INTERNATIONAL HIGHER SCHOOL OF MEDICINE

Department of Natural Sciences Disciplines

SYLLABUS
Molecular Biology

2023-2024 academic year
for students of medical faculty
5th course 9th semester, for 13th, 14th, 31st, 32nd , 47th groups of Central campus; 3-4th groups of Issyk-Kul campus
2 credits (72 hours, including Auditory 36 hours, independent work: 36 hours)

Lecturer: **PhD, Senior lecturer**
Kostritsyna Tatiana Vladimirovna
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Venue: Zoom

Practical lessons: **PhD, Senior lecturer**
Kostritsyna Tatiana Vladimirovna
+996 772 9529 35(Whatsapp)
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Venue: № 419 of Administrative building IHSM, 4th floor

The Syllabus is considered
at the meeting of the department of Natural Sciences Disciplines
Protocol №1 dated 5.09. 2023
Head of the Department Ch. S. Ismailova

Course Objective: To increase wide and depth of knowledge and understanding of modern progress of molecular biology, molecular genetics, medical biochemistry and cell biology. Ascertainment and interrelations of human's health as a results of environmental influences ; the genotype; applications of methods and notable achievement of the molecularly-genetic analysis in biomedicine.
To integrate the results and achievements of molecularly-biological, cell and gene technologies to clinical practice of the doctors.

After study of the discipline the student must:
Knowledge:
1) the subject of molecular biology, the basic methods of molecular biological and molecular genetic analysis. Fundamentals of the biological implementation of the human genotype at the molecular level. 2. The basic principles of the implementation of human genetic information at the organismic and molecular level. Cell cycle, mitosis, meiosis. structure and morphology of chromosomes and their relationship with some hereditary and acquired pathologies.
Skills:
1) Demonstrate knowledge of the principles of the structural and functional organization of biological objects and mechanisms of homeostatic regulation;
2) Demonstrate basic ideas about the basic laws and modern achievements of genetics, about genomics, proteomics and other new areas of molecular biology;
3) Demonstrates modern ideas about the basics of genetic engineering, gene therapy, the principles of the work of diagnostic laboratories.
Attitude:
To integrate the results and achievements of molecularly-biological, cell and gene technologies to clinical practice of the doctors.

Pre-requisites. For successful study of this discipline, the student must know the basic disciplines, such as: General Biology, Medical Biology, Biochemistry, Histology, Microbiology, Pathological anatomy, Pathological physiology, General surgery, Obstetrics and gynecology, Pediatrics, Therapy, Oncology
Post-requisites: Evidence-based medicine, • Family medicine.

THEMATIC PLAN OF LECTURES

№	Themes of lectures	Hours	Date
1.	Introduction to Molecular biology	2	28.08.23
2.	DNA Structure & Replication. Genetic code.	2	28.08.23
3.	Protein synthesis: Transcription, Translation.	2	29.08.23
4.	Controlling of Gene Expression. Model of operon. Regulation of an expression of genes. Gene regulation – operon concept Gene regulation - repression	2	29.08.23
5.	Controlling of Cell Cycle, Cyclins & Cyclin-dependent kinases.	2	30.08.23
6.	Molecular biology of Cancer . Classification of oncogenes, Warburg effect, Human oncogenic viruses.	2	30.08.23
7.	Review of General Principles Of Gene Technology	2	31.08.23
8.	DNA Technology: DNA Sequencing	2	01.09.23
9.	Methods of Cell biology in Medicine. Embryo Cloning & Nuclear Transfer	2	09.02.23

THEMATIC PLAN OF PRACTICAL LESSONS

№	Theme of practical lessons	Hours	Date
1.	Cellular Basis of Inheritance . Chromosome structure. Steps of cytogenetic analysis.	2	29.08.23 11.10.23 21.11.23
2.	DNA Repairing, Mutations, Classification & Problems of Mutagenesis	2	05.09.23 12.10.23 29.11.23
3.	Inborn Errors of Metabolism.	2	06.09.23 18.10.23 30.11.23
4.	Problems of Cell Death And Apoptosis. Hayflick Limit.	2	12.09.23 19.10.23 05.12.23

5.	Summary of Cellular and Molecular basis of inheritance. Formative assessment & Questioning.	2	13.09.23 25.10.23 07.12.23
6.	Human Cytogenetics, Modern Trends of Molecular Cytogenetics.	2	19.09.23 26.10.23 12.12.23
7.	Gel Electrophoresis, Northern and Southern Blotting.	2	20.09.23 02.11.23 14.12.23
8.	Medical implications of Gene Technology Stem cell therapy	2	26.09.23 03.11.23 19.12.23
9.	Small group discussion/assignment of projects, Group Presentation	2	27.09.23 08.11.23 21.12.23

THEMATIC PLAN OF INDEPENDENT WORK OF STUDENTS

Unit №	Theme of independent work	Hours	Date
1	Molecular biology and cancer nature.	36	During the semester
1	Modern theories of cancer origin.	36	During the semester
1	Cancer as point mutation and clonal evolution of cell.	36	During the semester
1	Diagnostic methods for detection genetic errors.	36	During the semester
1	Application of the molecularly-cytogenetic analysis for diagnosis and the prognosis of hereditary diseases.	36	During the semester
1	Using of modern methods of the molecularly-cytogenetic analysis (FISH) for prognosis and the therapy of cancer diseases.	36	During the semester
1	Major developments in gene therapy: Problems and ethics, In popular culture.	36	During the semester
1	The gene therapy and therapeutic cell cloning in medicine.	36	During the semester
1	Methods of somatic cell hybridization in biomedicine.	36	During the semester
1	The embryo cloning, embryonic steam & tissue steam cell therapy and ethical problems in biomedicine.	36	During the semester
2	Application of the molecularly-cytogenetic analysis to newborn screening tests and prenatal diagnosis.	36	During the semester
2	Polymerase Chain Reaction (PCR)-analysis in diagnostics of various infectious diseases.	36	During the semester
2	Application gel electrophoresis to diagnostics of hereditary diseases.	36	During the semester
2	Development and approaches of gene therapy of cardiovascular diseases and pathologies.	36	During the semester
2	Possible risks of usage of genetically modified organisms for human health, the agriculture, the forestry and the Nature.	36	During the semester
2	The gene technologies, the farm animals and medicine.	36	During the semester
2	The International Scientific Project «Human Genome»: main approaches and achievements. Formations of DNA & genomic libraries of the human and other species.	36	During the semester
2	Molecular diagnostics of the human hereditary mitochondrial diseases.		During the semester

2	Possible risks of usage of genetically modified organisms for human health, the agriculture, the forestry and the Nature.		During the semester
2	The gene technologies, the farm animals and medicine.		During the semester

Recommended reading for the discipline:

I. Basic literature:

1. Keith Roberts, Martin Raff, Bruce Alberts, Peter Walter, Julian Lewis and Alexander Johnson, 1616 pages. Molecular Biology of the Cell (Seventh Edition) 7th Edition, Kindle Edition (July 1, 2022) Publisher : W. W. Norton & Company; 7th edition https://cdn.bc-pf.org/resources/biology/Molecular_biology/Wilson-Molecular_Biology_of_The_Cell_The_Problem_Book_6th_Edition.pdf
2. Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections 2017 10th edition Hardcover ISBN 10: 013429601X ISBN 13: 9780134296012 Publisher: Pearson
3. Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 /Basal reader for senior students of University Medical - Bishkek
4. Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. 6th Edition © 2021 View newer edition ISBN10: 1260087328 | ISBN13: 9781260087321 By Sylvia Mader, Michael Windelspecht
5. Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. 19th Edition , 14 November 2017 and Harrison's Manual of Medicine 19th Edition VAL PAK Hardcover – Import

II Additional literature:

1. Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series April 1, 2007 Edited by: Julio E. Celis, 2007, 2006, ISBN: 978-0-12-088546-6. 272 pages https://epdf.tips/molecular-biology-and-genomics4af83953d77eaf4e83289d818029c00b97550.html
2. Walt Ream and Katharine Molecular Biology Techniques An Intensive Laboratory Course 1999 Copyright © 1999 Author(s): G. Field ISBN: 978-0-12-583990-7 https://s3-us-west-2.amazonaws.com/oww-files-public/d/d9/IT-5B_(Basic)_Laboratory_Techniques_(in_Molecular_Biology).pdf
3. David P Clark, Nanette J Pazdernik Molecular Biology Understanding the Genetic Revolution 13th February 2012 Copyright © 1995, ISBN: 978-0-12-397720-5 https://lib.rudn.ru/file/Biochemistry_Genetics_Molecular_Biology_Catalogue_eBook.pdf

Grading policy and procedures for all types of work

Rating of scores (standards of judgement)

Total score is 100 marks as maximal score, and consists of three parts:

Independence or self-doing work: score is 20 marks, (individual work – 20 MCQs);

Current score - 40 marks

Control score – 40 marks

Reduction scores rating:

- ✓ Missed lecture and/or practice lesson is decreasing minus 2 marks of attendance score for 2 hours irrespective of reason.
- ✓ Being late to class reduces on 1 mark of attendance for each case.

Request to appearance: clean accurate doctor's uniform cloth (lab coat), Student with inappropriate appearance **will not be admitted** to lesson.

To taking module MOLECULAR BIOLOGY student must have:

A. Attendance of lectures and practical lessons will be >50% of total number lessons of current unit.

B. Regular and Positive marks of class activity (>20).

Passing of missed class is mandatory Student will have to prepare of review of missed lessons topics in copybook or separate hard copy essay

Requirements for the implementation of the review:

- ✓ Given with hard copy review
- ✓ Recitation in according general each particular item of missed lessons

Grading system for student's achievements

Grading criteria per discipline				
Maximum score	Intervals			
	«unsatisfactory»	«satisfactory»	«good»	«excellent»
Independent work -20 marks	0-11	12-15	16-17	18-20
Interval description	The student has not considered an	The student has the necessary	The student has studied the basic	The student has studied the basic

	any of self-doing work question (main and/or additional) to the end. The student has refused to prepare self-doing work.	educational material within the framework of the program, but the answers to the questions are not complete and accurate enough; only simplified information from the main literature on the discipline is used in the answer	literature and is familiar with additional literature on the program and uses this knowledge when answering; in the process of answering additional questions, the material is presented correctly, but without sufficient logical consistency; when answering, uses the necessary, neatly executed graphic material (diagrams, drawings, etc.); To clarify answers, leading questions from the teacher are sometimes required.	and additional literature on the discipline and competently uses the acquired knowledge when answering; in answers uses course materials in related disciplines, giving various examples as justification; in the process of preparation, at a high level, completes the necessary diagrams and diagrams and uses them when answering; does not need any help from the teacher; strives to independently replenish and update the knowledge necessary in professional activities.
Current control – 40 marks	0-23	24-30	31-35	36-40
Interval description	The student does not know a significant part of the program material, makes significant blunders; the main content of the material is not disclosed; poor knowledge of terminology; there is no necessary theoretical knowledge and the ability to apply them to solve practical problems. It will be also marked "unsatisfactory" if the student refuses to answer.	The student has mastered only the basic program material, but does not know individual features and details; admits inaccuracies; violates the sequence in the presentation of the program material; the material is not systematized, incorrectly formulated; speech is mostly literate, but poor; has a minimum sufficient level of competence; solves professional practical problems with	The student has demonstrated the formation of competencies, has a sufficient level of professional terminology; correctly, logically and essentially sets out the answer, doesn't allow significant errors and inaccuracies when answering questions, but the presentation is sufficiently systematic and consistent; when solving a practical problem, basically justifies the decisions made correctly.	The student has demonstrated the formation of competencies and can apply them in professional activities; exhaustively, consistently, competently and logically harmoniously presents the answer, without errors; the answer does not require additional questions; good speech, fluency in professional terminology; does not have difficulties in answering when changing assignments; knows how to

		errors, mainly justifies the decisions made		solve professional practical tasks; correctly justifies the decisions, is able to summarize and present the material independently
Control score -40 marks	0-23	24-30	31-35	36-40
Interval description	The student has identified gaps in knowledge of the educational material provided by the program, and cannot give clear answers to basic, additional and leading questions	The student knows the necessary educational material within the program, but the answers to the questions are not complete and accurate enough; When answering, only data from the main literature on the discipline is used.	The student fully discloses the educational material provided by the program; minor errors (inaccuracies) were made that do not distort the content of the answers to the essence of the questions.	The student presents program material deeply, meaningfully, in full at a high scientific level; answers all questions and additional questions completely and without errors.

Conduct Policy: (lateness, absence, behavior in the auditorium, late submission of work).
Punctuality and completion of tasks.
- Mandatory attendance of classes.
- Attending class in a clean medical uniform.
- Eliminating conversations on a cell phone in the classroom.
- Active participation in the learning process.
- Doing homework on time.
- Academic detention at the time specified by the teacher.

For violations of the Conduct Policy, the total points for discipline might be reduced to 1-10 marks.

Academic Ethics Policy.
- Be tolerant, respect the opinions of others.
- Formulate objections in the correct form.
- Constructively support feedback in all classes.
- Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the following: the absence of references when using printed and electronic materials, quotes, thoughts and works of other authors or students.
- Prompting and cheating during tests, exams, classes is unacceptable as well as passing an exam for another student, unauthorized copying of materials.

For violations of the Academic Ethics Policy, the total points for the discipline may be reduced to 1-10 marks.

Guidelines for the lessons of the discipline

THEME 1. MOLECULAR BIOLOGY – THE SCIENCE – ABOUT STRUCTURES AND FUNCTION OF LIVING SYSTEMS ON MOLECULAR LEVEL.

Key questions covered in lesson № 1 (*Lecture)*

1. History of basis and development of science – Molecular biology.
2. The role of molecular biology in interdisciplinary scientific research.

Recommended reading for the discipline:

[1] Keith Roberts, Martin Raff, Bruce Alberts, Peter Walter, at all //Molecular Biology of the Cell P.183-186, 194
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015// P.7-10
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. P. 63-89
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. P. 54-56

Key questions covered in lesson №2 (*Practice)*

1. Cellular Basis of Inheritance. Cell divisions: Binary Fission, Mitosis, Meiosis.
2. Chromosome structure & morphology.
3. Steps of cytogenetic analysis. Romanovsky-Giemsa staining.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series P.183-186, 194

[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015//P.7-10

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. P. 63-89

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. P. 54-56

THEME 2. STRUCTURE AND FUNCTION OF NUCLEIC ACIDS. DNA REPLICATION.

Key questions covered in lesson № 3 (*Lecture).*

1. Structure and function of nucleic acids.
2. Process of DNA replication.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series P.47, 188-192.

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections P. 360-361.

[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P.10-11

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. P. 83-89, 281-293

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. P. 200-213

Key questions covered in lesson № 4 (*Practice)*–

1. Classification of mutations: point mutations, frameshift mutations.
2. Classification of mutagens.
3. DNA mistakes. Mechanisms of DNA reparation.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series // P. 201, 273.

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 368-369

[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015//P. 14-16

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 281-297

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. P. 209-213

THEME 3. THE CENTRAL DOGMA OF MOLECULAR BIOLOGY. TRANSCRIPTION - TRANSLATION – SYNTHESIS OF PROTEIN. POSTTRANSLATIONAL MODIFICATION OF PROTEIN PRODUCTS

Key questions covered in lesson № 5 (*Lecture)*

1. RNA transcription. Protein factors in pro- and eukaryotes. Splicing of eukaryotes
2. Genetic code. Translation of proteins
3. Posttranslational modification of protein products.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series//P.194-200.

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections//P. 361-362.

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 297-314

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. // P. 215-227

Key questions covered in lesson № 6 (*Practice)*

1. Inborn Errors of Metabolism. Historical review, explanation of terminology.
2. Basic principles of hereditary monogenic diseases classification.
3. A scientific understanding of the molecular mechanisms of the hereditary diseases development and occurrence. DNA repair disorders. Mitochondrial dysfunction.

Recommended reading for the discipline:

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 364, 374-375.

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. // P. 314-323

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 264-267

THEME 4. THE REGULATION OF GENE EXPRESSION IN PRO- AND EUKARYOTES. EXON/INTRON ORGANIZATION OF HUMAN GENES. SPLICING OF EUKARYOTIC GENES. MULTIGENE FAMILIES

Key questions covered in lesson № *7 (Lecture).*

1. Regulation of gene expression in prokaryotes.
2. Regulation of gene expression in eukaryotes.
3. Exon/intron structure of eukaryotic genes.
4. Splicing of eukaryotic genes. Multigene families.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P.210 – 219.

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 363.

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 351-360

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 234-241

Key questions covered in lesson № *8 (Practice).*

1. Problems of Cell Death and Apoptosis.
2. Apoptosis and its role in the body. The role of p53.
3. Cell cycle. Regulation. Necrosis. Apoptosis. Oncogenesis.
4. The main theories of aging, their molecular and genetic mechanisms
5. Hayflick Limit. Mechanisms of cellular aging.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series// P.225, 552.

[2] Campbell N.A., Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P.1907, 1023.

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY.// P.978-986

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. // P. 295.

THEME 5. CELL CYCLE CONTROL SYSTEM. CYCLINS AND CYCLIN-DEPENDENT KINASES. GENERAL MECHANISM OF CYCLIN - CDK REGULATION.

Key questions covered in lesson № 9 (*Lecture)* .

1. Overview of the biological regulation of the cell cycle: Cell cycle control system.
2. Cyclins and Cyclin-dependent kinases.
3. General mechanism of cyclin - CDK interaction.

a) Cell cycle checkpoints:

- G2/S (restriction) control point
- point of control
- G2 checkpoint
- Metaphase as a control point during the cell cycle

4. Cancer and cell cycle regulation.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P.131, 136-138.

[2]. Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P.1924-1927

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY // P.214-217, 980

Key questions covered in lesson № 10 (*Practice).*

1. Summary of Cellular and Molecular basis of inheritance.
2. Formative assessment & Questioning. Testing

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P.131, 136-138.

[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections// P.1924-1927

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P.214-217, 980

THEME 6. MOLECULAR BIOLOGY OF CANCER.

Key questions covered in lesson № 11 (*Lecture)*

1. General overview: main groups of oncogenes. Oncogenes. It's role in Cancerogenesis.
2. Proto-oncogenes and Tumor suppressor genes. Genes, responsible for DNA repairing
3. Human viruses and cancer. Viral theory of cancer.
4. Some features of the cancer cells metabolism, the Warburg effect

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P.223-227.

[2] Campbell N.A., Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P.486-488, 447-453

[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. // P. 217-218.

[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 302-304, 355

Key questions covered in lesson № 12 (*Practice)* .

1. Review of modern methods of human molecular cytogenetics: (FISH method), its modifications Molecular-cytogenetic analysis of human genome.
2. FISH method for chromosomes abnormalities analysis at metaphase and interphase stages.
3. Medical application Human genome project. Modifications of FISH hybridization methods.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P. 244
[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 378-381.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P. 46-53
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 384-385
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 247-249.

THEME 7. MODERN MOLECULAR-BIOLOGICAL METHODS, APPLIED IN MEDICINE.

Key questions covered in lesson № 13 (*Lecture)* .

1. Genetic engineering: an overview. Main stages:
2. Enzymes, applied in molecular methods: DNA – polymerases, DNA – ligases, endonucleases, restriction enzymes.
3. Isolation of DNA and mRNA (genes of interest) from the donor species (organisms).
4. Cloning of cDNA. Genome libraries. Vectors.
5. Application of genetic engineering methods.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P. 232-237.
[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections// P. 364-362, 451.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P. 23-29
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 369-375

Key questions covered in lesson № 14 (*Practice)*

1. Polymerase chain reaction. Steps and procedure. PCR analysis of Human genome.
2. Gel electrophoresis. Documentation of results.
3. DNA microarrays. Fingerprinting method. Southern and Northern blotting.

Recommended reading for the discipline:

[1]. Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P. 239, 241-242, 309
[2]. Campbell N.A., Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P.365, 378.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P.31-36
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 376-396
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 708-710.

THEME 8. MOLECULAR-BIOLOGICAL METHODS FOR DNA SEQUENCING.

Key questions covered in lesson № 15 (*Lecture)*

1. DNA Technology: Medical implications of Gene Technology Stem cell therapy DNA Technology: DNA Sequencing
2. Targeted gene transfer technologies: an overview.
3. Medicine and genetic engineering. Human Genome Project.
4. Gene therapy: main types. Gene therapy is like human genetic engineering.
5. Application of genetic engineering in industry and agriculture.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P. 237-239
[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections// P.365, 378
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 // P.39-43
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 376-396

Key questions covered in lesson № 16 (*Practice)*

1. Medical implications of Gene Technology Stem cell therapy.
2. Application of gene technologies and gene therapy in clinical medicine.
3. Vectors in gene therapy: virus and non-virus methods, hybridom method.
4. Gene therapy of hemophilia, kidney's diseases and etc.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell, Molecular Biology and Genomics The Experimenter Series //P. 235, 249, 306.

[2] Campbell N.A., Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P.392, 482, 597, 1073.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015// P. 23-26
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 384-388
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 248, 263-266

THEME 9. STEM CELL BIOLOGY.

Key questions covered in lesson №17 (*Lecture)*

1. General review about artificial genetic systems, methods of molecular cloning; methods of creating transgenic animals, knockout animals.
2. Basic methods of genetic engineering of cultured animal cells. Embryonic stem cells in genetic engineering.
3. Application of different types of stem cells in the cell therapy.

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell, Molecular Biology and Genomics The Experimenter Series //P. 480
[2] Campbell N.A. , Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 393-395.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P. 54-56
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 981
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine //P. 283, 528-529

Key questions covered in lesson № 18 (*Practice)*

1. Presentations of students' projects. Small group discussion/assignment of projects
2. Passing of Unit №2. General review: Methods of molecular genetic analysis, gene and cell therapy

Recommended reading for the discipline:

[1] Cornel Mülhardt and E.W. Beese, M.D. Cell , Molecular Biology and Genomics The Experimenter Series //P. 480
[2] Campbell N.A., Lawrence G. Mitchell, Jane B.Reece.. Biology: Concepts and connections //P. 393-395.
[3] Methods of molecular biology and genetics in Medicine. Colleges// complied by Kostritsyna T.V. 2015 //P. 54-56
[4] Hopson Janet L., Wessells Norman K. - McGRAW Essentials of BIOLOGY. //P. 981
[5] Dennis L.Kasher, Eugene Braunwald, Anthony fauci, J.L. Jameson Harrison's. Principles of Internal Medicine. //P. 283, 528-529

METHODOLOGICAL INSTRUCTIONS FOR THE IMPLEMENTATION OF INDEPENDENT WORK ON THE DISCIPLINE

The basis of independent work of students is systematic, purposeful and thoughtful reading of recommended literature. It is necessary to read what is recommended for each topic by the curriculum, seminar plans, other teaching materials, as well as by teachers. The basic literature includes the minimum of sources that is necessary for the complete and solid development of educational material.

Additional literature is recommended for a more in-depth study of the program material, expanding the horizons of the student. It is necessary to read literature systematically, according to the plan, correctly allocating time. Working with sources requires to:

1) focus on what you are reading;
2) highlight the main thoughts;
3) "embrace the thought" of the author quite clearly and distinctly, which helps to develop clarity and distinctness of your own thoughts;
4) think consistently;
5) imagine vividly and distinctly, as if experiencing what you read in the source;
6) consult with the instructor if facing difficulties during fulfilling practical tasks or something is not clear.