BIOLOGY

FOR INTERNATIONAL STUDENTS

IN THE SPECIALTY «PHARMACY»

Practical book

Minsk BSMU 2017

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА БИОЛОГИИ

БИОЛОГИЯ

ДЛЯ ИНОСТРАННЫХ СТУДЕНТОВ ПО СПЕЦИАЛЬНОСТИ «ФАРМАЦИЯ»

BIOLOGY

FOR INTERNATIONAL STUDENTS IN THE SPECIALTY «PHARMACY»

Практикум

2-е издание, исправленное и дополненное

Минск БГМУ 2017

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А в т о р ы: канд. мед. наук, доц. В. Э. Бутвиловский; ассист. В. В. Григорович; ассист. Е. А. Романовский; канд. мед. наук, доц. А. В. Бутвиловский

Р е ц е н з е н т ы: канд. биол. наук, доц. А. В. Колб; канд. мед. наук, доц. О. Н. Ринейская

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В издание включены контрольные вопросы, основные термины и понятия, закрытые и открытые тесты для самоконтроля, тексты задач по цитологии и генетике, схемы и контуры рисунков и оригинальные фотографии изучаемых препаратов, экзаменационные вопросы. Первое издание вышло в 2016 году. В настоящем издании изменены многие темы занятий и материалы к ним.

Предназначен для студентов 1-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Фармация».

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Бутвиловский Валерий Эдуардович
Григорович Виктор Васильевич
Романовский Евгений Александрович
Бутвиловский Александр Валерьевич

БИОЛОГИЯ
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Plan of the course in the 1st semester and current marks

Name of the student _____ Group _____

Week number	Topic of practice	Grade	Lecturer's signature
1.	The role of Biology in medical education. Methods used to investigate cell		
2.	Biology of the cell. Flow of substances and energy in the cell		
3.	The flow of genetic information in the cell		
4.	Arrangement of hereditary material (part 1)		
5.	Arrangement of hereditary material (part 2)		
6.	Genetic engineering		
7.	Gene interactions. Genetic linkage. Genetics of sex		
8.	Variation		
9.	Fundamentals of human genetics (part 1)		
10.	Fundamentals of human genetics (part 2)		
11.	**Colloquium in Cytology and Genetics**		
12.	Reproduction of living matter		
13.	Fundamentals of ontogenesis (prenatal period)		
14.	Fundamentals of ontogenesis (postnatal period)		
15.	Introduction to Parasytology		
16.	Parasytes as pathogens of diseases		
17.	Poisonous fungi and plants		
18.	Venomous and poisonous animals		

DEMANDS OF THE BIOLOGY DEPARTMENT TO THE STUDENTS:

1. **Observe the safety rules in the classrooms of the department**; obey internal regulations of the Belarusian State Medical University.
2. Do not come late for practical classes. Students who came late **are not admitted** to the practical classes.
3. Students must have **gowns** and **practical books** each time they come to the class. Students who do not have gowns and practical books **are not admitted** to the practical classes.
4. Missed classes must be fulfilled within **2 weeks**.
5. Students who have not fulfilled the missed practical classes within 2 weeks **are not admitted** to the further classes, summary classes, credit and the end-of-course examination without dean's permission.
6. Students with result marks for the year **lower than 4.0** who got an **unsatisfactory mark** at the examination can retake the examination only **at the end of August**.
7. Students with average of all marks (except summary classes) for the year **8.25 and higher** (under condition that they pass all final classes with the marks "**8**", "**9**" and "**10**") may be examined only for micropreparations and problems. If the task is done successfully, they get a "**ten**".

I have read the demands of the department: _____ 201___ _____

(date) (signature)

CRITERIA FOR ACADEMIC PROGRESS ASSESSMENT OF STUDENTS IN THE BELARUSIAN STATE MEDICAL UNIVERSITY

10 (ten), passed:

comprehended, profound and full knowledge in the material of all the sections of the educational program and good knowledge of main issues beyond the educational program;

accurate usage of scientific terminology (including terms in foreign languages), competent, logically correct presentation of answers to questions, ability to generalize and make logical and accurate conclusions;

mastery skills of work with tools and instruments necessary for the discipline, ability of efficient use of them for setting objectives and solving scientific and professional cases;

remarkable ability for individual creative solution of problems in unconventional situations;

full and profound comprehension of information from basic and recommended additional literature in the discipline;

ability to orient in theories, concepts and issues of the studied discipline and analytically estimate them;

creative individual work at practical and laboratory classes, active and creative participation in group discussions, high cultural level of solutions to questions.

9 (nine), passed:

comprehended, profound and full knowledge in the material of all the sections of the educational program;

accurate usage of scientific terminology (including terms in foreign languages), competent, logically correct presentation of answers to questions;

skills of work with tools and instruments necessary for the discipline, ability to use them for setting objectives and solving scientific and professional cases;

ability for individual creative solution of problems in unconventional situations of the discipline;

full comprehension of information from basic and recommended additional literature in the discipline;

ability to orient in theories, concepts and issues of the studied discipline and

regular active individual work at practical and laboratory classes, active and creative participation in group discussions, high cultural level of solutions to questions.

8 (eight), passed:

comprehended, profound and full knowledge in the material of all the sections of the educational program;

usage of scientific terminology (including terms in foreign languages), logically correct presentation of answers to questions;

skills of work with tools and instruments necessary for the discipline, ability to use them for solving scientific and professional cases;

ability for individual solution of problems in the educational discipline;

comprehension of information from basic and recommended additional literature in the discipline;

ability to orient in theories, concepts and issues of the studied discipline and analytically estimate them;

active individual work at practical and laboratory classes, regular and active participation in group discussions, high cultural level of solutions to questions.

7 (seven), passed:

comprehended, profound and full knowledge in the material of all the sections of the educational program;

usage of scientific terminology (including terms in foreign languages), logically correct presentation of answers to questions;

skills of work with tools and instruments necessary for the discipline, ability to use them for solving scientific and professional cases;

ability for individual solution of problems in the educational discipline using typical methods;

comprehension of information from basic and recommended additional literature in the discipline;

ability to orient in theories, concepts and issues of the studied discipline and analytically estimate them;

individual work at practical and laboratory classes, participation in group discussions, high cultural level of solutions to questions.

analytically estimate them;	

6 (six), passed: full knowledge in the material of all the sections of the educational program; usage of necessary scientific terminology, logically correct presentation of answers to questions; skills of work with tools and instruments necessary for the discipline, ability to use them for solving scientific and professional cases; ability for individual solution of problems in the educational discipline using typical methods; comprehension of information from basic literature in the discipline; ability to orient in basic theories, concepts and issues of the studied discipline and analytically estimate them; active individual work at practical and laboratory classes, periodic participation in group discussions, high cultural level of solutions to questions. **5 (five), passed:** enough knowledge in the material of educational program; usage of necessary scientific terminology, logically correct presentation of answers to questions; skills of work with tools and instruments necessary for the discipline, ability to use them for solving scientific and professional cases; ability for individual solution of problems in the educational discipline using typical methods; comprehension of information from basic literature in the discipline; ability to orient in basic theories, concepts and issues of the studied discipline and analytically estimate them; active individual work at practical and laboratory classes, partial participation in group discussions, enough cultural level of solutions to questions. **4 (four), passed:** enough knowledge in the material of educational program required for higher education; comprehension of information from basic literature in the discipline; usage of necessary scientific terminology, logically correct presentation of	skills of work with tools and instruments necessary for the discipline, ability to use them for solving typical professional cases; ability to solve standard cases under commands of a lecturer; ability to orient in basic theories, concepts and issues of the studied discipline and analytically estimate them; work at practical and laboratory classes under commands of a lecturer, acceptable cultural level of solutions to questions. **3 (three), not passed:** not enough knowledge in the material of educational program required for higher education; comprehension of some information from basic literature in the discipline; usage of scientific terminology, presentation of answers to questions with considerable mistakes; not enough skills of work with tools and instruments necessary for the discipline, incapacity to use them for solving typical professional cases; incapacity to orient in basic theories, concepts and issues of the studied discipline and analytically estimate them; passiveness at practical and laboratory classes un, low cultural level of solutions to questions. **2 (two), not passed:** very low knowledge in the material of educational program required for higher education; knowledge of some basic literature in the discipline; inability to use scientific terminology, presentation of answers to with serious mistakes; passiveness at practical and laboratory classes un, low cultural level of solutions to questions. **1 (one), not passed:** absence of knowledge in the material of educational program required for higher education, refuse to answer, unjustified absence.

answers to questions, ability to make conclusions without considerable mistakes;	

CRITERIA OF KNOWLEDGE ASSESSMENT FOR COMPUTER TESTS

Points	Grade
96–100	– «10»
91–95	– «9»
83–90	– «8»
73–82	– «7»
63–72	– «6»
53–62	– «5»
44–52	– «4»
33–43	– «3»
20–32	– «2»
0–19	– «1»

CRITERIA OF KNOWLEDGE ASSESSMENT FOR WRITTEN TESTS

Points	Grade
94–100	– «10»
73–82	– «8»
56–62	– «6»
42–48	– «4»
11–25	– «2»
83–93	– «9»
63–72	– «7»
49–55	– «5»
26–41	– «3»
0–10	– «1»

END-OF-COURSE EXAMINATION

Plan of the test and estimation of answers

№	Type of issue	Points per issue	The number of issues	Maximal number of points for the issues
1.	Written question	**25**	**1**	**25**
2.	Multichoice tests	**3**	**4**	**12**
3.	Problems	**9**	**3**	**27**
5.	Gap-filling tests	**3**	**12**	**36**
	Totally		**20**	**100**

CRITERIA OF KNOWLEDGE ASSESSMENT

Points	Grade
94-100	10 (ten)
83-93	9 (nine)
73-82	8 (eight)
63-72	7 (seven)
56-62	6 (six)
49-55	5 (five)
42-48	4 (four)

Unsatisfactory grades

26-41	3 (three)
11-25	2 (two)
0-10	1 (one)

The ultimate grade for the course is based on:

- ***Grade of the colloquium (10 %);***
- ***Grade-Point Average (30 %);***
- ***Grade of the end-of-course examination (60 %).***

List of all Nobel Laureates in Physiology or Medicine

1. 2016: Yoshinori Ohsumi «for his discoveries of mechanisms for autophagy»;
2. 2015: William C. Campbell and Satoshi Ōmura «for their discoveries concerning a novel therapy against infections caused by roundworm parasites»; Youyou Tu «for her discoveries concerning a novel therapy against Malaria»;
3. 2014: John O'Keefe, May-Britt Moser and Edvard I. Moser «for their discoveries of cells that constitute a positioning system in the brain»;
4. 2013: James E. Rothman, Randy W. Schekman and Thomas C. Südhof «for their discoveries of machinery regulating vesicle traffic, a major transport system in our cells»;
5. 2012: Sir John B. Gurdon and Shinya Yamanaka «for the discovery that mature cells can be reprogrammed to become pluripotent»;
6. 2011: Bruce A. Beutler and Jules A. Hoffmann «for their discoveries concerning the activation of innate immunity»; Ralph M. Steinman «for his discovery of the dendritic cell and its role in adaptive immunity»;
7. 2010: Robert G. Edwards «for the development of in vitro fertilization»;
8. 2009: Elizabeth H. Blackburn, Carol W. Greider and Jack W. Szostak «for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase»;
9. 2008: Harald zur Hausen «for his discovery of human papilloma viruses causing cervical cancer»; Françoise Barré-Sinoussi and Luc Montagnier «for their discovery of human immunodeficiency virus»;
10. **2007**: **Mario R. Capecchi**, **Sir Martin J. Evans** and **Oliver Smithies** «for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells»;
11. 2006: Andrew Z. Fire and Craig C. Mello «for their discovery of RNA interference - gene silencing by double-stranded RNA»;
12. 2005: Barry J. Marshall and J. Robin Warren «for their discovery of the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease»;
13. 2004: Richard Axel and Linda B. Buck «for their discoveries of odorant receptors and the organization of the olfactory system»;
14. 2003: Paul C. Lauterbur and Sir Peter Mansfield «for their discoveries concerning magnetic resonance imaging»;
15. 2002: Sydney Brenner, H. Robert Horvitz and John E. Sulston «for their discoveries concerning genetic regulation of organ development and programmed cell death»;
16. 2001: Leland H. Hartwell, Tim Hunt and Sir Paul M. Nurse «for their discoveries of key regulators of the cell cycle»;
17. 2000: Arvid Carlsson, Paul Greengard and Eric R. Kandel «for their discoveries concerning signal transduction in the nervous system»;
18. 1999: Günter Blobel «for the discovery that proteins have intrinsic signals that govern their transport and localization in the cell»;
19. 1998: Robert F. Furchgott, Louis J. Ignarro and Ferid Murad «for their discoveries concerning nitric oxide as a signalling molecule in the cardiovascular system»;
20. 1997: Stanley B. Prusiner «for his discovery of Prions - a new biological principle of infection»;
21. 1996: Peter C. Doherty and Rolf M. Zinkernagel «for their discoveries concerning the specificity of the cell mediated immune defence»;
22. 1995: Edward B. Lewis, Christiane Nüsslein-Volhard and Eric F. Wieschaus «for their discoveries concerning the genetic control of early embryonic development»;
23. 1994: Alfred G. Gilman and Martin Rodbell «for their discovery of G-proteins and the role of these proteins in signal transduction in cells»;
24. 1993: Richard J. Roberts and Phillip A. Sharp «for their discoveries of split genes»;
25. 1992: Edmond H. Fischer and Edwin G. Krebs «for their discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism»;
26. 1991: Erwin Neher and Bert Sakmann «for their discoveries concerning the function of single ion channels in cells»;
27. 1990: Joseph E. Murray and E. Donnall Thomas «for their discoveries concerning organ and cell transplantation in the treatment of human disease»;
28. 1989: J. Michael Bishop and Harold E. Varmus «for their discovery of the cellular origin of retroviral oncogenes»;
29. 1988: Sir James W. Black, Gertrude B. Elion and George H. Hitchings «for their discoveries of important principles for drug treatment»;

30. 1987: Susumu Tonegawa «for his discovery of the genetic principle for generation of antibody diversity»;

31. 1986: Stanley Cohen and Rita Levi-Montalcini «for their discoveries of growth factors»;
32. 1985: Michael S. Brown and Joseph L. Goldstein «for their discoveries concerning the regulation of cholesterol metabolism»;
33. 1984: Niels K. Jerne, Georges J. F. Köhler and César Milstein «for theories concerning the specificity in development and control of the immune system and the discovery of the principle for production of monoclonal antibodies»;
34. 1983: Barbara McClintock «for her discovery of mobile genetic elements»;
35. 1982: Sune K. Bergström, Bengt I. Samuelsson and John R. Vane «for their discoveries concerning prostaglandins and related biologically active substances»;
36. 1981: Roger W. Sperry «for his discoveries concerning the functional specialization of the cerebral hemispheres»; David H. Hubel and Torsten N. Wiesel «for their discoveries concerning information processing in the visual system»;
37. 1980: Baruj Benacerraf, Jean Dausset and George D. Snell «for their discoveries concerning genetically determined structures on the cell surface that regulate immunological reactions»;
38. 1979: Allan M. Cormack and Godfrey N. Hounsfield «for the development of computer assisted tomography»;
39. 1978: Werner Arber, Daniel Nathans and Hamilton O. Smith «for the discovery of restriction enzymes and their application to problems of molecular genetics»;
40. 1977: Roger Guillemin and Andrew V. Schally «for their discoveries concerning the peptide hormone production of the brain»; Rosalyn Yalow «for the development of radioimmunoassays of peptide hormones»;
41. 1976: Baruch S. Blumberg and D. Carleton Gajdusek «for their discoveries concerning new mechanisms for the origin and dissemination of infectious diseases»;
42. 1975: David Baltimore, Renato Dulbecco and Howard Martin Temin «for their discoveries concerning the interaction between tumour viruses and the genetic material of the cell»;
43. 1974: Albert Claude, Christian de Duve and George E. Palade «for their discoveries concerning the structural and functional organization of the cell»;
44. 1973: Karl von Frisch, Konrad Lorenz and Nikolaas Tinbergen «for their discoveries concerning organization and elicitation of individual and social behaviour patterns»;
45. 1972: Gerald M. Edelman and Rodney R. Porter «for their discoveries concerning the chemical structure of antibodies»;
46. 1971: Earl W. Sutherland, Jr. «for his discoveries concerning the mechanisms of the action of hormones»;
47. 1970: Sir Bernard Katz, Ulf von Euler and Julius Axelrod «for their discoveries concerning the humoral transmittors in the nerve terminals and the mechanism for their storage, release and inactivation»;
48. 1969: Max Delbrück, Alfred D. Hershey and Salvador E. Luria «for their discoveries concerning the replication mechanism and the genetic structure of viruses»;
49. 1968: Robert W. Holley, Har Gobind Khorana and Marshall W. Nirenberg «for their interpretation of the genetic code and its function in protein synthesis»;
50. 1967: Ragnar Granit, Haldan Keffer Hartline and George Wald «for their discoveries concerning the primary physiological and chemical visual processes in the eye»;
51. 1966: Peyton Rous «for his discovery of tumour-inducing viruses»; Charles Brenton Huggins «for his discoveries concerning hormonal treatment of prostatic cancer»;
52. 1965: François Jacob, André Lwoff and Jacques Monod: «for their discoveries concerning genetic control of enzyme and virus synthesis»;
53. 1964: Konrad Bloch and Feodor Lynen «for their discoveries concerning the mechanism and regulation of the cholesterol and fatty acid metabolism»;
54. 1963: Sir John Carew Eccles, Alan Lloyd Hodgkin and Andrew Fielding Huxley «for their discoveries concerning the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane»;
55. 1962: Francis Harry Compton Crick, James Dewey Watson and Maurice Hugh Frederick Wilkins «for their discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material»;
56. 1961: Georg von Békésy «for his discoveries of the physical mechanism of stimulation within the cochlea»;
57. 1960: Sir Frank Macfarlane Burnet and Peter Brian Medawar «for discovery of acquired immunological tolerance»;

58. 1959: Severo Ochoa and Arthur Kornberg «for their discovery of the mechanisms in the biological synthesis of ribonucleic acid and deoxyribonucleic acid»;

59. 1958: George Wells Beadle and Edward Lawrie Tatum «for their discovery that genes act by regulating definite chemical events»; Joshua Lederberg «for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria»;
60. 1957: Daniel Bovet «for his discoveries relating to synthetic compounds that inhibit the action of certain body substances, and especially their action on the vascular system and the skeletal muscles»;
61. 1956: André Frédéric Cournand, Werner Forssmann and Dickinson W. Richards «for their discoveries concerning heart catheterization and pathological changes in the circulatory system»;
62. 1955: Axel Hugo Theodor Theorell «for his discoveries concerning the nature and mode of action of oxidation enzymes»;
63. 1954: John Franklin Enders, Thomas Huckle Weller and Frederick Chapman Robbins «for their discovery of the ability of poliomyelitis viruses to grow in cultures of various types of tissue»;
64. 1953: Hans Adolf Krebs «for his discovery of the citric acid cycle»; Fritz Albert Lipmann «for his discovery of co-enzyme A and its importance for intermediary metabolism»;
65. 1952: Selman Abraham Waksman «for his discovery of streptomycin, the first antibiotic effective against tuberculosis»;
66. 1951: Max Theiler «for his discoveries concerning yellow fever and how to combat it»;
67. 1950: Edward Calvin Kendall, Tadeus Reichstein and Philip Showalter Hench «for their discoveries relating to the hormones of the adrenal cortex, their structure and biological effects»;
68. 1949: Walter Rudolf Hess «for his discovery of the functional organization of the interbrain as a coordinator of the activities of the internal organs»; Antonio Caetano de Abreu Freire Egas Moniz «for his discovery of the therapeutic value of leucotomy in certain psychoses»;
69. 1948: Paul Hermann Müller «for his discovery of the high efficiency of DDT as a contact poison against several arthropods»;
70. 1947: Carl Ferdinand Cori and Gerty Theresa Cori, née Radnitz «for their discovery of the course of the catalytic conversion of glycogen»; Bernardo Alberto Houssay «for his discovery of the part played by the hormone of the anterior pituitary lobe in the metabolism of sugar»;
71. 1946: Hermann Joseph Muller «for the discovery of the production of mutations by means of X-ray irradiation»;
72. 1945: Sir Alexander Fleming, Ernst Boris Chain and Sir Howard Walter Florey «for the discovery of penicillin and its curative effect in various infectious diseases»;
73. 1944: Joseph Erlanger and Herbert Spencer Gasser «for their discoveries relating to the highly differentiated functions of single nerve fibres»;
74. 1943: Henrik Carl Peter Dam «for his discovery of vitamin K»; Edward Adelbert Doisy «for his discovery of the chemical nature of vitamin K»;
75. 1942: No Nobel Prize was awarded this year.
76. 1941: No Nobel Prize was awarded this year
77. 1940: No Nobel Prize was awarded this year.
78. 1939: Gerhard Domagk «for the discovery of the antibacterial effects of prontosil»;
79. 1938: Corneille Jean François Heymans «for the discovery of the role played by the sinus and aortic mechanisms in the regulation of respiration»;
80. 1937: Albert von Szent-Györgyi Nagyrápolt «for his discoveries in connection with the biological combustion processes, with special reference to vitamin C and the catalysis of fumaric acid»;
81. 1936: Sir Henry Hallett Dale and Otto Loewi «for their discoveries relating to chemical transmission of nerve impulses»;
82. 1935: Hans Spemann «for his discovery of the organizer effect in embryonic development»;
83. 1934: George Hoyt Whipple, George Richards Minot and William Parry Murphy «for their discoveries concerning liver therapy in cases of anaemia»;
84. 1933: Thomas Hunt Morgan «for his discoveries concerning the role played by the chromosome in heredity»;
85. 1932: Sir Charles Scott Sherrington and Edgar Douglas Adrian «for their discoveries regarding the functions of neurons»;

86. 1931: Otto Heinrich Warburg «for his discovery of the nature and mode of action of the respiratory enzyme»;

87. 1930: Karl Landsteiner «for his discovery of human blood groups»;
88. 1929: Christiaan Eijkman «for his discovery of the antineuritic vitamin»; Sir Frederick Gowland Hopkins «for his discovery of the growth-stimulating vitamins»;
89. 1928: Charles Jules Henri Nicolle «for his work on typhus»;
90. 1927: Julius Wagner-Jauregg «for his discovery of the therapeutic value of malaria inoculation in the treatment of dementia paralytica»;
91. 1926: Johannes Andreas Grib Fibiger «for his discovery of the Spiroptera carcinoma»;
92. 1925: No Nobel Prize was awarded this year.
93. 1924: Willem Einthoven «for his discovery of the mechanism of the electrocardiogram»;
94. 1923: Frederick Grant Banting and John James Rickard Macleod «for the discovery of insulin»;
95. 1922: Archibald Vivian Hill «for his discovery relating to the production of heat in the muscle»; Otto Fritz Meyerhof «for his discovery of the fixed relationship between the consumption of oxygen and the metabolism of lactic acid in the muscle»;
96. 1921: No Nobel Prize was awarded this year.
97. 1920: Schack August Steenberg Krogh «for his discovery of the capillary motor regulating mechanism»;
98. 1919: Jules Bordet «for his discoveries relating to immunity»;
99. 1918: No Nobel Prize was awarded this year.
100. 1917: No Nobel Prize was awarded this year.
101. 1916: No Nobel Prize was awarded this year.
102. 1915: No Nobel Prize was awarded this year.
103. 1914: Robert Bárány «for his work on the physiology and pathology of the vestibular apparatus»;
104. 1913: Charles Robert Richet «in recognition of his work on anaphylaxis»;
105. 1912: Alexis Carrel «in recognition of his work on vascular suture and the transplantation of blood vessels and organs»;
106. 1911: Allvar Gullstrand «for his work on the dioptrics of the eye»;
107. 1910: Albrecht Kossel «in recognition of the contributions to our knowledge of cell chemistry made through his work on proteins, including the nucleic substances»;
108. 1909: Emil Theodor Kocher «for his work on the physiology, pathology and surgery of the thyroid gland»;
109. 1908: Ilya Ilyich Mechnikov and Paul Ehrlich «in recognition of their work on immunity»;
110. 1907: Charles Louis Alphonse Laveran «in recognition of his work on the role played by protozoa in causing diseases»
111. 1906: **Camillo Golgi** and **Santiago Ramón y Cajal** «in recognition of their work on the structure of the nervous system»;
112. 1905: **Robert Koch** «for his investigations and discoveries in relation to tuberculosis»;
113. 1904: **Ivan Petrovich Pavlov** «in recognition of his work on the physiology of digestion, through which knowledge on vital aspects of the subject has been transformed and enlarged»;
114. 1903: **Niels Ryberg Finsen** «in recognition of his contribution to the treatment of diseases, especially lupus vulgaris, with concentrated light radiation, whereby he has opened a new avenue for medical science»;
115. 1902: **Ronald Ross** «for his work on malaria, by which he has shown how it enters the organism and thereby has laid the foundation for successful research on this disease and methods of combating it»;
116. 1901: **Emil Adolf von Behring** «for his work on serum therapy, especially its application against diphtheria, by which he has opened a new road in the domain of medical science and thereby placed in the hands of the physician a victorious weapon against illness and deaths».

Practice 1. Topic: **THE ROLE OF BIOLOGY IN MEDICAL EDUCATION. METHODS USED TO INVESTIGATE CELLS** «____» _____ 201__ year

Purpose of the practice: to learn the role of Biology in medical education, peculiarities of human being as a biological and social object; to learn basic methods used for cell investigation.

CONTENTS OF THE TOPIC

1. Human being as a biological and social object.
2. Role of Biology in medical education. Significance of Biology for pharmaceutical education.
3. Subject matter, tasks and methods of cytology.
4. Light microscopy.

BASIC TERMS AND CONCEPTS

1. **Isotopic labeling (autoradiography) –**
2. **Life –**
3. **Cell –**
4. **X-ray crystallography –**
5. **Microsurgery of cells –**
6. **Metabolism –**
7. **Taxonomy of Homo sapiens –**
8. **Cytology –**

TESTS FOR SELF-CONTROL

1. Main tasks of cytology are: 1 – studying the transmission of genetic information, 2 - studying the structure of tissues, 3 - studying the structure and functions of the nucleus, 4 - studying the cell divisions, 5 - studying the functions of plasma membrane and organelles: a) 1, 2, 3, 4, 5; b) 1, 3, 4, 5, c) 3, 4, 5, d) 2, 3, e) 3, 4.

2. Methods of cytology are: a) light and electron microscopy, cytogenetic karyotyping, b) isotopic labeling and differential centrifugation, c) cytogenetic karyotyping and cell microsurgery, d) genealogical and cytochemical, e) X-ray crystallography and twin method.

3. Certain components of the cell can be extracted by: a) light and electron microscopy, b) hyctochemical and biochemical methods, c) genealogical and hybridological methods, d) differential centrifugation, e) X-ray crystallography.

4. Characters of the species Homo sapiens: a) high development of the brain; b) thought, consciousness, straight walking; c) hair coat and nails; d) differentiated teeth and straight walking; e) apparent thumb opposition.

5. As a biological being, human has: a) heredity and variability; b) social life; c) struggling for existence; d) metabolism, thought and consciousness; e) speech.

6. As a social being, human has: a) heredity and variability, thought; b) speech and social working; c) metabolism, growth, development, ability to perform work; d) growth, development, ability to perform work; e) social mode of life and thought.

Fill in the gaps:

1. Structure of cells is studied by … microscopy.
2. Chemical composition of cells and location of various substances can be assessed by …
3. Smallest structural components of cells can be studied by the … microscopy.
4. Chemical composition of cells and chemical reactions occurring there are studied with ...
5. The method which allows to separate different components of cells is ...
6. Homo sapiens belongs to the subclass …
7. Homo sapiens belongs to the family …

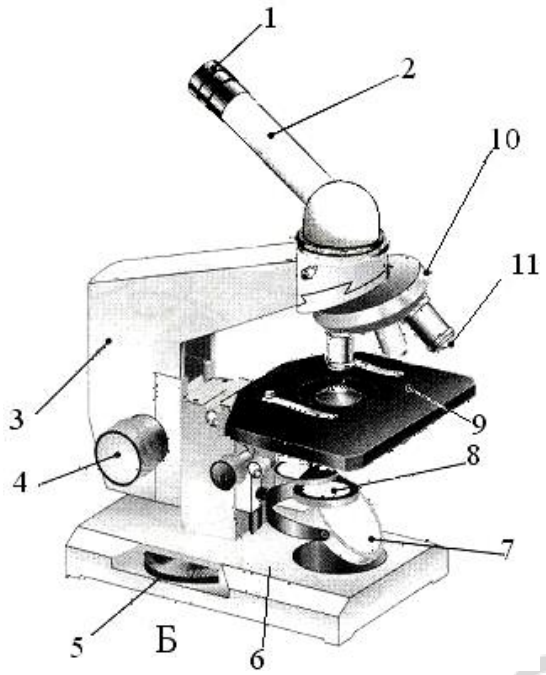


Fig. 1. Structure of a microscope «BIOLAM»:
1 — ocular lens, *2* — draw tube, *3* — arm, *4* — coarse adjustment knob, *5* — fine adjustment knob, *6* — base, *7* — mirror, *8* — condenser, diaphragm and lens filter, *9* — stage, *10* — revolving nosepiece, *11* — objective lens

PRACTICAL WORK

Task 1. Read the name of the cytological technique and find the letter indicating the description which corresponds to this technique:

1. Light microscopy	A – removal of cell organelles and their transplantation to another cells
2. Electron microscopy	B – tracking of chemical compounds in the cell and reactions of matrix synthesis
3. Differential centrifugation	C – separation of cell components by a centrifuge
4. Cytochemical and histochemical	D – obtaining the cell image based on usage of visible light rays
5. X-ray crystallography	E – assessment of the chemical composition of cells and chemical reactions occurring in them
6. Photo and videorecording	F – location of organelles and molecules with various dyes
7. Cell culture	G – determination of spatial arrangement and physical properties of atoms in the molecules of the cell
8. Cell microsurgery	H – studying of processes occurring in the cell such as division
9. Scanning microscopy	I – growing separate cells of multicellular organisms in artificial media
10. Biochemical	J – obtaining the images of the cell components based on usage of electrons as a source of illumination
11. Autoradiography	K – obtaining a tridimensional image of the object

1	2	3	4	5	6	7	8	9	10	11

DIRECTIONS FOR USE OF A MICROSCOPE (LOW-POWERED MAGNIFICATION - 7 × 8)

1. Put the microscope on a table (at the distance approximately equal to palm width from the edge of the table). Column should be directed towards you and the mirror towards the light source.
2. Turn the coarse adjustment knob to set the objective lens to the level 2–3 cm above the surface of the stage.
3. Turn and set the objective lens with low magnification (8×) towards the aperture of the stage. It should click when fixed properly.
4. Put the condenser to the middle position and open the diaphragm completely.
5. Look at the ocular lens and turn mirror surface to the light source for even illumination of the field of vision.
6. Put a micropreparation on the stage. Its side with the cover glass should be directed towards the objective lens.
7. Look at the stage, but not at the ocular lens, and lower the objective lens (turning the coarse adjustment knob) to the level 0.5 cm above the surface of the micropreparation.
8. Start looking at the ocular lens and turn coarse adjustment knob slowly until clear image of the object appears (the focal distance of the 8× objective lens is ~1 cm).
9. Study the object. Move the micropreparation manually.

Notes:

✓ The cover glass is sometimes dirty with dust and fingerprints. It is recommended to clean it with a tissue before using.

✓ The focal distance of the 8× objective lens is approximately 1 cm. I you have lost the image and pass this distance, then you have to repeat steps 7 and 8.

✓ If the object is too small and is not seen at low magnification, then adjust the microscope to the eadge of the cover glass. Having obtained a clear image of the glass surface, move it and search for the object.

DIRECTIONS FOR WORK WITH A HIGH-POWERED MAGNIFICATION (7 × 40)

1. Move the area of the micropreparation you need to see with high magnification to the center of the field of vision.
2. Turn and set the objective lens with high magnification (40×) instead of the current lens. It should click when fixed properly.
3. Put the condenser to the upper position to increase illumination. Look at the stage, but not at the ocular lens and carefully lower the objective lens (with coarse adjustment knob) until it touches the surface of the cover glass.
4. Looking at the ocular lens and slightly turn the coarse adjustment knob until object's outlines appear (the focal distance of 40× objective is approximately 1–2 mm).
5. Use the fine adjustment knob for getting better image.
6. Study the needed area of the micropreparation.

Notes:

✓ The focal distance of the 8× objective lens is approximately 0.1-0.2 cm, so turn the fine adjustment knob slowly. If you need to focus once more than:

- Look at the stage, but not at the ocular lens and carefully lower the objective lens (with coarse adjustment knob) until it touches the surface of the cover glass,
- repeat steps 4-6.

✓ If the contrast of the object is low, then cover the diaphragm or lower the condenser.

DIRECTIONS FOR WORK WITH OIL-IMMERSION OBJECTIVE LENS (7 × 90)

1. Move the area which should be magnified to the center of the vision field. Increase the volume of light: the concave surface of the mirror should be used and the condenser should be in upper position.
2. Turn and set the objective lens into free (not fixed) position.
3. Put a drop of immersion oil on the surface of the cover glass.
4. Fix the objective lens above the micropreparation.
5. Find the clear image in the same way as in case of work with high-powered magnification.

Lecturer's signature

Practice 2. Topic: **BIOLOGY OF THE CELL. FLOW OF SUBSTANCE AND ENERGY IN THE CELL** «____» _____ 201__ year

Purpose of the practice: to study distinguishing features of prokaryotic and eukaryotic cells, anabolic system of the cell, to study catabolic system of the cell, to analyze electron-diffraction photographs.

CONTENTS OF THE TOPIC

1. The modern Cell Theory.
2. Difference between pro- and eukaryotic cells.
3. Structure of plasma membrane, its properties and functions. Transport of substances through the membrane.
4. Anabolic and catabolic systems of the cell.
5. Energy exchange in the cell. Characteristic of its stages.
6. Connection between flows of substances and energy in the cell.

BASIC TERMS AND CONCEPTS

1. Concentration gradient —

2. Glycocalyx —

3. Glycolysis —

4. Glyoxysomes —

5. Enzymes of Krebs cycle —

6. Enzymes of oxidative phosphorylation —

7. Enzymes of tissue respiration —

8. Mesosomes —

9. Nucleoid —

10. Peroxisomes —

11. Plasma membrane —

TESTS FOR SELF-CONTROL

1. **Plasma membrane contains:** a) bilayer of carbohydrates; b) bilayer of lipids; c) two layers of proteins covering the surface of the membrane; d) semi-integral proteins; e) integral proteins.

2. **Properties of plasma membrane are:** a) plasticity; b) impermeability and fluidity; c) semi-permeability; d) elasticity; e) self-locking.

3. **Energy is not required for:** a) diffusion; b) facilitated diffusion; c) phago-cytosis and pinocytosis; d) endocytosis and diffusion; e) pinocytosis and osmosis.

4. **Transport of substances into the cell that requires ATP energy is:** a) transport of ions into the cell down the concentration gradient; b) phagocytosis; c) pinocytosis and diffusion; d) osmosis and endocytosis; e) transport of substances into the cell against the concentration gradient.

5. **Energy is required for such transport as:** a) phagocytosis and diffusion; b) facilitated diffusion and osmosis; c) osmosis and pinocytosis; d) endocytosis; e) active transport.

6. **Organelles of the cell anabolic system are:** a) mitochondria and rough endoplasmic reticulum; b) ribosomes and Golgi complex; c) endoplasmic reticulum; d) lysosomes and peroxisomes; e) glyoxysomes, ribosomes and lysosomes.

7. **Organelles of the cell catabolic system are:** a) mitochondria; b) ribosomes, glyoxysomes and endoplasmic reticulum; c) endoplasmic reticulum and mitochondria; d) Golgi complex and peroxisomes; e) peroxisomes and lysosomes.

8. **Ribosomes are located:** a) on membranes of endoplasmic reticulum and in hyaloplasm; b) in hyaloplasm and karyoplasm; c) on internal nuclear membrane and in chloroplasts; d) on external nuclear membrane and in the mitochondria; e) in mitochondrial matrix and lysosomes.

9. **Functions of the ER are:** a) synthesis of proteins; b) DNA

10. **Parts of the Golgi complex:** a) vesicles and cisternae; b) canals, criaste and stroma; c) granae, stroma and vesicles; d) subunits, criatae and vacuoles; e) cristae, matrix and canals.

11. **Functions of Golgi complex are:** a) sorting, packing and secretion of substances; b) formation of lysosomes and complex organic compounds; c) synthesis of ATP, proteins and glyoxysomes; d) synthesis of cell membranes; e) protein synthesis and substance secretion.

12. **Primary lysosomes:** a) are small spherical organelles, size up to 2 μm; b) are rod-shaped organelles having one membrane; c) are small spherical organelles, have two membranes, size up to 2 μm; d) have ribosomes in their matrix; e) have up to 40 hydrolytic enzymes in their matrix.

13. **Functions of secondary lysosomes (phagosomes):** a) splitting of proteins and polysaccharides; b) synthesis of proteins and polysaccharides; c) heterophagy; d) ATP synthesis and autophagy; e) destruction of larval organs in animals having indirect development.

14. **Functions of peroxisomes:** a) splitting of proteins and polysaccharides; b) oxidation of amino acids with production of H_2O_2; c) synthesis of polysaccharides and fats; d) heterophagy and oxidation of amino acids with production of H_2O_2; e) destruction of larval organs in animals having indirect development and autophagy.

15. **Components of mitochondria:** a) external and internal membranes, thylakoids; b) circular DNA, ribosomes and cristae; c) thylakoids and ATP-somes; d) cristae, cisternae and vesicles; e) matrix and thylacoids.

16. **Functions of mitochondria are:** a) synthesis of specific proteins; b) splitting of proteins into amino acids; c) synthesis of ATP; d) synthesis of AMP (adenylic acid); e) splitting of organic substances into H_2O and CO_2.

17. **The first stage of energy exchange proceeds in:** a) digestive tract; b) mitochondria; c) digestive tract and ER; d) cytoplasm and mitochondria; e) nucleus and cytoplasm.

18. **Anaerobic stage of energy exchange occurs in:** a) intestine; b) cytoplasm and mitochondria; c) cytoplasm and endoplasmic reticulum; d) cytoplasm; e) Golgi complex and cell nucleus.

synthesis and compartmentalization; c) synthesis of fats and carbohydrates; d) compart-mentalization and transport of substances; e) formation of peroxisomes and RNA synthesis.	

Fill in the gaps:

1. The division of cytoplasm of the cell by membranes is called ...
2. The receptor apparatus located on the outer surface of a plasma membrane is called ...
3. ER (endoplasmic reticulum) and ... form the transport system of the cell.
4. The diameter of cytoskeleton microfilaments is … nm.
5. Peroxisomes are made in …
6. The large subunit of ribosomes contains 40–50 molecules of proteins and … molecules of r-RNA ...
7. The destruction of cell organelles by its own lysosomes is called ...
8. Integral proteins of membranes forming pores and providing their permeability are called …
9. The efficiency of the anaerobic stage of energy exchange is ... %.

PRACTICAL WORK

Task I. Solve the problem:

Problem 1. Leg muscles of a man spend approximately 24 kJ/min for running. How much glucose is required (if it is split completely) for 20 min of run? The molal mass of glucose is 180 g/mol).

Task II. Make indications for the electron-diffraction photographs:

Fig. 1. Electron-diffraction photograph of a rough endoplasmic reticulum:
1 — membrane; 2 — canal;3 — ribosomes

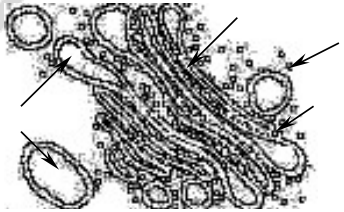


Fig. 2. Electron-diffraction photograph of a Golgi complex:
1 — membrane; 2 — canal; 3 — cisterna; 4 — lysosome; 5 — vesicle

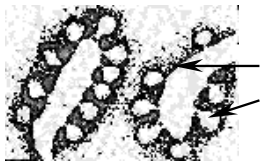


Fig. 3. ATP-somes (ATP-synthase) on a mitochondrion crista:
1 — inner membrane; 2 — ATP-some

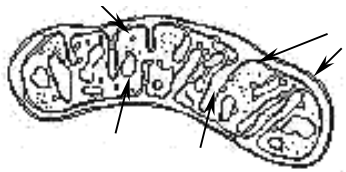


Fig. 4. Electron-diffraction photograph of a mitochondrion:
1 — outer membrane; 2 — inner membrane; 3 — matrix; 4 — cristae; 5 — ribosomes

Lecturer's signature

Practice 3. Topic: **FLOW OF GENETIC INFORMATION IN THE CELL** «____» _____ 201__ year

Purpose of the practice: to study the microscopic and submicroscopic structure of the cell nucleus, cell cycle and principles of interphase, types of cell division, to know how to write down the content of genetic material in different interphase periods and in different stages of mitosis and meiosis

CONTENTS OF THE TOPIC

1. Structure and functions of nucleus.
2. Types of chromosomes. Structure of chromosomes. Rules of chromosomes.
3. Karyotype and idiogram. Classification of human chromosomes.
4. Mitotic and cell cycles. Interphase. Cause of mitosis.
5. Regulators of the cell cycle (cyclins and cyclin-dependent kinases).
6. Comparison of mitosis and meiosis (content of genetic material during different stages of division).

BASIC TERMS AND CONCEPTS

1. **Bivaents –**
2. **Karyolymph –**
3. **Cell cycle –**
4. **Synapsis –**
5. **Meiosis –**
10. **Mitotic cycle –**
6. **Telomeres –**
7. **Centromere index (CI) –**
8. **Chromatin –**
9. **Nuclear-cytoplasmic ratio –**

TESTS FOR SELF-CONTROL

1. **Idiogram is:** a) non-systematized image of karyotype; b) systematized image of karyotype; c) order of genes in a chromosome; d) order of nucleotides in a gene; e) scheme or photograph of chromosomes arranged by their size.
2. **Processes occurring in the cell during the pre-synthetic period of interphase are:** a) synthesis of RNA, various proteins and enzymes; b) synthesis of DNA, RNA, proteins and ATP; c) growth of the cell and ATP synthesis; d) accumulation of DNA nucleotides, synthesis of tubulins for the spindle apparatus; e) synthesis of DNA, RNA and tubulins for the spindle apparatus.
3. **Processes occurring in the cell during the synthetic period of interphase are:** a) doubling of plastids and mitochondria; b) synthesis of DNA; c) synthesis of ATP and proteins; d) accumulation of DNA nucleotides, synthesis of mRNA and proteins; e) synthesis of tubulins for the spindle apparatus and DNA.
4. **Processes occurring in the cell during the post-synthetic period of interphase are:** a) synthesis of DNA and enzymes; b) synthesis of DNA, rRNA, growth of the cell; c) synthesis of ATP, accumulation of DNA

	nucleotides; e) synthesis of tubulins for the spindle apparatus.

5. **Complement of genetic material during the pre-synthetic period:** a) 1n1chr1c; b) 1n2chr2c; c) 2n1chr2c; d) 2n2chr4c; e) 1nbiv4chr4c.
6. **Complement of genetic material by the end of the synthetic period:** a) 1n1chr1c; b) 1n2chr2c; c) 2n1chr2c; d) 2n2chr4c; e) 1n4chr4c.
7. **Causes of mitosis are:** increase of nuclear-cytoplasmic ratio; b) decrease of nuclear-cytoplasmic ratio; c) replication of DNA and «wound hormones»; d) «wound hormones» and mitogenetic rays; e) damage of karyolemma.
8. **Complement of genetic material during the telophase:** a) 1n1chr1c; b) 1n2chr2c; c) 2n1chr2c; d) 2n2chr4c; e) 1n4chr4c.
9. **Cells that can divide by mitosis:** a) somatic cells; b) gametes; c) gametogonia; d) prokaryotic cells; e) cells without nucleus.
10. **Meiosis is a division of:** a) somatic and prokaryotic cells; b) gametes and embryonic cells; c) gametocytes; d) stem cells; e) tumor cells.
11. **The order of stages in the prophase of meiosis I:** a) diakinesis, diplotene, pachytene, zygotene, leptotene; b) leptotene, diakinesis, diplotene, pachytene, zygotene; c) leptotene, zygotene, diakinesis, diplotene, pachytene; d) leptotene, zygotene, pachytene, diplotene, diakinesis; e) diplotene, pachytene, zygotene, leptotene, diakinesis.
12. **Processes occurring in the cell during the metaphase of meiosis I:** a) centrioles move to the poles of the cell; b) decondensation of chromatin; c) bivalents are in the equator of the cell; d) synapsis; e) crossing-over.
13. **Complement of genetic material during the prophase of meiosis I:** a) 1n1chr1c; b) 1n2chr2c; c) 2n1chr2c; d) 2n2chr4c; e) 1nbiv2chr2c.

Fill in the gaps:

1. Nuclear lamina mostly consists of …
2. There is a … in the area of primary constriction which connects with microtubules of the spindle apparatus.
3. The region of secondary constriction of satellite chromosomes is called ...
5. During diplotene chromosomes of bivalents are connected only in the crossing regions called …
6. There are … on the equator of the cell during metaphase of the second meiotic division.
7. Complement of genetic material in the cell during the metaphase II is …

PRACTICAL WORK

Task 1. Solve the problems

Problem 1. The cells **A** and **B** have got mutation and lost the ability to synthesize DNA-polymerase. The mutation happened in the cell **A** during the G_1 while in the cell **B** it happened during G_2. What is probability (%) to transmit this mutation to a daughter cells?

Problem 2. Cells **A** and **B** have got mutated gene during interphase. They completed mitotic cycle but the cell **A** transmitted the mutation to both daughter cells and the cell **B** – to only one of them. How that happened?

4. Complement of genetic material in the cell during diplotene is …	

Problem 3. Genes that should be activated during G_2, remain inactive. Would it have effect on further mitosis?

Task 2. Study the diagrams and electron-diffraction photographs, make indications

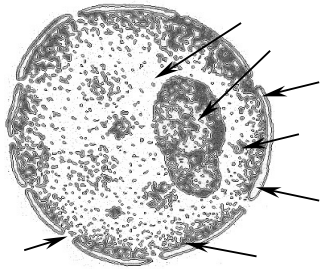


Fig. 1. Nucleus:
1 – external membrane, 2 – internal membrane, 3 – perinuclear space, 4 – pore, 5 – karyolymph, 6 – chromatin, 7 – nucleolus

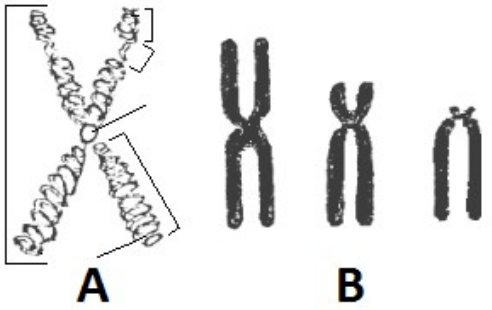


Fig. 2. Structure of chromosome (A) and types of chromosomes (B):
1 — arm; 2 — centromere; 3 — secondary constriction; 4 — satellite; 5 — chromatid; 6 — telomeres; 7 — metacentric chromosome; 8 — submetacentric

Task 3. Fill in the table

Write the complement of genetic material in the cell.

Phases and stages	Interphase	Mitosis	Meiosis I	Meiosis II
I. G_1				
II. S				
III. G_2				
A. Prophase				
• leptotene				
• zygotene				
• pachytene				
• diplotene				
• diakinesis				
B. Metaphse				
C. Anaphase				
D. Telophase				

chromosome; 9 — acrocentric chromosome	

Lecturer's signature

Подпись преподавателя

Practice 4. Topic: **ARRANGEMENT OF HEREDITARY MATERIAL (Part 1)** «____» _____ 201__ year

Purpose of the practice: to study molecular basis of a gene, its properties, to learn how to solve problems in DNA and RNA structure, replication, transcription, translation.

CONTENTS OF THE TOPIC

1. Levels of DNA condensation (nucleosomal, supernucleosomal, chromatid, metaphase chromosome levels).
2. Structural-functional levels of genetic material (gene, chromosome, genome levels).
3. Properties of genes. Primary functions of genes: autosynthetic (replication) and heterosynthetic (protein biosynthesis).
4. The central dogma of molecular biology.

BASIC TERMS AND CONCEPTS

1. **Gene –**
2. **Initiation –**
3. **Revertase –**
4. **Recon –**
5. **Supernucleosome –**
6. **Stability of genes –**
7. **Termination –**
8. **Trancription –**
9. **Cistron –**
10. **Elongation –**

TESTS FOR SELF-CONTROL

1. Structural-functional levels of eukaryotic genetic material: a) gene and genome levels; b) chromosome, cellular, genome levels; c) genome and subcellular levels; d) cellular, organism, gene levels; e) organism and population levels.

2. Consequences resulting from arrangement of genetic material at the gene level: a) genetic linkage; b) independent inheritance of genes; c) mutations of genes; d) crossing-over and interactions of genes; e) intraallelic interactions of genes and genetic linkage.

3. Consequences resulting from arrangement of genetic material at the chromosome level: a) genetic linkage; b) independent inheritance of genes; c) mutations of genes and interactions of genes; d) crossing-over; e) chromosome mutations.

4. Consequences resulting from arrangement of genetic material at the genome level: a) genetic linkage and crossing-over; b) independent inheritance of genes and chromosome mutations; c) mutations of genes and crossing-over; d) genome mutations; e) interactions of genes.

5. **Properties of genes:** a) stability and lability; b) integrity and pleiotropy; c) integrity, specificity and unambiguity; d) discretion and non-specificity; e) specificity, tripletness and universality.
6. **Specificity is the gene property to:** a) mutate; b) determine synthesis of the certain polypeptide; c) be responsible for development of several characters; d) vary the degree of its phenotypic manifestation; e) have different frequency of phenotypic manifestations.
7. **Pleiotropy is the gene property to:** a) mutate; b) determine synthesis of the certain polypeptide; c) be responsible for development of several characters; d) vary the degree of its phenotypic manifestation; e) have different frequency of phenotypic manifestations.
8. **Lability is the gene property to:** a) mutate; b) determine synthesis of the certain polypeptide; c) be responsible for development of several characters; d) vary the degree of its phenotypic manifestation; e) have different frequency of phenotypic manifestations.
9. **Expressivity is the gene property to:** a) mutate; b) determine synthesis of the certain polypeptide; c) be responsible for development of several characters; d) vary the degree of its phenotypic manifestation; e) have different frequency of phenotypic manifestations.
10. **Penetrance is the gene property to:** a) mutate; b) determine synthesis of the certain polypeptide; c) be responsible for development of several characters; d) vary the degree of its phenotypic manifestation; e) have different frequency of phenotypic manifestations.
11. **The least structural unit of a gene is:** a) nitrogenous base; b) pair of complementary nucleotides; c) codon; d) one nucleotide; e) triplet of nucleotides.
12. **The least functional unit of a gene is:** a) one nucleotide; b) pair of complementary nucleotides; c) codon; d) transcripton; e) triplet of nucleotides.

Fill in the gaps:

1. A DNA segment bound with a protein octamer for condensation is …
2. DNA becomes … times shorter at the first level of condensation.
3. DNA becomes 10-20 times shorter at the … level of condensation.
4. As result of condensation at all levels, DNA becomes … times shorter.
5. Autosynthetic function of gene is its …
6. DNA-polymerase moves along the matrix strand from its ... end to … end.
7. Process of detection and binding an amino acid by proper tRNA is …
8. There is mRNA triplet … in the P-site of the ribosome during initiation.
9. The process which begins at the moment when first peptide bond is formed and finishes at the moment when the last amino acid is connected to a polypeptide is called …
10. Some antibiotics are … of protein biosynthesis.

PRACTICAL WORK

Task 1. Solve the problems:

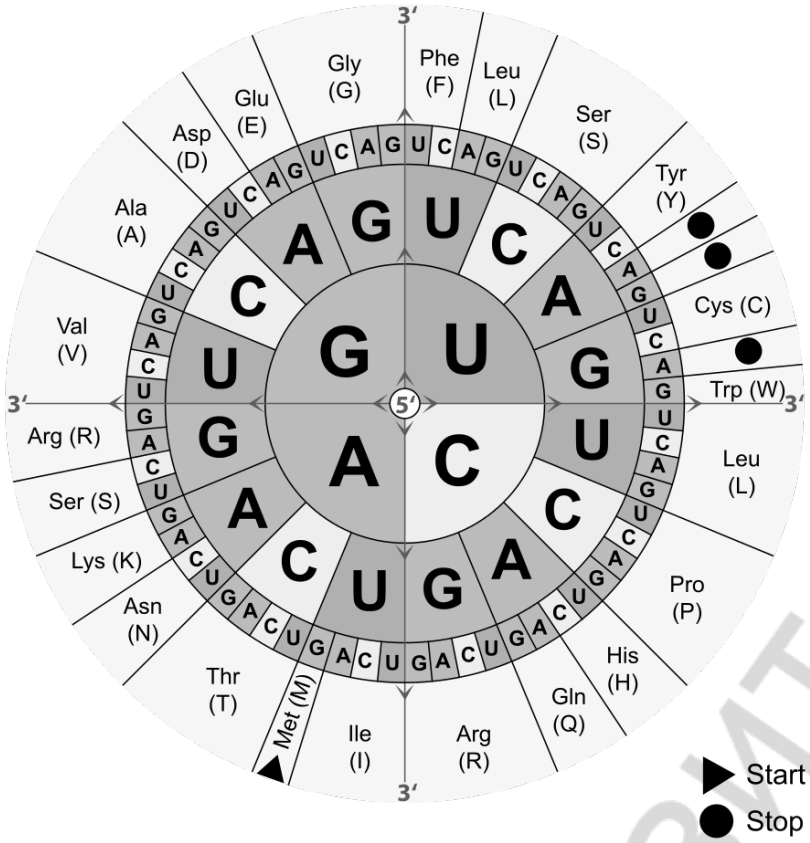
Problem 1. It was revealed that an mRNA consists of 34% adenine, 18% uracil, 28% cytosine and 20% adenine nucleotides. What is the percentage of nucleotides in a DNA which served as a matrix for this mRNA?

Problem 2. The distance between adjacent nucleotide pairs in the DNA is 3.4×10^{-10} m. There is a protein consisting of 200 amino acids. What is the length of the coding region of its gene?

Problem 3. The molal mass of a single-strand DNA of a phage is approximately 10^7 g/mol. Let's consider the average molal mass of a nucleotide 300 g/mol. How many proteins can this DNA code for if typical protein of the phage consists of approximately 400 monomers?

Problem 4. The velocity of enzymes performing DNA replication in a cell is 0.6 μm/min. This cell has 500 replicons with average length 60 μm. How much time would replication last in this cell?

Genetic code: mRNA codons and amino acids they code for



Problem 5. A fragment of a sense DNA strand has the following nucleotide sequence: GAGGCTCTAGGTACCAGT.
A)Write the numbers for DNA ends (3’ and 5’)
B) Find the order of nucleotides in the antisense strand.
C) Find the mRNA fragment made on this DNA (matrix for mRNA is antisense strand);
D) Find the amino acids of the protein coded by this DNA.

The coding (sense) strand:

_’ G-A-G-G-C-T-C-T-A-G-G-T-A-C-C-A-G-T _’

B)

C)

D)

Lecturer’s signature

Practice 5. Topic: **ARRANGEMENT OF HEREDITARY MATERIAL (Part 2)** «____» _____ 201__ year

Purpose of the practice: to study properties of genes and their classification, principles of cytoplasmic heredity, regulation of gene functioning; learn how to solve typical problems concerning regulation of gene functioning.

CONTENTS OF THE TOPIC

1. Classification of genes (structural and functional, unique, repeated sequences, transposons).
2. Regulation of transcription in prokaryotes (F. Jacob, J. Monod) and eukaryotes (G.P. Georgiev).
3. Cytoplasmic inheritance.

BASIC TERMS AND CONCEPTS

1. Operator -

2. Inductor -

3. Intron -

4. Operon –

5. Promotor –

6. Processing –

7. Pseudocytoplasmic inheritance –

8. Repressor –

9. Splicing –

10. Transcripton –

11. Transposon -

12. Exon -

TESTS FOR SELF-CONTROL

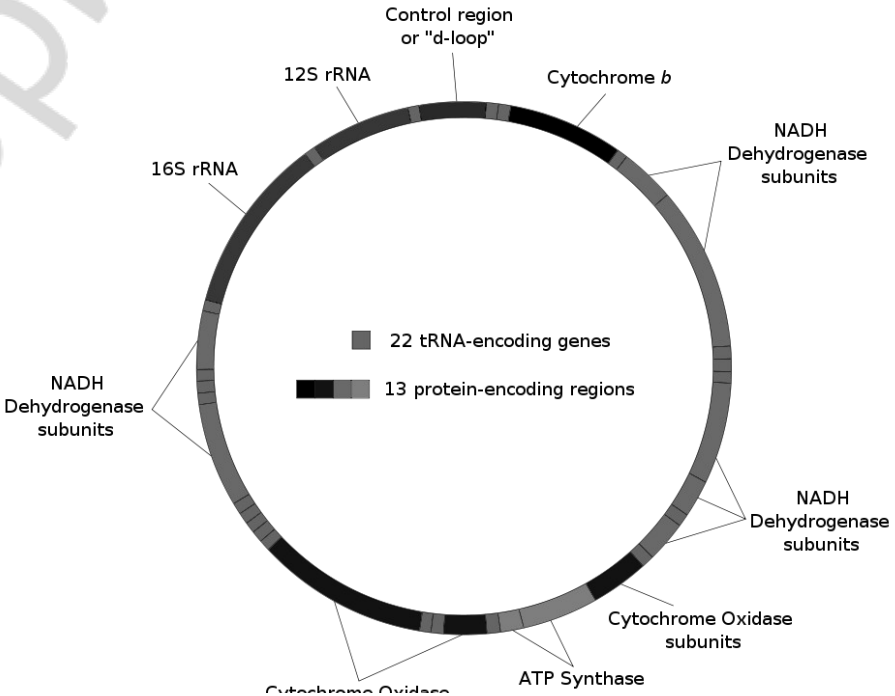
1. **The roles of structural genes:** a) code for repressor protein; b) code for enzymes; c) code for histones; d) code for various types of RNA; e) code for various RNA and repressor.
2. **The role of functional genes:** a) code for repressor protein; b) code for enzymes; c) code for histones; d) code for products regulating the work of structural genes; e) code for ribosomal RNA.

3. **The role of operator** a) codes for repressor protein; b) codes for enzymes; c) participates in switching the work of structural genes on and off; d) codes for mRNA; e) regulates activity of functional genes.
4. **Classification of genes:** a) structural, modifiers and repressors; b) introns, exons, inhibitors; c) functional and structural; d) corepressors and operators; e) regulators and intensifiers.
5. **Parts of transcripton are:** a) exons and several operators; b) operators and regulatory genes; c) structural genes and promoter; d) promoter terminator and repressor; e) initiator and regulators.
6. **Information about the structure of a polypeptide is encoded by:** a) terminators; b) operators; c) introns; d) exons; e) promoter.
7. **Repeated sequences participate in:** a) regulation of DNA replication; b) formation of operators and exons; c) formation of introns and crossing-over; d) formation of exons and terminators; e) formation of promoters and initiators.
8. **Functions of introns:** a) regulate translation and replication of DNA; b) separate exons; c) participate in crossing-over and regulation of translation; d) contain spare information providing variability; e) regulate translation.
9. **Criteria of cytoplasmic heredity are:** a) segregation of characters occurs in accordance with Mendel's laws; b) segregation of characters does not correspond to Mendel's laws; c) it is possible to reveal linkage groups; d) inheritance goes on mother's line; it is not possible to reveal linkage groups; e) identical results of recurrent crossings.
10. **Features of human mitochondrial genome are:** a) circular DNA contains 16 500 pairs of nucleotides; b) circular DNA contains 500 pairs of nucleotides and includes r-RNA genes; c) both strands are transcribed, contains gene of cytochrome b; d) one strand is transcribed; includes r-RNA genes; e) contains information about 22 t-RNA, circular DNA contains 160 pairs of nucleotides.

Fill in the gaps:

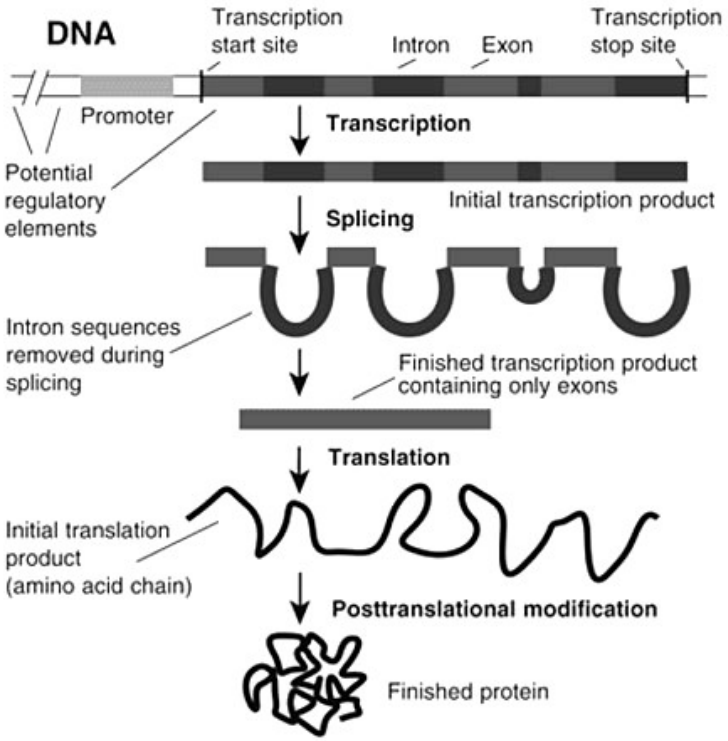
1. Regulatory genes code for proteins …
2. For transcription of structural genes, operators should get rid from proteins …
3. Assembling several variants of mRNA from the same exons is called …
4. A region in a transcripton determining the end of transcription is …
5. A substance which can be broken by enzymes encoded in the operon and causing its activation is …
6. Leber disease is caused by mutation of …

Human mitochondrial DNA

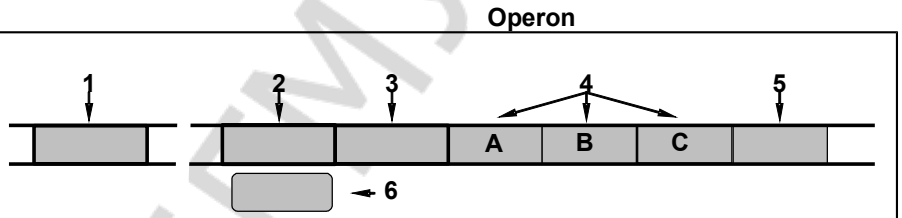


Some mitochondrial diseases

Leber's hereditary optic neuropathy (LHON)	Myoclonic Epilepsy with Ragged Red Fibers (MERRF)
Neuropathy, ataxia, retinitis pigmentosa, and ptosis (NARP)	Mitochondrial myopathy, encephalomyopathy, lactic acidosis, stroke-like symptoms (MELAS)
Leigh syndrome (subacute sclerosing encephalopathy)	Diabetes mellitus and deafness (DAD)



Expression of a gene



PRACTICAL WORK

Task 1. Write the indications:

Fig. 1. Scheme of an operon

1 –
2 –
3 –
4 –
5 –
6 –

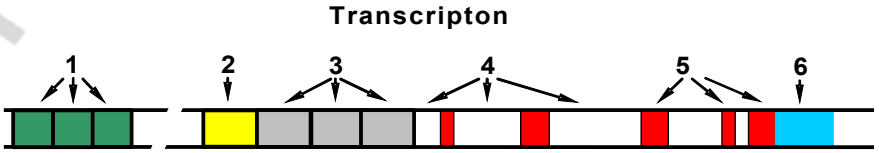


Fig. 2. Scheme of a transcripton

1 –
2 –
3 –
4 –
5 –
6 –

Task 2. Solve the problems:

Problem 1. Let's consider the mass of one nucleotide is 1 unit.

1. There is an operon where each promoter, initiator and terminator consist of 10 pairs of nucleotides and structural genes code for proteins consisting of 50 amino acids. What is the mass of this operon?

2. Is it possible to calculate the mass of a transcripton on the basis of such information? Explain your answer.

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Problem 2. Do genes coding for proteins with the same number of amino acids in bacteria and yeasts have the same length? Explain your answer.

Problem 3. A human gene was introduces into bacterial genome. Why is it reasonable to expect the bacterium will produce the human protein?

Practice 6. Topic: **GENETIC ENGINEERING** «____» _____ 201__ year

Purpose of the practice: to study the principles of genetic engineering and organism cloning, to know how to solve problems in the context of genetic engineering.

CONTENTS OF THE TOPIC

1. Genetic engineering as a science.
2. Obtaining genetic material: techniques. Restriction endonucleases.
3. Insertion of DNA fragments into a vector molecule. Vectors.
4. Incorporation of the recombinant DNA into a recipient cell.
5. Techniques used in genetic engineering and biotechnology: polymerase chain reaction, southern blot, DNA fingerprinting.

BASIC TERMS AND CONCEPTS

1. **Autoradiogram –**
2. **Thermocycler –**
3. **Vector –**
4. **DNA-probe –**
5. **Sticky ends –**
6. **Liposomes –**
7. **Plasmids –**
8. **Polymerase chain reaction (PCR) –**
9. **Primers –**
10. **Recognition sites –**
11. **Transfection –**
12. **Blunt ends –**

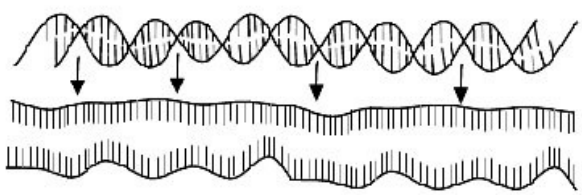
TESTS FOR SELF-CONTROL

1. **Purposes of genetic engineering are:** a) designing of genetic structures according to a plan; b) decoding the nucleotide sequences of DNA; c) creation of organisms with the new genetic program; d) revealing linkage groups and sequencing of genes; e) construction of a chromosome genetic map.
2. **Main stages of genetic engineering are:** a) obtaining genetic material; b) making genetic maps of chromosomes; c) decoding the nucleotide sequence of human DNA and assembling recombinant DNA; d) selection of the transformed cells; e) incorporation of a recombinant DNA into the host cell.
3. **Genes for cloning in a vector can be obtained:** a) by artificial gene synthesis; b) synthesis on a protein matrix; c) by reverse transcription; d) by making a map of a chromosome; e) cleaving from the genome with restriction endonucleases.
4. **Recombinant DNA can be made by insertion of genes into:** a) proteins; b) plasmids; c) viral genome; d) lipid molecule; e) phage genome.
5. **Enzymes used in genetic engineering:** a) DNA-polymerases; b) lipases and restriction enzymes; c) revertases and restriction enzymes; d) restriction enzymes and amylases; e) ligases.
6. **Achievements of genetic engineering:** a) strains of E. coli producing inulin; b) strains of E. coli producing somatotropin; c) plants acquiring atmospheric nitrogen; d) microorganisms producing petrol from food proteins; e) antiviral serums.
7. **The directions for further development of genetic engineering:** a) transfer of genetic information in eukaryotes by means of sexual reproduction; b) inducing mutations by chemical mutagens; c) sequencing of human genome; d) substitution of mutated genes with normal ones; e) insertion of artificial genes into human genome.

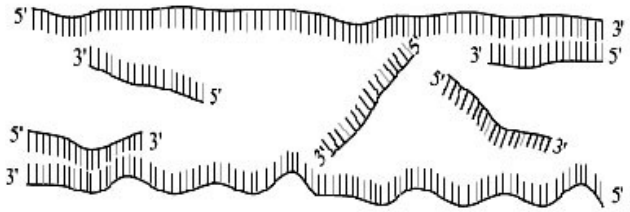
Fill in the gaps:

1. Enzymes capable of cutting DNA in certain sites and form sticky ends are called …
2. Synthesis of genes by on mRNA matrix is based on a process which is called …
3. Vectors used in genetic engineering are bacterial plasmids, phage genomes, phasmids and …
4. The restriction enzyme Eco R I forms … ends in DNA.
5. Hybrid vectors capable of developing both as a phage and as a plasmid are called …
6. The plasmids containing cos-sites (sticky ends) of phage λ DNA are called …
7. Size of the DNA fragments which can be cloned in cosmids is about … thousand nucleotide pairs …
8. The basic vector for the animal genes cloning is the genome of the virus …
9. The restriction enzyme Hind II forms … when cuts both DNA strands in same points.

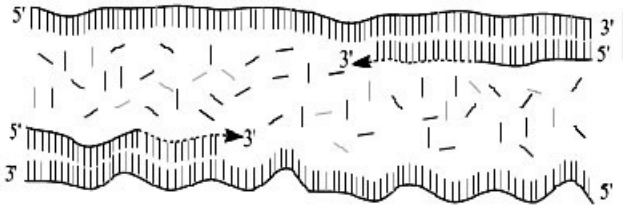
Polymerase chain reaction



- **Denaturation:** the mixture of reagents is heated up to 90°C. During 15 seconds hydrogen bonds between DNA strands break and two single-strand molecules are formed.



- **Annealing:** the temperature is lowered to +50°C. Primers connect to the complementary region of the DNA sample. This stage requires about 30 seconds.

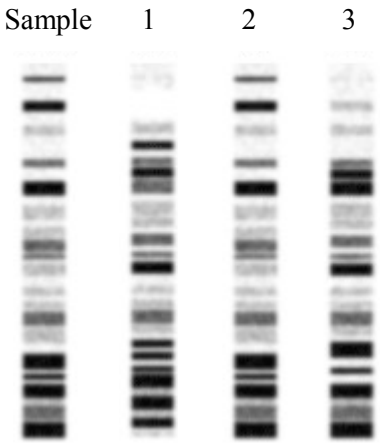


- **Elongation (or extension, polymerization)** the reaction is heated again to 70°C. At this temperature the Taq-polymerase assembles complementary strands moving from primers to the 5' end of the matrix. This process takes 90 sec.

As a result, DNA duplicates many times. During 20 cycles the number of DNA copies reaches to 106. At the present day PCR is performed automatically in a thermocycler 10^6.

Some restriction endonucleases

#	Enzyme	Recognition site
1.	Bal I	5′ - T G G↓ C C A – 3′ 3′ - A C C↑ G G T – 5′
2.	Bam H I	5′ - G↓G A T C C – 3′ 3′ - C C T A G↑ G – 5′
3.	Eco R I	5′ - G↓A A T T C – 3′ 3′ - C T T A A↑ G – 5′
4.	Hind III	5′ - A↓ A G C T T – 3′ 3′ - T T C G A↑ A – 5′
5.	Sal I	5′ - G↓T C G A C – 3′ 3′ - C A G C T↑ G – 5′
6.	Xba I	5′ - T↓C T A G A – 3′ 3′ - A G A T C↑ T – 5′



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Practice 7. Topic: **GENE INTERACTIONS. GENETIC LNKAGE. GENETICS OF SEX** «____» _____ 201__ year

Purpose of the practice: to study regularities of inheritance, interaction of genes, genetic linkage and genetics of sex. To learn how to solve problems based on these phenomena.

CONTENTS OF THE TOPIC

1. Inheritance of blood groups: systems AB0, MN and Rh.
2. Non-allelic (inter-allelic) gene interactions.
3. Autosomal and gonosomal linkage groups.
4. Chromosome theory of inheritance.
5. Determination of sex in human and its disorders.
6. X-chromosome's sex chromatin. Mary F. Lyon's hypothesis of X-chromosome inactivation.
7. Sex chromosome disorders.

BASIC TERMS AND CONCEPTS

1. **Crossover gametes –**

2. **Hemizygosity –**

3. **True hermaphroditism –**

4. **Pseudohermaphroditism –**

5. **Complementation –**

6. **Polymeria –**

7. **Recombinants –**

8. **Klinefelter syndrome –**

9. **Androgen insensitivity syndrome –**

10. **Shereshevsky-turner syndrome –**

11. **X trisomy –**

12. **Physical determinants of sex –**

13. **Epistasis –**

TESTS FOR SELF-CONTROL

1. Complete linkage is observed: a) in female Drosophila and male silkworm; b) if different allelic pairs are situated in different chromosomes; c) if crossing over occurs; d) if crossing over does not occur; e) in male Drosophila and female silkworm.

2. Characteristics of complementation: a) mutual influence of different genes situated in adjacent loci of the same chromosome; b) two dominant alleles of different genes are required for development of a trait; c) two recessive alleles of different genes are required for development of a trait; d) dominant or recessive allele of one gene suppresses effect of dominant or recessive allele of another gene; e) alleles of different genes have effect on degree of character's development.

3. Characteristics of epistasis: a) mutual influence of different genes situated in adjacent loci of the same chromosome; b) two dominant alleles of different genes are required for development of a trait; c) two recessive alleles of different genes are required for development of a trait; d) dominant or recessive allele of one gene suppresses effect of dominant or recessive allele of another gene; e) one gene has effect on development of several traits.

4. Incomplete genetic linkage is observed: a) if different allelic pairs are situated in the same chromosome; b) if different allelic pairs are situated in different chromosomes; c) if crossing over occurs; d) if crossing over does not occur; e) in male Drosophila and female silkworm.

5. Period when anlagen of sex organs differentiate into male or female sex organs: a) 1^{st} – 4^{th} weeks; b) 4^{th} – 6^{th} weeks; c) 4^{th} – 8^{th} weeks; d) 4^{th} – 12^{th} weeks; e) 10^{th} -16^{th} weeks.

6. Characteristics of polymeria: a) mutual influence of different genes situated in adjacent loci of the same chromosome; b) two dominant alleles of different genes are required for development of a trait; c) two recessive alleles of different genes are required for development of a

7. Inter-allelic gene interactions: a) hemizygosity and recessive epistasis; b) epistasis and cumulative polymeria; c) co-dominance and polymeria; d) complementation and pleiotropy; e) superdominance and recessiveness.

8. Anlagen of genitalia are formed: a) by 1^{st} week of embryogenesis; b) by 2^{nd} week of embryogenesis; c) by 3^{rd} week of embryogenesis; d) by 4^{th} week of embryogenesis; e) by 5^{th} week of embryogenesis.

9. By 4^{th} week laying down anlagen of genitalia is determined by: a) autosomes; b) one X-chromosome; c) both X-chromosomes; d) Y-chromosome; e) both X- and Y- chromosomes.

10. If the second sex chromosome is absent in the genotype, then: a) gonads differentiate; b) gonads do not differentiate; c) normal tissue of gonads is substituted with connective tissue; d) gonads partially atrophy; e) gonads completely atrophy.

11. Transvestism is a phenomenon when: a) physical determinants of sex are impaired, person choses sexual partner of the same sex; b) psychological determinants of sex are impaired, person choses sexual partner of the same sex; c) gametic and hormonal sexes are impaired; d) genetic sex is not impaired, person wishes to wear clothes of the opposite sex; e) genetic and gametic sexes are impaired, person is sterile.

12. Karyotype in case of Klinefelter syndrome: a) 47,XXY; b) 45,X0; c) 47,XXX; d) 46,XY; e) 46,XY,9p+.

13. Karyotype in case of Shereshevsky-turner syndrome: a) 46,XY,$5p^-$; b) 45,X0; c) 47,XXY; d) 47,XX,21+; e) 46,XX,9p+.

14. Karyotype in case of X-trisomy: a) 46,XY,$5p^-$; b) 45,X0; c) 47,XXX; d) 47,XX,21+; e) 47,XXX, 5p-.

15. Karyotype in case of Androgen insensitivity syndrome: a) 46,XY,$5p^-$; b) 45,X0; c) 47,XXY; d) 47,XX,21+; e) 46,XY.

16. Barr body is: a) inactivated X-chromosome; b) inactivated Y-chromosome; c) active X-chromosome; d) active X-chromosome; e) inactivated X-or Y-chromosomes.

trait; d) one gene has effect on several characters; e) alleles of different genes have effect on degree of character's development.

Fill in the gaps:

1. Bombay blood group is an example of non-allelic interaction called …

2. Cross of diheterozygotes causes phenotypic segregation ratio 15:1 in case of inter-allelic gene interaction which is called …

3. Cross of diheterozygotes causes phenotypic segregation ratio 9:7 in case of inter-allelic gene interaction which is called.

4. A phenomenon which breaks genetic linkage is called …

5. One centimorgan is unit of the distance between genes equal one percent of …

6. In case of genetic linkage, the maximal percentage of crossing over is ... %.

7. Such phenotypic characters of a female as low position of ears, skin fold on the neck are characteristic of … syndrome.

8. Men having female body constitution, gynecomastia and impairment of spermatogenesis is example of a person sick with … syndrome.

9. Civil sex is … determinant of sex.

10. Persistent discrepancy of sexual identity and true genetic and gonad sex and a wish to change sex is called …

PRACTICAL WORK

Task I. Solve the problems:

Problem 1. A woman has blood groups O, Rh-, MN; her husband has groups AB, Rh+ (homozygote) and N. What combinations of blood groups can their children have?

Inheritance of blood groups in human:

Character	Gene	Genotype
System ABO		
Group O (I)	I^0	I^0I^0
Group A (II)	I^A	I^AI^A, I^AI^0
Group B (III)	I^B	I^BI^B, I^BI^0
Group AB (IV)	$I^A + I^B$	$I^A I^B$
System MN		
Group M	L^M	L^ML^M
Group N	L^N	L^NL^N
Group MN	$L^M + L^N$	L^ML^N
System Rh		
Rh+	D	DD, Dd
Rh-	d	dd

Problem 2. Congenital deafness of human can be determined by two recessive genes: **d** and **e**. Normal hearing requires both dominant alleles (**D** and **E**). There is a family where parents are deaf while all they seven children have normal hearing. What are the most probable the genotypes of all the family members?

Problem 3. A dominant gene of elliptocytosis (**El**) and the dominant gene determining blood group Rh+ (**D**), are situated in the same chromosome at the distance 3 cM. There is a man who is heterozygous for both genes. Besides, he got Rh+ from one parent and elliptocytosis from
the other one. His wife has blood group Rh- and normal erythrocytes. What combinations and of characters their percentage are possible for their children?

Character	Gene	Genotype	Gene location
Rh+	D	D-	Same autosome Distance D-El = 3 cM
Rh-	d	dd	
Elliptocytosis	El	El-	
Normal erythrocytes	el	elel	

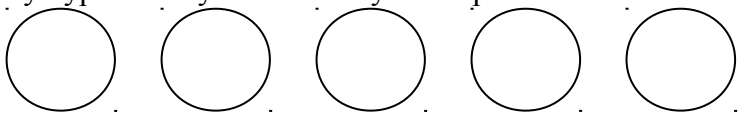
Problem 4. Recessive genes of hemophilia **(h)** and daltonism **(d)** are situated in the X-chromosome at the distance 10 cM. A woman whose father had both diseases and mother had no such recessive genes married a healthy man. What is the probability of giving birth to a child: 1) with both diseases; 2) with one disease; 3) phenotypically healthy?

Technique of X-chromatin detection

Scraping of cheek mucous membrane is performed by a spatula desinfected with alcohol in order to take epithelial cells. The sample is taken to a glass and smeared. The smear is processed with 2-3 drops of aceto-orcein (1 gram of orcein is dissolved in 100 ml of boiling acetic acid; distillated water is then added to make up the volume to 200 ml) and covered with cover-slip. In 20-30 minutes excesses of dye are removed by a blotting paper and study micropreparation under the microscope.

It is recommended to begin from low magnification to choose an area with one layer of well-stained cells. Interphase nuclei should be inspected. They are oval or spherical. The Barr body sticks to the nuclear membrane and can be of different shape: oval, triangle, square and etc. Immersion objective lens can be used if necessary.

Task II. Draw Barr bodies in these nuclei; write normal or abnormal karyotypes and syndromes they correspond to.



A **B** **C** **D** **E**

A. Female chromatin-positive nucleus ( )

B. Male chromatin-negative nucleus ( )

C. Female chromatin-negative nucleus ( )

D. Female double chromatin-positive nucleus ( )

	E. Male chromatin-positive nucleus ( )

Lecturer's signature

Practice 8. Topic: **VARIATION** «____» _____ 201__ year

Purpose of the practice: to learn basic types of variation and their causes, their medical and biological significance; to know mechanisms of gene, chromosome and genome mutations, DNA repair and biological basis of oncogenesis.

CONTENTS OF THE TOPIC

1. Phenotypic variation. Reaction norm.
2. Genotypic variation and its types (combinative and mutational). Comparison of mutations and modifications.
3. Mutagenic factors, their classification and action.
4. Classification of mutations.
5. Gene, chromosome and genome mutations, their characteristics, biological and medical significance.
6. Stability and repair of genetic material, antimutagens.
7. Biological basis of oncogenesis.

BASIC TERMS AND CONCEPTS

1. Genocopies –

2. Deletions –

3. Дупликация –

4. Isochromosomes –

5. Inversion –

6. Oncogenesis –

7. Ring chromosome –

8. Modifications –

9. Reaction norm –

10. Reading frame shift –

11. Transgenations –

12. Translocations –

TESTS FOR SELF-CONTROL

1. Properties of modifications: a) they are adaptive; b) they are inherited; c) they are not inherited; d) they are matter for natural selection; e) they are matter for artificial selection.

2. Physical mutagens cause: a) formation of thymine dimers; b) deamination and alkylation of nucleotides; c) replacement of bases with their analogs; d) breakage of microtubules in the spindle apparatus; e) embedding of foreign DNA in the DNA of a host cell.

3. Chemical mutagens cause: a) formation of thymine dimers; b) deamination and alkylation of nucleotides; c) replacement of bases with their analogs; d) breakage of microtubules in the spindle apparatus; e) embedding of foreign DNA in the DNA of a host cell.

4. Biological mutagens cause: a) structural defects of genes and chromosomes; b) polyploidy; c) formation of thymine dimers; d) haploidy; e) embedding of foreign DNA in the DNA of a host cell.

5. According to their causes, mutations are: a) somatic and genome; b) spontaneous and phylogenetic; c) gametic and chromosomal; d) induced and ecological; e) spontaneous and induced.

6. Characteristics of somatic mutations: a) occur in gametes; b) occur in somatic cells; c) have phenotypic manifestation in the individual who got them; d) are transmitted to descendants during sexual reproduction; e) are transmitted to descendants during asexual reproduction.

7. Characteristics of gametic mutations are: a) occur in sex cells; b) occur in somatic cells; c) have phenotypic manifestation in the individual who got them; d) are transmitted to descendants during sexual reproduction; e) are transmitted to descendants during asexual reproduction.

8. Mutations of functional genes cause: a) transpositions; b) impaired alternation of recognition and termination; c) impaired alternation of initiation and elongation; d) impaired alternation of induction and repression; e) transitions.

9. According to the level where they occur, mutations are: a) somatic and lethal; b) gene and genome; c) gametic and chromosome; d) gene and chromosome; e) chromosome and induced.

10. Genome mutations are caused by: a) non-separation of chromosomes and chromatids during mitosis and meiosis; b) impairment of crossing over; c) endomitosis; d) structural impairments of chromosomes; e) destruction of spindle apparatus.

11. Polyploidy is: a) increased abnormal number of chromosomes indivisible by 1n; b) increased abnormal number of chromosomes divisible by 1n; c) decreased abnormal number of chromosomes indivisible by 1n; d) decreased abnormal number of chromosomes divisible by 2n; e) haploid set of chromosomes.

12. Haploidy is: a) positive mutation; b) nullsomy; c) monosomy; d) absence of one chromosome; e) haploid set of chromosomes.

13. Types of mutations in structural genes: a) transductions; b) transpositions; c) translocations; d) reading frame shift; e) transitions.

14. Stability of genetic material is not provided by: a) haploid chromosome set; b) diploid chromosome set; c) double helix of DNA; d) redundancy of the genetic code; e) DNA repair.

15. Excision repair of a DNA occurs in the following order: 1) synthesis of a new fragment of DNA strand; 2) ligation of the synthesized strand with the rest of the repairing DNA; 3) recognition the damaged DNA strand; 4) cutting out the damaged fragment of DNA strand; 5) replication of the DNA: a) 1–5–2–3; b) 5–1–3–2; c) 3–4–5–2; d) 3–4–2–1; e) 3–4–1–2.

16. According to the oncogene concept, the basis of oncogeneis is: a) protooncogenes received from parents or introduced into the genome of the cell by viruses; b) chromosome mutations of somatic cells; c) presence of protooncogenes in somatic cells of an organism; d) genome mutations of somatic cells; e) incorporations of viral DNA in the genome of somatic cells.

Fill in the gaps:

1. A phenomenon when non-hereditary variation has the same phenotypic manifestation as the hereditary one is called …

2. Enzymes capable of cutting out the damaged part of DNA strand during repair are …

3. Transgenation when one purine base is replaced with another purine base is called ...

4. … of chromosome telomeres and connection of remaining ends leads to formation of ring chromosomes.

5. Mutation of … genes leads to the impairment of alternation of repression and expression of genes.

6. Non-separation of chromosomes during mitosis or meiosis causes … mutations.

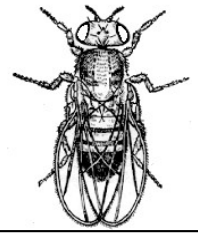
7. Aneuploidy when only one chromosome of a pair is present in the karyotype is called …

8. Genome mutation when somatic cells have single chromosome set is called …

9. Disease caused by the infringement of DNA repair and characterized by insufficiency of red bone marrow function resulting in deficit of blood cells and hyperpigmentation is called …

PRACTICAL WORK

Task I. Study micropreparations with mutations of Drosophilae and draw them in the pictures:

Eyes ***Bar*** 1st chromosome, dominant, chromosome mutation. 	Wings ***Curly*** 2nd chromosome, dominant, gene mutation. 	Body color ***Yellow*** 1st chromosome, recessive, gene mutation. 
White 1st chromosome, recessive, gene mutation. 	***Vestigial*** 2nd chromosome, recessive, gene mutation. 	***Black*** 2nd chromosome, recessive, gene mutation. 
Normal Red eyes, normal wings, grey body 		

Task II. Solve the problems:

Problem 1. Some cells of a person have 47 chromosomes, other have 45. What is the name of this phenomenon? What is the mechanism of its origination?

Problem 2. A father has got blue eyes, mother has got blue eyes, their daughter has one blue and the other brown eyes. How can it be explained?

Problem 3. Aged spouses got son who is heterozygous in the gene of daltonism. What conclusion about his karyotype can be drawn?

Problem 4. A fragment of DNA strand has the following nucleotide sequence:

G A G G C T C T A G G T A C C A G T

A) How would the encoded peptide change if 4th nucleotide disappear?

B) How would the encoded peptide change if 2nd codon disappear?

Lecturer's signature

Practice 9. Topic: **FUNDAMENTALS OF HUMAN GENETICS (Part 1)** «____» _____ 201__ year

Purpose of the practice: to learn modern tasks of human genetics and its basic techniques; to learn how to solve problems with pedigree charts, estimating roles of heredity in environment in development of characters.

CONTENTS OF THE TOPIC	**4. Discordance –**
1. Modern tasks of human genetics. 2. The human as an object of genetic investigations. 3. Classification of methods used in human genetics. 4. Genealogical analysis. Types of inheritance and their characteristics. 5. The method of twin study. Criteria determining zygosity of twins. Holzinger's fromula. 6. Karyotyping. 7. Cultivation and hybridization of somatic cells. 8. Biochemical genetic tests. 9. Genetic analysis. The Human genome project.	**5. Concordance –** **6. DNA cloning –**
BASIC TERMS AND CONCEPTS **1. Dizygotic twins –** **2. Monozygotic twins –** **3 DNA hybridization –**	**7. Proband –** **8. Sequencing –** **9. Synkaryote –** **10. Pedigree chart –**

TESTS FOR SELF-CONTROL

1. **Studying the human being has a number of difficulties such as:** a) simple karyotype; b) early sexual maturation; c) low number of children; d) high number of children; e) possibility to conduct experiments.
2. **Modern tasks of human genetics are:** a) early diagnosis of hereditary disorders by improvement of instant diagnosis tests and tests for prenatal diagnosis; b) elaboration of gene therapy on the basis of biotechnological techniques and genetic engineering; c) use of hybridological method; d) large-scale implementation of genetic counseling into medical service; e) study of primary and secondary sexual characters.
3. **Methods used in human genetics are:** a) basic and experimental methods; b) methods of prenatal diagnosis and crossing; c) instant diagnosis tests and basic methods; d) genetic and paleontological tests; e) sociological and comparative anatomical.
4. **Stages of genealogical analysis are:** a) collection of data about proband's relatives; b) calculation of gene frequency in the population; c) drawing genetic map of chromosome; d) estimation of environment's role in development of the character; e) analysis of the pedigree chart.
5. **Criteria of twins' zygosity are:** a) mode of dress and blood group; b) sex and blood groups in Rh and MN systems; c) color of eyes and mood; d) height and body temperature; e) fingerprints.
6. **Technique of karyotyping: 1) processing with hypotonic solution of NaCl; 2) staining; 3) arrest of mitosis at the stage of metaphase by colchicine; 4) cultivation of cells on artificial media; 5) induction of mitosis.** a) 1-5-3-4-2; b) 4-5-3-1-2; c) 4-1-5-3-2; d) 5-3-4-1-2; e) 4-5-1-3-2.
7. **Holzinger's formula is used to calculate:** a) gene frequency in the population; b) role of heredity for development of a character; c) role of environment for development of a character; d) probability of inheritance; e) genetic risk.
8. **Biochemical genetic tests study:** a) complete blood count; b) activity of enzymes; c) activity of digestion; d) composition of primary urine; e) structure of enzymes in a crystal.
9. **Loading tests are used to to reveal:** a) heterozygotes carrying recessive pathological gene; b) chromosome mutations; c) genome mutations; d) gene mutations; e) inheritance type.
10. **Methods of genetic analysis are based on:** a) mathematical expression of Hardy–Weinberg principle; b) extraction of DNA fragments and their analysis; c) drawing and analysis of pedigree charts; d) studying activity of enzyme systems; e) studying a karyotype under the microscope.
11. **Methods of genetic analysis are used to:** a) obtain certain genes and their parts for analysis; b) reveal genome mutations; c) detect certain nucleotide sequences; d) reveal chromosome mutations; e) reveal type of inheritance.
12. **Cultivation of somatic cells:** a) is based on uses Hardy–Weinberg principle; b) is based on extraction of DNA fragments and their sequencing; c) allows to obtain clones of a single cell; d) allows to select cells with certain characters; e) is based on karyotyping.
13. **Somatic cell hybridization is used to:** a) obtain synkaryotes of various cells; b) extract genes and their fragments for further sequencing; c) obtain clones of a single cell; d) select cells with certain characters; e) study karyotype with microscopy.

Fill in the gaps:

1. If parents are heterozygous (complete dominance, autosomal dominant inheritance, gene penetrance is 25%), then the probability of giving birth to a sick baby is ... %

2. If a mother is heterozygous and a father is healthy (X-linked dominant inheritance, gene penetrance is 40%), then the probability of
giving birth to a sick baby is ... %.

3. The type of inheritance when the father transmits his character to all daughters, but neither to sons is called ...

4. A hybrid somatic cell containing nuclei of two different cells …

5. Method of human genetic that allows to reveal the role of heredity and environment in development of a character is called …

6. Percentage of twins who are different in a certain character is called …

7. The method of human genetics that allows to reveal genome and chromosome mutations is called …

8. Heterozygous carriers of pathologic genes can be revealed by biochemical ... tests.

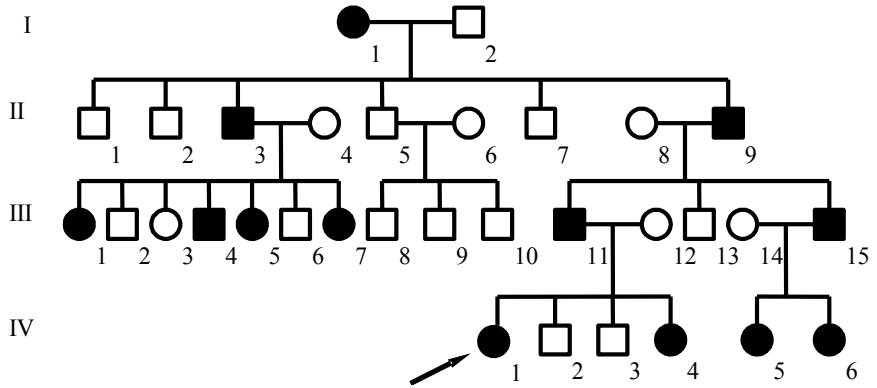
PRACTICAL WORK

Task I. Solve the problems:

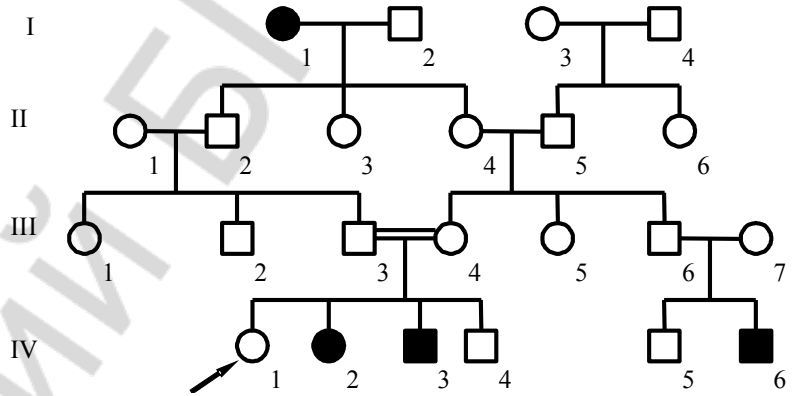
Problem 1. Concordance of monozygotic and dizygotic twins in body mass is 80% and 30%. What are proportion of heredity and environmental factors for this character?

Problem 2. Concordance of dizygotic twins in eye color is 23%, H is equal 0.96. What is the concordance of monozygotic twins in this character?

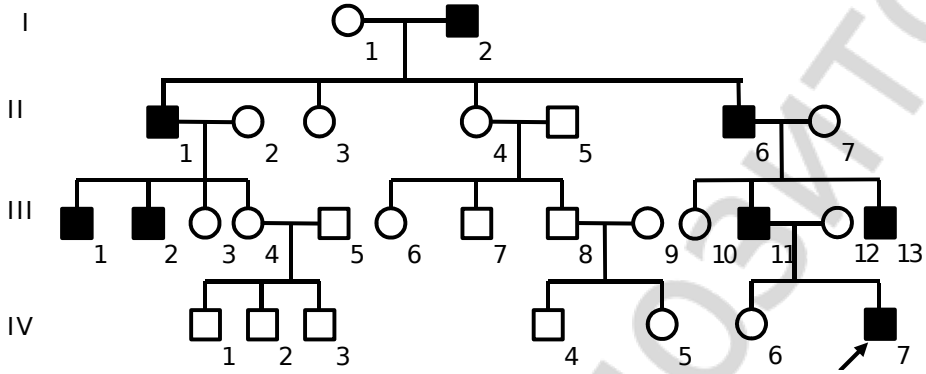
Problem 3. Analyze the pedigree chart. Find the type of inheritance and genotypes of all family members when it is possible.



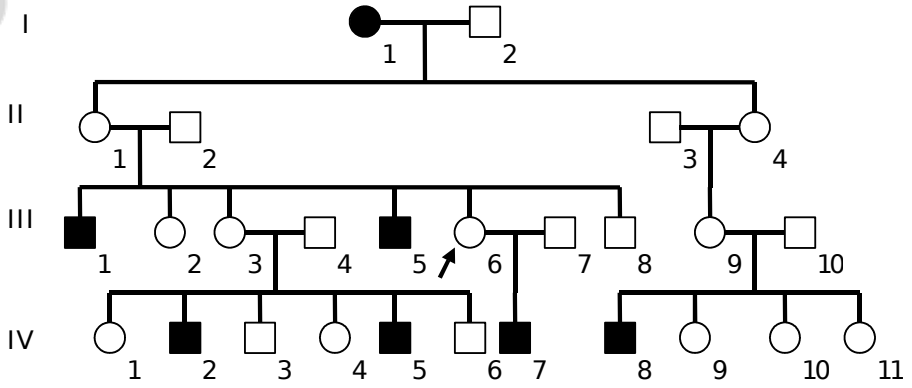
Problem 4. Analyze the pedigree chart. Find the type of inheritance and genotypes of all family members when it is possible.



Problem 5. Analyze the pedigree chart. Find the type of inheritance and genotypes of all family members when it is possible.



Problem 6. Analyze the pedigree chart. Find the type of inheritance and genotypes of all family members when it is possible.



Lecturer's signature

Practice 10. Topic: **FUNDAMENTALS OF HUMAN GENETICS (Part 2)** «____» _____ 201__ year

Purpose of the practice: to learn techniques used in human genetics: modeling, population statistics, instant diagnostic tests and methods of prenatal diagnosis of hereditary disorders; to learn how to solve problems in Hardy-Weinberg principle.

CONTENTS OF THE TOPIC	**4. Genetic drift –**
1. Mathematical and biological modeling. Vavilov's Law of Homologous Series. 2. Method of population statistic. The concept of population. Panmictic and non-panmictic populations. 3. Characteristic of human populations. Types of marriages. Genetic processes occurring in large populations. Hardy–Weinberg principle. 4. Factors impairing the equilibrium of genes and genotypes in populations (mutations, natural selection, population waves, isolation, migrations, genetic drift) and their characteristic. 5. Genetic load and its nature. 6. Methods of prenatal diagnosis of hereditary disorders and malformations. 7. Instant diagnosis tests (dermatoglyphics, microbiological, sex chromatin test, biochemical and chemical).	**5. Incest marriage -** **6. Panmixia –** **7. Population –**
BASIC TERMS AND CONCEPTS **1. Amniocentesis –** **2. α-fetoprotein –** **3. Demes –**	**8. Guthrie test –** **9. Ultrasonography –** **10. Chorion biopsy –**

TESTS FOR SELF-CONTROL

1. Demographic characteristics of human populations: a) the number of individuals and genetic composition; b) birth and death rates; c) panmixia and density; d) isolation and migration; e) age and gender composition.

2. Characteristics of ideal populations: a) unlimited number of individuals; b) low number of individuals; c) complete panmixia; d) absence of mutations; e) presence of mutations.

3. In mathematical expression of the Hardy–Weinberg principle, a «p» denotes the frequency of: a) dominant gene; b) recessive gene; c) dominant homozygotes; d) recessive homozygotes; e) heterozygotes.

4. In mathematical expression of the Hardy–Weinberg principle, a «p^2» denotes the frequency of: a) dominant gene; b) recessive gene; c) dominant homozygotes; d) recessive homozygotes; e) heterozygotes.

5. In mathematical expression of the Hardy–Weinberg principle, a «q» denotes the frequency of: a) dominant gene; b) recessive gene; c) dominant homozygotes; d) recessive homozygotes; e) heterozygotes.

6. In mathematical expression of the Hardy–Weinberg principle, a «q^2» denotes the frequency of: a) dominant gene; b) recessive gene; c) dominant homozygotes; d) recessive homozygotes; e) heterozygotes.

7. In mathematical expression of the Hardy–Weinberg principle, a «2pq» denotes the frequency of: a) dominant gene; b) recessive gene; c) dominant homozygotes; d) recessive homozygotes; e) heterozygotes.

8. Processes occurring in small populations: a) Hardy–Weinberg principle works; b) birth and death rates change; c) frequencies of genes and genotypes change; d) age and gender composition change; e) the number of individuals change.

9. A genetic pool is: a) sum of individual's genes; b) all the genes of individuals in a population; c) all the genes of individuals of the same species; d) all the genes of family members; e) all the genes of all individuals.

10. Types of marriages in human populations: a) same-sex marriages; b) unequal marriages; c) outmarriages; d) interracial marriages; e) incest marriages.

11. Microbiological tests allow to: a) create genetic maps of human chromosomes; b) determine the number of X-chromosomes; c) determine the number of Y-chromosomes; d) reveal some chromosome mutations; e) reveal some metabolic defects.

12. Dermatoglyphic analysis allow to: a) study pathogenesis of skin diseases; b) elaborate prophylactic measures of skin diseases; c) determine the causes of skin diseases; d) reveal possible hereditary origin of disease; e) diagnose metabolic defects.

13. Indirect methods of prenatal diagnostics are: a) α-fetoprotein test; b) ultrasonography; c) choroin biopsy; d) amniocentesis; e) fetoscopy.

14. Direct noninvasive methods of prenatal diagnostics are: a) alpha-fetoprotein test; b) ultrasonography; c) chorion biopsy; d) amniocentesis; e) fetoscopy.

15. Optimal terms for carrying out direct noninvasive methods of prenatal diagnostics are: a) 6–8 weeks; b) 8–10 weeks; c) 12–20 weeks; d) 23–30 weeks; e) 30–35 weeks.

16. Genetic load is: a) positive mutations saturating a population; b) all the mutations reducing adaptability in a population; c) neutral mutations saturating a population; d) negative mutations saturating a population; e) absence of mutations in populations.

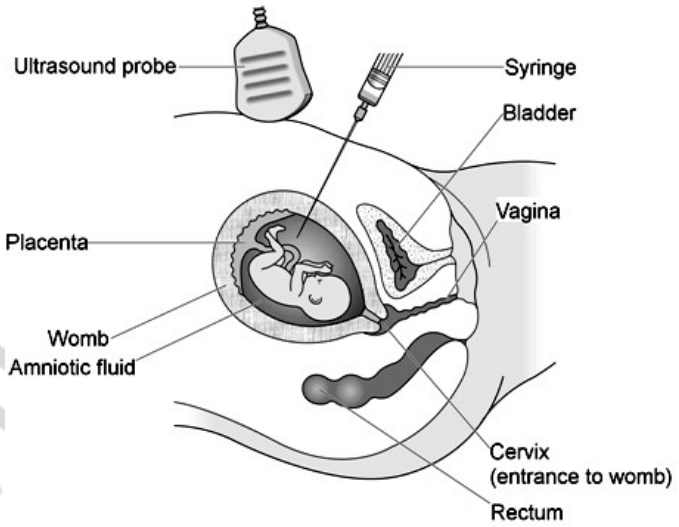
Fill in the gaps:	PRACTICAL WORK
1. Chorion biopsy is performed within … weeks of pregnancy. **2.** Changes of genetic structure of a population can be predicted by a methods of … **3.** Level of α-fetoprotein in the blood of a pregnant woman ... in case of Down syndrome of the fetus. **4.** Each pregnant woman compulsory undergoes … — a direct non-invasive method of prenatal diagnostics. **5.** Mother's age of over 37 years, spontaneous abortions and stillbirth in the anamnesis, children with congenital malformations are indications for carrying out ... methods of prenatal diagnostics. **6.** Sex chromatin Y is determined by staining the cells of buccal epithelium by … **7.** Normally the main palmar angle is not more than … **8.** Human populations with the number not exceeding 1500 people where intragroup marriages surpass 90 % are called … … **9.** Genetic load has no phenotypic manifestation when … of a pathological gene is observed. **10.** Consanguineous marriages lead to … depression as relatives have higher probability to carry the same pathological gene.	**Solve the problems:** **Problem 1.** In the USA, the 30% of the examined population could feel the bitter taste of phenylthiocarbamide (PTC) and the 70% did not. The ability to feel its taste is determined by the recessive gene **a**. Find out the frequency of the alleles **A** and **a** in the examined population. **Problem 2.** An aboriginal population of 127 (including children) persons lives in the jungle of the South America. The frequency of the M blood group there is 64%. Is it possible to find out the frequencies of **N** and **MN** blood groups in this population?

Problem 3. Congenital dislocation of the hip is recessive and dominant, the average gene penetrance is 25%. According to a research (Vladimir Pavlovich Efroimson, 1968) frequency of this pathology is 6:10 000. What is the frequency of recessive homozygotes in the studied population?

Problem 4. The rate of the disease gout is 2% (V. P. Efroimson, 1968), and it is conditioned by a dominant autosomal gene. According to some information gene penetrance in men is ~20% and ~0% in women. Find out the genetic structure of the population.

Problem 5. A woman who enquired with genetic counseling at 14th week of gestation has considerably high level of α-fetoprotein in blood. What should be the approach of a doctor in this case? What disorders could increase the level of α-fetoprotein in blood?

Problem 6. What method of prenatal diagnosis is it?



What are indications for this method?

Problem 7. The results of the dermatoglyphic analysis of a patient are the following: the single transverse palmar crease on both palms, radial loops on the 4th and 5th fingers of both hands, the main palm angle is 77 degrees. Is it possible to suspect that this man has a hereditary disorder according to this in-formation?

Lecturer's signature

Practice 11. Topic: **CONTROL PRACTICE IN CYTOLOGU AND GENETICS** «____» _____ 201__ year

Purpose of the practice: to estimate student's knowledge in studied topics.

QUESTIONS FOR CONTROL	
1. Human being as a biological and social object. **2.** Role of Biology in medical education. Significance of Biology for pharmaceutical education. **3.** Subject matter, tasks and methods of cytology. **4.** Light microscopy. **5.** The modern Cell Theory. **6.** Difference between pro- and eukaryotic cells. **7.** Structure of plasma membrane, its properties and functions. Transport of substances through the membrane. **8.** Anabolic and catabolic systems of the cell. **9.** Energy exchange in the cell. Characteristic of its stages. **10.** Connection between flows of substances and energy in the cell. **11.** Structure and functions of nucleus. **12.** Types of chromosomes. Structure of chromosomes. Rules of chromosomes **13.** Karyotype and idiogram. Classification of human chromosomes. **14.** Mitotic and cell cycles. Interphase. Cause of mitosis. **15.** Regulators of the cell cycle (cyclins and cyclin-dependent kinases). **16.** Comparison of mitosis and meiosis (content of genetic material during different stages of division). **17.** Classification of genes (structural and functional, unique, repeated sequences, transposons). **18.** Regulation of transcription in prokaryotes (F. Jacob, J. Monod) and eukaryotes (G.P. Georgiev).	**19.** Cytoplasmic inheritance. **20.** Genetic engineering as a science. **21.** Obtaining genetic material: techniques. Restriction endonucleases. **22.** Insertion of DNA fragments into a vector molecule. Vectors. **23.** Incorporation of the recombinant DNA into a recipient cell. **24.** Techniques used in genetic engineering and biotechnology: polymerase chain reaction, southern blot, DNA fingerprinting. **25.** Inheritance of blood groups: systems AB0, MN and Rh. **26.** Non-allelic (inter-allelic) gene interactions. **27.** Autosomal and gonosomal linkage groups. **28.** Chromosome theory of inheritance. **29.** Determination of sex in human and its disorders. **30.** X-chromosome's sex chromatin. Mary F. Lyon's hypothesis of X-chromosome inactivation. **31.** Sex chromosome disorders. **32.** Phenotypic variation. Reaction norm. **33.** Genotypic variation and its types (combinative and mutational). Comparison of mutations and modifications. **34.** Mutagenic factors, their classification and action. **35.** Classification of mutations. **36.** Gene, chromosome and genome mutations, their characteristics, biological and medical significance. **37.** Stability and repair of genetic material, antimutagens. **38.** Biological basis of oncogenesis. Modern tasks of human genetics. **39.** The human as an object of genetic investigations.

40. Classification of methods used in human genetics. **41.** Genealogical analysis. Types of inheritance and their characteristics. **42.** The method of twin study. Criteria determining zygosity of twins. Holzinger's fromula. **43.** Karyotyping. **44.** Cultivation and hybridization of somatic cells. **45.** Biochemical genetic tests. **46.** Genetic analysis. The Human genome project. **47.** Mathematical and biological modeling. Vavilov's Law of Homologous Series. **48.** Method of population statistic. The concept of population. Panmictic and non-panmictic populations. **49.** Characteristic of human populations. Types of marriages. Genetic processes occurring in large populations. Hardy–Weinberg principle. **50.** Factors impairing the equilibrium of genes and genotypes in populations (mutations, natural selection, population waves, isolation, migrations, genetic drift) and their characteristic. **51.** Genetic load and its nature. **52.** Methods of prenatal diagnosis of hereditary disorders and malformations. **53.** Instant diagnosis tests (dermatoglyphics, microbiological, sex chromatin test, biochemical and chemical).	

Practice 12. Topic: **REPRODUCTION OF LIVING MATTER** «____» _____ 201__ year

Purpose of the practice: to study reproduction as essential property of living matter, its types; to study structure of sex cells gametogenesis and peculiarities of human reproduction.

CONTENTS OF THE TOPIC

1. Reproduction as essential property of living matter.
2. Types of reproduction.
3. Gametogenesis (oogenesis and spermatogenesis).
4. Insemination and its types. Fertilization and its stages.
5. Biological peculiarities of human reproduction.

BASIC TERMS AND CONCEPTS

1. **Acrosome –**
2. **Gynogenesis –**
3. **Copulation –**
4. **Karyogamy –**
5. **Oogenesis –**
6. **Insemination –**
7. **Sexual process –**
8. **Pronucleus –**
9. **Synkaryon –**
10. **Spermatogenesis –**

TESTS FOR SELF-CONTROL

1. **Characteristics of asexual reproduction is:** a) two individuals participate in reproduction; b) only one individual participates in reproduction; c) the genotype of daughter individuals differ from parental ones; d) genotype of daughter individuals are identical to parental ones; e) the number of daughter individuals increases slowly.
2. **Characteristics of sexual reproduction is:** a) usually two individuals participate in reproduction; b) only one individual participates in reproduction; c) genotypes of daughter individual differs from parental ones; d) genotypes of daughter individuals are identical to parental ones; e) the number of daughter individuals increases quickly.
3. **Asexual reproduction of animals:** a) vegetative reproduction; b) conjugation; c) copulation; d) polyembryony; e) fragmentation.

4. Movement forward of spermatozoa in the female reproductive tracts is provided by: a) mobility of spermatozoa; b) ovum's immobility; c) contraction of muscles of female reproductive tracts; d) excretion of gynogamones; e) contraction of abdominal muscles.

5. Fertilization is: a) fusion of an ovum with a sperm; b) movement of gametes to one another; c) movement of spermatozoa through female reproductive tract; d) process when the ovum leaves an ovary; e) sexual process.

6. Phases of fertilization: a) destruction of ova with hyaluronidase; b) distal interaction of gametes; c) contact interaction of gametes; d) entrance of the sperm's head into the ovum; e) cleavage of the ova.

7. Peculiarities of human reproduction: a) reproductive period in women lasts till old age; b) men are capable for reproduction since the puberty up to 50 years; c) since puberty female organism produces one secondary oocyte a moon month; d) the older is the man, the longer is the time between the divisions of meiosis; e) sperms are produced periodically.

Fill in the gaps:

1. Exchange of genetic information between the individuals of the same species is ...

2. Fusion of pronuclei during fertilization is called ...

3. Sexual reproduction without fertilization is called ...

4. A phenomenon when an organism develops on the genetic basis of only male gametes is called …

5. During period of proliferation, cells divide by ...

6. During the period of maturation, cells divide by ...

4. A phenomenon of asexual reproduction of an embryo is called …

5. Gamones contributing to spermatozoon's fixation on the ovum's membrane are called …

6. Spermatozoa possess the ability of fertilization within …

PRACTICAL WORK

Task I. Study the micropreparations, make indications for the pictures and color them.

Fig. 1. **Human spermatozoon** (7x40)
1 – head, 2 – midpiece, 3 – tail, 4 – acrosome

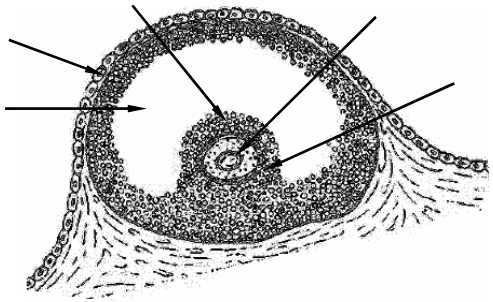


Fig. 2. **Graafian follicle in the cat's ovary** (7x8)
1 – secondary ovocyte, 2 – cumulus oophorus, 3 – follicular cells, 4 – follicular cavity, 5 – wall of the follicle

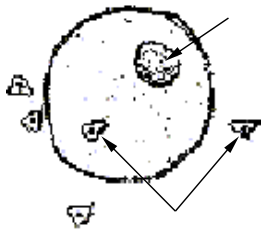


Fig. 3. **Fertilization of ascaris egg** (7x40)
1 – nucleus, 2 – spermatozoa

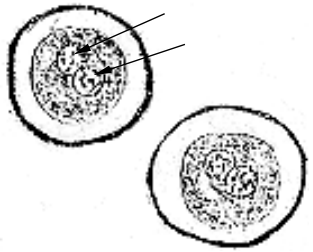


Fig. 4. **Karyogamy** (7x40)
1,2 – pronuclei

Task II. Solve the problems:

Problem 1. In case of parthenogenesis unfertilized ovum gives rise to a new organism. Why can't a spermatozoon do the same?

Problem 2. Planaria is hermaphrodyte and can multiply by self-fertilization. Besides, it is able multiply asexually. Is the genotype of the descendants of one individual same if some of them are formed by self-fertilization and the other ones by asexual reproduction? Why?

Problem 3. Semen analysis of persons P. and E. revealed that their spermatozoa have normal morphology, but P's sperms are immovable and E's sperms stay on the surface of the ovum and do not pass inside. Impairments of what cell structures can explain this?

Problem 4. Autopsy of 22-yeared dead women revealed that her ovaries contained:

Left ovary (smaller)	Right ovary (bigger)
17 000 follicles	25 000 follicles
10 atretic (degenerated) corpora lutea	48 atretic (degenerated) corpora lutea

Almost all follicles are very small though 219 of them were larger than 100 μm. If one follicle forms one corpus luteum, then:
a) what approximate age did ovulation begin in this woman?
b) for how many years could the ovulations happen?

Lecturer's signature

Practice 13. Topic: **FUNDAMENTALS OF ONTOGENESIS (PRENATAL PERIOD)** «___» _____ 201__ year

Purpose of the practice: to study periods of ontogenesis, its stages, critical periods and their nature, mechanisms providing realization of genetic information during development of embryo and fetus.

CONTENTS OF THE TOPIC

1. Ontogenesis, its types and periods.
2. Stages of embryogenesis (cleavage, gastrulation, hysto- and organogenesis). Provisional organs of chordates.
3. Peculiarities of embryonic development of human.
4. Mechanisms of embryogenesis and mechanisms of morphogenesis.
5. Critical periods of the prenatal ontogenesis. Teratogens.

BASIC TERMS AND CONCEPTS

1. Blastula –

2. Critical periods –

3. Morphogenetic fields –

4. Ontogenesis –

5. Progenesis –

TESTS FOR SELF-CONTROL

1. The cleavage type of a zygote depends on: a) sizes of the ovum; b) shape of the ovum; c) volume of yolk; d) distribution of yolk in the cytoplasm; e) potentialities of ovum's cytoplasm.

2. Cleavage of a zygote occurs at: a) 1st week after fertilization; b) 2nd -3rd weeks after fertilization; c) 4th–8th weeks after fertilization; d) 9th–18th weeks after fertilization; e) 18th–27th weeks after fertilization.

3. The wall is: a) blastopore consisting of blastocysts; b) blastopore consisting of blastocoels; c) blastoderm consisting of blastomeres; d) blastomere consisting of blastopores; e) blastocoel consisting of blastomeres.

4. Characteristic of the first stage of gastrulation of human embryo: a) delamination occurs; b) epiblast and hypoblast are formed; c) ingression occurs; d) mesoderm is formed; e) endoderm and mesoderm are formed.

5. Characteristic of the second stage of gastrulation of human embryo: a) delamination occurs; b) epiblast and hypoblast are formed; c) ingression occurs; d) mesoderm is formed; e) endoderm and mesoderm are formed.

6. Characteristics of teloblastic gastrulation: a) coelomic sacs are formed; b) teloblasts are formed near the blastopore; c) typical for invertebrates; d) mesoderm is formed; e) notochord is formed.

7. Primary causes of cells differentiation during embryogenesis are: a) chemical homogeneity of the ovum's cytoplasm; b) chemical heterogeneity of the ovum's cytoplasm; c) chemical homogeneity of spermatozoon's cytoplasm; d) chemical heterogeneity of spermatozoon's cytoplasm; e) different potencials of animal and vegetative poles of the ovum.

8. The main mechanisms of cell differentiation are: a) block of different transcriptons at certain stages of development; b) turning on all genes at the certain stages of development; c) block of all genes at the certain stages of development; d) unblocking of different transcriptons at the certain stages of development; e) block of one gene at the certain stages of development.

9. Action of genes during the ontogenesis: a) DNA → enzyme → mRNA → biochemical reaction → character; b) DNA → mRNA → enzyme → biochemical reaction → character; c) other genes have effect on a character; d) other genes do not have effect on the character; e) environmental factors do not have effect on the character.

10. At the early stages of embryogenesis (before early stage of gastrula) cells: a) are totipotent; b) are determined; c) can activate most of their transcriptons; d) can activate only some transcriptons; e) almost all the transcriptons are blocked.

11. At the stage of late gastrula cells: a) are totipotent; b) are determined; c) can activate most of their transcriptons; d) can activate only some transcriptons; e) almost all the transcriptons are blocked.

12. Human germinal layers are: a) endoderm and ectoderm; b) hypoderm and periderm; c) epidermis and dermis; d) mesoderm and epiblast; e) mesoderm.

13. Characteristics of totipotent cells are: a) their development is preprogrammed; b) their development is not preprogrammed; c) each of them can give rise to any type of cells; d) each of them can give rise to only one certain type of cells; e) the majority of transcriptons are blocked.

14. Characteristics of determined cells are: a) their development is finally preprogrammed; b) their development is not preprogrammed c) each of them can give rise to any type of cells; d) each of them can give rise to only one certain type of cells; e) the majority of genes can join the work.

15. Critical periods of embryogenesis are: a) prefetal and fetal; b) fetal and birth; c) birth and implantation; d) placentation; e) initial and prezygotyc.

16. Causes of critical periods of embryogenesis are: a) changes in conditions of embryo existence and feeding; b) transition from one development period to another one; c) appearance of new inductors; d) active dedifferentiation of cells; e) poor nutrition of the pregnant woman.

Fill in the gaps:

1. Mitotic division of the zygote into blastomeres that occurs at early stages of prenatal ontogenesis is called ...

2. The period of human embryonic development since the beginning of the 4^{th} and till the end of the 8^{th} weeks is called ...

3. Type of gastrulation in case of which cells of the blastoderm migrate to the blastocoel and multiply to form the second germ layer is called ...

4. Organisms blastopore of which transforms into anus and the mouth is formed at the opposite side of the body during embryogenesis are called ...

5. Nerve cells, neuroglia and epidermis of skin develop from ...

6. Amnion, chorion, allantois, yolk sac are ... organs of chordates.

7. The primary cause of cell differentiation during embryogenesis is … … of the ovum's cytoplasm.

8. Influence of one group of cells on another one by means of specific substances is called ...

9. Gradual change of intensity of metabolic activity at the ends of the embryo or fetus is the example of the ... of physiological activity.

PRACTICAL WORK

Task I. Study the micropreparations, and make indications.

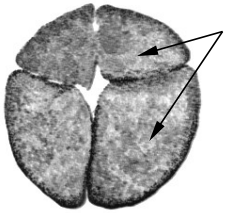


Fig. 1. **Cleavage of frog's zygote** (7x8)
1 – blastomeres

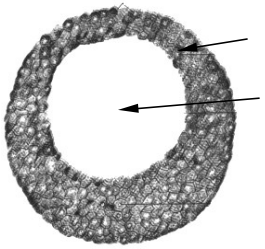


Fig 2. **Blastula of a frog** (7x8)
1 – blastomeres, 2 – blastocoel

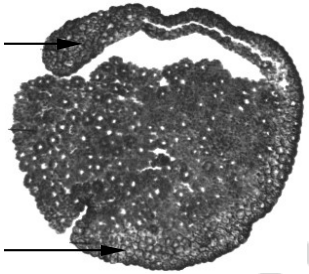


Fig 3. **Gastrula of a frog** (7x8)
1 – dorsal lip of the plastopore, 2 – ventral lip of the plastopore

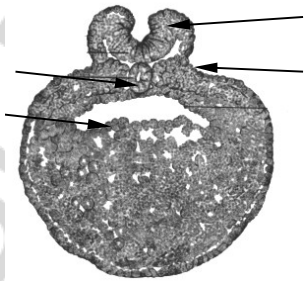


Fig. 4. **Neurula of a frog** (7x8)
1 – ectoderm, 2 – neural crest, 3 – notochord, 4 – endoderm

Task II. Solve the problems

Problem 1. A surgery of a frog embryo allowed to grow an embryo with two neural tubes – on dorsal and ventral sides. Experimentalist did not put that entire second neural tube to the embryo. What did he do?

Problem 2. Embryos having genome mutations with additional chromosomes stay alive during the cleavage, but most of them die after the cleavage. How can their survival during cleavage can be explained?

Lecturer's signature

Practice 14. Topic: **FUNDAMENTALS OF ONTOGENESIS (POSTNATAL PERIOD)** «____» _____ 201__ year

Purpose of the practice: to study periods of human postnatal ontogenesis, critical periods and their nature, growth types of tissues and organs, main theories explaining ageing; learn concepts of Gerontology, Geriatrics, acceleration and reanimation.

CONTENTS OF THE TOPIC	**6. Geriatrics –**
1. Periods of human postnatal ontogenesis. Critical periods of postnatal ontogenesis. 2. Growth. Growth types of human tissues and organs. Acceleration. 3. Human constitution and habitus. 4. Ageing. Basic theories of ageing. 5. Clinical and biological death. Reanimation. Euthanasia.	**7. Gerontology –** **8. Human constitution –**

BASIC TERMS AND CONCEPTS	
1. Acceleration – **2. Valeology –** **3. Biological age –** **4. Chronological age –** **5. Habitus –**	**9. Metamorphosis –** **10. Indirect development –** **11. Direct development –** **12. Reanimation –**

TESTS FOR SELF-CONTROL

1. Critical periods of postnatal ontogenesis: a) delivery; b) infancy; c) puberty; d) fading of reproductive function; e) senile age.

2. Characteristics of general growth of organs and tissues: a) intensive growth since birth and till 10–12 years; b) uniform growth during the whole period of growing; c) intensive growth during the first year of life and puberty; d) tissue grows intensively till 11–12 years and then gradually decrease to the volume characteristic of adults; e) rapid growth during puberty.

3. Characteristics of cerebral growth of organs and tissues: a) intensive growth since birth and till 10–12 years; b) uniform growth during the whole period of growing; c) intensive growth during the first year of life and puberty; d) tissue grows intensively till 11–12 years and then gradually decrease to the volume characteristic of adults; e) rapid growth during puberty.

4. Characteristics of reproductive growth of organs and tissues: a) intensive growth since birth and till 10–12 years; b) uniform growth during the whole period of growing; c) intensive growth during the first year of life and puberty; d) tissue grows intensively till 11–12 years and then gradually decrease to the volume characteristic of adults; e) rapid growth during puberty.

5. Criteria of biological age: a) development degree of body hair; b) size of reproductive organs; c) skeletal maturity ;d) body height; e) dental maturity.

6. Hypersthenics are predisposed to: a) neuroses; b) hypertension; c) stomach ulcer; d) atherosclerosis; e) obesity.

7. Cause of ageing according to genetic hypothesis is: a) changed colloidal properties of cytoplasm; b) decreased production of sexual hormones; c) impaired DNA repair and inability for replication; d) impaired adaptation and regulation of the body; e) genetically programmed number of cell mitoses.

8. Proofs of genetically programmed number of cell's mitoses is: a) fibroblasts of man's embryos in culture give about 50 generations; b) at each DNA replication some nucleotides of telomeres are lost; at each DNA replication some nucleotides of telomeres are added; c) after every mitosis the length of telomeres decreases; d) after every mitosis the length of telomeres increases.

9. Cause of ageing according to intoxication hypothesis is: a) changed colloidal properties of cytoplasm; b) decreased production of sexual hormones; c) accumulation of waste products in the large intestine and their adsorption to the blood; d) impaired adaptation and regulation of the body; e) accumulation of mutations.

Fill in the gaps:

1. The growth type of thymus and spleen is ...

2. The hormone of hypophysis ... play the main role in regulation of human growth

3. One of the main caused of acceleration is increasing … of young generations due to mixed marriages.

4. People of … constitutional type are predisposed to neuroses, ulcerous disease, tuberculosis.

5. The state of an organism characterized by cardiac and respiratory arrest, loss of consciousness but not critical impairments of cell metabolism is called … death.

6. Medical assistance to pass from life for a terminally ill patient according to his will or request of his relatives is called ...

PRACTICAL WORK

Task I. Solve the problems

Problem 1. What periods of postnatal ontogenesis last longer in men than in women?

Problem 2. What periods of postnatal ontogenesis last longer in women than in men?

Problem 3. What is the significance of Chernorutsky's study about constitutional types of human?

Problem 4. What is the difference between clinical and biological death?

Lecturer's signature

Practice 15. Topic: **INTRODUCTION TO PARASYTOLOGY** «____» _____ 201__ year

Purpose of the practice: to study parasitism as biological phenomenon, to learn classification of parasites and their hosts, interactions in the parasite-host system, adaptations of parasites, their pathogenic action and response of the host.

CONTENTS OF THE TOPIC

1. Origin and age of parasitism. Criteria of parasitism.
2. Classification of parasites and their hosts.
3. The parasite-host system.
4. Transmission rotes of parasites.
5. Adaptations to parasitism.
6. Pathogenic action and specificity of parasites.
7. Response of the host to parasitic invasion.
8. Biological basis of prophylaxis of parasitic diseases.

BASIC TERMS AND CONCEPTS

1. Invasions –

2. Infections –

3. Hyperparasitism –

4. Molecular mimicry –

5. Parasite –

6. Parasitocenosis –

7. Pathogenicity –

8. Symbiosis –

9. Specificity of the parasite –

10. Invasive stage –

TESTS FOR SELF-CONTROL

1. Types of biological interactions: a) competition and predation; b) symbiosis and parabiosis; c) parabiosis; d) symbiosis and antibiosis; e) anabiosis.

2. Competition is a biological interaction in which: a) one species hunts the other one; b) one species produces substances to suppress vital processes of the other one; c) two species require the same conditions or resources; d) any kind of interactions between two organisms; e) both species receive mutual benefit.

3. Antibiosis is a biological interaction in which: a) one species hunts the other one; b) one species produces substances to suppress vital processes of the other one; c) two species require the same conditions or resources; d) any kind of interactions between two organisms; e) both species receive mutual benefit.

4. Commensalism is a biological interaction in which: a) both species receive mutual benefit; b) one species uses the other one only as habitation without causing harm or benefit; c) one species uses the other one only as habitation and origin of food without causing harm or benefit; d) one species uses the other one only as habitation and harms it; e) none of the species have benefit.

5. Mutualism is a biological interaction in which: a) both species receive mutual benefit; b) one species uses the other one only as habitation without causing harm or benefit; c) one species uses the other one only as habitation and origin of food without causing harm or benefit; d) one species uses the other one only as habitation and harms it; e) none of the species have benefit.

6. Criteria of parasitism are: a) relation with a host; b) absence of contacts between species; c) feeding at the expense of the host and causing harm; d) one species uses the other one only as habitation without causing harm or benefit; e) production of substances that are required for the host survival.

7. Conditions for formation of a parasite-host system: a) contact between parasite and the host; b) parasite should cause death of a host; c) parasites and hosts not always need to contact; d) host must provide optimal conditions for the parasite; e) parasite should not resist the protective reactions of the host.

8. Types of symbiosis: a) mutualism and synoikia; b) anabiosis and parasitism; c) competition and anabiosis; d) predation and cannibalism; e) commensalism and parasitism.

9. Examples progressive morphological and physiological adaptations of parasites: a) presence of attachment organs and specialization of integument; b) simplification of the nervous system and sense organs; c) molecular mimicry and secretion of antienzymes; d) absence of the digestive tract in intestinal parasites; e) high fertility and complex life cycles.

10. Examples of biological adaptations of parasites: a) presence of attachment organs and anti-enzymes; b) simplification of the nervous system and sense organs; c) various forms of asexual reproduction and high fertility; d) complex life cycles, alternation of hosts and migration of larvae within the host; e) immunosuppressive action.

11. Pathogenic actions of parasites are: a) mechanical injury of tissues, toxicoallergic; b) supplying the host with vitamins; c) supplying the host with nutrients; d) absorption of nutrients and vitamins from the host; e) weakening the organism and increasing probability of secondary infection.

12. Pathogenicity of a parasite does not depend on: a) host's genotype and environmental factors; b) parasite's genotype; c) host's age and diet; d) body height and sex of the host; e) presence of other parasites in the host.

13. Protective reactions of the host's organism occur at levels: a) subcellular and cellular; b) cellular and organism; c) population and tissue; d) cellular and tissue; e) population-specific.

14. Adaptation of parasites at the population level: a) presence of cysts and active search for hosts; b) simplification of nervous system and absence of alimentary system in tapeworms; c) molecular mimicry and anti-enzymes; d) involvement of intermediate and reservoir hosts into the life cycle; e) synchronization of parasite's life cycle and hosts behavior.

Fill in the gaps:

1. Free-living organisms which can become parasites if they get to the organism of other species are called …

2. Hosts providing optimal biochemical conditions for the parasite and have biocoenotic contact with it are called ...

3. Hosts providing biochemical conditions for the parasite but don't have biocoenotic contact with it are called ...

4. Hosts characterized by the presence of biocoenotic contacts with parasites but absence of biochemical conditions for their development are called …

5. Route of transmission of parasites with water and foodstuffs is called …

6. Route of transmission of parasites through mucous membranes of respiratory pipes is called ...

7. Route of transmission of parasites with household goods is called …

8. Route of transmission of parasites with infected donor blood is called …

PRACTICAL WORK

Fill in the table: «Adaptations of parasites»:

Morphological and physiological progressive adaptations:
Morphological and physiological regressive adaptations:

Biological adaptations:

Lecturer's signature

Practice 16. Topic: **PARASYTES AS PATHOGENS OF DISEASES** «____» _____ 201__ year

Purpose of the practice: to study peculiarities of morphology and biology of parasitic species of classes Zoomastigota, Trematoda, Cestoidea, Nematoda, Arachnida, Insecta, their pathogenic action; to learn methods of diagnosis and prevention of diseases they cause

CONTENTS OF THE TOPIC

1. Trichomonas – parasitic protist.
2. Cat liver fluke – parasitic fluke.
3. Pork tapeworm – parasitic tapworm.
4. Ascaris – parasitic roundworm.
5. Itch mite – pathogen of scabies.
6. Lice – insects pathogens and vectors of diseases.

BASIC TERMS AND CONCEPTS

1. Proglottid —

2. Biohelminthes —

3. Cisticercus —

4. Dehelmithization —

5. Geohelminthes —

6. Marita —

7. Metacercaria —

8. Migration of larvae —

9. Migration ascariasis —

10. Miracidium —

11. Pediculosis —

12. Phthiriasis —

13. Scolex —

14. Strobila —

TESTS FOR SELF-CONTROL

1. Morphology of Trichomonas vaginalis: a) there are axostyle and undulating membrane; b) oval body shape and several nuclei in the cytoplasm; c) undulating membrane is absent, there is single nucleus; d) there are 4-5 flagella and spike; e) can form cysts.

2. Symptoms of urogenital trichomoniasis: a) itching, burning sensation, vaginal discharges; b) headache and general weakness; c) diarrhea with blood; d) aches in the region of the large intestine; e) urethritis and prostatitis.

3. Laboratory diagnosis of urogenital trichomoniasis is based on: a) detection of trophozoites in feces and duodenal content; b) immunoassay; c) detection of trophozoites in smears of urogenital organs; d) detection of cysts in smears of urogenital organs; e) detection of cysts in feces and duodenal content.

4. Intermediate host of cat liver fluke: a) freshwater snails and crustaceans; b) herbivorous animals; c) carnivorous animals; d) freshwater snails and fishes; e) sea crustaceans.

5. Invasion with teniasis occurs during: a) breaches of personal hygiene; b) contacts with sick people and animals; c) eating undercooked beef; d) eating undercooked pork; e) eating undercooked fish, shrimps and crabs.

6. Typical symptoms of migration ascariasis are: a) intestinal obstruction; b) fever and an asthmatic bronchitis; c) non-constant eosinophilic infiltrations in lungs; d) occlusion of choledoch duct; e) appendicitis.

7. Preventive measures of scabies are a) revealing and treating sick people; b) elimination of vectors; c) maintaining the purity of the body; d) washing vegetables and fruits before eating; e) sanitary inspection of hostels, bathhouses and health education.

8. Invasion with cysticercosis occurs by means of: a) swallowing eggs of park tapeworm; b) eating undercooked pork and beef; c) eating undercooked shrimps and crabs; d) contact with domestic pigs; e) autoinvasion in teniasis.

9. Medical significance of pubic louse: a) mechanic vectors transmitting eggs of helminthes and cysts of protists; b) biological vectors of the **louse-borne relapsing fever**; c) biological vectors of **epidemic typhus**; d) causes pediculosis; e) causes phthiriasis.

Fill in the gaps:

1. Trichomonas vaginalis has ... flagella.
2. Life cycle of a Cat liver fluke: egg → miracidium → sporocyst → redia → ... → metacercaria.
3. Supporting axis of some Zoomastigotes is called ...
4. Ovarium of Taenia solium consists of ... lobes.
5. Mature proglottid of Taenia solium have... branches of the uterus
6. Life span of mature Ascaris in the human body is about ...
7. Pediculus humanus capitis and Pediculus humanus humanus cause ...
8. Phthirus pubis causes …
9. Eggs of lice are called ...

PRACTICAL WORK

Task I. Study the preparations, color the pictures and make indications.

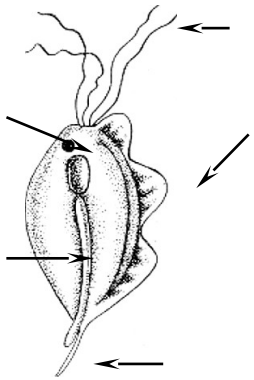


Fig. 1. Morphology of Trichomonas vaginalis (7×40)
1 — nucleus; 2 — undulating membrane; 3 — flagellum; 4 — axostyle; 5 — spike

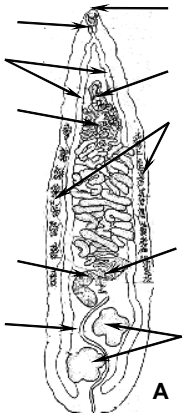


Fig. 2. Cat liver fluke (**)**
A — marita (×20): 1 — oral sucker, 2 — abdominal sucker, 3 — esophgus, 4 — branches of intestine, 5 — vitellaria, 6 — uterus, 7 — ovaria, 8 — seminal receptacle, 9 — testes, 10 — canal of excretory system

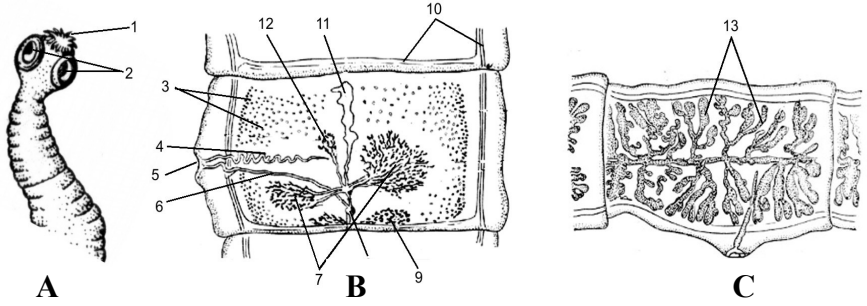


Fig. 3. Taenia solium:
A-C — schemes; A — scolex; B — hermaphroditic proglottid; C — mature proglottid

1 – 2 –
3 – 4 –
5 – 6 –
7 – 8 –
9 – 10 –
11, 13 – 12 –

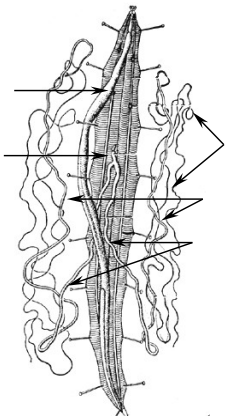


Fig. 4. Dissected female of Ascaris lumbricoides
1 — ovaries; 2 — oviducts; 3 — uteri; 4 — vagina; 5 — intestine

Fig. 5. Egg of Cat liver fluke, Taenia solium and Ascaris lumbricoides (7×40)

Fig. 6. Itch mite (7×40) ( )

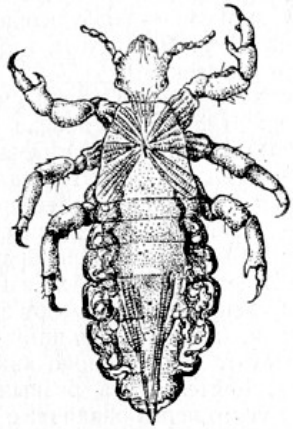


Fig. 7. Head louse
A — scheme (×20) ( )

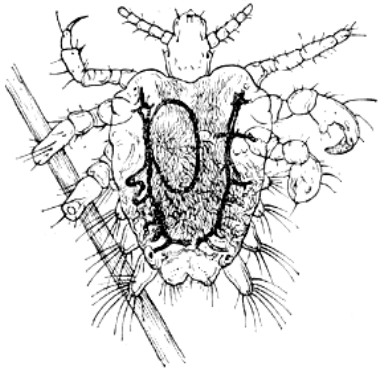


Fig. 8. Pubic louse.
A — scheme (7×8) ( )

Lecturer's signature

Practice 17. Topic: **POISONOUS FUNGI AND PLANTS** «____» _____ 201__ year

Purpose of the practice: to learn main groups of poisonous fungi and plants, physiological characteristics of myco- and phytotoxins and their medical use.

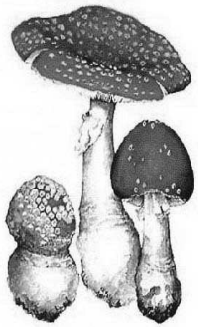
CONTENTS OF THE TOPIC	TESTS FOR SELF-CONTROL
1. Poisonous macro- and micromycetes, their characteristics, toxins and effects on the organism. First aid and prevention of poisonings with mycotoxins. 2. Poisonous algae, their characteristics, classification, toxins and effects on the organism. First aid and prevention of poisonings with algal toxins. 3. Poisonous plants, their characteristics, classification, toxins and effects on the organism. 4. Phytotoxins. Their nature and effects. First aid and prevention of poisonings with phytotoxins.	**1.** **Prevention of poisonings with micromycetes:** a) purity control of foodstuff and forage; b) thermal processing of food; c) withdrawal of foodstuff that is potentially polluted with toxins; d) nonuse of spoiled or improperly stored food; e) nonuse of tinned vegetables. **2.** **Edible mushrooms:** a) blewit; b) honey mushroom; c) peppery bolete; d) shaggy cup; e) birch bolete. **3.** **Edible mushrooms:** a) brown roll-rim; b) butter dish; c) fiber cap; d) yellow-cracked boletus; e) cep.

BASIC TERMS AND CONCEPTS	
1. Mycotoxins – **2. Toxins –** **3. Unpalatable mushrooms –** **4. Phytotoxins –** **5. Poison –**	**4. Mushrooms edible after proper cooking are:** a) blewit; b) common morel; c) bitter boletus; d) cep; e) brown roll-rim. **5. Poisonous mushrooms:** a) brown roll-rim; b) bitter boletus; c) fiber cap; d) velvet bolete; e) death cup amanita. **6. Clinical presentation of poisoning with death cup amanita:** a) incoercible vomiting, diarrhea, thirst; b) convulsions, muscular aches; c) erythrocyte lysis; d) death caused by renal and hepatic failure, e) intestinal obstruction. **7. Clinical presentation of poisoning with fly amanita**: a) vomiting, diarrhea; b) laboured breathing; c) elevation of temperature, tachycardia; d) excitation, euphoria, e) hallucinations and convulsions. **8. Prevention of toxications with mushrooms includes the following measures:** a) purity control of foodstuff and forage; b) obeying the processing rules of mushrooms edible after proper cooking; c) withdrawal of foodstuff that is potentially polluted with toxins; d) not to pick mushrooms growing near roads; e) obeying the rules of mushroom purchase.

9. Personal prophylaxis of toxications with plant toxins: a) not to grow highly-toxic plants in residential places; b) do not allow children to pick mushrooms and berries; c) not to eat unknown plants, berries and fruits; d) not to grow plants in villages; e) not to use herb medicine without medical control. **10. Clinical presentation of poisoning with Papaver somniferum**: a) vomiting, dizziness; b) allergic reactions, arterial blood hypotension; c) hallucinations, respiratory depression up to failure; d) death caused by cardiac arrest, e) retention of urine and bowel movement. **11. Clinical presentation of poisoning with cannabis:** a) bloody diarrhea: b) vinose state, verbal and motor excitement, hallucinations; c) bradycardia, arterial hypotension, diarrhea; d) psychological functional disturbances leading to disintegration of personality, e) merriment passing into sleep with dreams. **12. Clinical presentation of poisoning with marsh tea**: a) nausea and vomiting; b) weakness, drowse; c) throat irritation; d) arterial hypotension, tachycardia, e) repeated urination and convulsions. **13. Toxins of devil's trumpet are:** a) atropine; b) hyoscyamine; c) ergotoxine; d) nicotine; e) scopolamine. **14. Clinical presentation of poisoning with devil's trumpet:** a) photophobia, dryness and reddening of skin; b) cyanosis of mucous membranes; c) anemia; d) bloody diarrhea; e) edema of subcutaneous adipose tissue, face, forearms and shins. **15. Clinical presentation of poisoning with absinth sage:** a) impaired color perception, hallucination; b) cyanosis of mucous membranes; c) hypersalivation; d) convulsions; e) edema of subcutaneous adipose tissue, face, forearms and shins.	**Fill in the gaps:** **1.** Natural phenolic compounds accumulation in all organs of plants as glycosides are … **2.** Morphological groups of fungi are macromycetes and … **3.** The main toxin of the fungus ergot are called … **4.** The main toxin of fly amanita is called … **5.** Toxins of plants are called … **6.** Substance or mixture of substances that impair health if absorbed body surface, ingested or inhaled is called … **7.** Nitrogen-containing usually heterocyclic organic compounds of plants are called … **8.** Papacerine, morphine, codeine are alkaloids of the plant which is called …

PRACTICAL WORK

Fill in the table «Poisonous mushrooms»

Species	Morphology	Characteristic of poison	Typical symptoms	First aid
Death cap amanita Amanita phalloides				
Fly amanita Amanita muskaria				
Lorchel Gyromitra esculenta				

Fill in the table «Poisonous plants»

Species	Morphology	Characteristic of poison	Typical symptoms	Medical use
Marsh tea Ledum palustre				
Sosnowsky's hogweed Heracleum sosnowskyi				
Devil's trumplet Datúras tramónium				

Species	Morphology	Characteristic of poison	Typical symptoms	Medical use

Absinth sage Artemísia absínthium				
Garden poppy Papaver somniferum				
Cannabis sativa Cannabis sativa				**Lecturer's signature**

Practice 18. Topic: **VENOMOUS AND POISONOUS ANIMALS** «____» _____ 201__ year

Purpose of the practice: to study the classification and species of venomous animals, structure of apparatus for injecting venom and physiological characteristic of toxins, their action on the human; the first aid and prophylactic measures against bites and poisoning.

CONTENTS OF THE TOPIC

1. Classification of toxic animals (primarily and secondarily toxic, actively and passively toxic).
2. Physiological characteristic of toxins of invertebrates (jellyfish, arachnoids, hymenopterans), their effect on the body; the first aid and prophylaxis of bites and poisoning.
3. Physiological characteristic of toxins of vertebrate animals (fishes, am-phibians, reptiles), their effect on the body; the first aid and prophylaxis of bites and poisoning.

BASIC TERMS AND CONCEPTS

1. **Actively-venomous animals —**
2. **Actively-poisonous animals —**
3. **Secondary-toxic animals —**
4. **Passively-poisonous animals —**
5. **Primarily-toxic animals —**

TESTS FOR SELF-CONTROL

1. Actively-venomous and poisonous animals: a) jellyfish and snails; b) cobra and tarantula; c) python and tarantula; d) tarantula and pufferfish; e) pufferfish and snails.

2. Passively-poisonous animals: a) jellyfishes and a tarantula; b) cobra and a boa; c) python and a pufferfish; d) snails; e) pufferfish and snails.

3. Actively-venomous animals: a) snakes and sting ray; b) pufferfish and wasps; c) bees and amphibians; d) snails and bees; e) snakes and amphibians.

4. Actively-poisonous animals: a) both snakes and amphibians; b) pufferfish and sting ray; c) bees and sting ray; d) snails and amphibians; e) sting ray and snails.

5. Toads and frogs are: a) primary-toxic; b) secondary-toxic; c) actively-poisonous; d) passively-poisonous; e) secondary-venomous.

6. Bees and wasps are: a) primary-toxic; b) secondary-toxic; c) actively-venomous; d) passively-venomous; e) passively-poisonous.

7. Factors determining clinical presentation of toxication with zootoxins are: a) composition and the volume of the venom; b) site of biting; c) sex of the affected person; d) habitus of the affected person; e) time of a day.

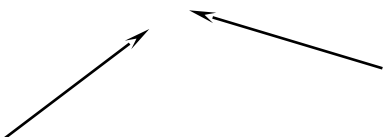
8. Symptoms of toxication with scorpion venom: a) sharp pain, hyperemia and edema of the affected area; b) hyperemia and edema of the injured area, fear; c) neither hyperemia nor edema of the injured place, but nausea and vomiting; d) sharp pain, fear; e) fear, nausea and vomiting.

9. Symptoms of toxication with tarantula venom: a) sharp pain and drowsiness; b) hyperemia and a edema of the affected area, necrosis of skin; c) neither hyperemia nor edema of the affected area; d) hyperemia and edema of the affected area, drowsiness; e) drowsiness, necrosis of skin. **10. Symptoms of toxication with bee or wasps venom:** a) sharp pain, fear; b) hyperemia and edema of the affected area, allergic reactions; c) neither hyperemia nor edema of the injured area; d) allergic reactions, fear; e) sharp pain. **11. Symptoms of toxication with cobra venom:** a) sharp pain, inflammation of lymphatic vessels; b) inflammation of lymphatic vessels, a necrosis of tissues; c) sharp pain, necrosis of tissues; d) excitation and then depression of CNS, necrosis of tissues; e) excitation and then depression of CNS, impairment of respiration are observed. **12. Symptoms of toxication with Viper snakes venom:** a) sharp pain and impairment of blood clotting; b) extremities numbness and hemorrhagic edema; c) hemorrhagic edema; d) numbness of extremities and impairment of respiration; e) impairment of blood clotting and respiration. **13. First aid in a toxication with hymenopterian venom:** a) to suck off the venom, to treat the area of stinging with disinfectants; b) to remove a sting, to treat the place of stinging with disinfectants; c) to treat the place of stinging with disinfectants, to apply heat to a place of stinging; d) to apply a warm compressive bandage to the place of stinging; e) to leave a sting, to treat the place of stinging with disinfectants. **14. First aid in a toxication with snake venom is:** a) to suck away venom and to treat the place of a biting with disinfectants; b) to scorch the place of biting and to put a victim in a shade; c) to scorch and to treat the place of a biting with disinfectants; d) to transport a victim in lying position; e) to apply a hard bandage to a place of a biting and to transport a victim in any position.	**Fill in the gaps:** **1.** Animals having glands producing toxins and specialized apparatus for its injection are called … **2.** According to physiological effect on the body zootoxins are divided into neurotoxins, cytotoxins, hemorrhagins and … **3.** Physalia's stinging organs are … **4.** Toxin of scorpions belongs to … **5.** Toxin of karakurts belongs to … **6.** Toxins of Brazilian spider are cytotoxins and … **7.** Toxins of hymenopterans are cytotoxins and … **8.** Toxin of Colombian cocoa frog is … times stronger than tetanus toxine. **9.** Viper snakes are primarily-toxic … animals.

Fill in the table

Species	Characteristic of animal venoms. Apparatus for stinging or biting	Physiological characteristic of venom	Clinics of poisoning	First aid and prophylaxis of poisoning
Phylum Coelenterate: – Jellyfish				
Phylum Arthropoda: – Scorpions – Arachnida – Hymenopterans				
Phylum Chordata – Snakes a) Elapidae (cobra) b) Viperidae (blunt-nosed viper, carpet viper, common viper)				

PRACTICAL WORK **Study the pictures, color them and sign the indications**	



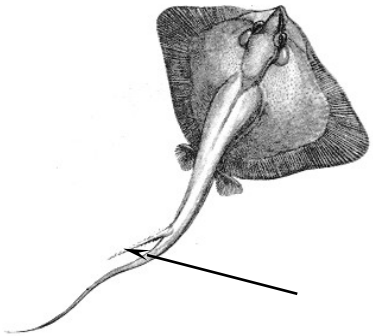


Fig. 1. Sting ray:
1 — stinger

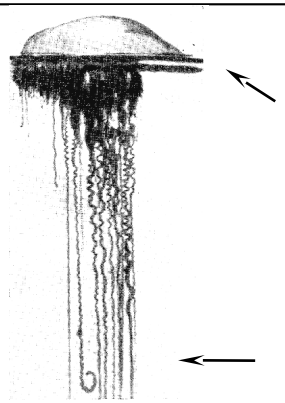


Fig. 3. Portuguese man-of-war:
1 — bell; 2 — tentacles

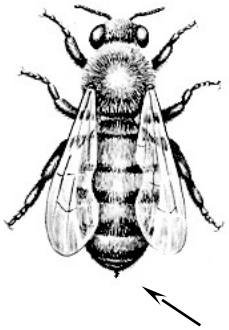


Fig. 2. Honey bee:
1 — sting

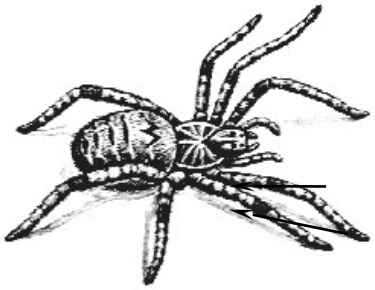


Fig. 4. Tarantulas:
1 — chelicerae; 2 — pedipalps

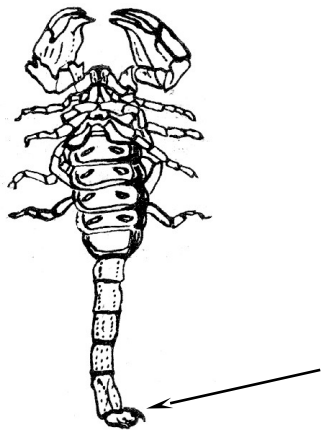


Fig. 5. Scorpion:
1 – cephalothorax, 2 – abdomen, 3 – stnger

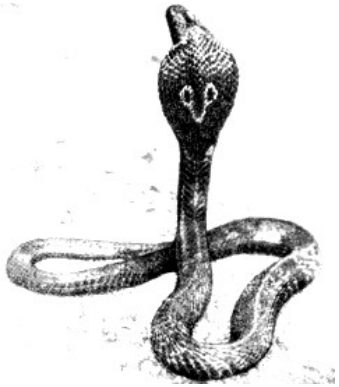


Fig. 6. Indian cobra

Lecturer's signature

EXAMINATION QUESTIONS

1. Human being as a biological and social object. **2.** Role of Biology in medical education. Significance of Biology for pharmaceutical education. **3.** Subject matter, tasks and methods of cytology. **4.** Light microscopy. **5.** The modern Cell Theory. **6.** Difference between pro- and eukaryotic cells. **7.** Structure of plasma membrane, its properties and functions. Transport of substances through the membrane. **8.** Anabolic and catabolic systems of the cell. **9.** Energy exchange in the cell. Characteristic of its stages. **10.** Connection between flows of substances and energy in the cell. **11.** Structure and functions of nucleus. **12.** Types of chromosomes. Structure of chromosomes. Rules of chromosomes **13.** Karyotype and idiogram. Classification of human chromosomes. **14.** Mitotic and cell cycles. Interphase. Cause of mitosis. **15.** Regulators of the cell cycle (cyclins and cyclin-dependent kinases). **16.** Comparison of mitosis and meiosis (content of genetic material during different stages of division). **17.** Classification of genes (structural and functional, unique, repeated sequences, transposons). **18.** Regulation of transcription in prokaryotes (F. Jacob, J. Monod) and eukaryotes (G.P. Georgiev). **19.** Cytoplasmic inheritance. **20.** Genetic engineering as a science. **21.** Obtaining genetic material: techniques. Restriction endonucleases. **22.** Insertion of DNA fragments into a vector molecule. Vectors. **23.** Incorporation of the recombinant DNA into a recipient cell. **24.** Techniques used in genetic engineering and biotechnology: polymerase chain reaction, southern blot, DNA fingerprinting.	**25.** Non-allelic (inter-allelic) gene interactions. **26.** Inheritance of blood groups: systems AB0, MN and Rh. **27.** Autosomal and gonosomal linkage groups. **28.** Chromosome theory of inheritance. **29.** Determination of sex in human and its disorders. **30.** X-chromosome's sex chromatin. Mary F. Lyon's hypothesis of X-chromosome inactivation. **31.** Sex chromosome disorders. **32.** Phenotypic variation. Reaction norm. **33.** Genotypic variation and its types (combinative and mutational). Comparison of mutations and modifications. **34.** Mutagenic factors, their classification and action. **35.** Classification of mutations. **36.** Gene, chromosome and genome mutations, their characteristics, biological and medical significance. **37.** Stability and repair of genetic material, antimutagens. **38.** Biological basis of oncogenesis Modern tasks of human genetics. **39.** The human as an object of genetic investigations. **40.** Clinical-genealogical method. Twin method. **41.** Cytogenetic method. Biochemical methods. **42.** Methods of a recombinant DNA. **43.** Characteristic of human populations. Types of marriages. Genetic processes in large populations. The law of Hardy–Weinberg. **44.** Genetic processes in small populations. Genetic load and its biological nature. **45.** Methods of prenatal diagnosis of hereditary disorders. Express-methods. **46.** Forms of reproduction, their characteristic. Evolution of the sex process. **47.** Gametogenesis. The structure of gametes. **48.** Insemination. Fertilization.

49. Biological peculiarities of human reproduction. **50.** Periods of ontogenesis. Embryogenesis. **51.** Critical periods of development. Teratogenesis. **52.** Growth: laws and regulation of growth. **53.** Constitution and habitus. Aging and old age. Theories of aging. **54.** Clinical and biological death. Reanimation and euthanasia. **55.** Origin of parasitism. Criteria of parasitism. **56.** Classification of parasites and their hosts. Transmission rotes of parasites. **57.** Morphophysiological and biological adaptations of parasites. **58.** Pathogenic action and specificity of parasites. **59.** Host's response to parasitic invasion. Basis of biological prophylaxis of parasitic diseases. **60.** Parasitizing flagellates: Trichomonas vaginalis: morphological peculiarities, life cycle, rotes of transmission, pathogenic action; characteristic symptoms, diagnosis and prophylaxis. **61.** Cat liver fluke: morphological peculiarities, life cycle, rotes of transmission, pathogenic action; characteristic symptoms, diagnosis and prophylaxis of opisthorchiasis. **62.** Taenia solium: morphological peculiarities, life cycle, rotes of transmission, pathogenic action; symptoms, diagnosis and prophylaxis of taeniosis and cysticerciasis. **63.** Ascaris lumbricoides: morphological and biological peculiarities, rotes of transmission, pathogenic action of ascaris and its larvae; symptoms of migration and intestinal stages of ascariasis, diagnosis and prophylaxis of ascariasis. **64.** Itch mite: peculiarities of morphology and biology; pathogenic action; symptoms, diagnosis and prophylaxis of scabies. **65.** Order Anoplura: peculiarities of morphology and biology; lice as patogens and vectors of diseases; prophylaxis. **66.** Poisonous micro- and macromycetes. Macromycetes classification.	**67.** Physiological characteristics of mycotoxins of micro- and macromycetes. **68.** Toxic plants and their classification. Toxic agents produced by plants and mechanism of action. **69.** Physiological characteristics of phytotoxins of thallophytes and embryophytes. **70.** Physiological characteristic of phytoitotoxins, their impact on the human; the first aid and prophylactic measures against bites and poisoning. **71.** Classification of toxic animals (primarily and secondarily toxic, actively and passively toxic). **72.** Physiological characteristic of toxins of invertebrates (jellyfish, arachnoidea, hymenoptera), their effect on the body; the first aid and prophylaxis of bites and poisoning. **73.** Physiological characteristic of toxins of vertebrate animals (fishes, amphibians, reptiles), their effect on the body; the first aid and prophylaxis of bites and poisoning.

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