reproduction of organisms.
3. Types of asexual and sexual reproduction of organisms.
4. Parthenogenesis.
5. Meiosis, its phases and biological significance.

TASKS FOR INDEPENDENT WORK

Find mistakes in the sentences (if any) and correct them:

1. Meiosis is an indirect cell division in which one diploid mother cell forms 4 haploid daughter cells, the genetic material which is the same as the parent cells.

2. Leptotene is stage of prophase I when DNA despiralized and chromosomes become visible in the form of thin fibers.

3. Each bivalent consists of 2 homologous chromosomes (2 chromatids (DNA)).

4. Formation of bivalents occurs at pachytene.

5. Crossing over is the exchange of parts between bivalents.

6. Chiasmata become visible in diplotene.

7. Bivalents line up on the equator of the cell in metaphase II.

8. The microtubules are attached to kinetochores only on one side of each centromere in anaphase I.

9. The independent assortment of chromosomes occurs in anaphase II.

10. The nuclear membrane reforms around each daughter nucleus in prophase.

11. Spindle fibers bind to both sides of the centromeres of chromosomes in telophase II.

12. Cytokinesis occurs in anaphase of mitosis.

13. The nuclear membrane disintegrates in metaphase II of meiosis.

14. You can see the bivalents in the cell in one of the phases of mitosis.

15. A chromosome is divided into two chromatids that move to different poles in metaphase of mitosis.

Unit 11. Genetics – is the science of heredity and variation. Genetic level of organization of the genetic information. Format- study discussion.

Discussion questions:

1. Subject, objectives and methods of genetics.
2. Evidence for the role of DNA as the hereditary material.
3. Properties of genetic code.
4. Gene – a functional unit of heredity.
5. Classification, properties and localization of genes.
6. The relationship between gene and trait. Hypothesis Beadle-Tatum.
7. The hypothesis of Jacob-Mono (operon hypothesis).
8. The chemical composition and structure of chromosomes.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Task 1. Add the missing words

1. The process of DNA duplication is called _____.
2. The information in the language of nucleotides is copied into another language – the language of amino acids during the process of _____.
3. The monomers of DNA are _____.
4. Each nucleotide of DNA is composed of three parts: phosphate, _____ and _____.
5. DNA consists of 4 types of nitrogenous bases: adenine, guanine, _____and _____.
6. Polynucleotide molecules are formed when nucleotides are joined together by the formation of _____ bond by reaction between _____ of one nucleotide and the _____ of another nucleotide.
7. DNA chains are interconnected by _____ bond.
8. DNA is found in the _____ in Eukaryotic cells.
9. DNA is found in the _____in prokaryotic cells like bacteria.
10. The structure of RNA nucleotides, unlike the DNA, includes _____ and _____.
11. One _____ codes for one protein.
12. Cells with two copies of the genome are called _____.

Task 2. Find and correct mistakes, if any

1. DNA has two polynucleotide strands: one strand runs 5′ to 3′, whilst the other strand runs in the opposite direction 3′ to 5′.

2. Each nucleotide is composed of a five-membered pentose carbon sugar, a nitrogenous base (purine or pyrimidine) and an amino acid.

3. The purine bases (composed of fused five- and six-membered rings), adenine (A) and guanine (G) and the pyrimidine (a single six-membered ring) cytosine (C) and thymine (T) are found in both RNA and DNA.

4. In the double helix of DNA, nucleotide A pairs only with T, and C pairs only with G.

5. All bacteria, many viruses, mitochondria and chloroplasts have circular DNA.

6. First-order packaging involves the winding of the DNA around a core complex of five small proteins repeated twice, termed histones (H1, H2A, H2B, H3 and H4).

7. During G1 phase, each chromosome is duplicated, identical chromosomes (sister chromatids) remain attached to one another at a point called the centromere.

8. Most plants and animals contain two copies of their genome and called haploid.

9. Genome can be defined as the complete set of genes of a cell, organelle or virus.

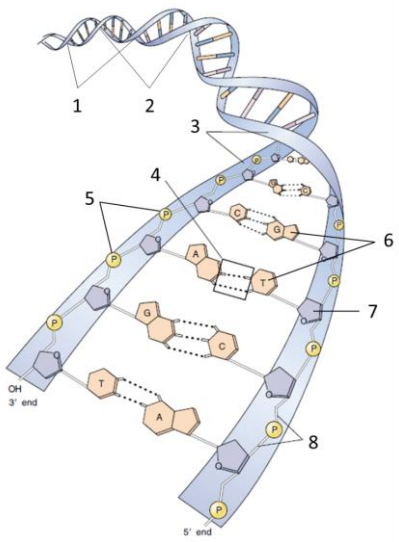
10. There is a relation between the size of genome, number of genes, and organism complexity.

TASKS FOR INDEPENDENT WORK

Task 1. Answer the questions

1. What are the 4 nitrogenous bases of DNA?
2. What are the 2 complementary base pairs of DNA? Of RNA?
3. Why the DNA helix is described as an antiparallel structure?
4. What is the denaturation and renaturation processes?
5. Which proteins participate in the DNA packaging in prokaryotes and eukaryotes?
6. What is the difference between a gene and a chromosome?
7. What is the difference in the genomes of prokaryotes, eukaryotes and viruses?

Task 2. Label the DNA structure



[fig. from *Raven, P. and Johnson, G. Biology, 6th ed. The McGraw Hill Companies, New York, 2002, 872 pp.*]

Unit 12. Types and variants of Mendelian inheritance. The interaction of genes. Format-practical's.

Discussion questions:

1. The laws of heredity of Gregor Mendel. Cytological basis of the laws of Gregor Mendel.
2. The concept of allelic genes.
3. Types of interaction between allelic genes: complete dominance, incomplete dominance, codominance, overdominance.

4. Multiple allelism. Inheritance of blood groups of humans.
5. The interaction of nonallelic genes: epistasis, complementarity, polymeria.
6. Pleiotropy genes.
7. Types and variants of Mendelian inheritance.
8. Monogenic inheritance. Genetics of sex.
9. Autosomal and sex-linked inheritance.
10. Independent and linked recessive inheritance.
11. Polygenic inheritance of the traits.
12. Cytoplasmic inheritance.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

MONOHYBRID CROSSING

1. Brown eye color dominates the blue eye color. Homozygous brown-eyed woman marries a blue-eyed man. Determine the probability of the birth of blue-eyed children from this marriage.
2. Brown eye color dominates the blue eye color. A blue-eyed child was born from a marriage of brown-eyed parents. Determine the genotypes of the parents and the possible genotypes and phenotypes of subsequent children.
3. Brown eye color dominates the blue eye color. A blue-eyed child was born from a marriage of a brown-eyed woman and a blue-eyed man. Determine the female genotype and possible genotypes and phenotypes of subsequent children.
4. Normal skin pigmentation dominates albinism. An albino child was born from the marriage of a woman with normal skin pigmentation and an albino male. Determine the female genotype and possible genotypes and phenotypes of subsequent children.
5. Normal skin pigmentation dominates albinism. An albino child was born from a marriage of parents with normal skin pigmentation. Determine the genotypes of the parents and the possible genotypes and phenotypes of subsequent children.
6. Normal skin pigmentation dominates albinism. A homozygous woman with normal skin pigmentation marries an albino male. Determine the genotypes of the parents and the possible genotypes and phenotypes of subsequent children.
7. The black color of dog hair dominates over white. Crossed breed dogs with black and white color. What offspring can be expected from this crossing in the first and second generation?
8. The black color of the dog's fur dominates over white. The black-haired dog was crossed with a white dog. A puppy with white fur appeared in their progeny. Determine the genotype of the black dog and the possible genotypes and phenotypes of subsequent puppies.

9. The black color of the dog's fur dominates over white. What offspring can we expect from crossing heterozygous dogs with each other?
10. Myopia is determined by the dominant gene, normal vision is determined by the recessive autosomal gene. What offspring can be expected from the marriage of heterozygous myopic parents?
11. Myopia is determined by the dominant gene, normal vision is determined by the recessive autosomal gene. What offspring can be expected from marriage of myopic parents, if their first child had normal vision?
12. Myopia is determined by the dominant gene, normal vision is determined by the recessive autosomal gene. What offspring can be expected from the marriage of myopic parents, if the mothers of both spouses had normal vision?

BLOOD GROUP INHERITANCE

1. Mother has a second group of blood and brown eye color, the father has a third group of blood and blue eyes. They had a son with the first group of blood and blue eyes. What kind of blood and eye color may be the children of this a married couple. It is known that brown eye color is dominant over blue.
2. A person has blood type O. Their mother is B and father is A. What is the genotype of this person and their parents?
3. Four babies are born in a hospital, and each has a different blood type: A, B, AB, and O. The parents of these babies have the following pairs of blood groups: A and B, O and O, AB and O, and B and B. Which baby belongs to which parents?
4. A woman is married for the second time. Her first husband has blood type A and her child by that marriage has type O. Her new husband has type B blood, and when they have a child its blood type is AB. What is the woman’s blood genotype and blood type?
5. A man with type A blood marries a woman with type B blood. Their child has type O blood. What are the genotypes of these three individuals? What genotypes, and in what frequencies, would you expect in future offspring from this marriage?
6. A paternity suit involves a child whose blood type is AB. The mother is blood type B, the alleged father is O. Make a ruling on this case as to whether it is reasonably possible this is the biological father.

DIHYBRID CROSSING

1. Brown eye color dominates the blue and is determined by an autosomal gene. poridactyly determined by the dominant autosomal gene. A homozygous woman with brown eyes and polydactyles marries a blue-eyed man with a normal hand. What offspring can you expect from this marriage?

2. Brown eye color dominates the blue and is determined by an autosomal gene. poridactyly determined by the dominant autosomal gene. A woman with brown eyes and a polydactyus marries a blue-eyed man with a normal hand. What offspring can be expected from this marriage, if it is known that among the ancestors of the woman there were no blue-eyed people, and the mother of the woman had a normal hand?

3. Brown eye color dominates the blue and is determined by an autosomal gene. Polydactyly is determined by a dominant autosomal gene. From the marriage of brown-eyed parents with polydactyly was born a child with blue eyes and a normal hand. What offspring can you expect from this marriage? What is the probability of birth of brown-eyed children with a normal hand?

4. Brown eye color dominates the blue and is determined by an autosomal gene. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of brown-eyed parents with polydactyly, if the mothers of both spouses had blue eyes and a normal hand? What is the probability of birth of brown-eyed children with a normal hand?

5. Brown eye color dominates the blue and is determined by an autosomal gene. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of a brown-eyed woman with polydactyly, whose mother had blue eyes and a normal hand, with a blue-eyed man with a normal hand? What is the probability of birth of brown-eyed children with a normal hand?

6. Albinism and normal hand are determined by recessive autosomal genes. What offspring can be expected from marriage of parents with normal skin pigmentation and polydactyly, if the mothers of both spouses had a normal hand and suffered from albinism?

7. Albinism and normal hand are determined by recessive autosomal genes. What offspring can be expected from a marriage of parents with normal skin pigmentation and polydactyly, if the first child had a normal hand and suffered from albinism?

8. Albinism and normal hand are determined by recessive autosomal genes. What offspring can be expected from marriage of a woman with normal skin pigmentation and polydactyly and a man with a normal hand and albinism, if the first child had a normal hand and suffered from albinism?

9. Albinism and normal hand are determined by recessive autosomal genes. What offspring can be expected from marriage of a homozygous woman with normal skin pigmentation and polydactyly and a man with a normal hand and albinism?

10. The black color of fur and long tail in dogs are determined by the dominant autosomal gene. What offspring in the first and second generation can be expected from crossing homozygous black long-tailed dogs with white short-tailed dogs?

TASKS FOR INDEPENDENT WORK

MONOHYBRID CROSSING

1. Myopia is determined by the dominant gene, normal vision is determined by the recessive autosomal gene. What offspring can be expected from marriage of a woman with myopia and a man with normal vision? Consider all possible options.
2. The red color of the tomato fruit dominates the yellow color of the fruit. What offspring can be expected from crossing homozygous plants with red and yellow fruits in the first and second generations?
3. The red color of the tomato fruit dominates the yellow color of the fruit. Yellow fruit plant is obtained by crossing the red fruit plants with each other. Determine the genotypes of the red fruit plants and the possible genotypes and phenotypes of the offspring from this crossing.
4. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of a woman with polydactyly and a man who has a normal hand? Consider all possible options.
5. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of parents with polydactyly, if their first child had a normal hand?
6. A pea plant heterozygous for inflated pods (Ii) is crossed with a plant homozygous for constricted pods (ii). Draw a Punnett square for this cross. Assume that pollen comes from the ii plant.
7. A normally pigmented man marries an albino woman. They have three children, one of whom is an albino. What is the genotype of the father?

Myopia is determined by the dominant gene, normal vision is determined by the recessive autosomal gene. What offspring can be expected from marriage of a woman with myopia and a man with normal vision? Consider all possible options.

8. The red color of the tomato fruit dominates the yellow color of the fruit. What offspring can be expected from crossing homozygous plants with red and yellow fruits in the first and second generations?
9. The red color of the tomato fruit dominates the yellow color of the fruit. Yellow fruit plant is obtained by crossing the red fruit plants with each other. Determine the genotypes of the red fruit plants and the possible genotypes and phenotypes of the offspring from this crossing.

10. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of a woman with polydactyly and a man who has a normal hand? Consider all possible options.
11. Polydactyly is determined by a dominant autosomal gene. What offspring can be expected from marriage of parents with polydactyly, if their first child had a normal hand?
12. A pea plant heterozygous for inflated pods (Ii) is crossed with a plant homozygous for constricted pods (ii). Draw a Punnett square for this cross. Assume that pollen comes from the ii plant.
13. A normally pigmented man marries an albino woman. They have three children, one of whom is an albino. What is the genotype of the father?

BLOOD GROUP INHERITANCE

7. A woman with the first group of blood marries a man with a fourth group of blood. What blood types are possible in children from this marriage?
8. A woman with the first group of blood marries a man with a third group of blood. What blood types are possible in children from this marriage? Consider all possible options.
9. A woman with the first group of blood marries a man with the second group of blood. What blood types are possible in children from this marriage? Consider all possible options.
10. A woman with a third blood group marries a man with a second blood type. What blood types are possible in children from this marriage if the first child had the first blood type?
11. A woman with a third blood group marries a man with a second blood type. What blood types are possible in children from this marriage, if the mothers of both spouses had the first blood type?
12. What is the probability of having a child with the first blood group from a woman's marriage with the first group and a man with the fourth blood group?

DIHYBRID CROSSING

1. The black color of fur and long tail in dogs are determined by the dominant autosomal gene. What offspring can be expected from crossing black long-tailed dogs with white short-tailed dogs, if there was a white short-tailed puppy in their offspring?
2. The black color of fur and long tail in dogs are determined by the dominant autosomal gene. A black long-tailed dog intersects with a white short-tailed dog. In the offspring, there are 8 short-tailed black puppies and 9 long-tailed black puppies. Write down the genotypes of the parents and the possible genotypes and phenotypes of the offspring.

3. The black color of fur and long tail in dogs are determined by the dominant autosomal gene. From the crossing of black long-tailed dogs among themselves in the progeny, 12 black long-tailed puppies and 4 white short-tailed puppies were obtained. Write down the genotypes of the parents and the possible genotypes and phenotypes of the offspring.
4. What is the expected phenotypic ratio in a dihybrid cross between two organisms that are heterozygous for both traits?
5. Two pea plants heterozygous for the characters of pod color and pod shape are crossed. Draw a Punnett square to determine the phenotypic ratios of the offspring.
6. Polydactyly is inherited as a dominant autosomal gene, the normal hand inherited as a recessive autosomal gene. Also analyzed the inheritance of blood groups. Woman with polydactyly and 3 blood group marries a man with polydactyly and 2 blood group. They had a child with the normal hand and 1 blood group. What is the probability of having a child with the normal hand and 3 blood group?
7. Myopia and polydactyly are inherited as autosomal dominant genes. A woman has polydactyly and myopia, but her mother did not have these diseases. She marries a man who does not have these diseases. What is the probability of the birth of children without anomalies of the couple.

Unit 13. Chromosomal and genomic levels of organization of the genetic information. Format-practical's.

Discussion questions:

1. Chromosome as a group of adhesion genes.
2. Chromosomal theory of inheritance by Thomas Morgan.
3. Characterization of the genome of prokaryotes and eukaryotes.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

1. Cataracts and polydactyly are determined by dominant genes located in the same chromosome at a distance of 20% crossing-over. A woman with a cataract and polydactyly marries a man who does not have these diseases. It is known that the mother of the woman did not have these diseases too. What is the probability of having a child without anomalies from this marriage?

2. Positive rhesus and elliptocytosis are determined by dominant genes localized in one chromosome at a distance of 3% crossing-over. A woman with positive rhesus and elliptocytosis marries a man with negative rhesus and the normal form of red blood cells. It is known that the mother of the woman was Rh-

negative and the normal form of red blood cells. What is the probability of having children with the mother's phenotype?

3. Brown eye color and polydactyly are determined by dominant genes localized in one chromosome at a distance of 40% crossing-over. A woman with brown eyes and a polydactyus marries a man with blue eyes and a normal wrist. It is known that the father of the woman was with blue eyes and a normal hand too. What is the probability of having a baby with a father's phenotype?

4. Myopia and phenylketonuria are determined by dominant genes located in the same chromosome at a distance of 15% crossing-over. A woman with normal vision and normal metabolism marries a man with myopia and phenylketonuria. It is known that the man’s mother did not have these diseases. What is the probability of having a child without myopia and phenylketonuria?

5. Myopia and normal skin pigmentation are determined by dominant genes located in the same chromosome at a distance of 30% crossing-over. A woman with myopia and normal skin pigmentation marries a man with normal vision but suffering from albinism. It is known that the mother of the woman had normal vision and was sick with albinism. What is the probability of having a baby without myopia and albinism?

6. The red color of tomato fruits and the round shape are determined by dominant autosomal genes located on the same chromosome at a distance of 18% crossing-over. A plant with red and round fruits crossed with a plant having yellow and oval fruits. It is known that the first plant is derived from a plant with yellow oval fruits. What is the probability of offspring with yellow oval fruits?

7. Albinism and diabetes are determined by recessive genes located at the same chromosome at a distance of 10% crossing-over. A healthy woman whose mother suffered from albinism and diabetes marries a man suffering from both diseases. What is the probability of having a child without anomalies?

8. Blue eye color and diabetes are determined by recessive autosomal genes located on one chromosome at a distance of 26% crossing-over. Brown-eyed healthy woman marries a blue-eyed man with diabetes. It is known that the mother of the woman was blue-eyed and suffered from diabetes. What is the probability of having a blue-eyed baby without diabetes?

9. Cataract and eliptocytosis are determined by dominant genes located on the same chromosome at a distance of 8% crossing-over. A woman with a cataract and an elliptocytosis marries a man who does not have these diseases. It is known that the mother of the woman also did not have these diseases. What is the probability of having a child without anomalies?

10. Positive rhesus and elliptocytosis are determined by dominant genes localized in one chromosome at a distance of 3% crossing-over. A woman with

positive rhesus and elliptocytosis marries a man with negative rhesus and the normal form of red blood cells. It is known that the mother of the woman was Rh-negative, and the father of the woman had the normal form of red blood cells. What is the probability of birth of children with negative Rh and the normal form of red blood cells?

TASKS FOR INDEPENDENT WORK

1. Cataracts and polydactyly are determined by dominant genes located in one chromosome at a distance of 20% crossing-over. A woman with a cataract and polydactyly marries a man with normal vision and a normal hand. It is known that the father of the woman had a normal hand, and the mother of the woman had normal vision. What is the probability of having a child without both anomalies?
2. Brown eye color and polydactyly are determined by dominant genes localized in one chromosome at a distance of 40% crossing-over. A woman with brown eyes and a polydactyus marries a man with blue eyes and a normal wrist. It is known that the father of the woman was with blue eyes, and the mother of the woman was with a normal hand. What is the probability of having a child with a father's phenotype (blue eyes, normal hand)?
3. Myopia and phenylketonuria are determined by dominant genes located in the same chromosome at a distance of 15% crossing-over. A woman with normal vision and normal metabolism marries a man with myopia and phenylketonuria. It is known that the man’s mother did not have myopia, and his father did not suffer from phenylketonuria. What is the probability of having a child without myopia and phenylketonuria?
4. Myopia and normal skin pigmentation are determined by dominant genes located in the same chromosome at a distance of 30% crossing-over. A woman with myopia and normal skin pigmentation marries a man with normal vision but suffering from albinism. It is known that the mother of the woman had normal vision, and the father of the woman was sick with albinism. What is the probability of having a baby without myopia and albinism?
5. The red color of tomato fruits and the round shape are determined by dominant autosomal genes located on the same chromosome at a distance of 18% crossing-over. A plant with red and round fruits crossed with a plant having yellow and oval fruits. It is known that the first plant is derived from the crossing of a plant variety with yellow and round fruits with a plant variety with red and oval fruits. What is the probability of offspring with yellow oval fruits?
6. Albinism and diabetes are determined by recessive genes located at the same chromosome at a distance of 10% crossing-over. A healthy woman marries a man suffering from both diseases. It is known that the mother of the woman

suffered from albinism, and the father of the woman had diabetes. What is the probability of having a child without anomalies?

7. Blue eye color and diabetes are determined by recessive autosomal genes located on one chromosome at a distance of 26% crossing-over. Brown-eyed healthy woman marries a blue-eyed man with diabetes. It is known that the mother of the woman was blue-eyed, and her father suffered from diabetes. What is the probability of having a blue-eyed child without diabetes?
8. Cataract and eliptocytosis are determined by dominant genes located on the same chromosome at a distance of 8% crossing-over. A woman with a cataract and an elliptocytosis marries a man who does not have these diseases. It is known that the woman's mother did not have cataracts, and the woman's father did not suffer from elliptocytosis. What is the probability of having a child without anomalies?
9. Positive rhesus (Rh) and elliptocytosis are determined by dominant genes localized in one chromosome at a distance of 3% crossing-over. Both spouses had positive rhesus and elliptocytosis. It is known that the fathers of both spouses were with negative Rh and the normal form of erythrocytes. What is the probability of birth of children with negative Rh and the normal form of red blood cells?
10. Cataracts and polydactyly are determined by dominant genes located in one chromosome at a distance of 20% crossing-over. Both spouses had cataracts and polydactyly. It is known that the mothers of both spouses did not have these diseases. What is the probability of having a child without both diseases?

Unit 14. Modification and combinative variability. Format-practical's.

Discussion questions:

1. Modification variability, especially, adaptive significance in ontogenesis and evolution.
2. The concept of norm of the reaction.
3. Mechanisms of combined variability (genetic recombination).
4. The value of combinative variability in ensuring genotypic diversity.

Unit 15. Mutational variability. Format-practical's.

Discussion questions:

1. Mutational variability.
2. Classifications of mutations.
3. The concept of the genetic, chromosomal mutations.
4. Genomic mutations (euploidiya and aneuplodiya).
5. Genetic, chromosomal and genomic of human disease.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS (UNIT 14-15)

Task 1. Complete the table

Kind of mutation	General characteristics	Importance in nature
Combinative variability		
Mutational variability		
Modification variability		

Task 2.

1. T-RNA with anticodons of the UUA, GGC, CGC, AUU, UGU participated in the biosynthesis of the polypeptide. Determine the nucleotide sequence of a portion of each strand of the DNA molecule that carries information about the synthesized polypeptide, and the number of nucleotides containing adenine (A), guanine (G), thymine (T) and cytosine (C) in the double-stranded DNA molecule. Explain the answer.
2. Molecules of tRNA with anticodons of AGC, GCC, UCA, CGA, AGA participated sequentially in the biosynthesis of a fragment of the protein molecule. Determine the amino acid sequence of the synthesized fragment of the protein molecule and the nucleotide sequence of the section of the double-stranded DNA molecule, which encodes information about the primary structure of the protein fragment. Explain the sequence of your actions. To solve the problem, use the genetic code table.
3. The tRNA molecules with the ACA, AUG, and GUA anticodons successively participated in the biosynthesis of a fragment of the protein molecule. Determine the amino acid sequence of the synthesized fragment of the protein molecule and the nucleotide sequence of the section of the double-stranded DNA molecule, which encodes information about the primary structure of the protein fragment. Explain the sequence of your actions. To solve the problem, use the genetic code table.
4. All types of RNA are synthesized on a DNA template. The fragment of the DNA molecule on which the region of the central loop of the tRNA is synthesized has the following nucleotide sequence: CTTACGGGCCATGCT. Establish the

nucleotide sequence of the region of tRNA that is synthesized on this fragment, and the amino acid that this tRNA will carry in the process of protein biosynthesis, if the third triplet corresponds to the tRNA anticodon. Explain the answer. To solve the problem, use the genetic code table.

5. It is known that all types of RNA are synthesized on a DNA template. The fragment of the DNA molecule on which the region of the central loop of tRNA is synthesized has the following nucleotide sequence: TSGTTGGGCTTGGTTT. Establish the nucleotide sequence of the region of tRNA that is synthesized on this fragment, and the amino acid that this tRNA will carry in the process of protein biosynthesis, if the third triplet corresponds to the tRNA anticodon. Explain the answer. To solve the problem, use the genetic code table.

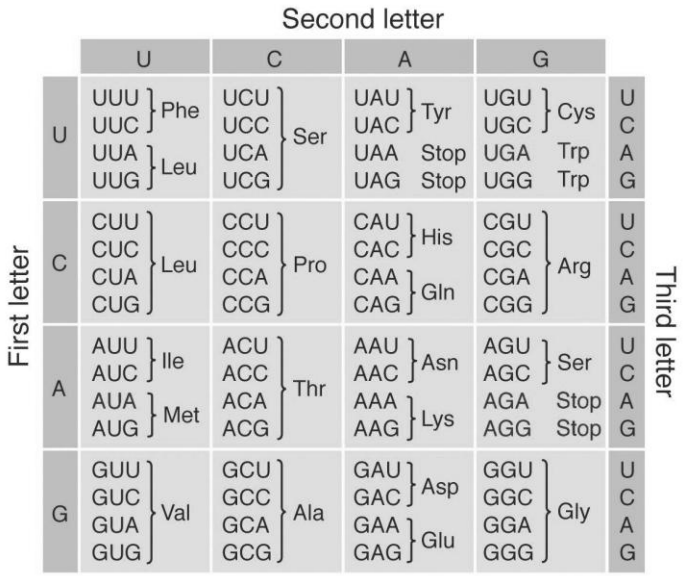
6. It is known that all types of RNA are synthesized on a DNA template. The fragment of the DNA molecule on which the region of the central loop of tRNA is synthesized has the following nucleotide sequence: TAGTGAACGGACT. Establish the nucleotide sequence of the region of tRNA synthesized on this fragment and the amino acid that this tRNA will transfer during the biosynthesis of the protein, if the third triple corresponds to the tRNA anticodon. Explain the answer. To solve the problem, use the genetic code table.

7. The DNA molecule has the following composition: G-A-T-G-A-A-T-A-G-T-G-C-T-T-C. List at least 3 consequences that may result from the random replacement of the 7th thymine nucleotide by cytosine (C).

8. The region of the DNA molecule encoding the amino acid sequence in a protein has the following composition: G-A-T-T-A-A-T-A-T-T-G-C-T-T-C. Explain the consequences of the accidental addition of the guanine nucleotide (G) between the seventh and eighth nucleotides.

9. The site of one of the two chains of the DNA molecule contains 300 nucleotides with adenine (A), 100 nucleotides with thymine (T), 150 nucleotides with guanine (G) and 200 nucleotides with cytosine (C). What is the number of nucleotides with A, T, G and C contained in the double-stranded DNA molecule? How many amino acids must contain the protein encoded by this section of the DNA molecule? Explain the answer.

10. The region of the DNA chain encoding the primary structure of the polypeptide consists of 15 nucleotides. Determine the number of nucleotides on the mRNA encoding the amino acids, the number of amino acids in the polypeptide and the number of tRNA required to transfer these amino acids to the site of synthesis. Explain the answer.



TASKS FOR INDEPENDENT WORK

Task 1

1. Heritable variability is divided into
   a) mutational and combinative
   b) mutational and modificational
   c) phenotypic and genotypic
   d) combinative and nonhereditary
2. Modificational variability is variability, affecting
   a) only the phenotype and not affecting the genotype
   b) only the genotype and not affecting the phenotype
   c) genotype and phenotype
   d) neither genotype nor phenotype

3. Wears group character as similar changes occur in a group of individuals
   a) mutational variability
   b) modificational variability
   c) genotypic variability
   d) combinative variability

4. The boundaries of this variability is called the norm of reaction and defined genotype
   a) mutational variability
   b) modificational variability
   c) genotypic variability
   d) combinative variability

5. This variability is not related to changes in the genes, but only with their recombination in the offspring
   a) mutational variability
   b) modificational variability

c) genotypic variability
d) combinative variability

6. The reason of combinative variability is

a) crossing over
b) changes in genes
c) changes in chromosomes
d) modification of the phenotype

7. The changes occurring in organisms do not usually wear an adaptive character during

a) mutational variability
b) modificational variability
c) phenotypic variability
d) nonhereditary variability

8. Mutations associated with changes in the genotype are

a) lethal, half-lethal, neutral
b) genetic, chromosomal, genomic
c) somatic and generative
d) dominant and recessive

9. Genome mutations are associated

a) with a change in the structure of gene
b) with a change in the number of chromosomes in the genome
c) with a change in the structure of chromosome
d) with a loss of chromosome plot

10. There are 2 types of genome mutations

a) aneuploidy and euploidy
b) deletion and duplication
c) polyploidy and duplication
d) inversion and translocation

11. Trisomy refers to mutations

a) genetic
b) chromosomal
c) genomic
d) somatic

12. Deletion associated with

a) repetition chromosome region
b) loss of chromosome region
c) twist chromosome region 180 degrees
d) change in the number of chromosomes

13. Translocation refers to mutations

a) genetic
b) chromosomal
c) genomic
d) somatic

14. Duplication associated with
a) repetition chromosome region
b) loss of chromosome region
c) twist chromosome region 180 degrees
d) change in the number of chromosomes

15. Inverse associated with
a) repetition chromosome region
b) loss of chromosome region
c) twist chromosome region 180 degrees
d) change in the number of chromosomes

16. Change in the number of nucleotides is typical for mutation
a) gene
b) chromosomal
c) genomic
d) polyploidy

17. Somatic mutation occurs in
a) gametes
b) normal cells of the body
c) in sperm
d) the egg

18. Generative mutation occurs in
a) gametes
b) normal cells of the body
c) brain cells
d) blood cells

19. The mutations differ in their localization in the cell
a) nuclear
b) dominant
c) neutral
d) genomic

20. The mutations occurring in the DNA of mitochondria and plastids
a) nuclear
b) cytoplasmic
c) chromosomal
d) genomic

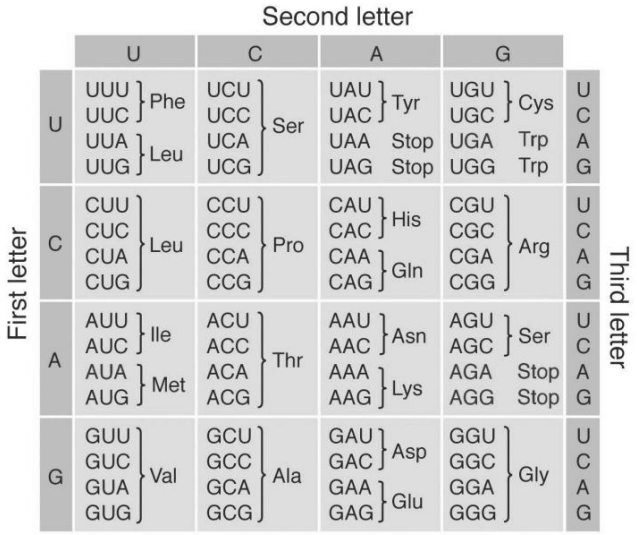
Task 2.

11. A fragment of one of the DNA strands has the sequence of nucleotides: TCGCGGAGC. Determine the mRNA nucleotide sequence and the order of amino acids in the corresponding polypeptide. How will the amino acid sequence in a polypeptide change if the second and fourth triplets of DNA are swapped? To perform the task, use the genetic code table.
12. A fragment of one of the DNA chains has the sequence of nucleotides: -ATAAGGATGCCTTTT-. Determine the nucleotide sequences in mRNA and amino acids in the polypeptide chain. What will happen in a polypeptide if a second triplet of nucleotides falls out as a result of a mutation in a gene fragment? To perform the task, use the genetic code table.
13. The DNA chain fragment has a nucleotide sequence: GGATCTAAACAT. Determine the nucleotide sequence on the second DNA strand, the mRNA, and the amino acid sequence in the fragment of the protein molecule using the table of the genetic code.
14. The DNA chain fragment has the sequence of nucleotides: GTGTGGGAAGT. Determine the nucleotide sequence for mRNA, the corresponding tRNA anticodons, and the amino acid sequence in a fragment of the protein molecule using the genetic code table.
15. The segment of the DNA molecule that determines the primary structure of the polypeptide contains the following nucleotide sequence: AATG CACG G. Determine the nucleotide sequence of mRNA, the number of tRNAs involved in peptide biosynthesis, the nucleotide composition of their anticodons and the sequence of amino acids that carry these tRNAs. To solve the problem, use the genetic code table. Explain the results.
16. The genetic apparatus of the virus is represented by an RNA molecule. A fragment of this molecule has a nucleotide sequence: GUGUAGGUCUAUCU. Determine the nucleotide sequence of a fragment of a double-stranded DNA molecule, which is synthesized as a result of reverse transcription into virus RNA. Set the nucleotide sequence in mRNA and amino acids in the fragment of the virus of the virus, which is encoded in the found fragment of DNA. The template for the synthesis of mRNA, on which the viral protein is synthesized, is the second strand of DNA, which is complementary to the first strand of DNA found from viral RNA. To solve the problem, use the genetic code table.
17. The DNA chain fragment contains 15 nucleotides. Determine the number of nucleotides in the mRNA molecule, the number of types of tRNA molecules involved in protein synthesis, the number of amino acid residues in the protein molecule.

18. An mRNA chain fragment has the sequence of nucleotides: AUGCCAUAUCG. Determine the nucleotide sequence of the DNA fragment on which it is synthesized, the number of tRNAs required and the amino acid sequence in the fragment of the protein molecule using the table of the genetic code.

19. The mRNA chain fragment has the sequence of nucleotides: UUCCAGAUCGGC. Determine the nucleotide sequence of the DNA fragment on which it is synthesized, the number of tRNAs required and the amino acid sequence in the fragment of the protein molecule using the table of the genetic code.

20. A fragment of one of the DNA strands has the sequence of nucleotides: TCGCGGAGAC. Determine the mRNA nucleotide sequence and the order of amino acids in the corresponding polypeptide. How will the amino acid sequence in a polypeptide change if the second and fourth triplets of DNA are swapped? To perform the task, use the genetic code table.



<u>Unit 16</u>. Individual development of organisms. Format- study discussion.

Discussion questions:

1. The concept of ontogenesis.
2. Periods of ontogenesis.
3. Gametogenesis (spermatogenesis. oogenesis).
4. Fertilization, and it stages (penetration, activation, nuclei fusion).
5. Cleavage. Yolk distribution in three kinds of egg cells.
6. The Blastula. Types of blastula.

<u>Unit 17</u>. Embryonic development of organisms. Format-practical's.

Discussion questions:

1. Gastrulation, modes early and late gastrulation.

2. The Gastrula, germ layers: ectoderm, mesoderm, and endoderm.
3. Neurulation.
4. Organogenesis.
5. Extraembryonic organs (amniotic membrane, chorion, yolk sac, allantois, placenta): structure and physiological importance.

Unit 18. Regularities and mechanisms of ontogenesis. Format-practical's.

Discussion questions:

1. Differentiation in development.
2. Stages and factors of differentiation.
3. The mechanisms of ontogenesis.
4. Embryonic induction as a mechanism of ontogenesis.
5. The regeneration of organs and tissues as a process of development.
6. The physiological and reparative regeneration.
7. Methods of reparative regeneration.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS (UNIT16-18)

1. Blastula consists of:

a) blastoderm and blastocoel

b) head, body, tail

c) blastoderm and blastopore

d) ectoderm and endoderm

2. Cleavage is special mitotic division of

a) gastrula without growth of daughter cells

b) zygote without growth of daughter cells

c) zygote with growth of daughter cells

d) neurula without growth of daughter cells

3. Ways of early gastrulation

a) fertilization, epiboly, immigration, delamination

b) invagination, epiboly, immigration, delamination

c) fertilization, epiboly, gametogenesis, delamination

d) gametogenesis, epiboly, immigration, delamination

4. Micromers of animal pole of blastula divide faster macromers of vegetal pole and overgrown them, forming ectoderm during

a) invagination,

b) epiboly,

c) immigration,

d) delamination

5. Blastoderm stratified into two pieces: the inner - endoderm and the outer – ectoderm during

a) invagination,

b) epiboly,

c) immigration,

d) delamination

6. Blastoderm located on the vegetal pole inside blastocoel and forming the inner layer - the endoderm and the outer layer - the ectoderm during

a) invagination,

b) epiboly,

c) immigration,

d) delamination

7. Some blastomers of the blastula migrate into the cavity and form the endoderm during

a) invagination,

b) epiboly,

c) immigration,

d) delamination

8. Ectoderm leads to the formation of

a) nervous system,

b) circulatory system,

c) digestive system,

d) muscular system

9. Entoderm leads to the formation of

a) nervous system,

b) circulatory system,

c) digestive system,

d) muscular system

10. Mesoderm leads to the formation of

a) nervous system,

b) respiratory system,

c) digestive system,

d) muscular system

11. The chorion is formed from

a) only ectoderm

b) ectoderm, mesoderm

c) mesoderm and entoderm

d) only entoderm

12. The amnion is formed from

a) only ectoderm

b) ectoderm, mesoderm

c) mesoderm and entoderm

d) only entoderm

13. The allantois is formed from

a) only ectoderm

b) ectoderm, mesoderm

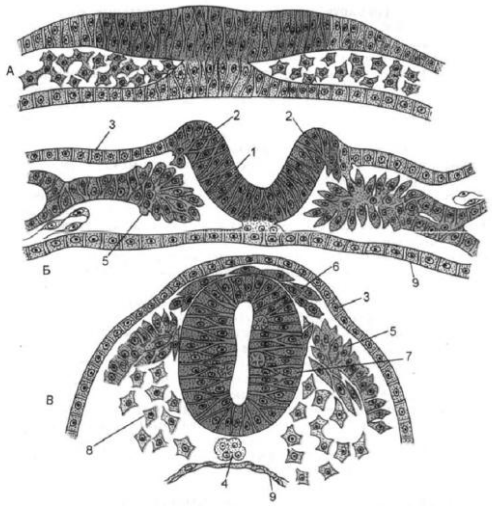
c) mesoderm and entoderm

d) only entoderm

TASKS FOR INDEPENDENT WORK (UNIT16-18)

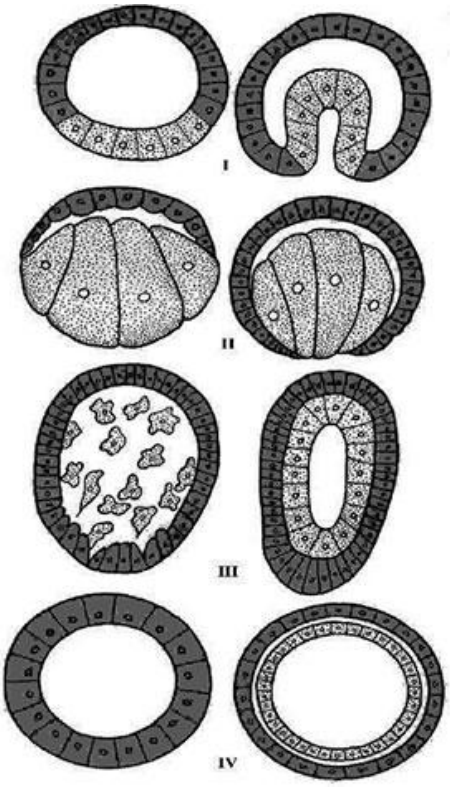
Task 1.

Describe the process shown in the figure. What is indicated by the numbers 1-9?



Task 2.

Describe the methods of gastrulation, indicated by the numbers I-IV.

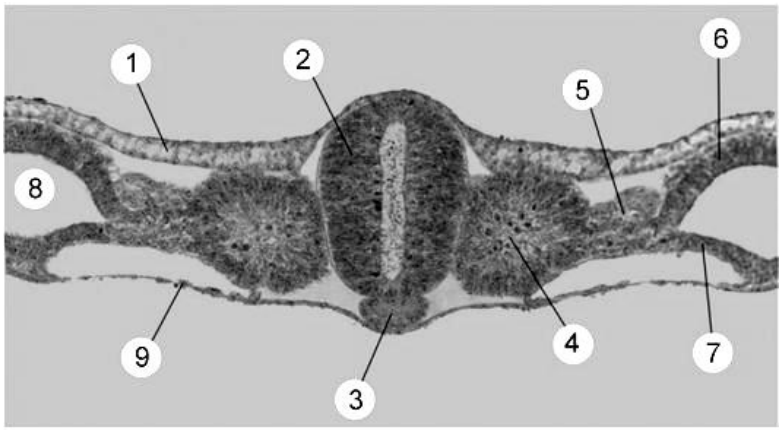


Task 3.

What are the terms: zygote, cleavage, blastula, gastrula, ectoderm, endoderm, neurula

Task 4.

Describe which structures of the embryo are indicated by the numbers 1-9.



Task 5.

1. During spermatogenesis in stage of growth cells called

a) spermatogonia

b) primary spermatocytes

c) secondary spermatocytes

d) spermatids

2. During spermatogenesis in stage of reproduction cells called

a) spermatogonia

b) primary spermatocytes

c) secondary spermatocytes

d) spermatids

3. During oogenesis in stage of growth cells called

a) oogonia

b) primary oocyte

c) polar bodies

d) secondary oocyte

4. In stage of maturation during first meiosis primary oocyte is divided into two cells:

a) oogonia and primary oocyte

b) primary oocyte and secondary oocyte

c) primary oocyte and polar bodies

d) secondary oocyte and polar bodies

5. In stage of maturation during second meiosis secondary spermatocyte is divided into two cells:

a) two spermatogonia

b) two primary spermatocytes
c) two sperm
d) two spermatids
6. The acrosomal reaction of the sperm occurs during stage of
a) gametogenesis
b) contact interaction of gametes
c) distant interaction of gametes
d) formation synkaryon
7. Each spermatozoon has
a) head, body, tail
b) head, body, leg
c) neck, body, tail
d) head, neck, tail
8. Nucleus of the ovum contains 23 chromosomes:
a) 22 autosomes and the last one – sex chromosome (only y).
b) 22 autosomes and the last one – sex chromosome (only x).
c) 21 autosomes and two – sex chromosome (xx).
d) 21 autosomes and two – sex chromosome (xy).
9. Oligolecytal oocyte
a) contain moderate yolk inclusions
b) contain great volume of yolk
c) not contain egg yolk
d) contain a lot of carbohydrates
10. The embryo is formed by the cleavage
a) blastula
b) gastrula
c) neurula
d) zygote
11. The embryo is formed by the gastrulation
a) blastula
b) gastrula
c) neurula
d) zygote
12. The embryo is formed by the fertilization
a) blastula
b) gastrula
c) neurula
d) zygote

Section 3. Population-specific level of organization of the living systems. Biogeocoenotic and biosphere levels of organization of the biological systems.

Unit 19. Evolution. Format-practical's.

Discussion questions:

1. Pre-Darwinian evolutionary ideas the period of formation.
2. J.-B. Lamarck´s theory of evolution.
3. The main provisions of the theory of evolution of the Charles Darwin.
4. Modern (synthesis) theory of evolution. Factors of evolution.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Answer the questions

1. Who is the author of the theory of gradation?
2. Who first proposed the idea of natural selection?
3. What is the premise of evolution?
4. What is the reason for the changes in living organisms on the views of Lamarck and Darwin respectively?
5. What is the essence of the law of use and disuse of organs?
6. Who wrote the book "Philosophy of Zoology"?
7. What scientists believed that species of living organisms do not really exist and why?

TASKS FOR INDEPENDENT WORK

Answer the questions

1. What is a "struggle for existence" in Darwin's opinion?
2. What kind of struggle for survival has Darwin allocated?
3. What is natural selection?
4. What is the cause of the struggle for existence?
5. What is the result of evolution?

Unit 20. The notion of biological species. Format-practical's.

Discussion questions:

1. Microevolution.
2. Macroevolution.
3. Modes of speciation.
4. The species. Criteria for the species.
5. The main directions of evolution (biological progress and regression).

6. Ways to achieve of biological progress (aromorphosis, idioadaptation, total degeneration) and its forms.

Unit 21. Anthropogenesis. Format-practical's.

Discussion questions:

1. The position of Homo sapiens in the animal world.
2. The qualitative uniqueness of the person.
3. Biological and social factors of anthropogenesis.
4. The role of biological factors of the anthropogenesis at the present stage.
5. Human races and the unity of the human species.

Unit 22. Ecology. Format-practical's.

Discussion questions:

1. Environmental factors: classification and general patterns of action of the environmental factors on a organism.
2. The concept of trophyc levels.
3. The rule of the ecological pyramid.
4. The biosphere.
5. Biogeochemical cycles.

Unit 23. Parasitology. Protists. Class Sarcodina. Format-practical's.

Discussion questions:

1. Parasitism as an ecological phenomenon.
2. Classification of animal parasitic forms.
3. Ways of origin of the various groups of parasites.
4. Interaction between parasite and host-level individuals.
5. Factors of the action of parasite on the host organism.
6. Factors action hostess on the parasite.
7. Morphophysiological adaptation to a parasitic lifestyle.
8. Population level of interaction of the parasites and their hosts.
9. The life cycles of parasites. Intermediate and major host. Vector-borne and natural focal, parasitic and infectious diseases.
10. Ecological principles to combat parasitic diseases.
11. General characteristics of the class Sarcodina.
12. Morphophysiology and the life cycle of Entamoeba histolytica. Diagnosis and prevention of amebiasis.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

Fill in the gaps in the sentences

1. Parasites that cannot exist without a host are called _____.
2. Parasites that are able to exist in soil and water, regardless of the host under favorable environmental conditions are called _____.
3. Parasites which enter accidentally and can live in a host different from their normal one are called _____.
4. Parasite which only visits its host for food is called _____.
5. Parasite which passes only a definite part of its life cycle as a parasite is called _____.
6. Parasites which are found attached to the skin of their host or its superficial tissue are called _____.
7. The organism, in which the adult stage of the parasite lives or where sexual reproduction takes place is called _____.
8. The organism, in which occur the larval stage of the parasite and its asexual reproduction is called _____.
9. The host in which the parasite does not undergo any development but in which it remains alive in the larval stage and can be infective to another host is called _____.
10. The organism is able to accumulate a parasite as reservoir in addition to the main host is called _____.

TASKS FOR INDEPENDENT WORK

Properly connect the type of action of the parasite with the characteristic action

Pathogenesis of parasitic infection

Type of parasite action	Characteristics of the parasite action
Mechanical	Destruction of red blood corpuscles occurs in malaria, reticuloendothelial cells in *Leishmania donovani* and other tissue cells in Trypanosoma cruzi
Traumatic	Allergic reactions occur with insect bites
Toxic	The parasite may obstruct a normal passage e.g. *Ascaris lumbricoides* may cause intestinal obstruction or bile duct obstruction, *Enterobius vermicularis* may cause

	appendicitis
Necrosis	Parasitic infections may contributed to tumour formation. *Schistosoma haematobium* can cause cancer bladder
Stimulation of the host immune response	Parasitic antigens stimulate both a cellular and humoral immune response provoking tissue reactions consisting of cellular proliferation and infiltration at the site of parasite antigens, or deposition of circulating immune complex in the tissues
Cellular destruction	Enzymes elaborated by the parasite produce necrosis of tissue as in *Entamoeba histoytica*
Allergic manifestations	Circulation of certain toxic byproducts of parasites produces generalized manifestations as in hookworms producing butterfly pigmentation of the face
Neoplastic formation	When the parasite invades the skin as in scabies or myiasis. Internal damage can also occur as in hookworms, which attach themselves by their buccal capsule to the intestinal mucosa producing ulcers

Unit 24. Protists. Class Zoomastigophora. Format- study discussion.
Discussion questions:

1. General characteristics of the class Zoomastigophora.
2. The life cycle of pathogens, pathogenesis, diagnosis and prevention of trypanosomiasis.
3. The life cycle of pathogens, pathogenesis, diagnosis and prevention of leishmaniasis, trypanosomiasis and giardiasis.

Unit 25. Protists. Classes Sporozoa and Cilliophora. Format-practical's.
Discussion questions:

1. General characteristics of the class Sporozoa.
2. The life cycle of Plasmodium sp., pathogenesis, diagnosis and prevention of malaria.
3. The life cycle of pathogens, pathogenesis, diagnosis and prevention of toxoplasmosis.
4. General characteristics of the class Cilliophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of balantidiasis.

TASKS FOR INDEPENDENT WORK (UNIT 24-25)

PARASITES – REPRESENTATIVES OF PROTOZOA

1. The main host of Plasmodium falciparum
    a) trophozoite
    b) man
    c) anopheles mosquito of genus Anopheles
    d) fish
2. Intermediate host of Plasmodium falciparum
    a) mollusc
    b) man
    c) anopheles mosquito of genus Anopheles
    d) fish
3. Who enters the the human body through the bite of a mosquito with malaria
    a) merozoites
    b) sporozoites
    c) schizonts
    d) ookinete
4. Who forms of the erythrocytes after schizogony
    a) merozoites
    b) sporozoites
    c) schizonts
    d) ookinete
5. Sporozoites are formed as a result of the process
    a) schizogony
    b) sporogony
    c) fertilization
    d) gametogenesis
6. Who fall into into the stomach of a mosquito when it feeds on the blood of human malaria patient
    a) sporozoites;
    b) merozoites;
    c) gametocytes;
    d) oocyst
7. Cyst of dysentery amoeba has
    a) two nuclei
    b) three nuclei
    c) four nuclei
    d) eight nuclei

8. Trophozoites of dezintery amoeba destroys mucous membrane and feed on
    a) blood
    b) kidney tissue
    c) lymph
    d) protozoa
9. A person infected with dysentery amoeba;
    a) through unwashed hands;
    b) through the meat of sick animals;
    c) through blood;
    d) sexually transmitted
10. Giardia *lamblia* trophozoites are located in the
    a) duodenum;
    b) blood;
    c) skin;
    d) heart
11. Giardia is characterized by the presence of
    a) radial symmetry
    b) two pairs of flagella
    c) pear-shaped with two nuclei
    d) four axonemes
12. The trophozoites of Giardia *lamblia*
    a) can attach to the intestinal villi by the ventral sucking discs
    b) feed on blood
    c) destroy mucosa
    d) penetrate the muscular layer of the intestinal wall
13. The trophozoite is found in the urethra and vagina of women and the urethra and prostate gland of men
    a) in life cycle of *Giardia lamblia.*
    b) in life cycle of *Trypanosoma brucei*
    c) in life cycle of *Trypanosoma cruzi*
    d) in life cycle of *Trichomonas*
14. The vector is the tsetse fly
    a) in life cycle of *Giardia lamblia.*
    b) in life cycle of *Trypanosoma brucei*
    c) in life cycle of *Trypanosoma cruzi*
    d) in life cycle of *Trichomonas*
15. The vector for transmission are reduviid bugs
    a) in life cycle of *Giardia lamblia.*
    b) in life cycle of *Trypanosoma brucei*

c) in life cycle of *Trypanosoma cruzi*
d) in life cycle of *Trichomonas*

16. The parasite that causes the formation of deep skin ulcers
a) *Trypanosoma brucei*
b) *Giardia lamblia*
c) *Leishmania donovani*
d) *Leishmania tropica minor*

17. The most severely affected organs are the organs of the reticuloendothelial system (liver, spleen and bone marrow) in lesions
a) *Trypanosoma brucei*
b) *Giardia lamblia*
c) *Leishmania donovani*
d) *Leishmania tropica minor*

18. This disease is accompanied by lethargy, tremors, meningoencephalitis, mental retardation, and general deterioration
a) Gambian sleeping sickness
b) mucocutaneous Leishmaniasis
c) trichomoniasis
d) amoebiasis

19. The vector for transmission of African trypanosomiasis is
a) tsetse fly
b) dogs
c) mosquitoes
d) clams

20. The reservoir hosts in *Leishmania major* are
a) rodents
b) antelope
c) tsetse fly
d) dogs

<u>Unit 26</u>. Class Trematoda. Class Cestoda. Format-practical's.

Discussion questions:

1. Types of Platyhelminthes (flatworms). Class Trematoda: The Flukes.
2. The life cycle of pathogens, pathogenesis, diagnosis and prevention of fasciolasis.
3. The life cycle of pathogens, pathogenesis, diagnosis and prevention of opistorhosis.

4. The life cycle of pathogens, pathogenesis, diagnosis and prevention of lung fluke disease.
5. The life cycle of pathogens, pathogenesis, diagnosis and prevention of dicroceliasis.
6. Morphophysiology and the life cycle of blood fluke (Schistosoma).
7. Class Cestoda: The Tapeworms.
8. The life cycle of pathogens, pathogenesis, diagnosis and prevention of teniasis and cysticercosis.
9. The life cycle of pathogens, pathogenesis, diagnosis and prevention of teniarinhosis.
10. The life cycle of pathogens, pathogenesis, diagnosis and prevention of hymenolepiasis.
11. The life cycle of pathogens, pathogenesis, diagnosis and prevention of diphyllobothriasis.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

a) The definitive main host of the Fasciola hepatica is _____.
b) Larva of Fasciola hepatica, which comes out of the eggs and introduced into the mollusk is called _____.
c) Within the aquatic snail mother sporocyst of the Fasciola hepatica form and produce many mother _____, which subsequently produce many daughter _____ which shed crawling _____, a larva that is capable of swimming with its large tail.
d) Liver fluke disease causes _____.
e) _____ is the reason Paragonimiasis.
f) The second intermediate host of lung fluke (Paragonimus) is _____.
g) The second intermediate host of Opisthorchis viverrini is _____.
h) The second intermediate host of Dicrocoelium dendriticum is _____.
i) The adult worms of Opisthorchis viverrini lives in the _____.
j) The adult worms of _____ lives in the lungs.
k) Tapeworms of cestodes do not have _____ system.
l) Adult worm of HYMENOLEPIS NANA is made up of _____, neck and _____.
m) The head of HYMENOLEPIS NANA carries _____ suckers and a rostellum armed with one row of _____.
n) Oncosphere of HYMENOLEPIS NANA penetrate the villi of the small intestine, where it forms _____.
o) The adult worm of Echinococcus granulosus measures _____ cm in length.

p) Definitive host of Echinococcus granulosus is _____.
q) Adult worms of Echinococcus granulosus live in _____ of definitive host.
r) Man is an _____ host of Echinococcus granulosus - carrying the hydatid cyst (larva).
s) Definitive host of TAENIA SAGINATA is/are _____.

TASKS FOR INDEPENDENT WORK

a) Intermediate host of TAENIA SAGINATA is/are _____.
b) Each of the terminal segments of TAENIA SAGINATA contains only _____ made up of a median stem with 15-30 lateral branches.
c) 6-hooked embryo escapes from egg of TAENIA SAGINATA, penetrates through the intestinal wall into the blood vessels and is carried to the muscles where it develops into a larval stage, _____ (made up of an invaginated /inverted head and spherical body).
d) Humans become infected TAENIA SOLIUM by eating pork containing larvae – _____.
e) The globular scolex of TAENIA SOLIUM has rostellum with _____.
f) The first larvae of DIPHYLLOBOTRIUM LATUM which hatch from the eggs in the water is called _____.
g) The second larvae of DIPHYLLOBOTRIUM LATUM which develops in the Cyclops is called _____.
h) The second intermediate host of DIPHYLLOBOTRIUM LATUM is/are _____.
i) The adult form of Dicrocoelium dendriticum lives in the _____.
j) The larvae of Opisthorchis viverrini developed in the following sequence: miracidia, _____, _____, metacercariae.
k) Under the ventral sucker of Dicrocoelium dendriticum is _____.
l) Under the ventral sucker of Opisthorchis viverrini is _____.
m) Adult worms of schistosomes reside in pairs: the female lying in the _____ of the male.
n) Adult worms of schistosomes lives in the _____.
o) Stage rediae absent in the life cycle of _____.
p) Ant is the second intermediate host of _____.
q) Crabs are the second intermediate host of _____.
r) The intermediate host of _____ is a land snail

Unit 27. Nemathelminthes. Medical importance of class Arachnids. Format-practical's.

Discussion questions:

1. Characteristics of class Nematoda (roundworms).
2. The life cycle of pathogens, pathogenesis, diagnosis and prevention of ascariasis, enterobiasis and trichinosis.
3. The life cycle of pathogens, pathogenesis, diagnosis and prevention of ankylostomiasis, strongyloidosis.
4. The life cycle of pathogens, pathogenesis, diagnosis and prevention of guinea worm, filariosis.
5. General characteristics of the class Arachnids. Troop mites: morphology, life cycle, medical value.

TASKS TO CONTROL THE LEVEL OF STUDY TOPICS

1. Ascaris lumbricoides is localized in the _____ of man.
2. The infecting larvae in the egg of Ascaris lumbricoides develops in the soil within _____.
3. Definitive host of Ascaris lumbricoides is/are _____.
4. Migration on blood flow through the heart and lungs is typical for the larvae of _____, _____, _____.
5. The female of _____ comes out of the anus and lay eggs in the folds of the perineum.
6. Adult worms of Ancylostoma duodenale is localized in _____.
7. Filariform larvae of Ancylostoma duodenale penetrate the human body through _____.
8. Rabditioform larvae of _____ can produce a generation of free-living worms.
9. Intermediate host of Enterobius vermicularis is/are _____.
10. The intermediate hosts of Wuchereria bancrofti are _____.
11. Site of localization of _____ is large intestine – caecum.
12. Human is infested Trichinella eating _____.
13. The larva of Trichinella forms a capsule in meat, and can survive up to _____ days/months/years.
14. Adult worms of _____ are located in the lymph nodes, disrupting the flow of lymph.
15. Adult worms of Trichuris trichiura are located in _____.
16. Adult worms of Strongyloides stercoralis is localized in _____.
17. Rabditioform larvae of Strongyloides stercoralis develops in _____ larvae which penetrate the human body through the skin.

Unit 28. Medical importance of class Insects. Format-practical's.

Discussion questions:

1. Morphophysiological characteristics and life cycle of the class Insects.
2. Morphology, life cycle and medical importance of insects - ectoparasites (lice, fleas, houses and volfartova flies).
3. Insects - the carriers of infectious and parasitic diseases (gnats, mosquitoes, sandflies, tsetse flies, midges), morphophysiological characteristics, life cycle and medical importance.

Self-guided work

№	Section, unit	Summary	Number of hours	Form of control
1.	Cellular and molecular-genetical levels of organization of life	Biology as a science of patterns and mechanisms of functioning and development of organisms. Defining the essence of life. The fundamental properties of living. . Evolutionary-based levels of organization of life. The main stages of development of the cell theory. Cell theory of Schleiden-Schwann. Modern cell theory. Structure and function of cell membrane organelles. Structure and function of cell organelles nemembrannyh. Structural and functional organization of the interphase nucleus. Comparative characteristics of pro- and eukaryotic cells. Distinctive features of the cells of plants and animals. The life cycle of the cell. Characteristics of the interphase. Mitosis: phase and biological significance. Morphofunctional characteristic of the hereditary apparatus of cells. Reproduction - the universal property of living. The evolution of	22	Questions at the exam. Interview

		reproduction. Biological aspects of sexual dimorphism. Methods of asexual and sexual reproduction. Cytological and cytogenetic characterization of meiosis.		
2.	Organismic (ontogenetic) the level of organization of biological systems	Subject, objectives, methods and stages of development of genetics. The main provisions of the chromosome theory of heredity. Linked inheritance. The gene as a functional unit of heredity. Classification, properties and localizations of gene. Mendel's laws and cytological bases. Sex linkage. Genetics of sex. The regulation of the activity of genes in prokaryotes. Modification variability, its adaptive nature, meaning in ontogeny and evolution. The concept of normal reaction. Mechanisms combinative variability. The value of combinative variability in ensuring the genotypic diversity of people. Mutational variability. Classification of mutations. The concept of genetic mutations. Genetic disease. Chromosomal mutations (aberration). The concept of chromosomal diseases. Genomic mutations. Euploidiya and aneuplodiya. The concept of ontogenesis. Periodization of ontogenesis. The life cycles of organisms as a reflection of their evolution. Cleavage. Types of cleavage. Types blastula. Gastrulation. Methods gastrulation. Primary and final organogenesis. Embryonic membranes (provisionals organs): structure and physiological	19	Questions at the exam. Interview

		significance. Differentiation in development. Stages and differentiation factors. Embryonic induction. The critical periods of development. Teratogenic agents factors. General characteristics and periodization of postnatal ontogenesis of the person. The regeneration of organs and tissues as a process of development. The physiological and reparative regeneration. Methods of reparative regeneration.		
3	Population-specific level of organization of living systems. Biogeocoenotic and biosphere levels of organization of biological systems.	Pre-Darwinian evolutionary ideas infancy. The evolutionary concept of J.B. Lamark. Darwin's contribution to the development of evolutionary theory. The main provisions of the theory of evolution. The modern synthetic theory of evolution. Population - the unit of evolution. Species - qualitative stage of evolution. Criteria for the species. Factors evolution. The main directions of evolution (biological progress and regression). Ways to achieve biological progress and its forms. Macro- and microevolution. Characteristic of their results. Speciation and its forms. The position of Homo sapiens in the animal world. The qualitative uniqueness of the person. The ratio biological and social factors in the development of human rights. Race and the unity of the human species. Ecology as a science. Environmental factors. Patterns of action of environmental factors on the	13	Questions at the exam. Interview

		organisms. The concept of ecosystem biogeocoenose, antropobiogeotsenoze. The principles of interaction of the parasite and the host at an individual level. Parasitism as a biological phenomenon. The origin of parasitism. General characteristics of the class Sarcodina. Morphophysiology and the life cycle of dysenteric amoeba. Diagnosis and prevention of amoebiasis. Morphophysiological characteristic of the class Zoomastigophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of trypanosomiasis, leishmaniasis, trichomoniasis and giardiasis. Class Sporozoa. The life cycle of Plasmodium falciparum. Pathogenesis, diagnosis and prevention of malaria and toxoplasmosis. General characteristics of the class Cilliates. The life cycle and pathogenic effect balantidiums. Prevention balantidiaza. Morphological characteristics and breeding trematodes. Features of biology and pathogenic action of opisthorchosis, fascioliasis and paragonimiasis. Features of biology and pathogenic action of tropical trematodes. Total morphophysiological characteristic of the class Cestoda. Class Cestoda. The life cycle of pathogens and pathogenic action, diagnosis and prevention of hymenolepiasis diphilobotriosis, echinococcosis and alveococcosis, teniasis, cysticercosis		

		and teniarinhosis. Morphophysiological characterization of the class Nematoda. The morphology, development cycle and pathogenic effect ascaris, pinworm, whipworm. hookworm, strongyloidiasis, trichinosis, dracunculiasis, onchocerciasis and wuchereriasis. General characteristics of the class Arachnids. Troop mites: morphology, life cycle, medical value. Morphophysiological characteristics and life cycle of the class Insects. Morphology, life cycle and medical importance of insects - ectoparasites (lice, fleas, houses and volfartova flies). Insects - the carriers of infectious and parasitic diseases (gnats, mosquitoes, sandflies, tsetse flies. Midges), morphophysiological characteristics, life cycle and medical importance.		
Total				**54**

COURSE RESOURCE

List of recommended literature:

a) Core reading*:*

1. Cambell N.A. Biology / N.A. Cambell et al. // Benjamin Cummings, 2013. – p. 1484.

2. Kurnosova N.A., Micheeva N.A. Training toolkit "Cytology". Ulyanovsk: ULSU, 2016. – 120p.

3. Kurnosova N.A., Micheeva N.A. Training toolkit "General Biology. Part A". Ulyanovsk: ULSU, 2017. – 92p.

4. Kurnosova N.A., Micheeva N.A. Training toolkit "General Biology. Part B". Ulyanovsk: ULSU, 2017. – 91p.

b) Supplementary reading*:*

1. Raven P.H. Biology / P.H. Raven, G.B. Johnson, K.A. Mason // MGH, 2002. – p. 1239.
2. Ash, L.R. and Orihel, T.C. 1990. Atlas of Human Parasitology.3rd ed. ASCP Press.
3. Roberts, L.S. and Janovy, J.J. Jr. 2000. Gerald D. Schmidt & Larry S. Roberts. Foundations of Parasitology. 6th ed. McGraw-Hill Publishers.

c) IT software:

Standard software provided by by the Division service maintenance Service of pro-rector on scientific work and information technologies UlGU.

1. Microsoft Windows (only valid version of not lower than Windows XP);
2. Microsoft Office Professional (only valid version of not lower than Office 2003), which includes Word, Excel, Access;
3. Internet-browser of (Internet Explorer, Opera, Mozila and the like)

d) databases, information and reference systems, search systems:

database, information and referral and search engines

1. The electronic catalog of the library of USU
2. System GARANT: electronic periodic reference [electronic resource]. The electronic data. - [BI, 199-].
3. ConsultantPlus: - Search Engine [electronic resource]. The electronic data. - [BI, 199-].
4. The information system "Single window access to educational resources» (http://window.edu.ru/.).

10. **Course facilities:**

- microscopes,
- slides,
- tables,
- cytological atlases,
- research microscope.

ASSESSMENT FUND
on the subject "Biology"

1. Requirements for the results of mastering the discipline

Competence Index	Content of competence	As a result of studying the discipline, students should:		
		to know	***to be able to***	***to be skilled at***
OPC – 7	the readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems.	general laws of the origin and evolution of life, anthropogenesis. The theory of biological systems, their organization, cellular and non-cellular forms of life; Cellular organization of living organisms, the distinguishing characteristics of pro - and eukaryotic cells, the role of cellular structures in the life of the cell, the mechanisms of energy production in living systems.	use educational, scientific, popular scientific literature, the Internet for professional activities. To use biological equipment. Research with magnifying equipment (microscopes, optical and simple loops). Cooking time and explore their products under a light microscope and magnifying glass. Put a simple biological experiment and analyze the results. Read and analyze the electron	research with a microscope. Skills cooking time products. Skills mapping studied objects in the figures; Electron diffraction analysis skills. Skills determining of karyotype. Genetic approaches to solving problems. Standard notation for drawing pedigrees. Denver classification system for the analysis of chromosome ideograms microscopy.

		Regularities of processes and mechanisms for the storage, transfer and use of biological information in the cell, principles of control of gene expression; Structural and functional organization of genetic material features of the genome of prokaryotes and eukaryotes. Cytological basis of reproduction, gametogenesis, structure of germ cells. The laws of genetics and its importance for medicine. Patterns of heredity and variation in individual development, biological basis of inherited human diseases and methods of their diagnostics. Regularities of individual	diffraction pattern of cell structures. In the form of generalized diagrams show the processes occurring in the cell. Using this notation, to solve problems on mitosis, meiosis, gametogenesis. Explain the causes and possible mechanisms of birth of children with chromosomal diseases. Solve problems on genetics, molecular, make the pedigrees using standard notation, analyze pedigrees. Compile and analyze the ideograms, using the Denver classification system chromosomes. Identify the type of parasite, stage of development of the proposed	

		development of organisms, human ontogenesis, molecular mechanisms of embryonic development, critical periods of ontogenesis. Environmental category environmental health issues, bioecological disease. The phenomenon of parasitism. The morphological features of the parasites, their life cycles, ways of infection, pathogenic action, symptoms, diagnosis, prevention of diseases. Parasitological and medical characteristics of arthropod - vectors and pathogens.	drug. To solve situational problems in parasitology.	

2. Passport of fund of appraisal funds for the discipline

№	Supervised discipline sections	Competence Index	Evaluation tools		Control method
			Name	Task number	
1.	Cellular and molecular-genetical levels of organization of life	OPC – 7	Questions for the exam (to know) Situational task (to be able) Slides (to be skilled at)	1-13 1-22 1-6	Interview
2.	Organismic (ontogenetic) the level of organization of biological systems	OPC – 7	Questions for the exam (to know) Situational task (to be able) Slides (to be skilled at)	14-34 23-35 7-15	Interview
3	Population-specific level of organization of living systems. Biogeocoenotic and biosphere levels of organization of biological systems.	OPC – 7	Questions for the exam (to know) Situational task (to be able) Slides, macropreparation (to be skilled at)	35-70 36-60 16-30, 1-8	Interview

3. Evaluation tools for intermediate certification of the discipline "Biology"

3.1. Suggested final test questions of *the discipline "Biology"*

1. Biology as a science of patterns and mechanisms of functioning and development of organisms.
2. Defining the essence of life. The fundamental properties of living. . Evolutionary-based levels of organization of life.

3. The main stages of development of the cell theory. Cell theory of Schleiden-Schwann, Vi. Modern cell theory.
4. Structure and function of cell membrane organelles.
5. Structure and function of cell organelles nemembrannyh.
6. Structural and functional organization of the interphase nucleus.
7. Comparative characteristics of pro- and eukaryotic cells. Distinctive features of the cells of plants and animals.
8. The life cycle of the cell. Characteristics of the interphase.
9. Mitosis: phase and biological significance.
10. Morphofunctional characteristic of the hereditary apparatus of cells.
11. Reproduction - the universal property of living. The evolution of reproduction. Biological aspects of sexual dimorphism.
12. Methods of asexual and sexual reproduction.
13. Cytological and cytogenetic characterization of meiosis.
14. Subject, objectives, methods and stages of development of genetics.
15. The main provisions of the chromosome theory of heredity. Linked inheritance.
16. The gene as a functional unit of heredity. Classification, properties and localizations of gene.
17. Mendel's laws and cytological bases.
18. Sex linkage. Genetics of sex.
19. The regulation of the activity of genes in prokaryotes.
20. Modification variability, its adaptive nature, meaning in ontogeny and evolution. The concept of normal reaction.
21. Mechanisms combinative variability. The value of combinative variability in ensuring the genotypic diversity of people.
22. Mutational variability. Classification of mutations. The concept of genetic mutations. Genetic disease.
23. Chromosomal mutations (aberration). The concept of chromosomal diseases.
24. Genomic mutations. Euploidiya and aneuplodiya.
25. The concept of ontogenesis. Periodization of ontogenesis. The life cycles of organisms as a reflection of their evolution.
26. Cleavage. Types of cleavage. Types blastula.
27. Gastrulation. Methods gastrulation.
28. Primary and final organogenesis.
29. Embryonic membranes (provisionals organs): structure and physiological significance.
30. Differentiation in development. Stages and differentiation factors.
31. Embryonic induction.
32. The critical periods of development. Teratogenic agents factors.

33. General characteristics and periodization of postnatal ontogenesis of the person.
34. The regeneration of organs and tissues as a process of development. The physiological and reparative regeneration. Methods of reparative regeneration.
35. Pre-Darwinian evolutionary ideas infancy. The evolutionary concept of J.B. Lamark.
36. Darwin's contribution to the development of evolutionary theory. The main provisions of the theory of evolution.
37. The modern synthetic theory of evolution. Population - the unit of evolution.
38. Species - qualitative stage of evolution. Criteria for the species. Factors evolution.
39. The main directions of evolution (biological progress and regression). Ways to achieve biological progress (aromorphosis, idioadaptation total degeneration) and its forms.
40. Macro- and microevolution. Characteristic of their results. Speciation and its forms.
41. The position of Homo sapiens in the animal world. The qualitative uniqueness of the person.
42. The ratio biological and social factors in the development of human rights.
43. Race and the unity of the human species.
44. Ecology as a science.
45. Environmental factors. Patterns of action of environmental factors on the body.
46. The concept of ecosystem biogeocoenose, antropobiogeotsenoze.
47. The principles of interaction of the parasite and the host at an individual level. Parasitism as a biological phenomenon. The origin of parasitism.
48. General characteristics of the class Sarcodina. Morphophysiology and the life cycle of dysenteric amoeba. Diagnosis and prevention of amoebiasis.
49. Morphophysiological characteristic of the class Zoomastigophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of trypanosomiasis.
50. Morphophysiological characteristic of the class Zoomastigophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of leishmaniasis.
51. Morphophysiological characteristic of the class Zoomastigophora. The life cycle of pathogens, pathogenesis, diagnosis and prevention of trichomoniasis and giardiasis.
52. Class Sporozoa. The life cycle of Plasmodium falciparum. Pathogenesis, diagnosis and prevention of malaria.
53. Morphophysiology, lifecycle and pathogenic effect of the pathogen of toxoplasmosis.
54. General characteristics of the class "Cilliates". The life cycle and pathogenic effect balantidiums. Prevention balantidiaza.

55. Class Flukes. Morphological characteristics and breeding trematodes.
56. Features of biology and pathogenic action of opisthorchosis, fascioliasis and Paragonimiasis.
57. Features of biology and pathogenic action of tropical trematodes.
58. Total morphophysiological characteristic of the class Cestoda.
59. Class Cestoda. The life cycle of pathogens and pathogenic action, diagnosis and prevention and hymenolepiasis diphilobotriosis.
60. Class Cestoda. The life cycle of pathogens and pathogenic action, diagnosis and prevention of echinococcosis and alveococcosis.
61. Class Cestoda. The life cycle of pathogens and pathogenic action, diagnosis and prevention teniasis, cysticercosis and teniarinhosis.
62. Morphophysiological characterization of the class Nematoda.
63. The morphology, development cycle and pathogenic effect ascaris, pinworm, whipworm. Laboratory diagnosis and prevention nematosis.
64. Class Nematoda. The life cycle of pathogens pathogenic action, diagnosis and prevention of hookworm, strongyloidiasis, trichinosis.
65. Class Nematoda. The life cycle of pathogens pathogenic action, diagnosis and prevention of dracunculiasis, onchocerciasis and wuchereriasis.
66. General characteristics of the class Arachnids.
67. Troop mites: morphology, life cycle, medical value.
68. Morphophysiological characteristics and life cycle of the class Insects.
69. Morphology, life cycle and medical importance of insects - ectoparasites (lice, fleas, houses and volfartova flies).
70. Insects - the carriers of infectious and parasitic diseases (gnats, mosquitoes, sandflies, tsetse flies. Midges), morphophysiological characteristics, life cycle and medical importance.

Criteria and rating scales:

- assessment criteria - the correct answers to the questions asked;
- assessment indicator - the percentage of correct answers to questions;
- assessment scale (assessment) - 4 levels of competency assessment are highlighted:

high (excellent) - more than 80% of correct answers;
sufficient (good) - from 60 to 80% correct answers;
threshold (satisfactory) - from 50 to 60% correct answers;
critical (unsatisfactory) - less than 50% of correct answers.

3.3. The situational tasks

1. The microscope is installed opposite the switched on source of artificial illumination, however, the field of view in the eyepiece is dark. What should be done and in what sequence, so that the field of view becomes the most illuminated?

2. With a high magnification, the object looks fuzzy at all positions of the microscrew. Explain the sequence of your actions to overcome this situation.

3. A foreign body is visible in the field of view. How can one determine its localization (drug, objective lens, eyepiece lens) and improve image quality?

4. The microscope is installed opposite the source of artificial light. The field of view is not evenly illuminated. Observed the decomposition of light (diffraction). What should be done to overcome this situation?

5. At low magnification microscope obtained high-quality image of the object. In the transition to the consideration of the object with a high magnification microscope objective lens rests on the cover glass and can not assume the normal position. Explain the cause of the defect and the sequence of your actions to overcome this situation.

6. If during mitosis in humans did not separate one pair of chromosomes? two pairs? How many chromosomes will be in the daughter cells?

7. In human tissue culture, one chromosome was eliminated. How many chromosomes will be in the daughter cells after mitosis (consider the possibility of elimination in different phases of mitosis)?

8. Cytophotometric studies revealed single- and dual-core tetraploid cells in the liver. At what phase was the course of mitosis not completed in either case?

9. By experimental intervention, the cell was artificially divided into two parts - with and without a nucleus. What is the viability of these parts of the cell?

10. In the cage, the figures of the two daughter stars are visible. What is the phase of mitosis?

11. At mitotic division of a somatic human cell, daughter cells were formed. What set of chromosomes do they have?

12. The cell is in mitosis. Does it contain protein synthesis for "export"?

13. Using a quantitative method, it was determined that the nucleus of an interphase cell contains twice the amount of DNA. What is the cell cycle period?

14. After processing cells in tissue culture with colchicine, the researchers stopped finding dividing cells. How can this be explained, if it is known that colchicine destroys tubulin filaments?

15. Is it possible to say that between two chromosomes in one cell during the prophase of the first division of meiosis is conjugation?

16. During abnormal meiosis in the original human cell with 46 chromosomes, one pair of homologous chromosomes did not go to different poles. Where it leads?

17. As a result of the elimination of one of the chromosomes, an XO-type cell enters meiosis, where O denotes the absence of a chromosome. What cells will result from meiosis?

18. Using morphometry, comparative data on the diameter of eggs from chicken, turtles, cats and humans are obtained. Between which of them are the differences found and which are close in this indicator? Explain why?

19. In a dispute, one student claimed that the zygote contains a haploid set of chromosomes, the second one argued that it was diploid. Explain which of them is right.

20. An electron micrograph of the sperm cell shows a centriole with an axoneme extending from it. What is the sperm section?

21. At what phases of spermatogenesis is the germ cell most sensitive to the action of ionizing radiation? With what it can be connected?

22. One student claimed that the spermatozoon acrosome is a derivative of the Golgi complex; another believed that the acrosome is an analogue of lysosomes; a third student expressed the opinion that it contains hydrolytic enzymes. Rate these judgments.

23. A woman turned to the genetic counseling department, concerned that her husband had polydactyly. She wondered whether the occurrence of this disease is possible in her future children. After examining the genealogies of both spouses and finding that the father of the spouse, as well as all the relatives along the line of the wife did not have this disease, the doctor concluded that the probability of polydactylism in the children of this couple is 50%. Explain the conclusion of the doctor, if it is known that the gene of polydactyly dominates over the gene of the normal structure of the brush.

24. A deaf-and-dumb woman married a man with normal hearing. They had a deaf-mute child. The couple turned into a genetic consultation with the question, is it possible to have a healthy child? What answer did they get if the hereditary deaf-mutism gene is recessive with respect to the gene for normal hearing?

25. A man turned to genetic counseling, concerned that his child had blood group II, while he had I, and his wife had group IV. The doctor dispelled the doubts of his father. Explain the response of the genetic counseling officer.

26. In the mulatto family a white child was born. The father of the family is concerned that the boy who was born is not his son. Are his concerns justified?

27. The boy, who has a small height, is concerned that he will not grow up anymore, as his parents are also short. Can a son be higher than his parents?

28. A man with normal blood clotting is excited about the news that his wife's sister gave birth to a hemophilic boy (he thinks about the health of his future

children). To what extent could he be reassured by the message that among the relatives of his maternal wife, hemophilia was never observed?

29. In the study of gastrulation revealed stratification of blastoderm cells into two layers lying one above the other. What are these two cell layers called first? What is this method of gastrulation called? For which groups of animals is it characteristic?

30. A thick ectoderm and endoderm in the form of a thin leaf, represented by flattened cells, are clearly visible on the microscope of the chicken embryo. On the midline of the embryo, the ectoderm forms an embossment in the form of a groove. The mesoderm is located between the ecto-and endoderm in the direction to the side of the midline, due to which the embryo has a three-layer structure. What stage of development of the embryo is represented on this microdrug?

31. Studying the development of the embryo of an animal, the researchers observed the process of introduction into the blastocella cavity of individual cells migrating from the wall of the blastula. What is the name of this phenomenon? For which animals is it typical?

32. With this method of gastrulation, the material of the future mesoderm is screwed together with the endoderm as part of a single gastric weaving, and in the process of invagination the boundary between the two tabs is usually indistinguishable. What group of animals has this method of laying mesoderm? What is it called?

33. After transplanting a part of cells from one embryo (donor) of amphibians onto the ventral surface of the body to the second embryo (recipient), the latter formed the caudal part of the body of the additional (second) embryo. From which part of the donor embryo were cells taken for transplantation to donor-recipient? At what stage of development of the donor and recipient can such an experiment be carried out? From which part of the donor embryo is it necessary to take cells in order to form the cranial part of the additional recipient embryo?

34. Transplantation of the otic vesicle, the nasal placode, or the pituitary gland into the lateral line region of the newt embryo has been shown to induce the development of accessory limbs. What do these experiments show? What is the role of the inducer and the reacting region in the formation of a specific response?

35. After treating the embryos of tritons at the gastrula stage with the enzyme trypsin, the destruction of the material connecting the cells to each other occurred. What happens if for dissociated cells to create conditions for free movement and connection with each other? What mechanism of ontogenesis is demonstrated by experience?

36. It is known that mutational variability in organisms supplying material for selection is random and not directed. How does microevolution then become directional?

37. Give an explanation from an evolutionary standpoint to the following expression: "Not individual genes are selected, but integral phenotypes. The phenotype is not only an object of selection, but also acts as a transmitter of hereditary information in generations."

38. Most mutations are extremely rare, independent of the number of genes in the genotype of organisms. Bacteria possessing the smallest number of genes and, consequently, the smallest number of mutations per individual, generally have a high rate of mutation in populations. Explain why? What determines the speed of the mutation process in populations?

39. Female butterflies of bear bears of normal and melanistic forms are more likely to intersect with males of a color other than their own. Why is such a crossing in natural populations occur more often?

40. Modern science in determining the type uses different criteria. What are the errors that can lead to the establishment of species by only one of the criteria? Show it with concrete examples.

41. Five races of the Sevan trout are known, which spawn in different months. The shift in the timing of reproduction of fish is small, but very significant for the existence of individual populations. What is the mechanism responsible for the differences between the populations of Sevan trout? What is its significance for the species as a whole?

42. Your comrades argue on four questions and ask you to help them figure out: How did life begin on Earth? Some argue that it originated biogenically, while others - abiogenically; What are the most important biopolymers should the bodies of the first living organisms consist of? Some believe that proteins could be such a substance, others that nucleic acids, others - proteins + nucleic acids; What organisms on the method of nutrition occurred first? Some believe that heterotrophic organisms appeared before everyone else, after them autotrophs. Others hold the opposite opinion; What type of breathing was characteristic of the first living organisms? Odnitschitaet more ancient anaerobic type, others - aerobic. What is your opinion on these issues? What arguments can you give to confirm your opinion?

43. It is known that miscarriages in humans make up 25% of all conceptions. Survival is higher in those children whose weight is close to the average. What is the evolutionary factor in question? What is the significance of this factor in the evolution of modern man?

44. The main factors in the evolution of the organic world include hereditary variability and natural selection. Which of these factors retains its value in human society? What can the effect of this factor lead to under conditions of weakening the action of natural selection?

45. Compare social insects, a herd of monkeys and modern human society and explain in the life of which of them there are biological and social factors of evolution? In the life of which of them are only biological laws?

46. In many literary sources it is written that at present the life of a person is no longer regulated by natural selection. Do you agree with this statement? Give examples of evidence that you are right.

47. What features of the structure of the body and lifestyle helped the ancient two-legged monkeys to survive in the struggle for existence? Explain how the development of the structure and lifestyle changes in human ancestors could lead to the emergence of a qualitative line between monkeys and the most ancient people?

48. Some scientists attribute Australopithecus to human ancestors, while others do not. Why are scientists' opinions about them divided?

49. The vertical position of the body in humans has led to a number of changes in the structure of the skeleton (especially the spine, pelvis, hand), muscles and internal organs. What are these changes and what is their significance?

50. Arthropod U moves to the blood supply of terrestrial vertebrates. Describe the likely set of morphological and biological adaptations that has arisen in this species.

51. In some species of trematodes S, the amount of glycogen per dry weight is about 70%, in another type of trematodes Q, this figure is about 10%. What can be said about the localization of these trematodes. Justify the answer.

52. The parasite has hairs on the surface of the tegument. What are the peculiarities of nutrition of this parasite? What is characteristic of his digestive system?

53. Endoparasite feeds on blood. What are the needs of the parasite, in addition to food, while it can be met and how?

54. Metacyclic trypanosomes of the Trypanosoma lewesi species accumulate in the posterior gut of fleas, with flea excrement they fall on the host's skin, and then through the mucous membrane into the blood. Determine how the host is infected.

55. Ducks catch the trematode Echinostoma, eating aquatic mollusks, in which these trematodes are cystic cercidated. Determine how the host is infected.

56. In cats, the strobylar stage of the cestode is parasitic, Dipylidium caninum, and in fleas, the cysticercoid of this cestode is parasitic. In the named pair of hosts, determine the final and intermediate.

57. The patient has a fever, an enlarged spleen and liver; found a decrease in the content of red blood cells. Microscopic examination of smear punctate of the sternum showed that the bone marrow leaflets contain a large number of small, unicellular, free-burning parasites. In the cytoplasm is one nucleus. When the parasite is cultivated in an artificial medium, it turns into a flagellate form. What disease can be assumed in this case?

58. Microscopic examination of the patient's discharge from skin ulcers revealed small parasites of a round or oval shape, in the body of which there are single nuclei displaced to the periphery. Parasites either fill the cytoplasm of the cells, or freely lie near the destroyed cells. When such organisms are cultivated in an artificial nutrient medium, they turn into a flagellate form. Specify the species name of the parasite.

59. A patient has an increase in body temperature, an increase in lymph nodes, on the skin of the hand, the bite of some insect is surrounded by a mild rash. In the blood smear between erythrocytes, single-terminal single-celled organisms with a single nucleus are found. Make a diagnosis.

60. A sick, middle-aged man with complaints of severe headache, high fever (39-40 C) was delivered to the infectious diseases department of the clinical hospital. From the anamnesis - a week before the disease went into the woods, took off a few ticks sucked. On examination, the neuropathologist revealed characteristic lesions in the gray matter of the spinal cord and trunk: paralysis of the muscles of the neck and forelimbs; the absence of reflexes on the hands and a decrease in the muscle tone of both hands. What is your presumptive diagnosis? What clinical and laboratory research methods need to be conducted to confirm the final diagnosis? Specify the path of infection? What recommendations should be given on measures of personal prevention?

Criteria and rating scales:

- assessment criteria - the correct answers to the questions asked;
- assessment indicator - the percentage of correct answers to questions;
- assessment scale (assessment) - 4 levels of competency assessment are highlighted:

high (excellent) - more than 80% of correct answers;

sufficient (good) - from 60 to 80% correct answers;

threshold (satisfactory) - from 50 to 60% correct answers;

critical (unsatisfactory) - less than 50% of correct answers.

The microscopic slides and macropreparations.

a) the slides

1. Golgi complex.
2. Mitochondria in the cells of the intestinal roundworm.
3. Inclusion of fat in liver cells amphibian.
4. The inclusions of glycogen.
5. Pigment inclusion in chromatophores tadpole skin.
6. Mitosis in onion of root.
7. Polytene chromosomes.
8. Blastula frog.
9. Frog gastrula.
10. Frog neurula (early).
11. Frog neurula (average).
12. Frog neurula (late).
13. Primary chicken embryo strip.
14. Somites, notochord, neural tube.
15. Trunk and chicken embryo amniotic fold.
16. Lancet fluke.
17. Cat fluke.
18. Lung fluke.
19. Roundworm eggs.
20. Eggs of liver fluke.
21. Eggs of bovine tapeworm.
22. Eggs of broad tapeworm.
23. Eggs of pinworm eggs.
24. Oncosphere.
25. The tick Ixodes.
26. Gamasid mites.
27. Mouthparts of the mosquito.
28. Flea dog.
29. Head louse.
30. Nit.

b) the macropreparation

1. Ascaris (male and female).
2. Wide tapeworm.
3. Liver fluke.
4. Echinococcus.
5. Ascaris (male and female).

6. Wide tapeworm.
7. Liver fluke.
8. Echinococcus.

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