Methodological instructions for independent work of students

Module: "Genes and heredity".

Discipline: «Molecular biology»

Code of discipline: GN 1204

Name of EP: 6B10115 «Medicine»

Volume of study hours (credits): 120 hours/4 credits

Course and semester of study:1-2

Shymkent 2023

The Methodological instructions for practical classes was developed in accordance with the working curriculum of the EP "Genes and heredity", the discipline "Molecular biology" and discussed at the meeting of the department.

Protocol no. __6_ of «_28__» ___12_____ 2023 y.

Head of Department, Professor _____ Yessirkepov M.M.

№ 1

1. Topic: Human Karyotype.
2. Objective: study of karyotype, its classification, method of mapping genes of genes to obtain gene position and determination of linkage groups
3. Tasks:
1. Define the concept of genetic map of chromosomes
2. G. Sturtevant and the first genetic map of Drosophila chromosomes
3. stages of gene mapping
4. Cytogenetic maps
5. Linkage groups and their determination by mapping
6. Genome maps
7. Anatomy of the normal karyotype.
8. Anatomy of pathological karyotype.
4. Form of performance/evaluation (abstract, presentation, report, test, drawing up algorithms, writing a case history, scenario for role-playing games, reviews, etc.): Small group work, presentation defense, glossary writing.
5. Performance Criteria (requirements for completing the assignment): Oral questioning
6. Due Date: 2 week.
7. Literature: see appendix 1
8. Control: (questions, tests, reports, etc.):
1. Answering test questions.
2. Solving situational tasks.
3. Completion of cards on the topic.
4. Answering the questions indicated in the assignments.

№2.2

1. Topic: Hereditary apparatus of cells. Dynamics of hereditary apparatus during cell cycle process
2. Objective: to study the structure of the genetic apparatus of the cell at the chromosomal level of genome organization; to study the dynamics of the hereditary apparatus during the cell cycle.
3. Learning objectives: the student should know the structure of the hereditary apparatus at the chromosomal level; be able to describe the changes of the hereditary apparatus in the process of the cell cycle.
4. Tasks:
1. Definition of the concept of hereditary material
2. Structural organisation of chromatin
3. The problem of compactisation of the DNA molecule
4. Levels of DNA molecule compactisation:
nucleosomal strand Chromatin fibril, chromomers and chromonemes,
euchromatin and heterochromatin
DNA loop domains
5. Polytene chromosomes.
6. Lamp-brush type chromosomes
4. Form of performance/evaluation (abstract, presentation, report, test, drawing up algorithms, writing a case history, scenario for role-playing games, reviews, etc.): Small group work, presentation defense, glossary writing.
5. Performance Criteria (requirements for completing the assignment): Oral questioning
6. Due Date: 2 week.
7. Literature: see appendix 1

8. Control: (questions, tests, reports, etc.):
1. Answering test questions.
2. Solving situational tasks.
3. Completion of cards on the topic.
4. Answering the questions indicated in the assignments.

№ 2

1. Topic. DNA sequences.
2. Objective: Familiarisation with the chemical structure of the DNA repeats sequence gene. Investigation of the special sequence of heredity information
3. Tasks:
1.DNA sequences: unique and repeats
2.DNA repeats: tandem, dispersed and opposite.
3.simple tandem repeats - satellites.
4. dispersed repeats
5. palindromes.
6.very repetitive and moderately repetitive sequences.
7.DNA sequences of the centromeric and telomeric regions of the chromosome.
8.medium length DNA repeats: VNTR and dinucleotide repeats. Copies of medium length genes.
9.DNA sequences
10. dispersed repeats
11. SINE sequences
12. LINE-sequences
13.Flanker-restricted repeats (LTRs and DCPs).
14. DNA transposons. Concept of transposons and retrotransposons.
15.Palindromes and their heritability in activity.
4. Form of performance/evaluation (abstract, presentation, report, test, drawing up algorithms, writing a case history, scenario for role-playing games, reviews, etc.): Small group work, presentation defense, glossary writing.
5. Performance Criteria (requirements for completing the assignment): Oral questioning
6. Due Date: 2 week.
7. Literature: see appendix 1
8. Control: (questions, tests, reports, etc.):
1. Answering test questions.
2. Solving situational tasks.
3. Completion of cards on the topic.
4. Answering the questions indicated in the assignments.

№ 3

1. Topic: Regulation of gene expression in prokaryotes and in eukaryotes.
2. Objective: Mechanisms of translation and explanation of the operon theory of gene expression by Jacob and Mono
3. Tasks:
1. Transcription, basic mechanisms and factors
2. operon theory of Jacob and Mono
3. translation, basic mechanisms and factors
4. regulation of expression of Repressible operons
5. regulation of the expression of inducible operons

6. lactose and tryptophan operon
4.Form of performance/evaluation (abstract, presentation, report, test, compilation of algorithms, writing of medical history, scenario for role-playing games, reviews, etc.): Small group work, defense of presentation compilation of glossary.
5.Performance criteria (requirements for the assignment): Testing, oral questioning on the CM materials.
6. Due Date: 7 week.
7. Literature: see appendix 1
8. Control: (questions, tests, reports, etc.):
1. Answering test questions.
2. Solving situational tasks.
3. Completion of cards on the topic.
4. Answering the questions indicated in the assignments.

№ 4

1. Topic: Routine control №1 on sections: "Molecular bases of cell functioning".
2. Objective: To control the assimilation of theoretical knowledge and practical skills on the passed topics of lectures, practical classes and IWL. Determination of students' knowledge level
3. Tasks:
1.Proteins. Definition, types and functions.
2.Amino acids. Structure, variety and formation or radical bonding: hydrophobic, hydrophilic, hydrogen, ionic and van der Waals.
3.Peptides and peptide bonds.
4.level of protein structure organisation: a) primary structure, b) secondary structure: α-helix, β-structure, c) tertiary structure, d) quaternary structure.
5.factors that determine structures in space.
6.protein folding - post-translational modification of protein.
7.Folding factors: chaperones and foldases.
8.diseases caused by folding disorders. Amyloidoses. Prionnaurses.
9.Protein function. Ligands also the role of their formalisation in protein structure. Active centre.
10.Classification of proteins.
11.Haemoglobin family. Supercompatibility of immunoglobulins. Cellular family, antigen-receptor family. Serine protease family.
12.Concept of intrinsic and extrinsic proteins.
13.p53 protein, its structure and role of regulation in cellular process.
14. role of proteins in nutrition.
15.changes in protein composition in the body.
16.basic functions of protein.
17. General structure of nucleic acids:
- nucleotide structure,
- structure of nucleic acids: linear sequence of nucleotides.
18. structure of the DNA molecule:
- complementarity of nitrogenous bases,
- antiparallelism of dna sequence.
19.Primary, secondary, tertiary structure of DNA (DNA supershirate).
20.Nucleosomal strand. Formation of chromatin strand.

21.Physico-chemical properties and functions of DNA.
22.Different forms of organization of DNA in the cell.
23.Recruitment of DNA and proteins.
24.Type of transmission of genetic information: general, specifically prohibited. Basic molecule dogma in biology
25.Nucleic acid biosynthesis: DNA replication: stages, factors.
26.DNA transcription - first level of expression of information in protein structure. Mechanisms of transcription.
27. transcription factors:
- general transcription factors;
-DNA-binding proteins and their types;
-p-53 protein as a transcription factor.
28. stages of transcription. Initiation, elongation, termination.
29. transcription in prokaryotes.
30. transcription in eukaryotes.
31. inhibitors of transcription.
32. pre-RNA processing. Mechanisms of splicing
33. non-transcriptional fusion of individual nucleotides.
34. formation of modifying nucleotides as part of pre-RNA
35. general plan of RNA construction.
36. difference between the RNA molecule and the DNA molecule
37.Primary, intracellular, tertiary structure and functions of mRNA.
38.primary, secondary tertiary structure of tRNA.
39.interaction of tRNA with ligand.
40. ribosomes. structural, functional centre of rRNA.
41. cytoplasmic and membrane ribosomes. Polyribosomes.
42.aggregate of RNA with proteins. kjarnk, ribozymes.
43.Principle difference between RNA synthesis and DNA synthesis.
44. principles of coding of genetic information.
45. Genetic code and its properties.
46. mRNA translation - the second level of genetic information dissemination. Main components involved in protein synthesis.
47. aminocyl tRNA synthetase.
48.Amino acid activity.
49.translation. Occurrence of the incident complex. Initiation factors.
50. Elongation, three steps of translation (elongation of peptide chain). Elongationfactors.
51.Translation. Terminationfactors.
52.ribosomes. Structural, service centre. Polysomes.
53.Gene - seed is the unit of measurement of cunning. Fine structure of gene (exons, introns, cistrons, Mutons, recons)
54.Classification of genes.
55. structure of Eukaryotic genes: coding and non-coding regions of eukaryotic genes? Histone gene cluster. Operon structure of prokaryotic gene.
56. Genome. Sections of DNA. To give an idea of genetic elements.
57. DNA polymorphism, its types.
58. Extra chromosomal and circular DNA.
59. simple tandem repeats (satellites)
60.tandemly organised gene cluster.

61.Cytoplasmic DNA genome : mitochondria and human.
62.Bacterial and viral genome.
63.Histones and the organisation of DNA in the Chromosome.
64. Metaphase chromosome; types of chromosomes:
- metacentric;
- submetacentric;
- acrocentric;
65. function of a chromosome;
66. the concept of karyotype. Classification of karyotypes:
- Denver;
- Paris.
67. definition of the concept of Homeostasis. Genetic homeostasis.

4.Form of performance/assessment (abstract, presentation, report, test, compilation of algorithms, writing of medical history, scenario for role-playing games, reviews, etc.): Testing, solving situational problems, oral questioning.

5.Performance criteria (requirements for the performance of the task):

6. Due Date: 10 week.

7. Literature: see appendix 1

8. Control: (questions, tests, reports, etc.):
1. Answers to test questions.
2. Solving situational tasks.
3. Filling in cards on the topic.
4. Answering oral questions.

№ 5

1.Topic: Molecular structure of cells

2.Objective: On the basis of the study of plant and animal cells to show the unity of organization of living forms on our planet. To know the difference between plant and animal cells. To become familiar with the molecular structure and functions of the cell

3. Tasks:
1. Molecular structure and functions of the major components of the cell:
2. Diseases associated with pathology of the nucleus:
reduction of genetic material
atypical mitoses
pathology of synthesis of ribosome and tRNA subunits in the nucleus
3 Diseases associated with disorder of EPR functioning and structure:
EPR cisternae dilatation, EPR fragmentation, EPR hyper- and hypotrophy, blockade of synthetic and/or transport processes in the cell.
4. Diseases associated with disorder of functioning and structure of the Golgi apparatus:
Diseases associated with disruption of intracellular transport signals
5. Diseases associated with disorders of mitochondrial function and structure:
mitochondrial diseases associated with defects in nuclear DNA
mitochondrial diseases caused by mtDNA defects
6. Diseases associated with disorders of lysosome function and structure:
Mucopolysaccharide accumulation diseases or genetic accumulation diseases;
diseases associated with disorders of sorting and transport of lysosomal enzymes - hydrolases.
diseases associated with damage to lysosomal membranes.
diseases associated with extracellular release

The role of lysosomes in the development of inflammatory processes
7. Diseases associated with disruption of peroxisome function and structure:
Diseases resulting from near total loss of peroxisomal function;
diseases arising due to excess of peroxisomal enzymes;
diseases due to impaired functioning of only one peroxisome enzyme .
8. Diseases due to impaired membrane function.
9. Diseases associated with changes in the structure and number of cytoskeleton elements.

4.Form of performance/assessment (abstract, presentation, report, test, compilation of algorithms, writing of medical history, scenario for role-playing games, reviews, etc.): Small group work, defense of presentation compilation of glossary

5.Performance Criteria (requirements for completing the assignment): Oral questioning

6. Due Date: 13 week

7. Literature: see appendix 1

8. Control: (questions, tests, reports, etc.):

1.Answering test questions.
2.Solving situational tasks.
3.Completion of cards on the topic.
4.Answering the questions indicated in the assignments.

№ 6

1.Topic: Mutations and mutagenesis

2.Objective: to familiarize with the process of mutagenesis and to study the factors leading to mutations, the role of mutagenesis in the formation of diseases, characterization of mutagenic factors and DNA repair processes.

3. Tasks:

1. Definition of the concept of mutations.
2. Mutagenesis and their types;
- spontaneous;
- induced;
3. Mutagenic factors:
- physical;
- chemical;
- biological;
4. Damage to the DNA molecule:
- hydrolytic base cleavages;
- hydrolytic deamination of bases;
- dimer-thymine formation;
- single-strand breaks;
- cross-linking;
5. Types of DNA damage repair:
- dark;
- light;
6. Biological antimutagenic cell barriers:
- chromosome pairing;
- DNA repair;
- matrix character of DNA synthesis;

4.Form of performance/evaluation (abstract, presentation, report, test, compilation of algorithms, writing of medical history, scenario for role-playing games, reviews, etc.): Work in small groups, defense of presentation compilation of glossary
5.Criteria of performance: Oral questioning
6. Due Date: 5 week.
7. Literature:
Appendix 1
Russian language:
Basic:
1. Genetics. Textbook for Higher Education Institutions / Edited by Academician of RAMS V.I. Ivanov - Moscow: ICC "Akademkniga", 2006-638c: ill.
2. Muminov T. Fundamentals of molecular biology: a course of lectures. -Almaty: Effekt, 2007.
Additional:
1. Ivanyushkin A.Y., Ignatiev V.N., Korotkikh R.V., SiluyanovaI.V.Izd-voor Progress, M.. 2008.
2. У. Clague, M. Cummings. Fundamentals of Genetics - M.: Technosphere, 2009.
3. Fundamentals of molecular biology of the cell. Textbook. 3 volumes. B. Alberts et al, OZON.RU Publishing House, 2018.

№	Name	Link
1	Electronic library	http://lib.ukma.kz
2	Republican interuniversity electronic library	http://rmebrk.kz/
3	Electronic library of the Medical University "Student Advisor"	http://www.studmedlib.ru
4	"Paragraph" information system "Medicine" section	https://online.zakon.kz/Medicine
5	Scientific electronic library	https://elibrary.ru/
6	Electronic library "BuxMed"	http://www.booksmed.com
7	«Web of science» (Thomson Reuters)	http://apps.webofknowledge.com
8	«Science Direct» (Elsevier)	https://www.sciencedirect.com
9	«Scopus» (Elsevier)	www.scopus.com
10	PubMed	https://www.ncbi.nlm.nih.gov/pubmed

Internet resource:
1. Genetics. Textbook for Higher Education Institutions / Edited by Academician of Russian Academy of Medical Sciences V.I. Ivanov - Moscow: ICC "Akademkniga", 2011-638.
2. Mushkambarov N.N., Kuznetsov S.N. Molecular biology. Textbook for students of medical universities, 3rd edition, Moscow: Nauka, 2016, 660.
3. У. Clague, M. Cummings. Fundamentals of genetics - M.: Technosphere, 2009.
4. Kurchanov.A. Human genetics with the basics of general genetics: textbook -SPb, 2009.
5. Alberts B. B., Bray D., Hopkin K. Fundamentals of molecular biology of the cell. Textbook. 2nd ed., revised, per. from Engl. 768p. 2018y.
6. Spirin A.S. Protein biosynthesis, the RNA World and the origin of life.
7. Spirin A.S. Molecular Biology. Structure of ribosomes and protein biosynthesis. - M.: (electronic textbook).
8. Control: (questions, tests, reports, etc.):
1.Answering test questions.
2.Solving situational tasks.

3.Completion of cards on the topic.
4.Answering the questions indicated in the assignments.