

APPROVED
at a meeting of the Academic
Council of NJSC “KazNU named
after al-Farabi”
Protocol №11 from 11.06.2024 y.

**The program of the entrance exam for applicants to the PhD
for the group of educational programs
D080 - «Biology»**

I. General provisions.

1. The program was drawn up in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 600 “On Approval of the Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Higher and Postgraduate Education” (hereinafter referred to as the Model Rules).

2. The entrance exam for doctoral studies consists of writing an essay, an exam in the profile of a group of educational programs and an interview.

Блок	Баллы
1. Interview	30
2. Essay	20
3. Exam according to the profile of the group of the educational program	50
Total admission score	100/75

3. The duration of the entrance exam is 3 hours 10 minutes, during which the applicant writes an essay and answers the electronic examination ticket. The interview is conducted at the university premises before the entrance exam.

Essay topics:

1. Give a justification for the concept of the material essence of life and describe the system of the organic world, defining living things in nature.
2. Describe the patterns of individual development of the organism, give examples that prove the integrity and unity of the organism.
3. Describe the systemic organization of biochemical processes that reveal the physiological and biochemical essence of life.
4. Give a detailed description of the main components of the biogeocenosis and characterize their relationship.
5. Assess the current ecological state of the state of biodiversity.
6. Understanding the role of cell membranes and their implications for all forms of life
7. Modern problems of cell and molecular biology.

8. Modern views on the phylogenetic diversity of organisms.
9. The importance of scientific planning in the modern world.
10. Thesis as an independent creative work of students, summarizing experimental data, systematizing the previously acquired theoretical knowledge and representing a platform for mastering the skills of professional presentation.

II. Procedure for the entrance examination.

1. Applicants for doctoral studies in the group of educational programs D080 - «Biology» write a problematic / thematic essay. The volume of the essay is at least 250 words.

The purpose of the essay is to determine the level of analytical and creative abilities, expressed in the ability to build one's own argumentation based on theoretical knowledge, social and personal experience.

Types of essays:

- motivational essay revealing the motivation for research activities;
- scientific-analytical essay justifying the relevance and methodology of the planned research;
- problem/thematic essay reflecting various aspects of scientific knowledge in the subject area.

2. The electronic examination card consists of 3 questions

Topics for exam preparation according to the profile of the group of the educational program:

Discipline "**Theoretical biology**"

System of the organic world. The law of the unity and diversity of life, or the law of Saint-Hilaire. The law of the globality of life, or the first law of Vernadsky. Biological evolution. The law of organic expediency, or Aristotle's law. Natural selection law, or Darwin's law.

Individual development of the body. The law of ontogenetic aging and renewal, or Krenke's law. The law of the integrity of ontogenesis, or Driesch's law.

Physiological and biochemical essence of life. The law of the chemical composition of living matter, or Engels's first law. The law of the systemic organization of biochemical processes, or Bertalanffy's law.

Genetic-cybernetic essence of life. The law of information conditioning of biological systems, or Waldington's law. The law of discreteness and continuity of biological information, or the Morgan-Ephrussi law.

Man and the life of the planet. The law of the leading role of labor in the formation and development of man, or the second law of Engels. The law of the biospheric role of reason, or the second law of Vernadsky.

Discipline "**Cell Biology**"

Cell theory. Cell is an elemental unit of living. Cell is a single system of conjugated functional units. The homology of the cells. Poultry from poultry. Single and multicellular organization. Cell density.

Cytology methods. Light microscopy. Vital (life) study of cells. Study of fixed cells. Electronic microscopy: correction of corporal objects, ultramicroscopy, other special methods of electronic microscopy of biological chemicals. Fractionation of cells.

The structure and chemistry of the cell nucleus. Morphology of nuclear structures. Pole of nuclear structures in the life of the cell. Nuclear components of the prokaryote. The nucleus of eucaryotic cells. Euchromatin and Heterochromatin. Chromosome cycle. General morphology of mitotic chromosome. Cellular cycle eucaryote. Endo preparation and polyploidy. The spatial arrangement of the chromosome in the interphase nucleus.

Chromatin structure and chemistry. DNA chemistry. Replication of eucaryotic DNA. The main proteins of chromatin are histones. Functional properties of histones. The first level of DNA compaction. Structural pole of nucleosome. Histones for replication and transcription. The second level of DNA compaction is 30 nm fibrillation. Core proteins. The DNA core domains are the third level of the structural organization of the chromatin.

The nucleolus is a source of ribosomes. Construction of ribosomes. What determines the number of nuclei in the cell. The multiplicity of the commercially available genes. Amplified nuclei. The structure and functioning of the rRNA ribosome genes. Nucleolus structure. Fibrillar center and nucleolus organizer. Structural types of nuclei. Proteins of the nucleus. General scheme for the operation of the nucleus as a special locus of synthesis. New, non-canonical functions of the nucleus. Nucleolus During Mitosis: Peripheral Chromatin Material.

Nuclear shell. Nucleolus components. Pole of the nuclear membrane in the nuclear-cytoplasmic exchange. Import of cytophilic proteins. Export from the nucleus to the cytoplasm of the Dynamic of the nuclear membrane in mitosis.

Cytoplasm. Hyaloplasm and organelles. General properties of biological membranes.

The basic membrane membrane is a double layer of lipids. Membrane proteins are embedded in the bilipid layer. Lipids and proteins of membranes have a lateral mobility. Cellular membranes are symmetrical. Different membranes have different properties. Membranes are adapted with cytoplasmic proteins. The growth of cytoplasmic membranes occurs due to the absorption of ready-made membrane bubbles

Plasma membrane. Barrier-transport field of plasma. Transmembrane transfer of ions and low-molecular connections. Vesicular transfer: endocytosis and exocytosis. Receptor pole of the plasmalemma. Shiny knowledge. Special intercellular connections (contacts). Cellular wall (shell) of plants. Cellular bacterial casings.

The vacuolar system within the cell transport. General diagram of the functioning of the vacuum system. Granular endoplasmic reticulum. Conveying transport of soluble proteins. Transport of integral (membrane) proteins. Synthesis of cell membranes. The transport between the endoplasmic reticulum and the Golgi apparatus.

Golgi apparatus. Fine structure of the Golgi apparatus. Golgi's secret function. Modification of proteins in the Golgi apparatus. Cytoskeleton in the Golgi apparatus.

Lysosomes. General characteristics of lysosomes. Morphological heterogeneity of lysosomes. Lysosomal pathologies.

Smooth reticulum and other membrane vesicles. Smooth (agranular) endoplasmic reticulum. Peroxisomes or peroxisomes. Peroxisomes (microbodies). Secretion of proteins and formation of membranes and bacteria.

Cytoplasm: cell energy supply systems. Mitochondria - structure and function. General morphology. Ultrastructure of mitochondria. Functions of mitochondria. Oxidative phosphorylation in bacteria. Increase in the number of mitochondria. Automatic production of mitochondria. Mitochondrial DNA.

The musculoskeletal system of the cell. Intermediate filaments. Microfilaments.

Microtubules. General properties of microfilaments. Actin-myosin components of nonmuscular cells. Muscle cells. General characteristics of microtubules. Microtubule organization centers. Dyneins and kinesins are motor proteins.

Cell center. Centrosomes and centrioles. Centrosome cycle. Basal bodies, structure and movement of the cilia and flagella. Bacterial propulsion system.

Cell division mechanisms. Mitotic cell division. Meiosis. General organization of mitosis. Various types of mitosis in eukaryotes. Morphology of mitotic figure. Centrosomes and kinetochore. Dynamics of mitosis. Self-organization of the microtubule system. Cell mitosis. Separation of bacterial cells. The characteristics of the pre-phase I of the meiotic division. Stage I of meiotic division.

Regulation of the cell cycle. Cell death: necrosis and apoptosis. Factors of mitosis stimulation. Cyclins. Regulation of cell growth and division. Cell cycle reference points.

Discipline "**Environmental protection and conservation of biological diversity**"

Discipline and tasks "Environmental Protection and Biodiversity Conservation".

Environmental Protection. Improving the natural state of the environment. Rational use of Natural Resources. A system of state and public events aimed at ensuring the harmonious interaction of nature and society on the basis of the preservation and improvement of Natural Resources. Methods of Environmental Protection. Analysis. Composition of Biological Diversity. Storage, identification, conservation and

implementation of measures for sustainable, effective use of Biological Diversity and its composition.

General state of the natural environment.

The state of the environment today. Man and the environment. Basic conditions for

Environmental Protection. Environmental pollution. Problems of Biological Diversity today. Storage. Sustainable use of Biological Diversity. Regular use of its components. Obtaining benefits related to the use of genetic resources in a fair and equal way.

Methods for assessing the current ecological state of biodiversity.

The doctrine of biogeocenosis is the scientific and theoretical basis for the sustainability of ecosystems and biodiversity. Plant component of the ecosystem (biogeocenosis). Autotrophic part of biota in biogeocenosis. Phototrophs, their functions and features. Diversity of ecosystems. Flora and fauna of protected middle regions and certain regions. The regional inventory of flora and fauna and specially protected areas are known. Biodiversity Protection Priorities. Long-term monitoring of the state of the biosystem. Goals and objectives of the strategy; strategic directions for the protection and effective use of biological diversity. Be able to use the legal framework for the protection and optimal use of biological diversity. Biological monitoring construction system. Protected areas and biodiversity. Inventory of forest ecosystems. End of inventory of moss flora. Inventory and listing of algal flora.

Obligations to protect the environment and preserve biodiversity.

Development of a National Biodiversity Conservation implementation plan and strategy. Financial support of the plan's activities. Identification of objects for protection. Assessment of the risk to bioanalysis under the influence of farming. Monitoring the state of Biological Diversity, creating a database of data on the problem. Control of genetically modified organisms. Legal approval of the protection of rare and endangered species. Implementation of measures to reproduce disappearing species. Take measures for regular use. Biological diversity of mixtures. Development of environmental knowledge. Education and upbringing. Collection of data on the calculation of Biological Diversity interests. Carrying out work on planning and implementing economic projects.

Environmental Protection, ways to preserve biodiversity.

Factors of the external environment, inhibiting the passage of the population cycle and inhibiting the sequence of Biological Diversity. Bringing a schematic version of specially protected areas and building nature reserves, national dachas and Botanical Gardens. Conservation of forest ecosystems and effective use of their components. In-situ conservation of mountain productive forests of Kazakhstan. A number of protected floodplain zones are of international importance, according to the Ramsar Convention. Development of the legal framework effective use and protection of Biological Diversity. Strengthening regional ties and international cooperation in the field of Biological Diversity. Issuance of certificates to specially protected areas, drawing up development schemes, drawing up reserves, national dachas and Botanical Gardens.

Biodiversity protection, protection goals. Protection of the agroal diversity of the mountain ecosystem in the conditions of in situ. Protection categories. Rational use of the biodiversity of the Balkhash and Alakol Lakes, Protection of their biodiversity, protection from desertification. Protection of Caspian biodiversity.

Discipline "**Organization and planning of scientific research**"
(**Genetics and molecular biology**)

The subject and objectives of modern genetics

Methodology of modern genetics. Using the laws of classical genetics in systems analysis. Empirical levels and procedures of scientific inquiry. Subjects, objectives, prospects, and methods of different genetics (pharmacogenetics, environmental genetics, radiation genetics, medical genetics, oncogenetics, immunogenetics, etc.). Heredity, inheritance, heritability.

Model objects and their role in genetic research.

Biological features of model objects and their role in genetic research. The main differences in the organization of cells of prokaryotes and eukaryotes. Application of knowledge about the life cycles of plants and animals in genetic experiments. The selection of a model object following the purpose and objectives of the study. Bioethics issues and risks. Statistical methods for data interpretation in genetic research.

Molecular genetic methods of analysis in genetic research.

The use of molecular genetic methods to study the mechanisms of genetic processes (gene expression, translation, transcription, DNA repair, methylation, and genomic imprinting, etc.), the action of individual genes, and intergenic interactions. Methods for identifying factors in the development of carcinogenesis. Methods for molecular genetic assessment of oncological diseases. Methods for the molecular genetic study of gametogenesis. Molecular diagnostics.

The use of genetic methods to solve problems in the food industry, agriculture, medicine.

Solving the problems of the food industry, agriculture based on genetic methods. Genetic background of modern methods of artificial insemination in humans (IVF). Polymerase chain reaction (PCR) method: principle, steps, reaction components, varieties, and equipment for PCR. Prospects and problems of using stem cells.

General principles and methods of genetic engineering.

An overview of enzymes used in genetic engineering. Genetic engineering of cultured mammalian cells. DNA based vector systems. The introduction of DNA into cells. Obtaining crops with higher yields and resistance to pests. Modern methods of plant transformation. Plant viruses as vectors for genetic engineering. The use of transgenic plants.

Radiation genetics.

Hereditary disorders in radiation injury. Routes of entry of radionuclides into the body. Radiation genetics methods. Nuclear medicine. "Peaceful" atom. Biodosimetry

The main directions of genetic analysis

The classical approach from phenotype to genotype and molecular genetic methods from genotype to phenotype. Mendel's laws. Chromosomal theory of heredity of the Morgan school.

Modern achievements in the breeding of cereals.

Methods of chromosome engineering of wheat. Problems of hetero-, poly- and aneuploidy of plants. Chromosomal abnormalities on the example of plants and, in particular, cereals. Development of the nomenclature of chromosomes. The discovery, study, and use of aneuploids. Methods for creating a series of aneuploid lines of soft wheat. Schemes for producing aneuploids. Chemical and radiation mutagenesis as a method of increasing the diversity of the starting material for hybridization.

The structure and properties of chromosomes.

Chromosomal rearrangements. Comparative analysis of prokaryotic and eukaryotic chromosomes and their properties. Euchromatin and heterochromatic regions of chromosomes. Methods for localizing genes in chromosomes.

The use of mutations in genetic analysis.

Endogenous and exogenous sources of mutations. Gene, chromosomal and genomic mutations, their classification, and examples of diseases associated with the occurrence of mutations. Mobile elements as a source of mutations. Induced and spontaneous mutagenesis.

The evolutionary views of de Lamarck and Darwin.

Evolutionary views of Lamarck. Driving forces of progressive evolution (gradation) and speciation. The contradictory views of Lamarck. The main driving forces of evolution, according to Darwin. Fundamentals of Darwin's theory. The main provisions of the synthetic theory of evolution.

A population is an elementary unit of an evolutionary process.

A population is an elementary unit of evolution. Genetic heterogeneity and population polymorphism. The genetic unity of the population. Hardy-Weinberg Law. The conditions under which the Hardy-Weinberg equilibrium holds.

Genetic foundations of evolution.

Variability: phenotypic, genotypic, paratypic, modification. Modifications. Reaction rate. The concept of the adaptive rate.

Elementary factors of evolution.

Evolutionary factors are causing changes in the genotypic structure of the population. Natural selection and the significance of probability and chance.

Biological and evolutionary significance of species.

The general concept of the species, characteristic of the difficulty in its universal application. The reasons for the increase in the number of species. Speciation. Instant speciation. Gradual and sympatric speciation.

Anthropogenesis.

The place of man in the system of the animal world. The ancestors of man. The main stages of the evolution of Homo. The main stages of the development of

Homo sapiens. The role of labor and social lifestyle in human evolution. Influence on the human evolution of elementary evolutionary factors.

III List of references

Main:

1. Төлеуханов С.Т. Теориялық биология. Оқу-әдістемелік кешен. – Алматы: Қазақ университеті, 2004. – 72 б.
2. Бауэр Э. С. Теоретическая биология. – СПб.: Издательство: Росток 2002. – 352.
3. Пригожин И. От существующего к возникающему: Время и сложность в физических науках: пер. С англ. / Под ред. Ю.Л.Климонтовича. – Изд. 2-е, доп. – м.: Едиториал УРСС, 2002. – 288 с.
4. Бигалиев А.Б. Проблемы окружающей среды и сохранения биологического разнообразия. Учебное пособие. Алматы. 2005.
5. «Проблемы окружающей среды и сохранения биологического разнообразия» на русском языке, Издательство NURPRESS, 2009г, 260 стр
6. Учебник «Общая экология», Издательство NURPRESS, 2011г, 150 стр.
7. Миркин Б.М., Наумова Л.Г. Биологическое разнообразие и принципы его сохранения. Учебное пособие. - Уфа, РИО БашГУ, 2004. - 124 с.
8. Национальный доклад Республики Казахстан об осуществлении конвенции ООН по борьбе с опустыниванием. - Кокшетау, 2000.
9. Гиляров М.М. Популяционная экология М. МГУ, 1990.
10. Красилов В.А. Охрана природы: принципы, проблемы, приоритеты. М. 1992.
11. Национальная программа действий по борьбе с опустыниванием в Республике Казахстан. МЭПР, ЭНЕП, Алматы, 1997.
12. Сохранение биоразнообразия Центральной Азии. Казахстан. Под Ред. Брагиной Т.М., Переладовой О.Б. Алматы, 1997.
13. Фурсов В.И. Экологические проблемы окружающей среды. Алма-Ата. 1991.
14. Ченцов Ю.С. Введение в клеточную биологию. М.: «Академкнига», 2004.-495 с.
15. Альбертс Б., Брей Д., Льюис Дж., Рэфф М., Робертс К., Уотсон Дж., 1994. Молекулярная биология клетки. 1-5 т. М: Мир, 1994.
16. Геннис Р. Биомембраны: Молекулярная структура и функции: Пер. с англ. – М.: Мир, 1997,-624с.

17. Финдель Дж. Б., Эванз У.Г. Биологические мембраны. Методы: Пер. с англ. – М.: Мир, 1990, - 424с.
18. Фаллер Дж. М., Шилдс Д. Молекулярная биология клетки. Руководство для врачей: пер. с англ. – М.: Бином - Пресс, 2004,-272с.
19. Елифанова О.Н. Лекции о клеточном цикле. КМК Scientific press , 1997.
20. Макрушин Н. М., Плугатарь Ю. В., Макрушина Е. М., Гончарова Ю. К., Гончаров С. В., Шабанов Р. Ю. Генетика: учебник для ВУЗов: 2-е изд. – СП-б.: Изд-во «Лань». – 404 с.
21. Инге-Вечтомов, С. Г. Генетика с основами селекции: учебник для студ. высш. учеб. заведений / С. Г. Инге-Вечтомов. - 3-е изд. – Санкт-Петербург: Изд-во Н-Л, 2015. - 718 с.
22. Абилев С.К., Глазер В.М. Мутагенез с основами генотоксикологии. – СПб.: НесторИстория, 2015. – 304 с.
23. Медицинская генетика: учебник / под ред. Н. П. Бочкова. - М.: ГЭОТАР-Медиа, 2014. - 224 с.
24. Черенков В. Г. Онкология: учебник / В.Г. Черенков. — 4-е изд., испр. и доп. — М.: ГЭОТАР-Медиа, 2020. — 512 с.
25. Актуальные вопросы радиоэкологии Казахстана: сборник / М-во индустрии и новых технологий. - Павлодар: ТОО "Дом печати", 2015
26. Северцов А.С. Теории эволюции: учебник для вузов/ А.С. Северцов. — 2-е изд., испр. и доп. — М.: Издательство Юрайт, 2020. — 384 с.
27. Бекман, И. Н. Ядерная медицина: физические и химические основы: учебник для бакалавриата и магистратуры / И. Н. Бекман. — 2-е изд., испр. и доп. — Москва: Издательство Юрайт, 2019. — 400 с.
28. Бочков Н.П. Клиническая генетика: учеб. / Н. П. Бочков, В. П. Пузырев, С. А. Смирнихина; под. ред. Н.П. Бочкова. - 4-е изд., доп. и прераб. - М.: Изд. группа "ГЭОТАР-Медиа", 2013. - 582 с.
29. Жимулев И.Ф. Общая и молекулярная генетика. Издание 4. Сибирское университетское издательство, Новосибирск, 2007. - 479 с.
30. Бияшева З.М., Ловинская А.В., Даулетбаева С.Б., Калимагамбетов А.М. Статистические методы в биологии с программным обеспечением //Учебное пособие для биол. специальностей: Алматы – Казак университет, 2019.
31. Моссэ, И.Б. Радиационная генетика: курс лекций / И.Б. Моссэ. – Электронный учебник, 2013 г.
32. Введение в молекулярную диагностику. В 2 томах / под редакцией Пальцева М., Залетаева Д. – М.: Медицина, 2011.
33. Фаллер, Д.М. Молекулярная биология клетки: руководство для врачей / Джеральд М. Фаллер, Деннис Шилдс; пер. с англ. под общ. ред. акад. И. Б. Збарского .— Москва: Бином-Пресс, 2012 .— 256 с.

34. Ястребов А.П., Гребнев Д.Ю., Маклакова И.Ю. Стволовые клетки, их свойства, источники получения и роль в регенеративной медицине. – Екатеринбург 2016. - 282с
35. Генетические основы селекции растений. В 4 т. Т. 4. Биотехнология в селекции растений. Геномика и генетическая инженерия. – Минск: Издательский дом "Белорусская наука", 2014. – 653 с.

Additional:

1. Инюшин В.М., Төлеуханов С.Т., Кулбаева М.С., Гумарова Л.Ж., Швецова Е.В., Қайрат Б.Қ. Экологиялық биофизика. Оқу құралы. – Алматы: Қазақ университеті, 2018. –126 б.
2. Смирнов А.Н. Эндокринная регуляция / Под ред. В.А.Ткачука, - М: «Гэотар Медия», 2009. – 135 с.
3. Эбелинг В., Зигель А., Файстель Р. Физика процессов эволюции. – СПб.: УРСС, 2001
4. Биохимические основы жизнедеятельности человека / Под ред. Ю.Б.Филипповича, А.С.Коничева– М.: ВЛАДОС, 2005
5. Мелатонин. Теория и практика / Под ред. С.И.Рапопорта, М: Медпрактика, 2009. –162 с.
6. Биологическая химия / Под ред. С.Е.Северина, М: «Гэотар Медия», 2011. – 145 с.
7. Ланге К.А. Организация управления научными исследованиями.

Лекция 11

- биологическая эволюция. – М.: Наука, 2009
8. Еськов К.Ю. История земли и жизни на ней. М.: МИРОС-МАИК "Наука/Интерпериодика" 2000.
9. Перечень редких и находящихся под угрозой исчезновения видов растений.
Утвержден Постановлением Правительства РК от 31 октября 2006 г., №1034. – Астана, 2006. – 9 с.
10. Перечень объектов охраны окружающей среды, имеющих особое экологическое, научное и культурное значение. Утвержден Постановлением Правительства РК от 21 июня 2007 года № 521. – Астана, 2007. -27 с.
11. Колчинский Э.Н. Эволюция биосферы. Ленинград, "Наука", 1990,236 с.
12. Проблемы, приоритеты и партнёрство национального плана действий по охране окружающей среды для устойчивого развития Республики Казахстан. Алматы, 1996.
13. Розанов А.Ю. (ред.). Проблемы доантропогенной эволюции биосферы. М. 1993.

14. Дебело Т.В., Левыкин С.В., Чибилев А.А. Стратегия сохранения ландшафтного и биологического разнообразия в западном секторе Российско-казахстанской границы.
15. Свенсен К., Уэбстер П. Клетка. М.: Мир, 1980.
16. Заварзин А.А., Харазова А.Д., Молитвин М.Н. Биология клетки: общая цитология.
17. СПб.: Изд-во СПб. ун-та, 1992.
18. Скулачев В.П. Энергетика биологических мембран. Москва, Наука, 1989 г
19. Мецлер Д. Биохимия. Химические реакции в живой клетке. Москва, Мир, 1980 г., т.т. 1-3
20. Спирин А.С. Молекулярная биология. Структура рибосомы и биосинтез белка. Москва, Высшая школа, 1986 г.
21. Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J. D. Molecular biology at the cell. 4th ed. N.Y.; L.: Garland Publ., 2001.
22. Karp G. Cell and molecular biology. 2nd ed. N.Y. etc.: John Wiley and Sons, 1996.
23. Lodish H., Berk A., Zipursky S.L., Matsudaira P., Baltimore D., Darnell J. Molecular cell biology. 4th ed. L.: Freeman, 2000.
24. Tobin A.J., Murel R.E. Asking about cells. Saunders college publ., 1997.
25. Горбунова В.Н., Имянитов Е.Н. Генетика и Канцерогенез. Методическое пособие. – Санкт-Петербург, 2007. – 24 с.
26. Коряков Д. Е., Жимулев И. Ф. Хромосомы. Структура и функции. — Новосибирск: Изд-во СО РАН, 2009. — 258 с.
27. Льюин Б. Гены. – М.: Бином. Лаборатория знаний. 2012. – 896 с.
28. Пухальский В.А., Соловьев А.А., Бадаева Е.Д. Практикум по цитологии и цитогенетике растений. - М.: КолосС, 2007. - С.62-67.
29. Рыбчин В.Н. Основы генетической инженерии. – Учебное пособие. С- Пб, 2002.-522 с.
30. Хедрик Ф. Генетика популяций. М.: Техносфера, 2003.
31. Яблоков А.В., Юсуфов А.Г. Эволюционное учение. М.: Высш. шк., 2004.
32. Генетика. Под ред. Иванова В.И. М., 2006. - С. 557-568.
33. Гинтер. Современная генетика. М., 2003. -448 с.
34. Медицинская биология и генетика. Учебное пособие под ред. проф. Куандыкова Е.У. Алматы, 2004.
35. Муминов Т.А., Куандыков Е.У. Основы молекулярной биологии (курс лекций). Алматы, 2007.
36. Мушкамбаров Н.Н., Кузнецов С.Л. Молекулярная биология. М., 2003